Asymmetric development in lexical encoding of L1-English L2-German front rounded vowels

Isabelle Darcy, Laurent Dekydtspotter, Rex A. Sprouse, Danielle Daidone, Christiane Kaden, Franziska Krueger, and John H. G. Scott

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DEPARTMENT OF
SECOND LANGUAGE STUDIES

INDIANA UNIVERSITY
College of Arts and Sciences
Bloomington

Overview

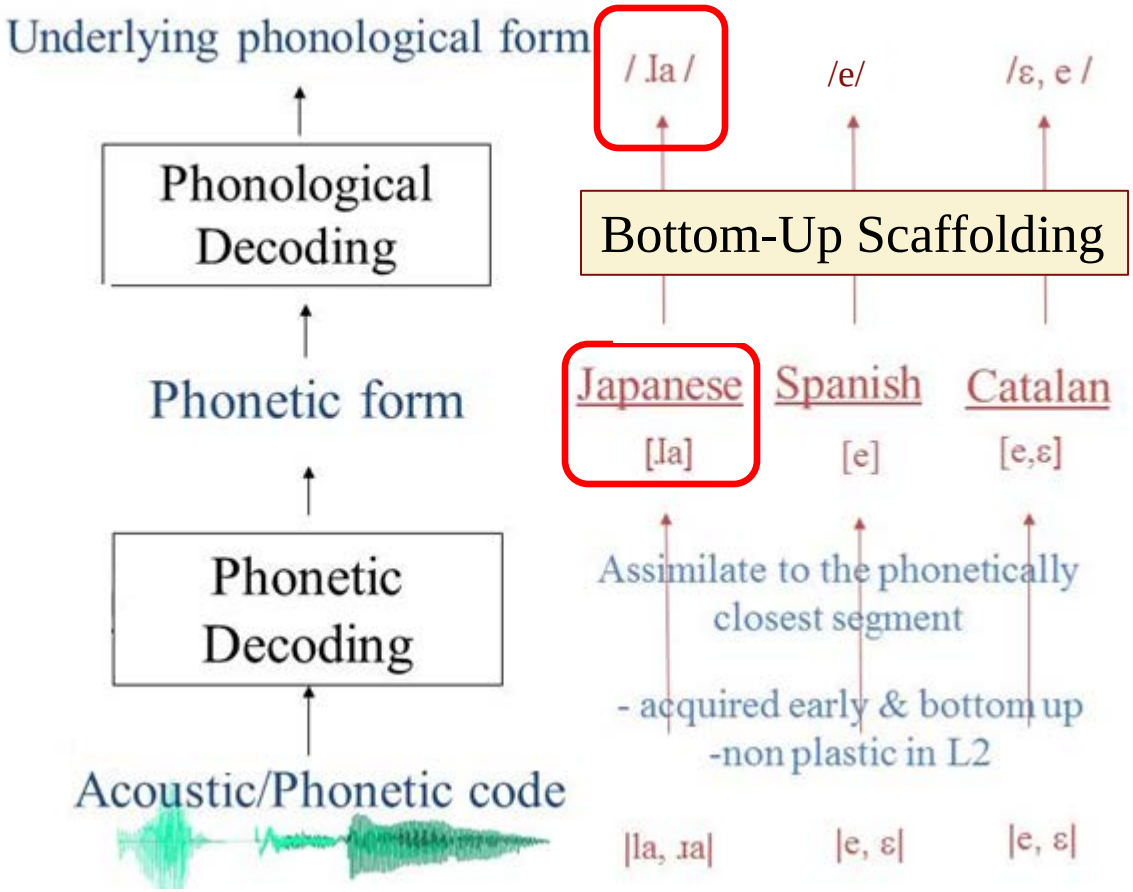
- basic speech processing theory
- dissociation of phonetic categories and lexical representations in L2 development
- DMAP (Direct Mapping of Acoustics to Phonology)
- previous study (AE L1 / French TL)
- brief summary
- current study (AE L1 / German TL)
- results of the German study
- discussion

Phonetic Decoding & L2 Lexical Encoding

Japanese/English:
Sheldon & Strange (1982)

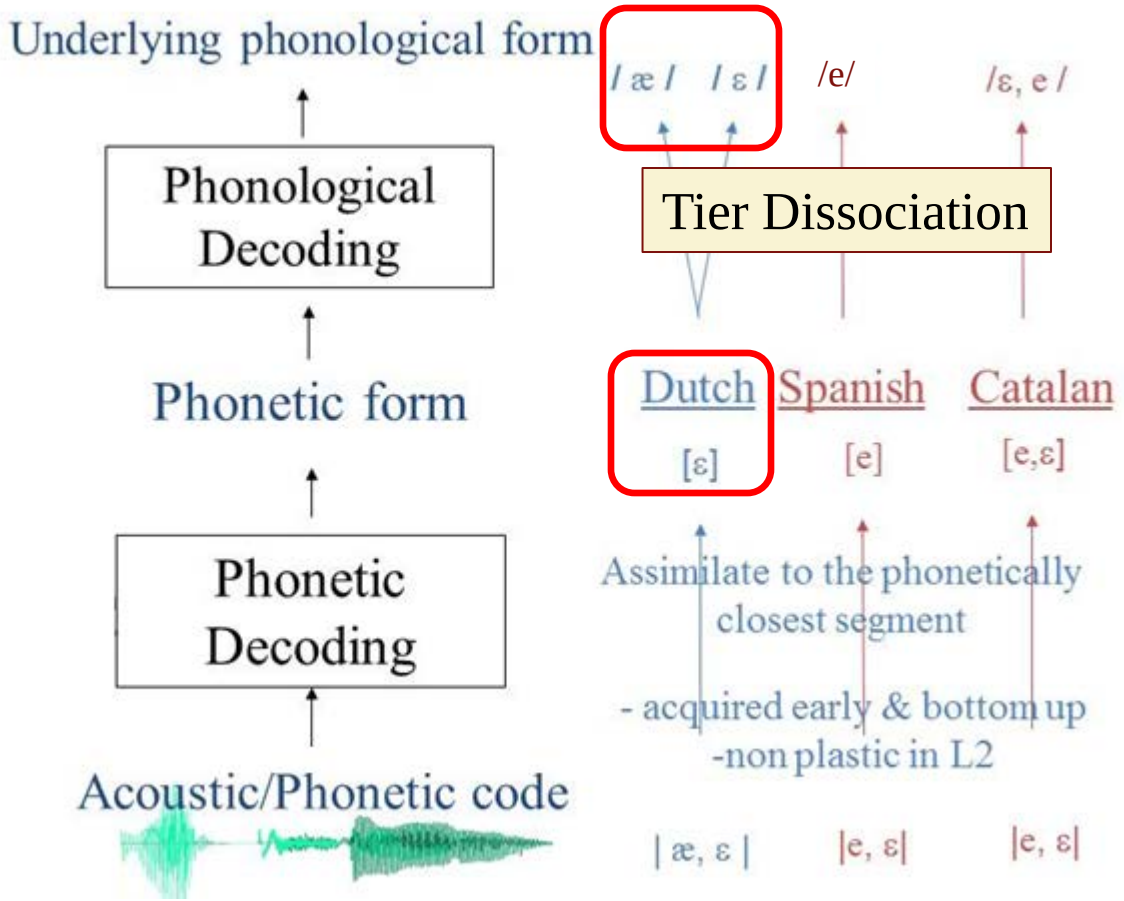
Spanish/Catalan:
Pallier et al. (1997)
Pallier et al. (2001)

assimilation to the closest L1 Category:
PAM-L2
Best & Tyler (2007)



