THE STORY OF AN AFRICAN LAB

CLICK PERCEPT!ON

EXPERIMENTS IN XHOSA AND ZULU

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bit.ly/lsa2025clicks

A BIT OF A CONUNDRUM

- Why are clicks…?
  - Hand 1: super salient (the only Cs consistently louder than Vs, e.g.)
  - Hand 2: rare, restricted, limited in distribution qua consonants
- Contradictory intuitions afoot
  - Clicks are very easy to recognize as different from nonclicks
  - Click vs click distinctions seem much less easy to discern

P-MAPPING CLICKS

- Steriade (2001/2008) P-map: confusability of a given contrast…
  - is different in different contexts
  - projects relative ranking of faithfulness constraints (less distinct ~> less important to distinguish)
- Oddball expectations for clicks:
  - faithfulness for clickiness is supreme (predicts clicks are hard to get rid of)
  - faithfulness among clicks less crucial (because less salient)

a.

Obstruent voicing	V_V	C_V	V_R	V_]	V_T	C_T
p/ b	p/b	p/b	p/b	p/b	p/b	p/b
t/ d	t/d	t/d	t/d	t/d	t/d	t/d
k/ g	k/g	k/g	k/g	k/g	k/g	k/g
s/z	s/z	s/z	s/z	s/z	s/z	s/z

CLICKS SHOULD BE EASY TO PERCEIVE

- Ladefoged & Traill (1994:45), !Xóõ
  - "clicks are probably the most salient consonants"
  - clicks easier to ID than non-clicks
- masking level test: confounds loudness and spectral distribution
- only looked at plain [ʘ | ! ǁ ǂ] vs. pulmonic consonants; doesn't establish click~click baselines

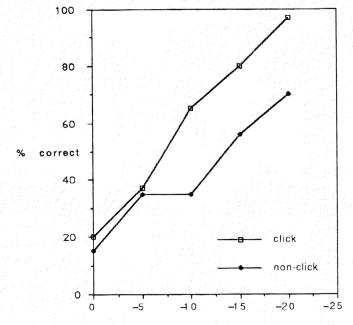

Figure 6. The perceptual saliency of clicks and non-clicks.

CLICKS SHOULD BE EASY TO PERCEIVE

- Most previous studies of click perception focus on non-native listeners (Best et al. 1988, 1999, 2003, 2008, 2020, among others)
  - American click-naïve listeners do not perceive clicks as speech sounds
  - Click-naïve listeners still extremely good at AXB discrimination (worst participant still 81% correct, cf. Zulu listener avg. 87%)
- Best et al. (2003) compare Sesotho & Zulu listeners, but both groups listened only to fricated clicks from !Xóõ, which are an obviously non-native category for them
- Point: none of these establish clear baseline expectations for the perceptibility of, e.g., different Zulu click contrasts by Zulu-speaking listeners

CLICKS ARE PERCEIVED AS DIFFICULT

- Anecdotal evidence abounds that people regard clicks as complex and difficult to master
  - probably not just an artifact of eurocentrism in descriptions ("*exotic!*")
  - L1 Xhosa & Zulu speaking undergraduates report this impression too
- Try it and see
  - click contrast test 1
  - click contrast test 2

FAILED ATTEMPTS AT REPLICATING PREVIOUS FINDINGS

- Pilot 1: ABX task, attempting to probe type vs accompaniment contrasts, using v!v intervals excised from real words, both Xhosa and click-experienced English speakers (Miller 2020)
  - all participants at chance (top performer ~54%) 😵
- Pilot 2: AXB task, new stimuli recordings of nonce a!a sequences
  - all participants still at chance; they can't discriminate
  - very much at odds with Best's findings; even L1 listeners failed to recover the contrasts from this set of stimuli

TODAY'S EXPERIMENT: DESIGN

- AXB paradigm, audio presentation, all CVCV nonce sequences
- Bipartite structure, stimuli recorded by Khethani Yende
- Side A: click type contrasts (c ~ q ~ x) (dental ~ alveolar ~ lateral)
  - intended to probe for differences based on dialect/accent
  - is c ~ q variation rooted in perceptual difference? (Yende 2023, in prep)
- Side B: two tranches
  - "Count" (!ada vs !a!a) (cf. Gallagher 2010)
  - "Site" (!ada vs da!a)
- Each side served as distractors from the other

