Learning consequences of derived-environment effects

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Across-the-board generalizations

- Phonological alternations often reflect static phonotactic restrictions in the lexicon
  - Duplication problem (Kenstowicz & Kisseberth, 1977)
- E.g. Navajo sibilant harmony (Sapir and Hoijer, 1967; Kari, 1976; McDonough, 1991, 2003; Fountain, 1998)

(1) Sibilants in a root agree in [anterior] (from Martin 2011)

a. /**ʧ**ʼo**ʒ**/ ʻwormʼ */**ʦ**ʼo**ʒ**/
b. /**ʦ**ʼó**z**í/ ʻslenderʼ */**ʧ**ʼó**z**í/

(2) Also holds across morph. boundaries → alternation

a. /ji-**s**-léé**ʒ**/ → [ji-**ʃ**-léé**ʒ**] ʻit was paintedʼ
b. /ji-**s**-ti**z**/ → [ji-**s**-ti**z**] ʻit was spunʼ

Derived-environment effects

- a.k.a. non-derived environment blocking (NDEB)
- E.g. Korean /t/-palatalization (Kiparsky, 1973, 1993; Iverson and Wheeler, 1988; Cho, 2001).

(3) /t, t^h/ → [tɕ, $tɕ^h$] / __+[i]   (*ti)

a. /mat-i/ → [matɕi]   ‘eldest.NOM’

b. /pat^h-i/ → [$patɕ^h$i]   ‘field.NOM’

(4) But [ti] and [t^hi] are attested within stems:

a. /mati/ → [mati]   ‘knot, joint’

b. /t^him/ → [t^him]   ‘team’

- Implications for phonological learning – mismatch between stem phonotactics and alternation

Questions

Overall question: *What is the relationship between phonotactic and alternation learning?*

1. Is phonotactically-unsupported phonology learnable at all (as in derived-env. patterns)?

2. Are derived-env. alternations more difficult to learn?
   - Constraint-based models: phonotactic knowledge assist alternation learning (Prince and Tesar, 2004; Jarosz, 2006; Tesar and Prince, 2007; Hayes and Wilson, 2008)
   - Predicts that phonotactic mismatch impedes alternation learning.

3. Does learning an alternation help learners notice a phonotactic gap? Is there a bias to maintain the same generalization?

Phonological knowledge: what do we know?

- Overall studies have generally looked at either:
  - Phonotactic knowledge (e.g. Saffran et al., 1996; Skoruppa & Peperkamp, 2011; Linzen & Gallagher, 2014) OR
  - Alternation learning (e.g. Wilson, 2006; Cristià et al. 2013, White, 2014).
- But not the **relation** between the two types of generalizations
- That phonotactic learning facilitates alternation learning

  → Lacks experimental support

  → Though see Pater & Tessier (2005)

Pater & Tessier (2005)

- Artificial grammar learning expt. (English speakers)

- Lang. 1 – [t]-epenthesis driven by Eng. phonotactics – lax vowels don't occur word-finally

	Root	Singular
a.	/blɪ/	[blɪt]
b.	/gɛ/	[gɛt]
c.	/blej/	[blej]

- Lang. 2 - [t]-epenthesis driven by frontness of final vowel – not supported by Eng. phonotactics

	Root	Singular
a.	/lij/	[lijt]
b.	/blej/	[blejt]
c.	/fuw/	[fuw]

Pater & Tessier (2005)

- Learners of Lang. 1 (phonotactically motivated) learnt the alternation better than learners of Lang. 2.

→ So: **phonotactics helps!**

- But pattern in Lang. 2 is typological unnatural
- This could have explained the poorer performance in Lang. 2.
  - Unnatural patterns dispreferred by learners (Hayes et al., 2009; Becker et al., 2011; Hayes & White, 2013)

- Fairer test: alternation motivated by same constraint, but with or without phonotactic support
- Derived env. patterns allow us to look at this.

Present study

- Artificial grammar learning study
- Artificial languages modeled on Korean /t/-palatalization
- Participants are tested on both static phonotactic knowledge as well as alternations.