In another case however, an apparent dissociation

Dutch/English:
Weber & Cutler (2004)



Direct Mapping of Acoustics to Phonology (DMAP)

- A. Rich Detection
- B. Economical Revisions of Feature Matrices
- C. IL-Dependent Lexical Representations
- D. Minimal IL Recategorizations

(Darcy et al. 2012: 14)

DMAP (A): Rich Detection

(Darcy et al. 2012: 14-16)

- *L2 learners detect more acoustic cues in the raw percepts than what they use to perform a segmental categorization response.*
- learners detect correlates of phonological features in input & extract the relevant features
- lack of robust discrimination abilities does not mean that relevant features cannot be detected at all
- BUT: even if everything can be detected, not everything is meaningful for L1 segmental categorization; i.e., some information that is irrelevant or redundant for the L1 grammar will be disregarded in earlier stages of IL development
- e.g., acquisition of /y/–/u/ & /œ/–/ɔ/ contrasts requires detection of complex acoustic cues relevant to the features [back], [front], [high], and [round] (Fant, 1969)

DMAP (B): Economical Revisions of Feature Matrices

(Darcy et al. 2012: 14-16)

- *Detected features trigger revisions of the interlanguage (IL) feature hierarchy in accordance with economy principles.*

- Early IL perceptual system detects correlates of {[front], [round]} combinations in L2 vowels
  - but if the phonological grammar initially does not know how to process this information, it fails to license them
  - they are ignored in lexical encoding at this stage

- At the beginning IL stages (for L1 English)
  - [round] is a redundant/enhancing feature for L1 back vowels
  - [front, round] vowels in L2 input are re-interpreted as [back, (round)]
  - thus target vowels /u/ and /y/ “merge” in the IL, perceived as one phone

DMAP (C): IL-Dependent Lexical Representations

(Darcy et al. 2012: 14-16)

- *Phonological lexical representations consist of feature matrices dependent upon the IL feature hierarchy at the time of encoding.*
- Learners' lexical representations only make use of feature matrices that the IL feature system can interpret (license) when representations are encoded
- Initially, some target-language contrasts are merged
  Leads to spurious homophony (i.e., minimal-pairs will be heard as the same)
- When {[front]/[back] + [round]} matrices (for the V in question) are acquired, rounded vowel contrasts can then be lexically encoded
- DMAP does not argue that IL lexical contrasts are represented by the same feature combinations across groups of learners with different L1s and at different proficiency levels

DMAP (D): Minimal IL Recategorizations

(Darcy et al. 2012: 14-16)

- *Detection of novel phonological contrasts triggers minimal changes in phonetic category definitions.*
- Definitions of phonetic categories must at least reflect phonological feature contrasts in order to support the establishment of lexical contrasts
- Category definitions in the IL grammar need not attune to target-like phonetic category boundaries
- Categorization is an important acquisition goal, but…

  Initial task: detect **acoustic correlates of phonological features** in raw percepts

  Not sufficient to completely overcome L1 category assimilations
- IL inventories are established at 2 disjointed levels:

  Development of phonological feature matrices (support for lexical encoding independent of attunement of phonetic categories)

  Adjustments of phonetic category definitions and boundaries

  (Maye 2000; Maye et al. 2002, 2008)

Support for DMAP: L1 AE / TL French (Darcy et al. 2012)

- French has front rounded vowels /y/-/œ/, English doesn't

➢ What do categories & lexical representations in learners' IL look like?

- **Intermediate Learners**:

  categorization: mid V (/œ/) < high V (/y/)

