Individual differences in morphological processing and stress variability in English complex words

Tammy Ganster, Trier University (Germany)

ganster@uni-trier.de

UNIVERSITÄT TRIER

13th Mediterranean Morphology Meeting (University of the Aegean, Rhodes, Greece)

Stress variability in English complex adjectives

Phenomenon: primary stress in verbal base is sometimes shifted in the derivative

and sometimes preserved within the same morphological category

verb	stress preserving derivative variant	stress shifting derivative variant
ánalyze	ánalyzable	analýzable
compáre	compárable	cómparable
célebrate	célebratory	celebrátory
artículate	artículatory	articulátory

What factors can account for this variation?

Previous research on stress variability

Stratum-based approaches (Kiparsky 1982 et seq., 2005, 2015, Fudge 1984)	**Structural approaches** (Trevian 2003, 2007, Bauer, Lieber & Plag 2013, Newell 2020)	**Paradigmatic approaches** (Steriade 1999a, 1999b, Stanton & Steriade 2021)
▶ strict division into three categories ▶ **stress shifting (stem level): -**ory > óscillate > oscillátory, oscíllatory, *óscillatory ▶ **stress preserving (word level):** -ness > alért > alértness, *álertness ▶ **variable (dual level):** -able > jústify > jústifiable ~ justifíable	▶ **segmental phonological features** of derivative assumed to influence stress position ▶ célebrate > célebr[ə]tory ~ celebr[éɪ]tory	▶ effect of **broader paradigmatic relationships?** ▶ what should we take as the **base of a complex word?** ▶ ~~démonstrate~~ demónstrative > demónstrable ?

Problems structure-based accounts

Stratum-based accounts

- empirical **evidence against uniform behavior of stem and word level**

→ stress preservation as well as stress shift underpredicted (*oscillátory ~ óscillatory*)

Structural accounts

- **effect** said to be **variable** (*ánalyze > ánal[aɪ]zable ~ anal[áɪ]zable*)
- can indentify a possible reason for stress shift but **cannot account for variability of stress shift**

Paradigmatic approaches

- **which related word from the paradigm should count** as the one influencing the stress pattern of another given word of the paradigm? → does **lexical frequency make the difference?**

- all accounts **abstract away from individual differences between speakers!**

Processing-based accounts: a possible solution?