Artificial languages

- Two languages created:
  1. Across-the-board: Alternation and stem phonotactic go together (like Navajo)
  2. Derived-environment: Alternation but no stem phonotactic (like Korean)

Artificial languages

- Consonants: [p, b, t, d, ʧ, ʤ]; Vowels: [a, i, u]
  - NB: /t/-/ʧ/ and /d/-/ʤ/ are phonemic
- Singular stems: CVC, CVCV, CVCVC
  - Plural: suffix –*i*
- Stress on initial syllable
- Highlighted phonotactic gap – increased the *Expected* value of [ti]/[di] – increased tV and Ci syllables
  - Otherwise, other CV syllables equally frequent in singulars

- Across-the-board: 52 singulars (no [ti]/[di] items)
- Derived-env.: 58 singulars (10 items with [ti]/[di])
  - Only difference was whether or not learners heard words with [ti]/[di]

Artificial languages

1. Plural alternations in **both** languages

/t, d/ -> [ʧ, ʤ] / __i

	Singular	→	Plural	%
V:	padu	→	padu-ʔi	~35%
p:	ʧap	→	ʧap-i	~36%
b:	dupib	→	dupib-i	
ʧ:	duʧ	→	duʧ-i	~7%
ʤ:	pubiʤ	→	pubiʤ-i	
t:	dat	→	daʧ-i	~21%
d:	dubad	→	dubaʤ-i	

2. Singular stems

Across-the-board	Derived-env. pattern
✗tib	✓tib
✗ʤati	✓ʤati
✗titab	✓titab

Participants

- Native American English participants recruited via UCLA Psych. Pool (received one course credit)
- One of the two language groups:
  - Across-the-board: n = 24
  - Derived-environment: n = 29
- Tested over the internet using Experigen (Becker and Levine, 2014)