  lexical. repres.: mid-V fine, spurious homophony for high V

  ➢ indicating front-back merger of high vowels in IL

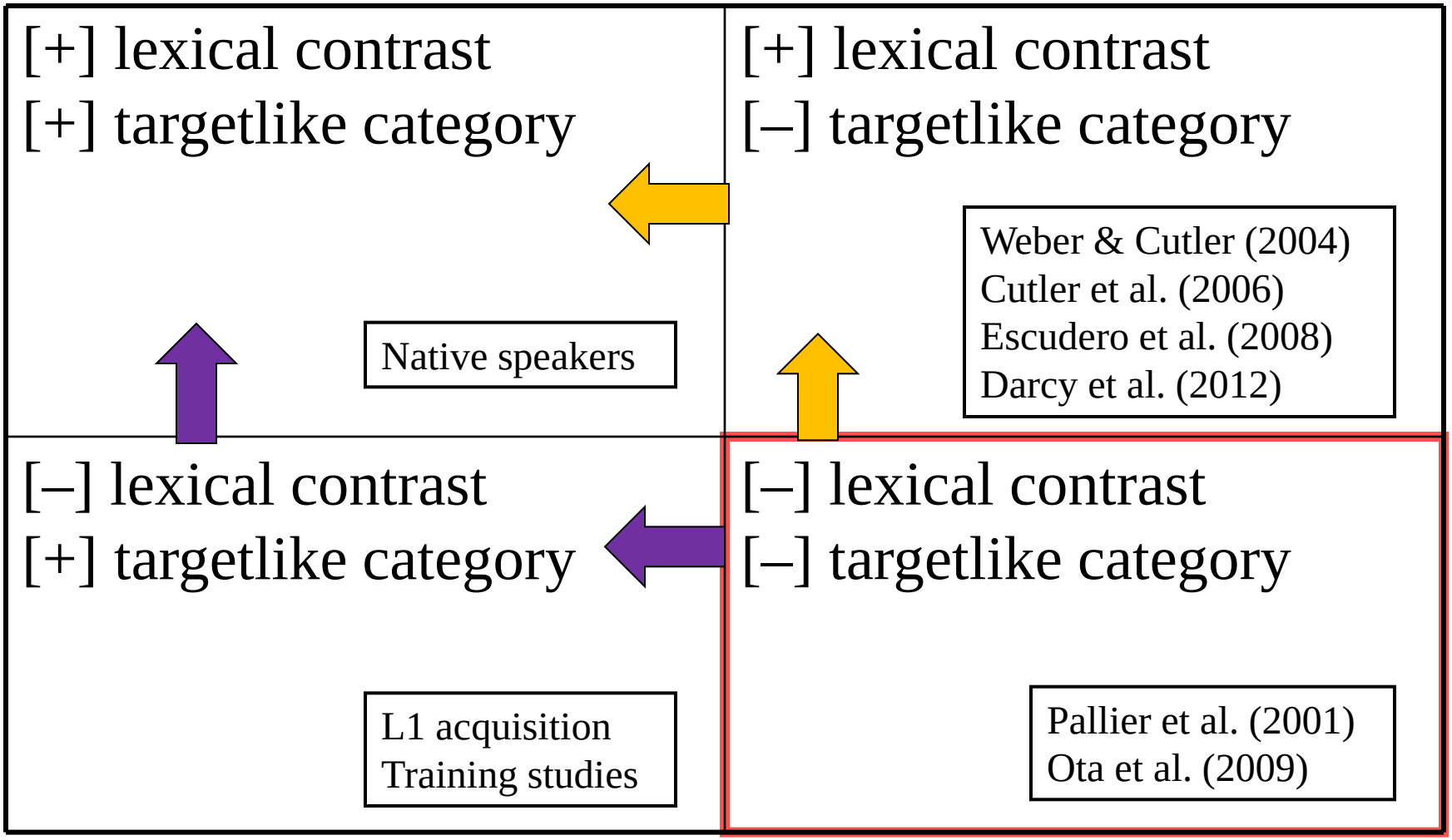
- **Advanced Learners:**

  categorization: mid V (/œ/) < high V (/y/)

  lexical. repres.: mid-V fine, no spurious homophony for high V detected

➢ confirming dissociation of phonetic categories & lexical representations (Weber & Cutler 2004; Cutler, Weber & Otake 2006)

Development of phonetic categories and lexical representations



Why German?

- crucial differences from French:
  - ➢ morphological load of front-back rounded vowel alternations
    plural: *Bruder-Brüder* (‘brother’, sg, pl), *Tochter-Töchter* (‘daughter’, sg, pl)
    strong subjunctive II: *fliegen-flog-flöge* (‘fly’, Inf., Pret., Subj.)
  - ➢ potential phonetic confound in French:
    collocation of /œ/ and /r/ (i.e., CVr, due to lexical gaps)

- similarity to French:
  - ➢ L2s with [front, round] vowels are numerous (Maddieson 1984)
  - ➢ not with as many L1 English learners
    control for L1 (AE) with sufficient number of learners

The German Study: Participants

categorization & lexical decision

21 Advanced (ADV)

55 Intermediate (INT)

18 Native (NS)

categorization only

20 Naïve (MONO)

age range:

INT: 18-29 (m = 20.5)

ADV: 21-38 (m = 27.2)

NS: 20-33 (m = 27.8)

MONO: 18-22 (m = 20)

late learners of German

advanced learners:

- at least 8 semesters of German
- residency in Germany (6 mo. - 3+ years)

intermediate learners:

max. 6 semesters of German

spent no time in a German speaking country

native speakers (control)

German (with knowledge of English)

naïve speakers (control)

English monolingual (no experience with any L containing the target phonemes)

The German Study: Methods & Stimuli (ABX)

- ABX-paradigm to test categorization abilities
- participants were asked to decide whether the 3rd item (X) matched the first (A) or the second (B) item
- A & B produced by a female speaker of German
  X produced by a 2nd female speaker of German
- stimuli presented in a block of 160 trials in total

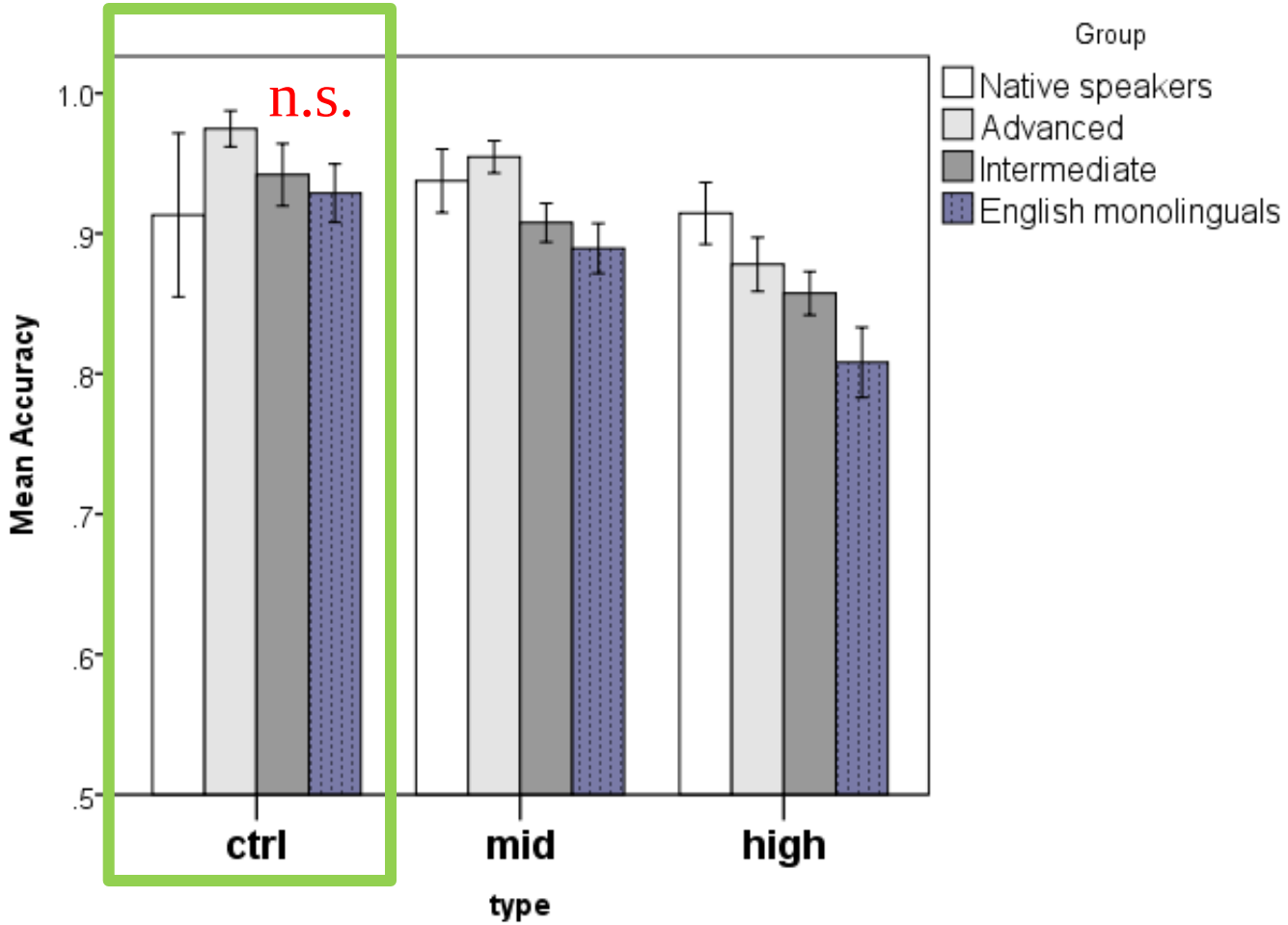
The German Study: Methods & Stimuli (ABX)