PARTICIPANTS

- 12 L1 speakers of Zulu recruited by Khethani Yende using word of mouth + snowball sampling
- Targeted recruitment to probe for regional/dialect variation
  - one group of speakers from Gauteng (=urban Zulu, "Sowetan" Zulu)
  - one group of speakers from KZN ("proper" Zulu, "deep" Zulu)
- All could also speak multiple languages (English, etc)
- No other participant factors considered here

PERCEPTIBILITY VARIATION BY CLICK TYPE

c ~ q	😩
c ~ x	😶
x ~ q	😶

- "Click type": synonymous with front closure place distinctions
  [IPA key: c = ǀ x = ǁ q = ǃ]
- c ~ q: attested as free variation (Gunnink 2014)
  ~> so maybe is harder to discern?
- c ~ x: predictions unclear
- x ~ q: predictions unclear

PERCEPTIBILITY VARIATION BY CLICK CONTEXT

da!a	😠
!ada	🙂
!a!a	🤷‍♂️

- Contradictory intuitions here
  - !ada > da!a would make sense bc initial prominence
  - But: da!a > !ada makes sense if the preceding vowel carries some of the cues
- Cross-interaction likely; different contrasts are made with different cues (burst vs VOT, e.g.)
- Also, count is a thing we looked at (!ada vs !a!a)

PERCEPTIBILITY VARIATION BY CLICK CONTEXT

"Site"

da!a	😠
!ada	🙂
!a!a	🤷‍♂️

- Contradictory intuitions here
  - !ada > da!a would make sense bc initial prominence
  - But: da!a > !ada makes sense if the preceding vowel carries some of the cues
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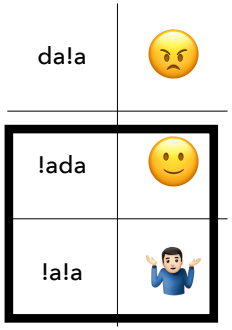
PERCEPTIBILITY VARIATION BY CLICK CONTEXT



"Count"

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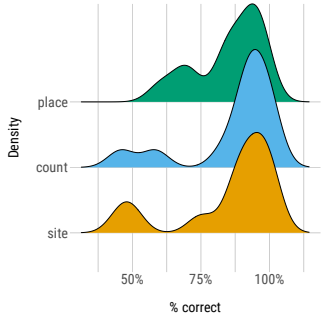
RESULTS

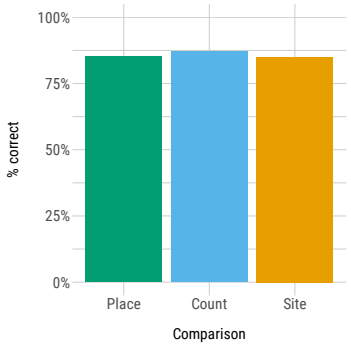
ANALYSIS

- Logistic mixed effects model (via `glmer`)
  - Fixed effects: tranche, place, site, correct answer, correct button
  - Random effects: intercepts for item and participant
- Marginal means computed and pairwise tests (via `marginaleffects`)

BIRD'S EYE VIEW

- Correct perception is similar in each tranche:
  - place 85.14%
  - count 87.15%
  - site 85.07%
- More in line with Best's prior work





OVERALL RESULTS BY TRANCHE

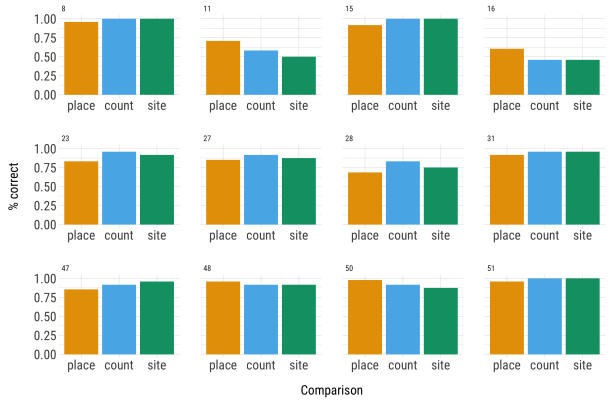
- place 85.14%
- count 87.15%
- site 85.07%