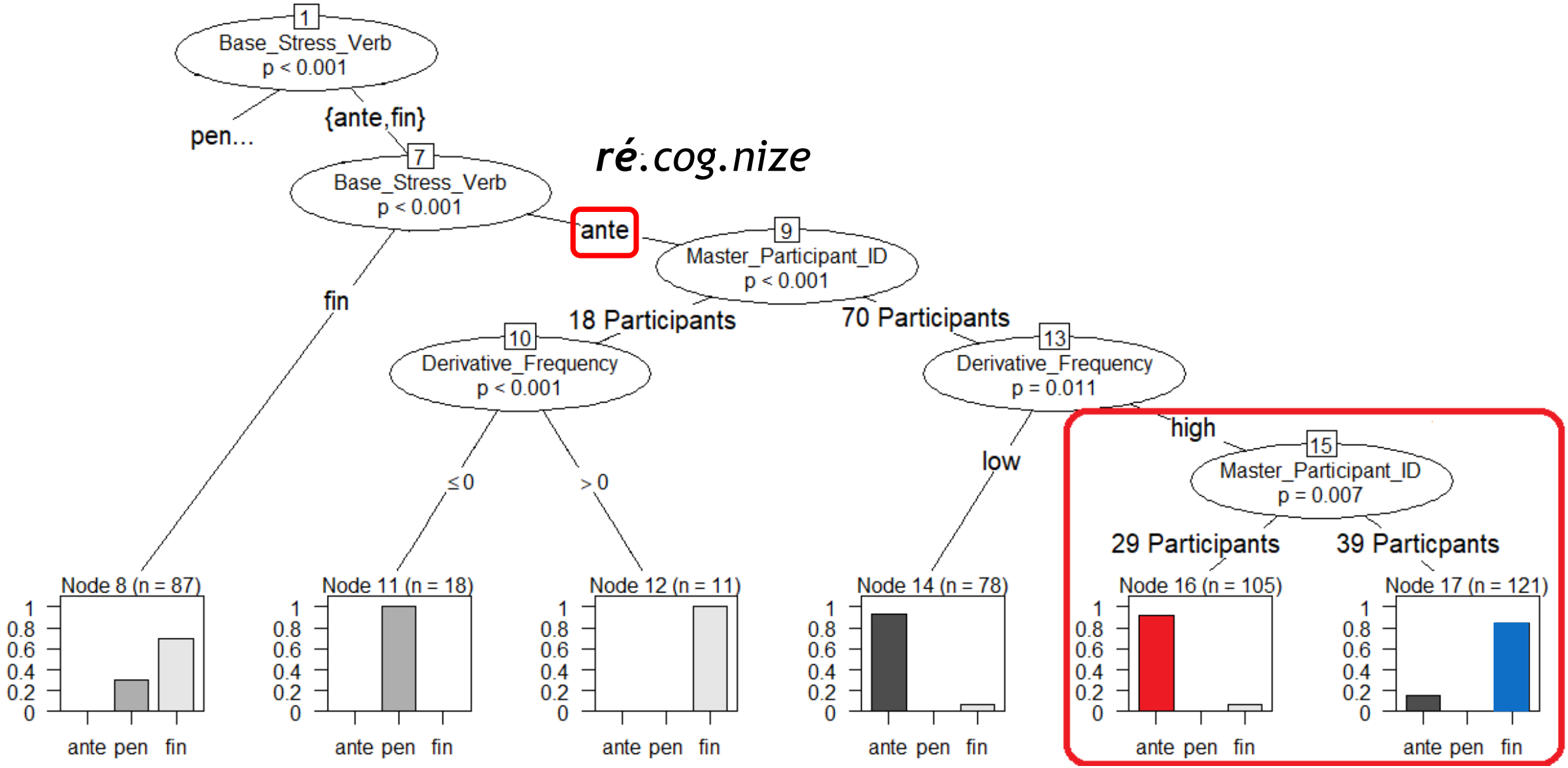
- **Hay's dual-route model** of lexical access (Hay 2001, 2003, Hay & Baayen 2003)
- **relationship** between **base frequency** and **derivative frequency** is crucial
- **the more frequent the base, the more likely** a speaker is to take the **decomposition route**
  - *identifiable* = *idéntify* + *-able* → ***idén****tifiable*

  → stress **preservation**
- **the more frequent the derivative, the more likely** a speaker is to take the **whole-word route**
  - *justifiable* = *justifiable* ~~*(jústify + -able)*~~ → *justi****fí****able*

  → stress **shift**
- (see Collie 2007, 2008, Bermúdez-Otero 2012, Dabouis 2017 for pertinent studies)

Problems of processing-based accounts

- processing-based accounts also **abstract away from individual differences**
- exclusive **reliance on corpus frequencies** to **account for processing effects** (that are assumed to be individual though)
- **individual differences marginalized**, to date mainly only looked at in reading acquistion (e.g. McCutchen et al. 2009) and second language acquisition (e.g. Coxhead et al. 2015)



***ré*.cog.nize**

***ré*.cog.niz.able ~ re.cog.*níz*.able**

(N = 711, 31 types; goodness-of-fit = 90%, from Ganster 2019, see also Arndt-Lappe & Sanz 2017 for complementary effect with base frequency)

Towards more individual models of morphological processing

- **more individual measures of morpholgical processing are needed**
- correlates that emerged as important in other fields
  - individual **awareness of morphological structure** (e.g. McCutchen et al. 2009)
  - **vocabulary size** (e.g. Brysbaert et al. 2016, Mainz et al. 2017)
- These measures **need to be tested for their effects on stress production in complex words**