- items were non-words in German & English
- monosyllabic (CVC), 2 contexts (labial, coronal)

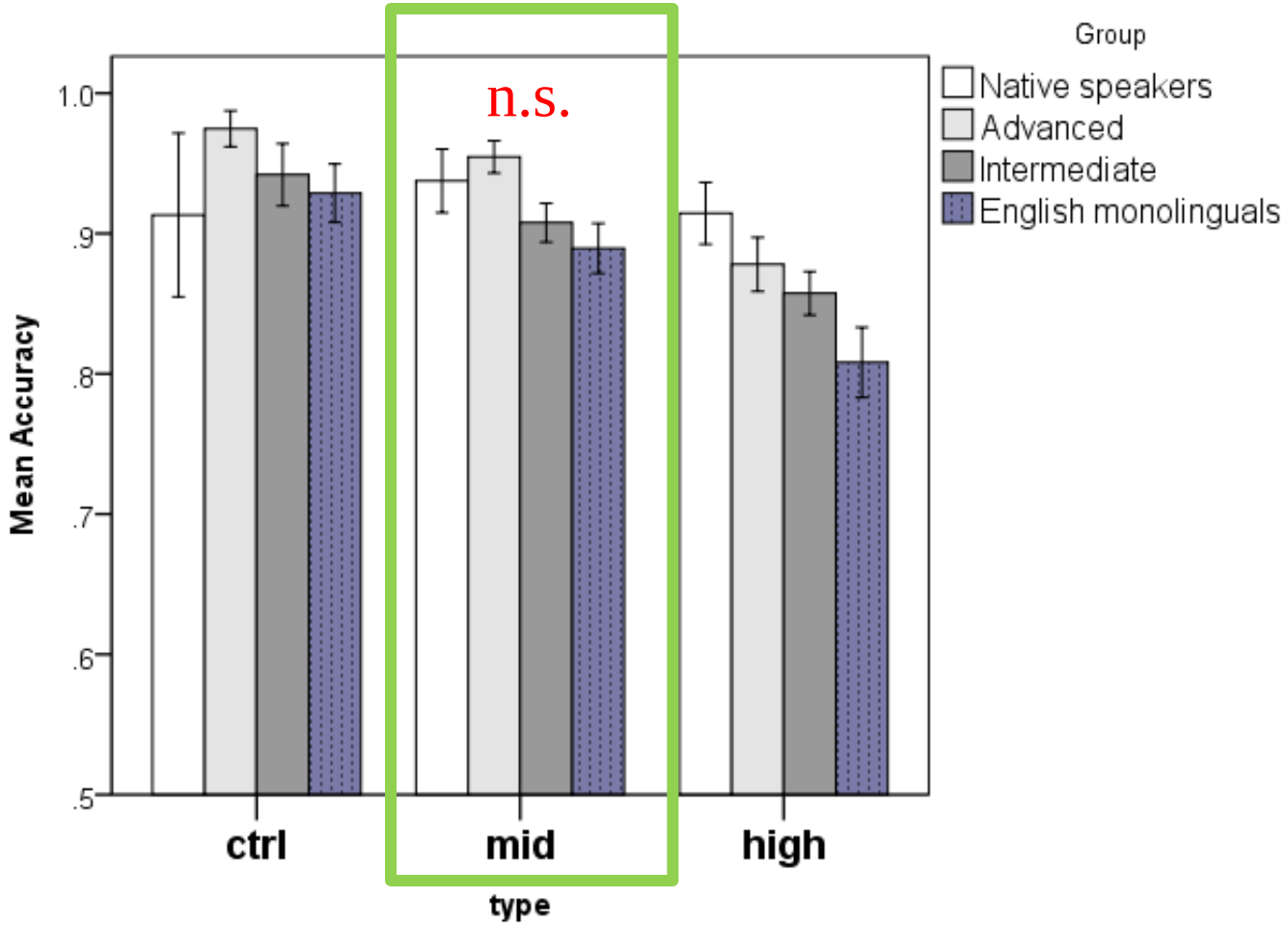
target vowel pairs:		**control vowel pairs**
[i: y:]	[u: y:]	[i a], [i o]
[ɪ ʏ]	[ʊ ʏ]	
[e: ø]	[o: ø]	e.g. A-[po:m] B-[pøm] X-[pøm]
[ɛ œ]	[ɔ œ]	A-[pe:m] B-[pøm] X-[pe:m]

front-front contrasts expected to be easier than front-back (according to PAM-L2 (Best & Tyler 2007))