Procedure overview

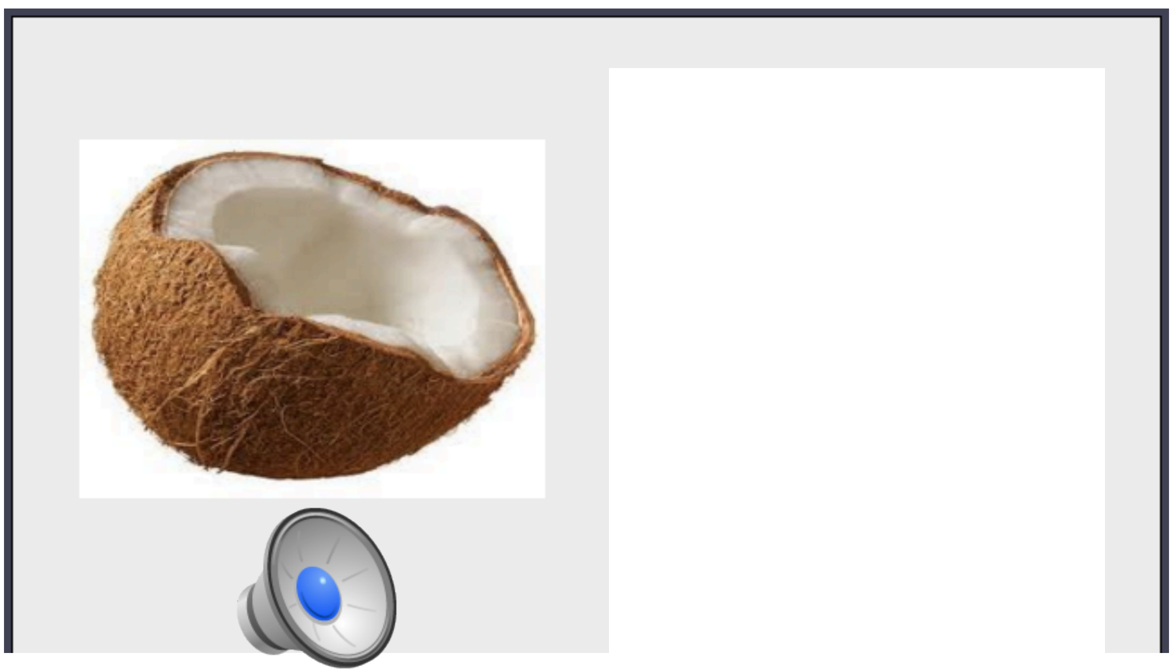
1. Training Phase

2. Blick test – well-formedness judgments on singulars

3. Wug test – decide correct plural

Training phase

- Listeners heard singular and plural forms for a nonce word on each trial
- Also saw images of objects (singular and plural)
- Two blocks of training – heard all words twice



Wug test

- Saw singular image, and heard singular word (as in training)
- Then saw plural image, and heard two plural options – asked to pick correct plural

Stem-final C		Changed-plural
p	→	ʧ
b	→	ʤ
ʧ	→	t
ʤ	→	d
t	→	ʧ
d	→	ʤ

Singular:

Plural:

- None of the test words contained [ti]/[di] sequences.
- 52 familiar singulars (words heard by both groups)
- 48 novel singulars: 8 per stem-final consonant

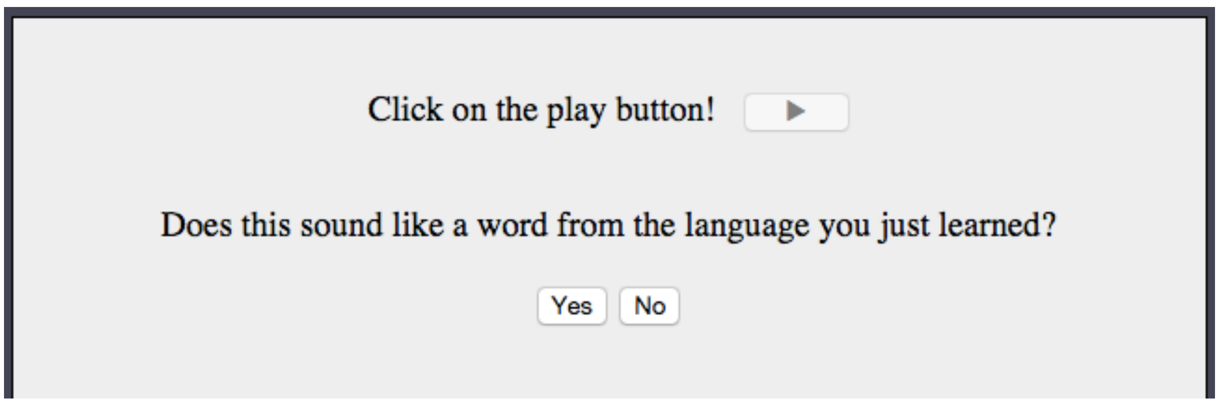
Results: Wug test

Modeled % changed plural selected

Learnt alternations equally well!

Blick test

- Well-formedness judgment of both familiar and novel **singular** stems (no images)