Experiment

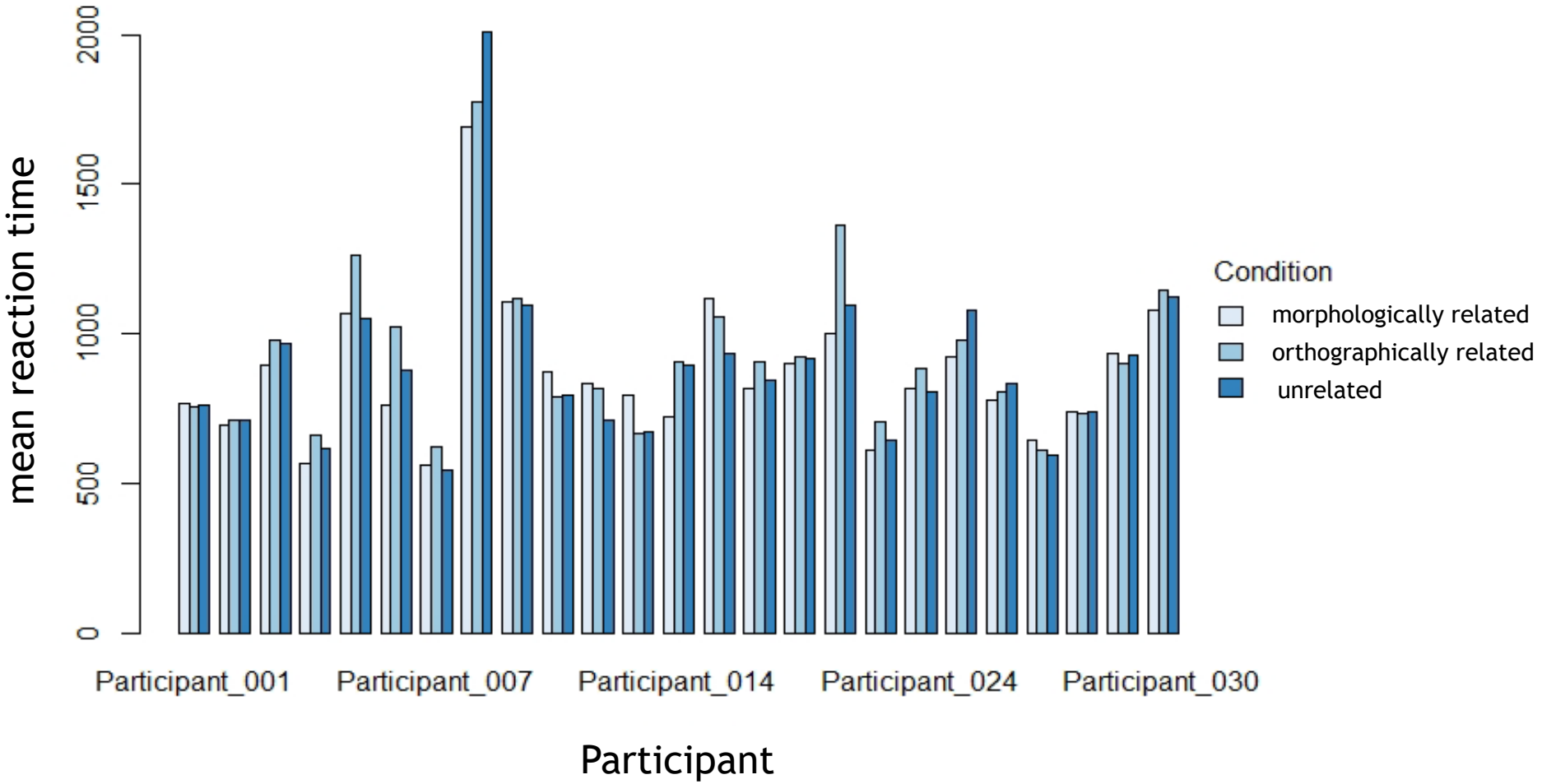
- **remote online** experiment
- **153 native speakers** of British English
  - age: **17-77 yrs,** mean: 25, median: 29.98 / sexes: **93 females, 60 males**
  - **recruited via the online platform Prolific**
- **multi-task experiment**
  - **PROCESSING**
    - **morphological sensitivity** task (masked priming with lexical decision)
    - **vocabulary size** test (standardized test, Coxhead et al. 2015, Nation & Beglar 2007)
  - **SOCIO-DEMOGRAPHIC DATA**
    - meta questionnaire (education, languages, geography, socio-economic status...)
  - **STRESS**
    - production task (read out test sentences with complex adjectives in them)
    - perception task (imitation task)