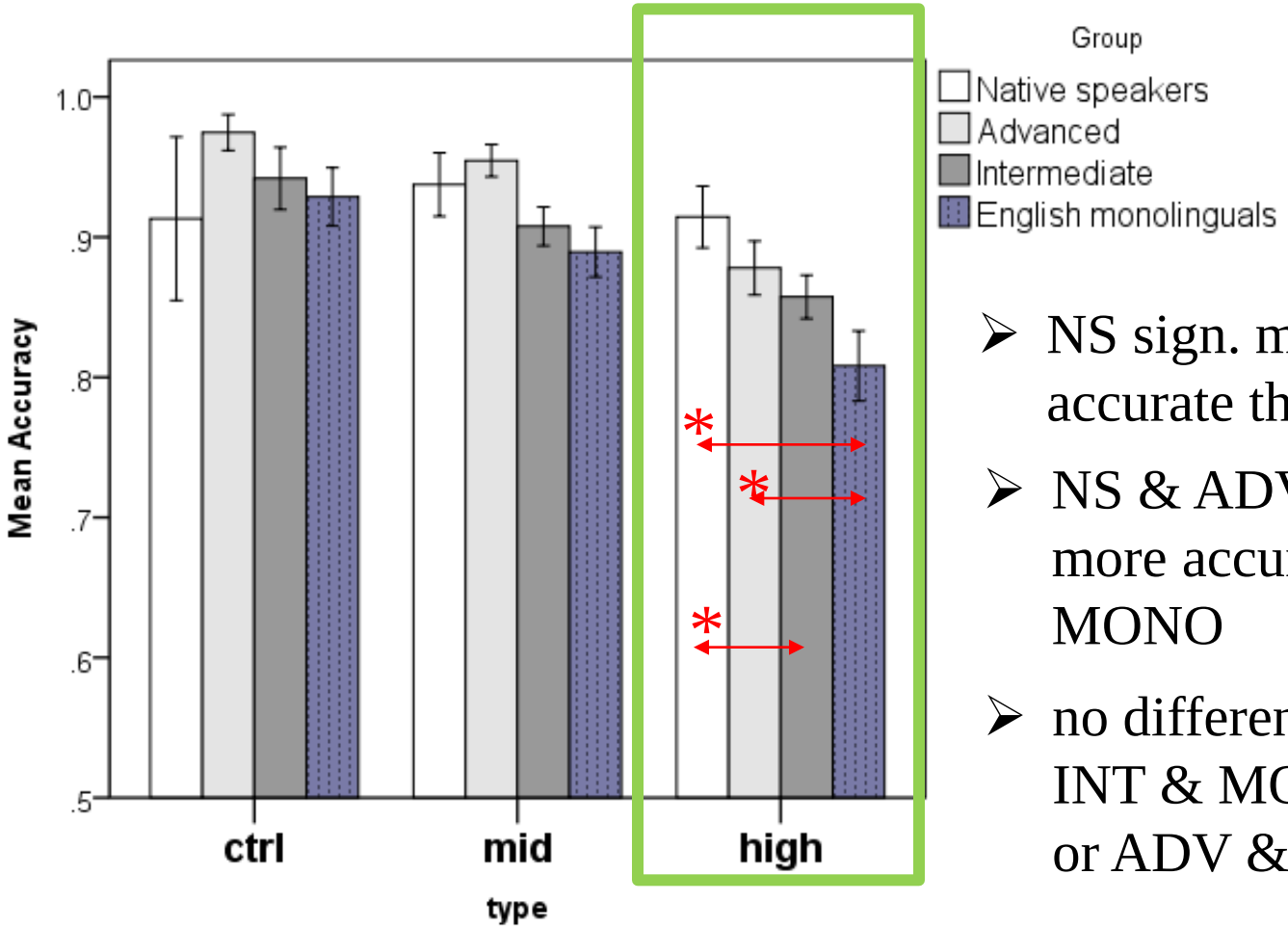
The German Study: Results (ABX)



The German Study: Results (ABX)



The German Study: Results (ABX)



- NS sign. more accurate than INT
- NS & ADV sign. more accurate than MONO
- no difference btw. INT & MONO or ADV & NS

The German Study: Methods & Stimuli (Lexical Decision)

- participants were asked to decide whether the item they heard was a German word or not and to press the corresponding button

- stimuli presented auditorily
- mono- or disyllabic stimuli
- 160 target item + 128 filler

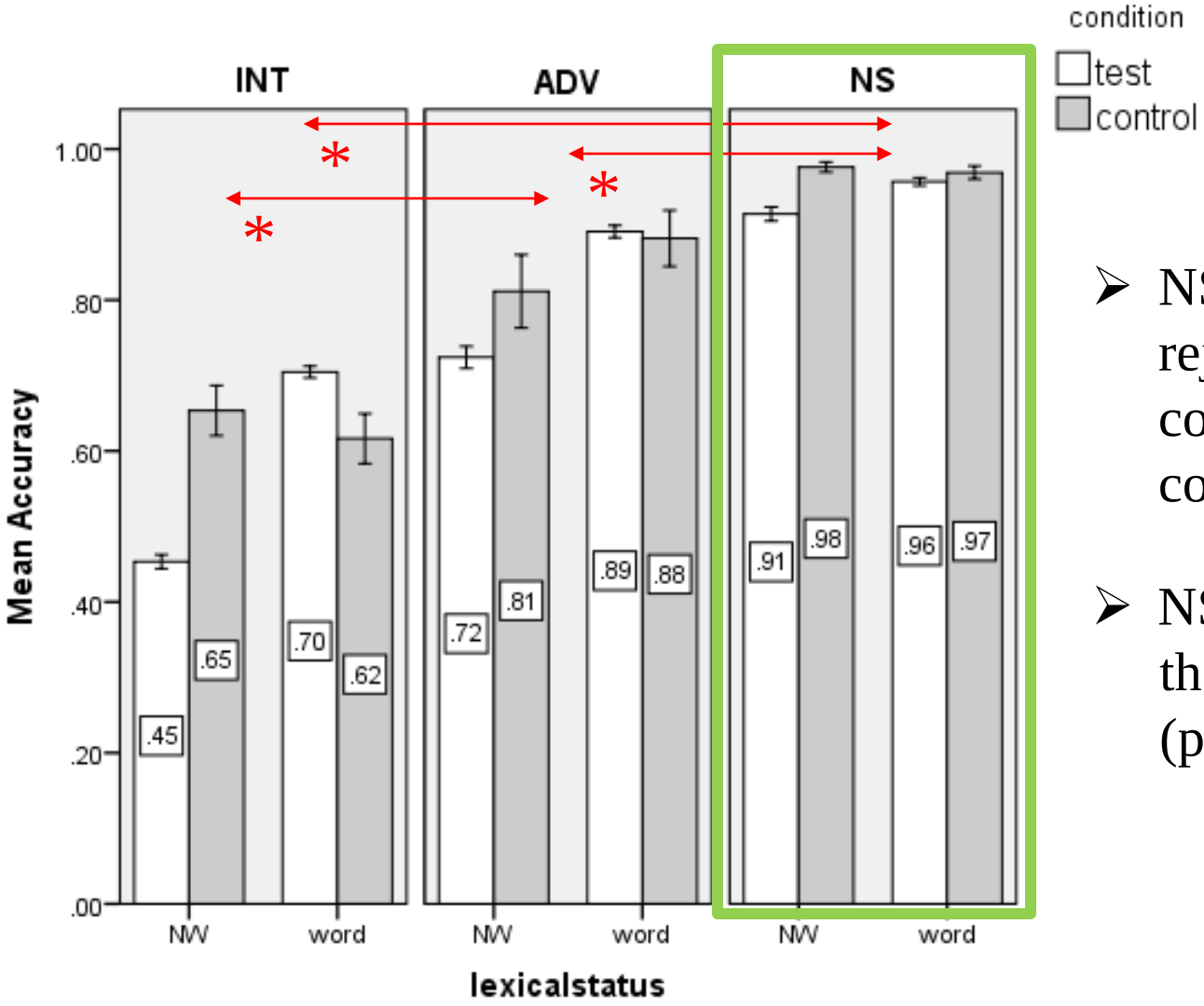
The German Study: Methods & Stimuli (Lexical Decision)