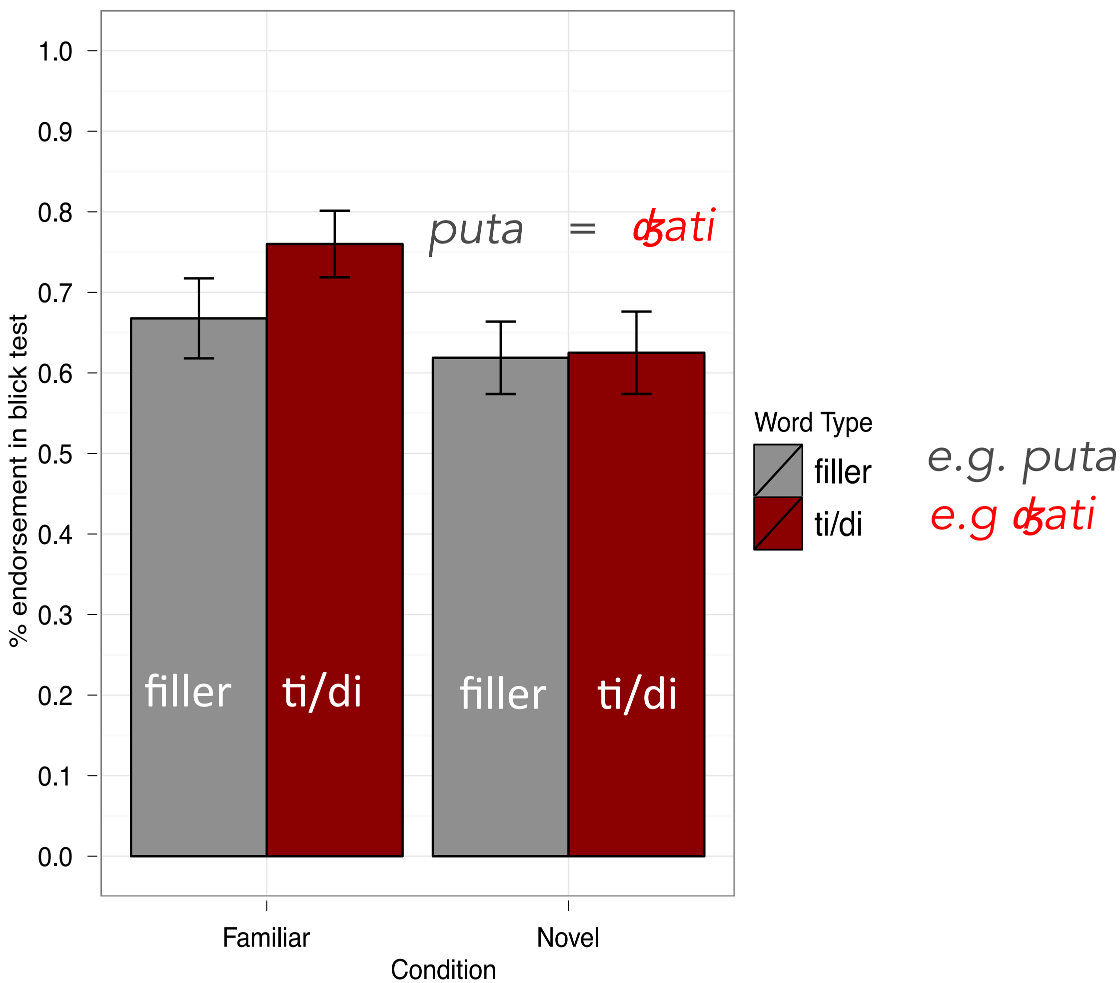
Blick test

- 58 Familiar singulars:
  - Both language groups judged the same familiar words
  - Including [ti]/[di] words –familiar for Derived-env. learners but not Across-the-board learners.
- 36 novel singulars formed in the same vein as familiar words – two types:
  - [ti]/[di] items: words with [ti]/[di] -- e.g. *ʤati, diʧap*
  - Filler items: words without [ti]/[di] -- e.g. *puta, ʧitup*
  - Apart from [ti]/[di] all other CV types occurred roughly equally