Data overview

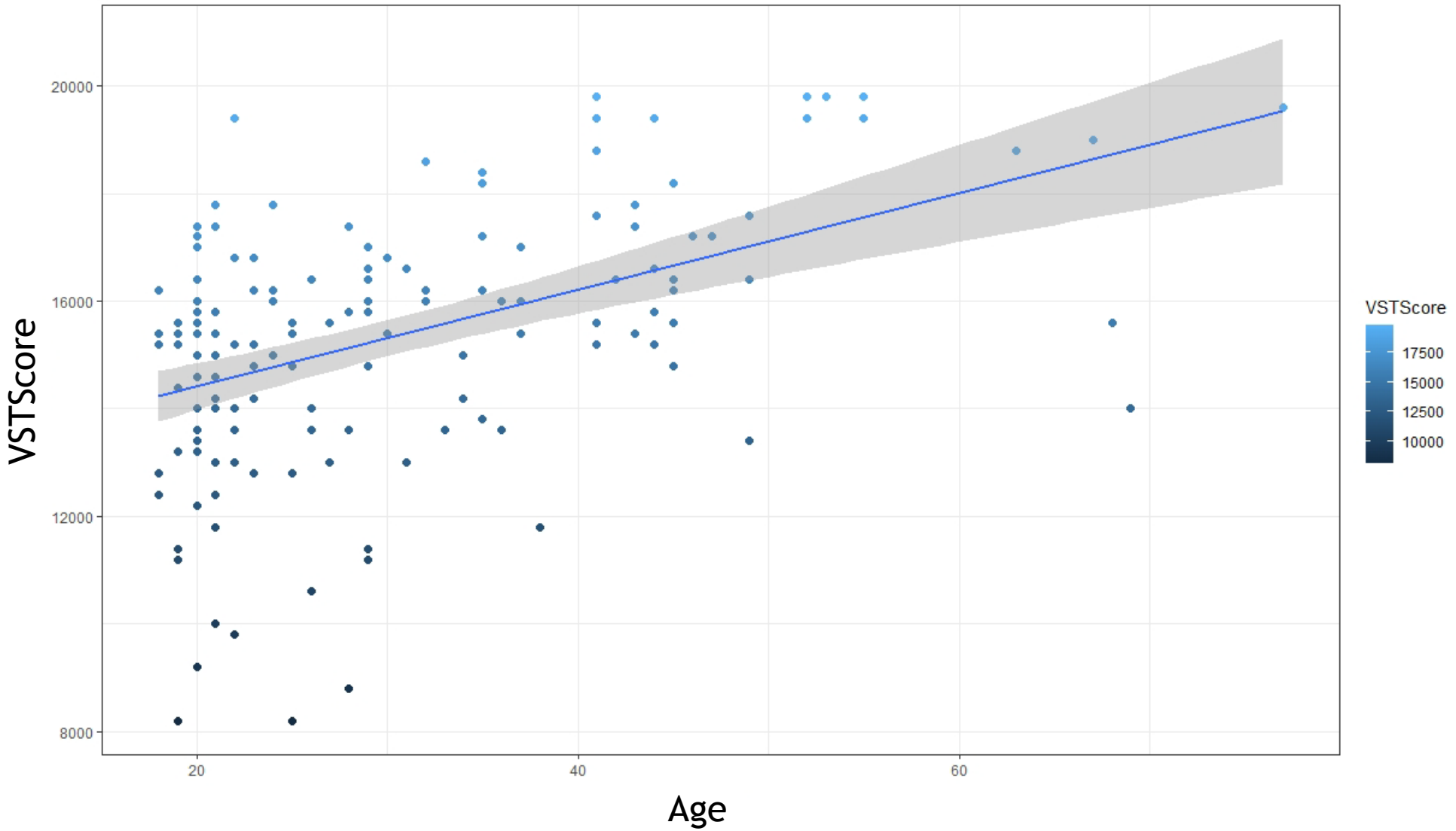
morphological sensitivity task	vocabulary size test	production task
3,467 observations	15,300 observations	
masked priming experiment with **lexical decision task**	**standardized** and multiply validated **forced choice test** (Nation & Beglar 2007)	
measured **reaction time** to **three different priming conditions**: **complex** words **primes - simplex** words **targets** ▶ **morphologically related** prime-target pairs *(subversion - subvert)* ▶ **orthographically related** prime-target pairs *(chargeable - charisma)* ▶ **unrelated** prime-target pairs *(inventive - remorse)*	**100 questions** **Example** *see: They SAW it.* *a) closed it tightly* *b) waited for it* *c) looked at it* **score from 0 - 20,000** (**estimates number of known word families**)	will be explained later