- 80 German words with the target vowels
- 80 corresponding nonwords

target vowel pairs:		
[i: y:] [u: y:]	‚grün' *green*	– *grun
[ɪ ʏ] [ʊ ʏ]	‚Mut' *bravery*	– *Müt
[e: ø] [o: ø]	‚Honig' *honey*	– *Hönig
[ɛ œ] [ɔ œ]	‚König' *king*	– *Konig

The German Study: Results (Lexical Decision)

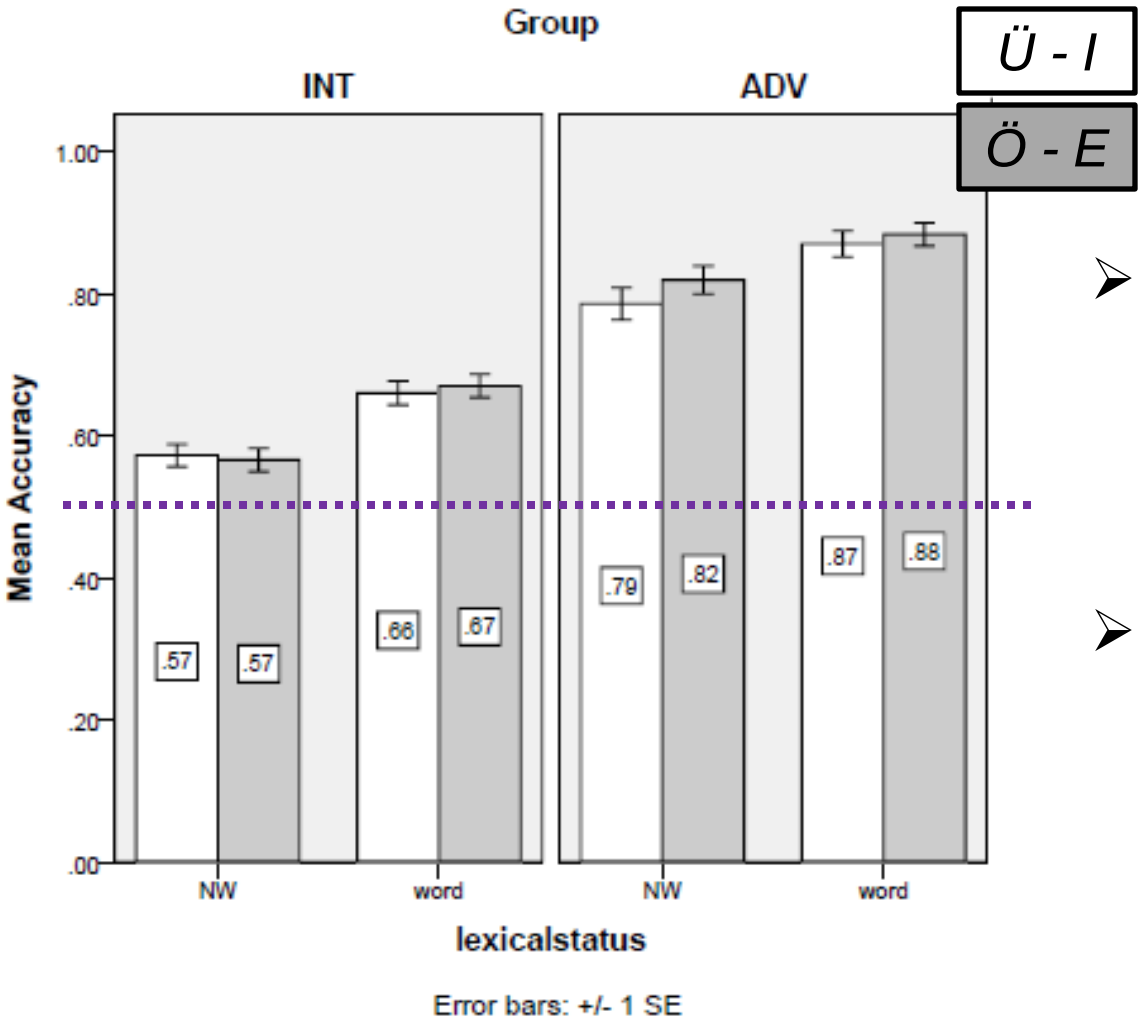
mean accuracy in test vs. control conditions



- NS accepted words & rejected nonwords correctly in every condition ($p > .05$)
- NS sign. more accurate than ADV & INT ($p<.001$)

The German Study: Results (Lexical Decision)

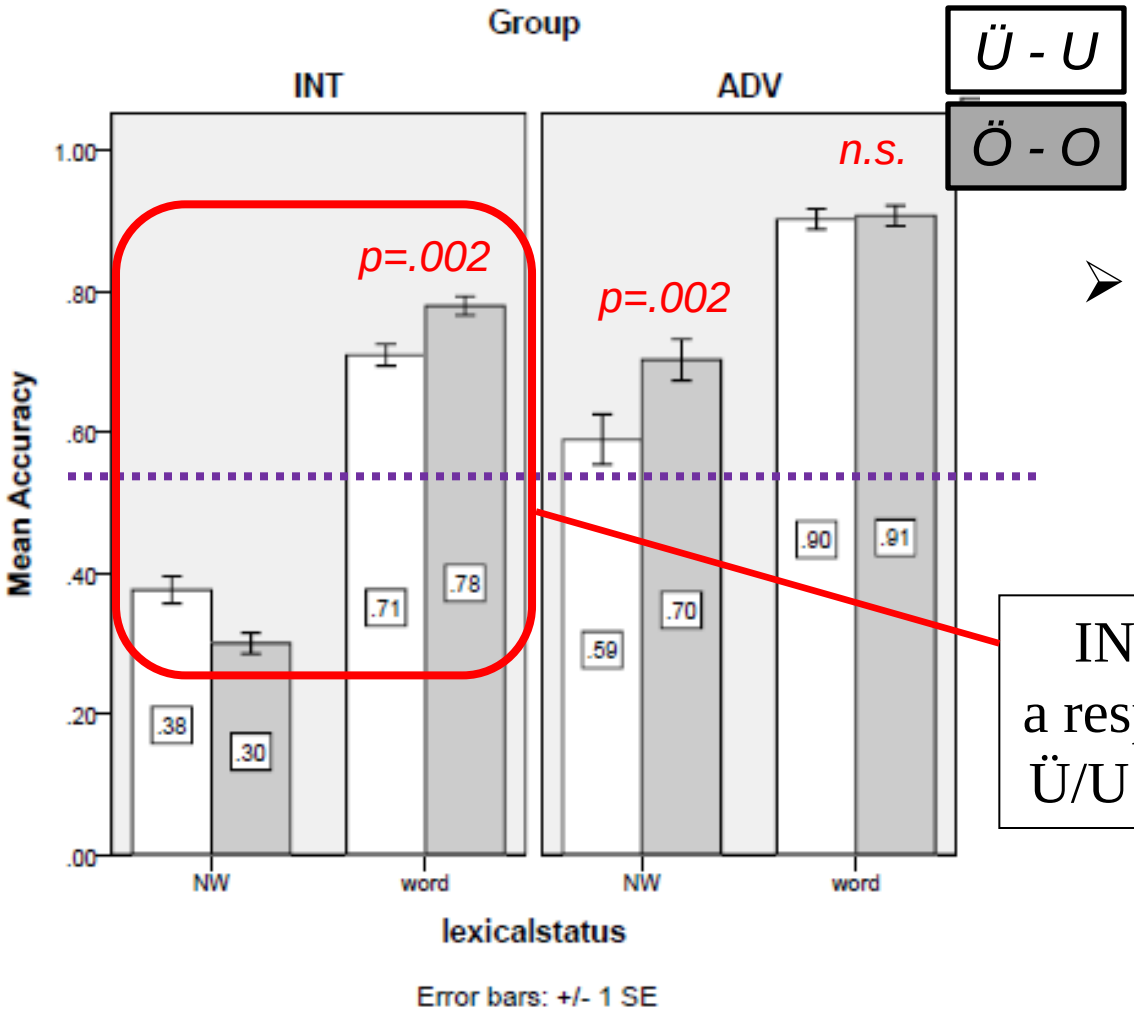
[front, rounded] – [front, unrounded] contrast