- Difference in endorsement of Filler vs. [ti]/[di] singulars

Results: Blick test

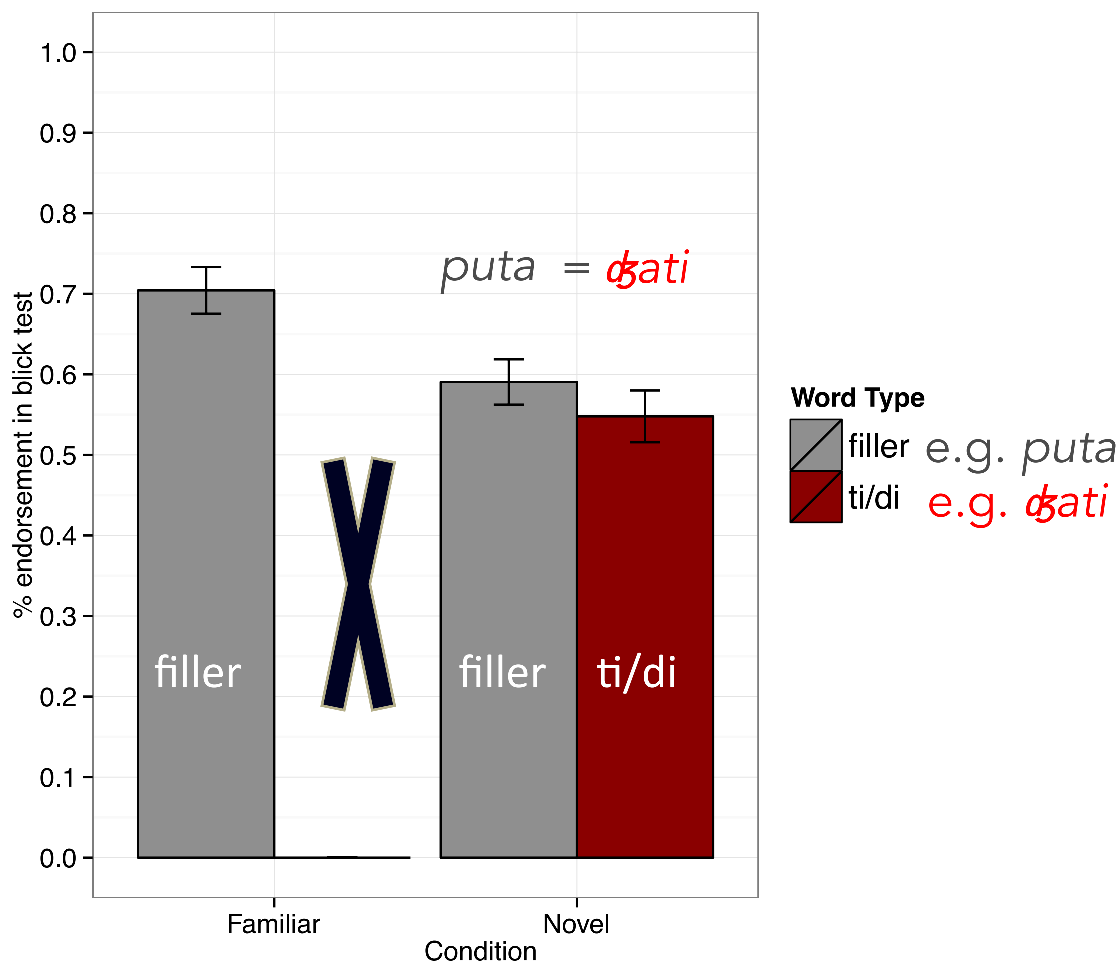
Derived-environment – Predicted: Filler = [ti]/[di]



- Overall lower endorsement of novel singulars
- No differences in endorsement rate for filler and [ti]/[di] singulars

Results: Blick test

Across-the-board – Predicted: Filler > [ti]/[di]



- Overall lower endorsement of novel singulars
- But **no additional dispreference** for [ti]/[di] singulars

