Exploring performance-based predictors of phonological judgments in Mandarin

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James Myers
Jane Tsay
National Chung Cheng University
Lngmyers@ccu.edu.tw

- Thanks to:

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Abstract

- We collected native-speaker judgments of **Mandarin syllables**, looking for effects of:
  - **Syllable properties** (lexical status, frequency, phonotactics, neighborhoods)
  - **Performance factors** (modality, judgment speed, relations with nonjudgment tasks)
- Results showed influence of all of these, especially **lexical status**

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Modeling judgments

- All evidence for competence comes from performance, but little is known about how the judgment making process works
- The literature on phonological judgments has focused on phonotactic and neighborhood influences (e.g., Coleman & Pierrehumbert, 1997; Bailey & Hahn, 2001)
- Work on typologically different languages and on other performance factors is lacking

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Mandarin syllables

- Mandarin syllable structure is simpler and thus there are fewer lexical syllables than in English (under 1400, including tone)

  - Practically, this means that a larger proportion of both lexical and "logically possible" syllables can be tested than in English

  - Theoretically, this means that neighborhoods are "denser": all syllables will have at least one neighbor, which may affect judgment-making

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Mandarin syllable judgments

- Anecdotal evidence suggests that Mandarin speakers may be less willing to accept nonlexical syllables than English speakers
- Nevertheless, Wang (1998) and Myers (2002) found that Mandarin speakers do judge (apparent) systematic gaps as worse than (apparent) accidental gaps

 Wang (1998): Words > Tonotactic accidental gaps (TAG) > Phonotactic accidental gaps (PAG) > Systematic gaps (SG)

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Collecting the data

- So far we have collected judgments from 120 Mandarin speakers across a variety of judgment conditions on a 6-point scale:

  1 = "most unlike Mandarin"
  6 = "most like Mandarin"

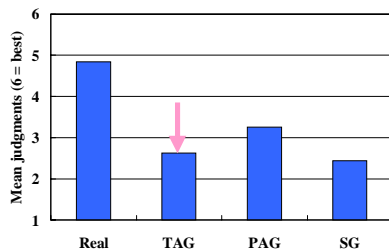- We've also conducted some nonjudgment tasks that presumably tap into components of the judgment process

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Choosing the syllables

| p
p^h
m
f
t
t^h
n
l | × | a
i
u
@ | × | n
ng
| × | Tone1
Tone2
Tone3
Tone4 | = | 384 |
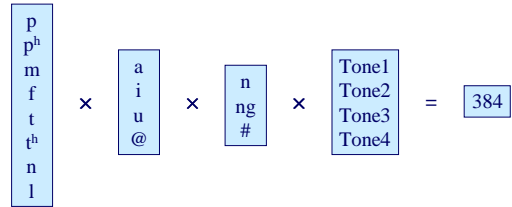
- 235 lexical ("words"), 149 nonlexical
  (Li, Li, & Tseng, 1997; Tsai, 2000)

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Our results for Wang's categories


- Why? Maybe because TAGs aren't so accidental.

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Three influences on judgments

- **Frequency:** relevant for real words only
- **Phonotactics:** operationalized as phoneme transition probabilities (**PTP**)
  - Specifically, we used the geometric mean of PTP with onset-toneme "transition" probability
- **Neighborhood density:** operationalized as number of nearest neighbors (**NNB**)
  - For some analyses we also used Bailey & Hahn's Generalized Neighborhood Model (**GNM**) with coefficients fit to our data
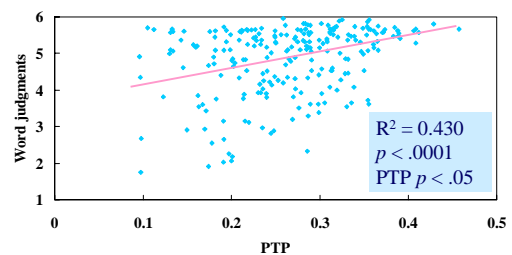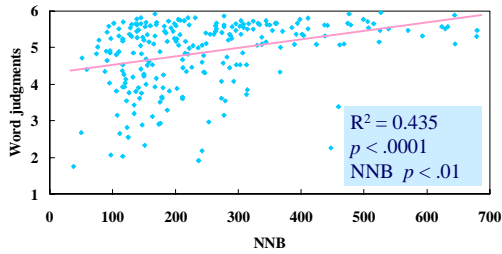
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Frequency affects word judgments

$R^2 = 0.416$
$p < .0001$
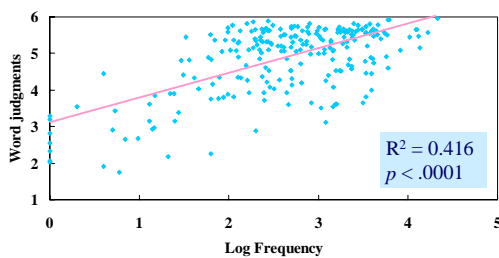
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Phonotactics affect words
(even with frequency factored out)

$R^2 = 0.430$
$p < .0001$
PTP $p < .05$

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Neighborhoods affect words
(even with frequency factored out)

$R^2 = 0.435$
$p < .0001$
NNB $p < .01$

(LogFreq + PTP + GNM: $R^2 = 0.483$, $p < .0001$)
$p < .0001$ $p < .05$ $p < .0001$

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Phonotactics affect nonwords
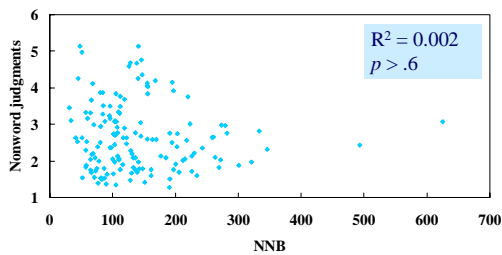