- ADV learners show no sign. difference between both conditions (/Ü-I/ & /Ö-E/)
- INT learners: same

The German Study: Results (Lexical Decision)

[front] - [back] contrast



- ADV learners exhibit sign. fewer correct rejections of NWs in the Ü/U-contrast compared to Ö/O-contrast

INT skewing is likely due to a response bias toward accepting Ü/U & Ö/O nonwords as words

Discussion: English learners of German

- no clear evidence for dissociation has been found

~~[+] lexical contrast~~
~~[–] targetlike category~~

- learners categorize German vowel contrasts accurately (in particular the mid vowels)
- but learners have difficulty rejecting NWs (though accuracy is higher on mid-vowel NWs first)

DMAP-B:
detected features trigger revisions of the IL feature hierarchy in accordance with economy principles. (Economical Revisions)

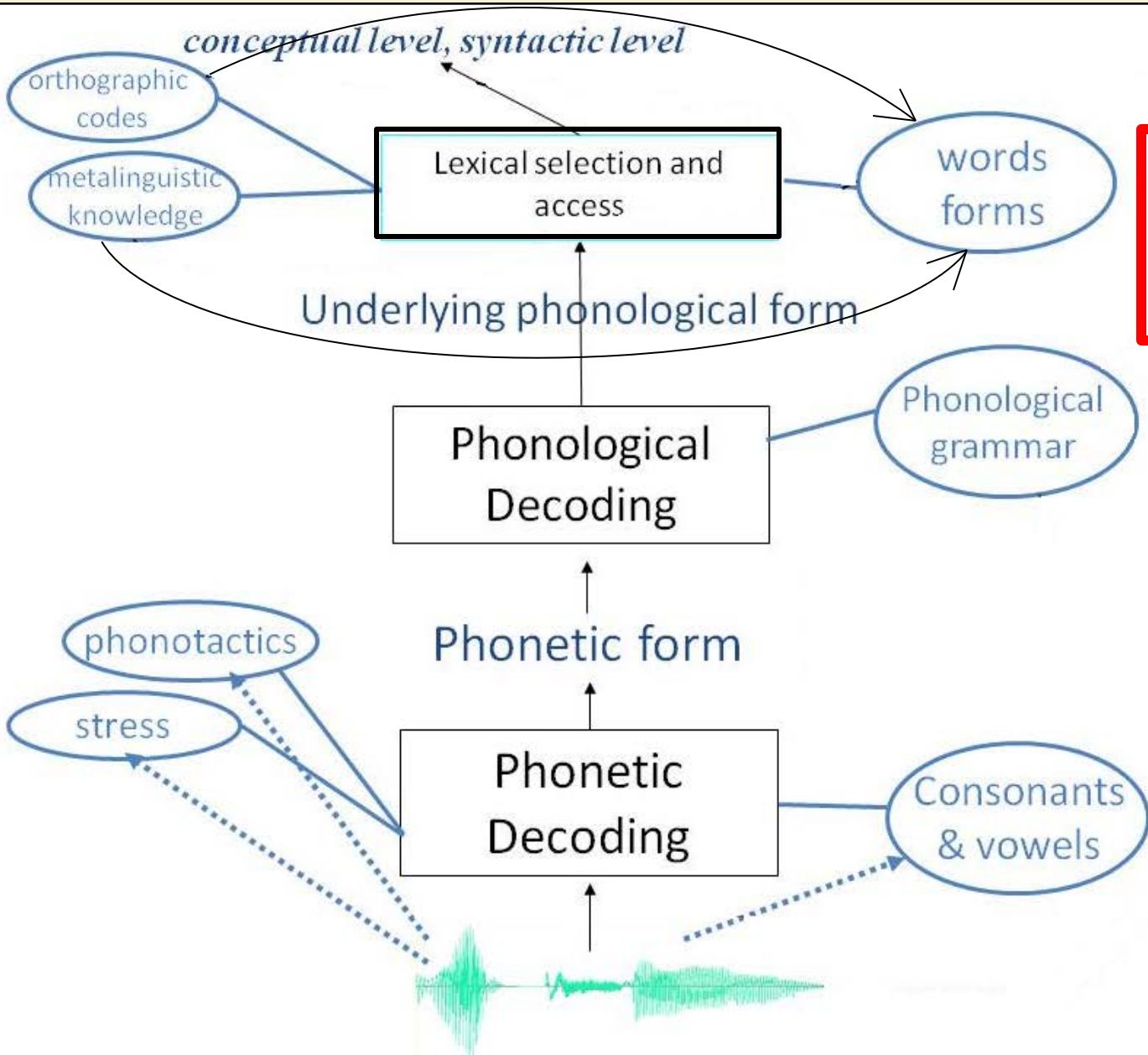
Discussion: English learners of German

- ADV learners show an asymmetry between mid and high vowels (mid > high)
- the difference was expected
    - in DMAP, mid vowels are assumed to be unmarked for this type of inventory and should be acquired earlier

➢ our data support this assumption

- Nonetheless, the frequency of vowel occurence in German could still explain these data for the ADV learners (*input-driven* acquisition)