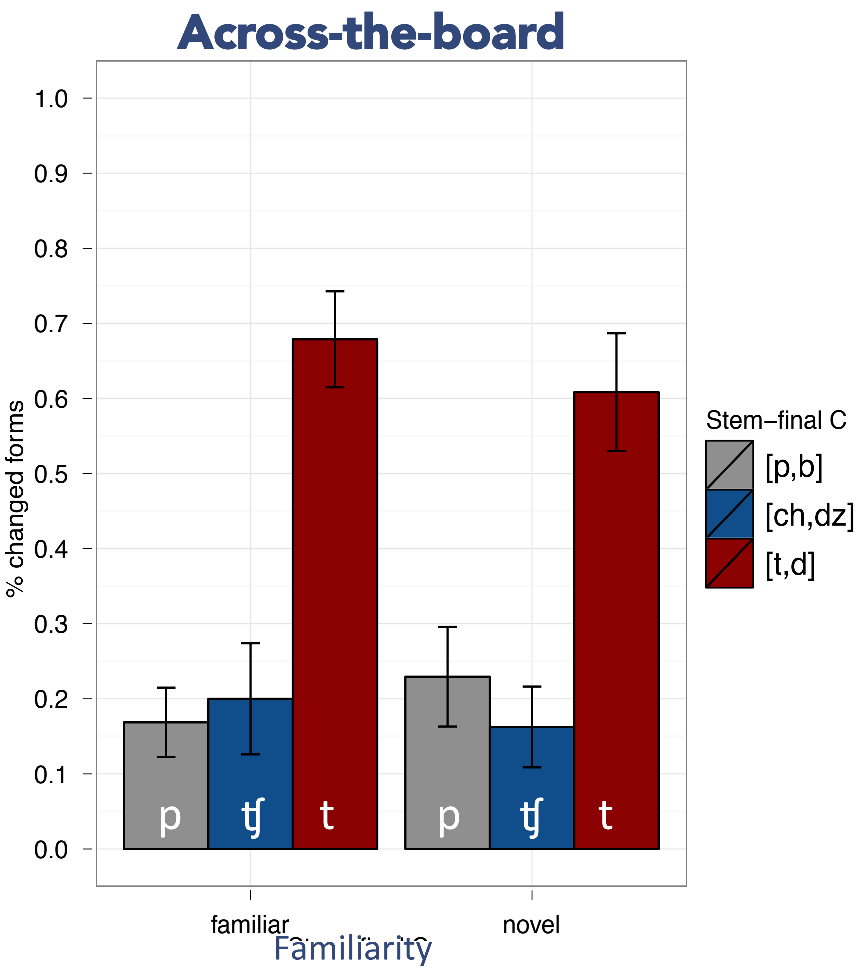
Interim discussion

- Learners in both languages learned the alternation equally well
  - Learners in derived-environment language noticed [ti]/[di] singulars in training → no difference
- But Across-the-board language learners **failed to notice the phonotactic gap** – never heard any words with [ti]/[di]
  - Treated [ti]/[di] stems like novel fillers
- Significant effect of familiarity in both languages:
  - Potential task effect: Were participants relying on pure recall of words they had heard?