$R^2 = 0.047$
$p < .001$
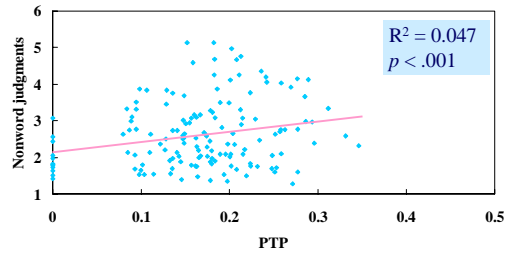
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## Neighborhoods don't affect nonwords

$R^2 = 0.002$
$p > .6$

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Modality effects

- Bailey & Hahn (2001) found no important differences in judgments made on auditory vs. written items in English
- Does modality affect how well phonotactics and neighborhoods predict Mandarin judgments?
- Written forms in Taiwan's phonetic system:
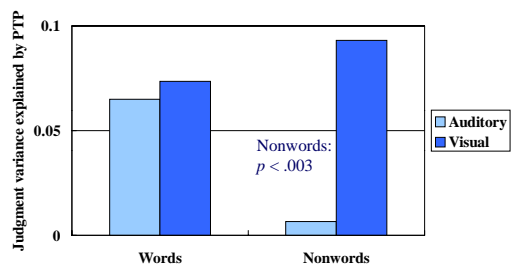 e.g. Pinyin "man" vs. "mang" is ㄇㄢ vs. ㄇㄤ

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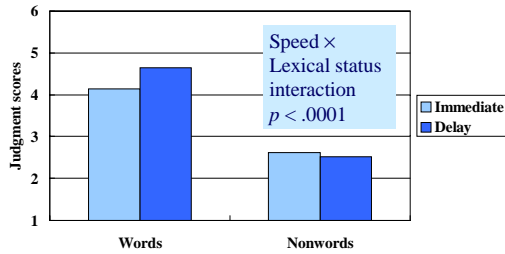## Modality doesn't change neighborhood effects
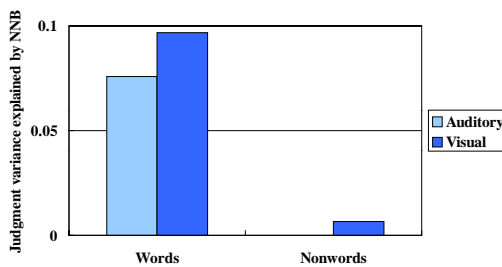
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Modality affects the role of phonotactics in nonwords

Nonwords:
$p < .003$

Yes, phonotactics predict *visual* nonword judgments!

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Effect of speed* on judgments

Speed ×
Lexical status
interaction
$p < .0001$

■ Immediate
■ Delay

Judgment scores

6
5
4
3
2
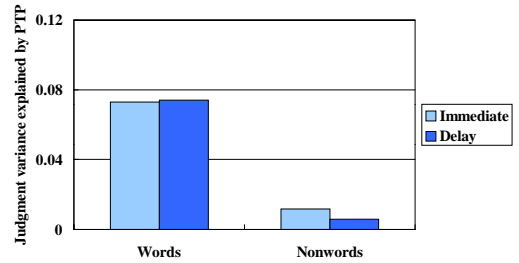1

Words   Nonwords

*Immediate: within 2 s; delayed: after forced 5 s delay.   19

Speed doesn't change phonotactic or neighborhood effects

Judgment variance explained by PTP

0.12
0.08
0.04
0

■ Immediate
■ Delay

Words   Nonwords

(Similarly null results for NNB and GNM)   20

Predicting judgments from tasks

- Finally, we attempted to predict judgments from other measures given by the same people in nonjudgment tasks:
  - **Perception**: proportion correct in identifying syllables presented in noise (PercPC)
  - **Production**: speed of reading aloud phonetically presented syllables (ProdRT)
  - **Recall**: speed of correctly recognizing previously presented syllables (RecallRT)
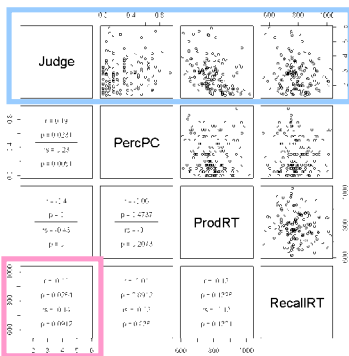
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Word judgment correlations
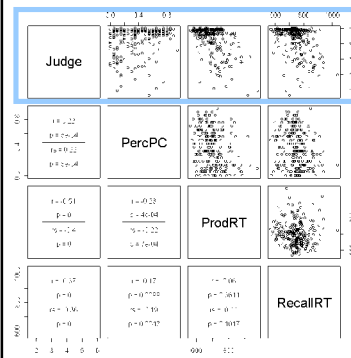
- Perception accuracy, production speed and recall speed were all correlated with judgments, even when all were included in a multiple regression along with PTP and NNB.

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Nonword judgment correlations

- The same was true for nonwords, though the correlation with recall RT was weaker than for words.

(r = Pearson's, rs = Spearman's; graphs produced using Harald Baayen's pairscor function in R.)   23

Summary

- Our experiments on Mandarin have shown:
  - **Phonotactics** affect both word and nonword judgments, but **neighborhood density** only affects word judgments
  - Nonword phonotactic effects on judgments are stronger with **written stimuli** (?!)
  - **Slower judgments** improve word scores, without affecting phonotactic or neighborhood influence
  - Both word and nonword judgments correlate with **perception**, **production**, and **recall** measures   24

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References

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