Traditional models

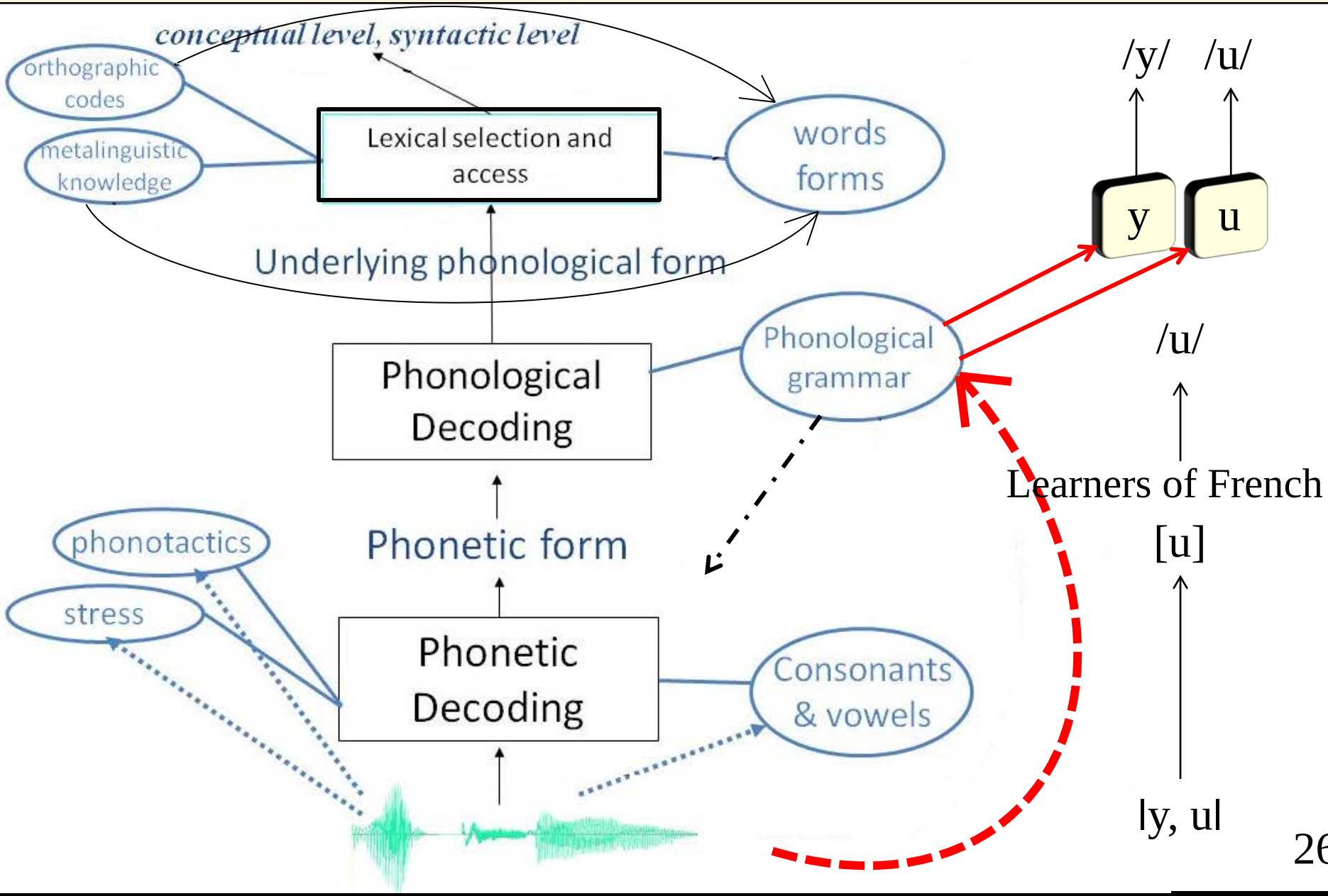


acquisition at the lexical Level is constrained by acquisition at the segmental level

Learners of German

[y] [u]

|yl |ul


conceptual level, syntactic level
orthographic codes
metalinguistic knowledge
Lexical selection and access
words forms
Underlying phonological form
Phonological Decoding
Phonological grammar
Phonetic form
phonotactics
stress
Phonetic Decoding
Consonants & vowels
/y/ /u/
y
u
/u/
Learners of French
[u]
ly, ul

Discussion – learners of French vs. learners of German

- dissociation shown in learners of French
- no dissociation shown in learners of German

Both the data from AE-French study & AE-German study can be explained with DMAP.

Without DMAP, we would need different approaches of L2-acquisition to explain these divergent results.

References

Best C.T. & Tyler M.D. (2007). Nonnative and second language speech perception. In: Bohn, O.-S. & Munro M.J. (eds.) *Language experience in second language speech learning: In honor of James Emil Flege* (13-34). Philadelphia: John Benjamins.

Cutler A., Weber A., and Otake T. (2006). Asymmetric mapping from phonetic to lexical representations in second-language listening. *Journal of Phonetics* 34: 269–84.

Darcy I., Dekydtspotter, L., Sprouse, R. A., Glover, J., Kaden, C., McGuire, M. and Scott, J.H.G. (2012). Direct mapping of acoustics to phonology: On the lexical encoding of front rounded vowels in L1 English-L2 French acquisition. *Second Language Learning* 28: 5–40.

Escudero P., Hayes-Harb R., and Mitterer H. (2008). Novel second-language words and asymmetric lexical access. *Journal of Phonetics* 36: 345–60.

Fant G. (1969). Distinctive features and phonetic dimensions. *Speech Transmission Laboratory Quarterly Progress and Status Report* 10: 1–18.

Maddieson, I. (1984). *Patterns of Sounds*. New York: Cambridge University Press. 248-251.

Maye J. (2000). The acquisition of speech sound categories on the basis of distributional information, unpublished doctoral dissertation, University of Arizona, Tucson, AZ, USA.

References

Maye J., Weiss D.J., and Aslin R.N. (2008). Statistical phonetic learning in infants: facilitation and feature generalization. *Developmental Science* 11: 122–34.

Maye J., Werker J.F., and Gerken L. (2002). Infant sensitivity to distributional information can affect phonetic discrimination. *Cognition* 82: B101–11.

Pallier C., Bosch L., and Sebastián-Gallés N. (1997). A limit on behavioral plasticity in vowel acquisition. *Cognition* 64: B9–17.

Pallier C., Colomé A., and Sebastián-Gallés N. (2001). The influence of native-language phonology on lexical access: Exemplar-based vs. abstract lexical entries. *Psychological Sciences* 12: 445–49.

Sheldon, A. & Strange, W. (1982). The acquisition of /r/ and /l/ by Japanese learners of English: Evidence that speech production can can precede speech perception. *Applied Psycholinguistics*, 3: 243-261.

Weber A. and Cutler A. (2004). Lexical competition in non-native spoken-word recognition. *Journal of Memory and Language* 50: 1–25.