Experiment 2

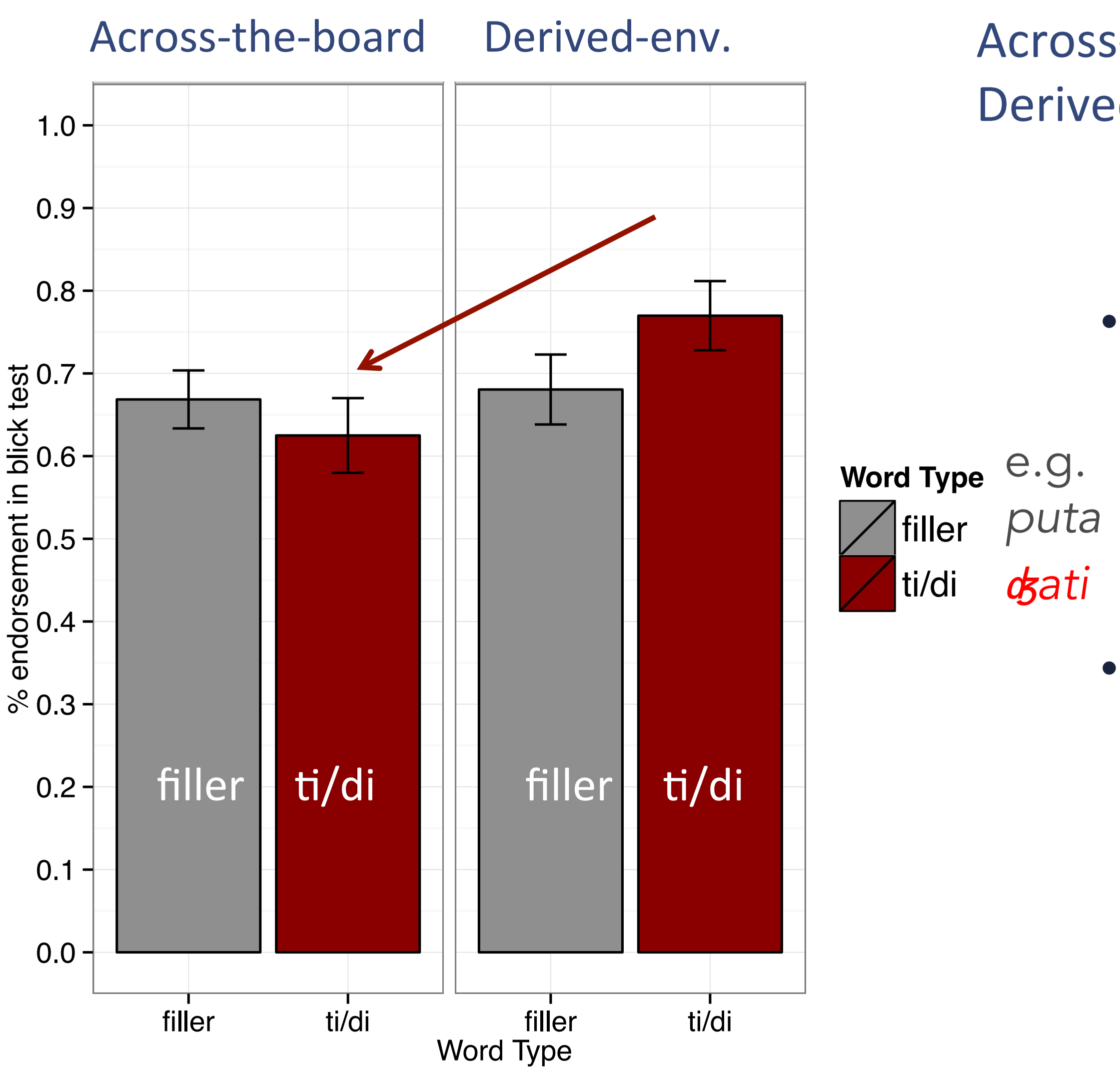
- Stimuli exactly the same as in Expt. 1
- Same procedure: but in Blick test, participants only had to rate **novel singulars**, and **not** familiar ones.
- Participants were told that they had not heard any of the upcoming words previously.
  - Rely less on pure recall
- Participants:
  - Across-the-board: n = 21
  - Derived env.: n = 22

Results: Wug test



Same as in Expt. 1

Results: Blick test



Across-the-board: Filler > [ti]/[di]
Derived-env.: Filler = [ti]/[di]

- In both languages: no differences between filler and [ti]/[di] singulars
- But Derived-env. learners endorsed [ti]/[di] singulars significantly more often than Across-the-board learners.

Discussion

- Wug test results of Expt. 2 replicate Expt. 1.
  - No differences in alternation learning between learners in both languages

- Across-the-board learners still failed to notice the phonotactic gap
  - Although difference endorsement rate for [ti]/[di] singulars by language

- Reasons for failure?
  - Size of the phonotactic gap is too small.
  - Learning **both** alternations and phonotactics in a task is too demanding? - Alternations are just very salient?

Conclusions

1. Is phonotactically-unsupported phonology learnable at all (as in derived-env. patterns)?
   - Yes – learners in both language groups learnt alternation

2. Is a derived-env. pattern more difficult to learn?
   - Unclear – crucial condition for comparing the languages not met
   - ➢ Across-the-board learners failed to learn phonotactic constraint

3. Does learning an alternation help learners notice a phonotactic gap?
   - **No** – learning an alternation does not have a backwards effect on stem phonotactics (see also Pizzo, 2015).

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