Model

Parameter	Coeff.	CI	z	p
(Intercept)	2.23	[1.36, 3.09]	5.05	0.00
correct ans [B]	0.29	[-0.14, 0.73]	1.32	0.19
tranche [count]	0.28	[-0.46, 1.01]	0.73	0.46
tranche [site]	-0.05	[-0.58, 0.48]	-0.19	0.85
place [q]	-0.04	[-0.58, 0.51]	-0.13	0.90
place [x]	-0.51	[-1.04, 0.02]	-1.88	0.06
site [2]	0.25	[-0.25, 0.75]	0.99	0.32
site [b]	0.07	[-0.82, 0.96]	0.15	0.88

Marginal means for tranche

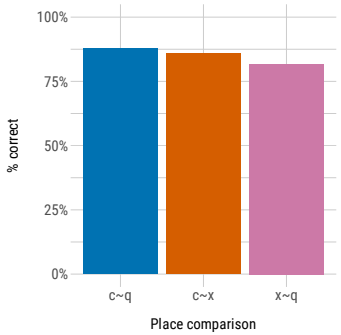
	Est.	statistic	p	CI
count - place	0.03	0.75	0.45	[-0.04, 0.10]
site - place	-0.01	-0.19	0.85	[-0.06, 0.05]

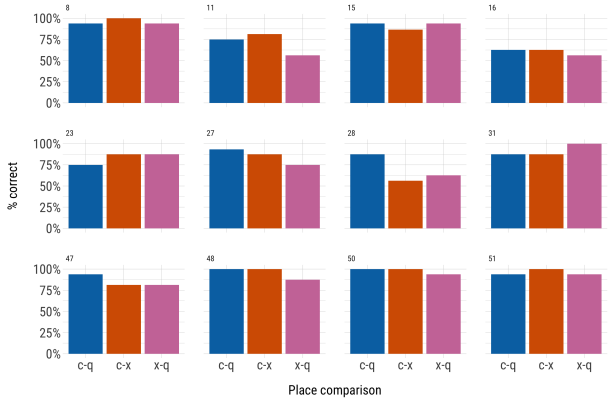


PLACE COMPARISONS

- Mean percent correct: 85.14%
- Place comparison type is not a significant predictor in the model
- Pairwise comparison of marginal means show no differences between any pair of place comparisons

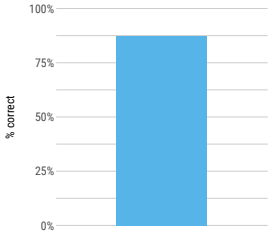
Comparisons	Contrast	conf.low	conf.high	p.value
x-q - c-q	-0.06	-0.16	0.04	0.22
x-q - c-x	-0.04	-0.14	0.06	0.46
c-q - c-x	0.02	-0.07	0.11	0.62





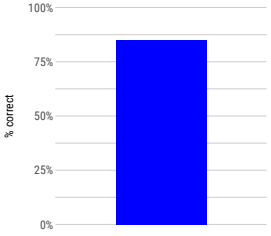
COUNT COMPARISONS

- Mean percent correct: 87.15%

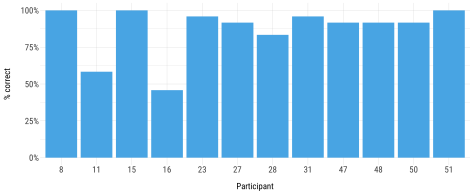


SITE COMPARISONS

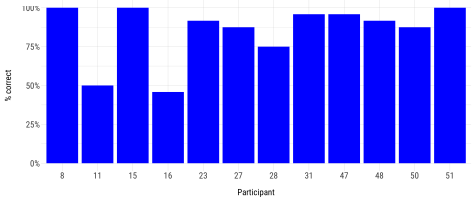
- Mean percent correct: 85.07%



- Count



- Site



CONCLUSION

- We have established now that the procedure we used in expt 3 is a good way to get some functional baselines
- Pilot experiment kinks seem mostly worked out
  - AXB > ABX
- Further task effects remain to be studied
  - CV vs. VCV vs. CVCV stimuli

NEXT QUESTIONS

- Place (c ~ q ~ x) vs. accompaniment (q ~ nq ~ ngq ~ gq)
- Does accompaniment modify place perception?
- Do clicks pattern like ejectives with respect to perceptual biases of site and count?
- How common is metathesis as a perceptual illusion with clicks (qada perceived as daqa)?
- Click-naive vs. click-experienced listeners (SA vs. US English L1s)
- Cue weighting within each accompaniment (e.g. pitch effects)

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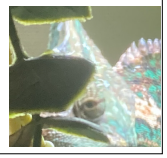

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