Individuality in morphological sensitivity

raw mean reaction times by condition across
sample of first 25 out of 129 participants, N = 3467

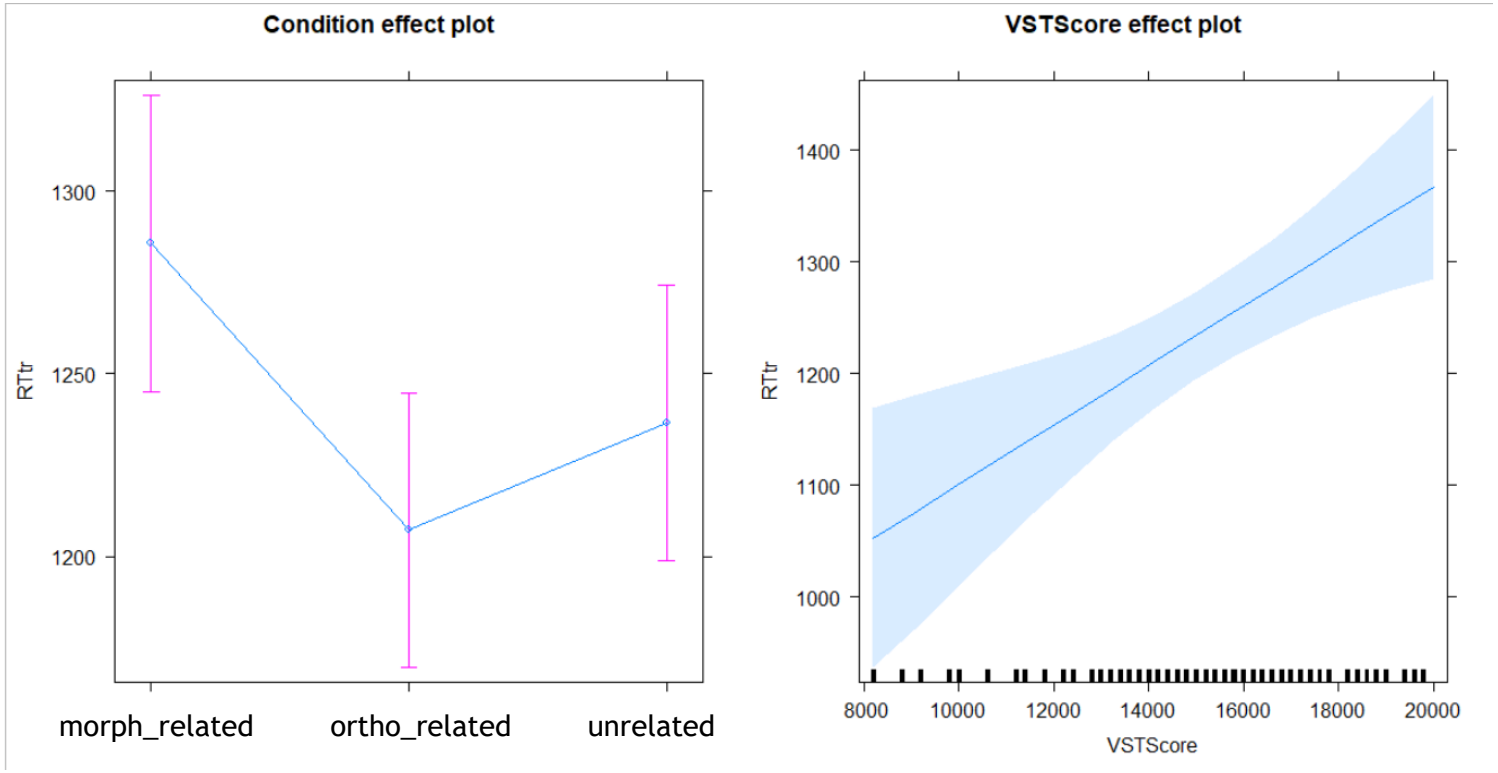


Variation in vocabulary size



Individuality in morphological processing

- **linear mixed effects model**
- model formula = **lmer(trRT ~ PrimingCondition + VSTScore + (1+ PrimingCondition | Participant) , data = MSfinal)**
- **RTs standardized and normalized** (using method of Baayen & Milin 2010)
- **RT transformation** applied here makes it so that **greater number = faster RT**



N = 3467

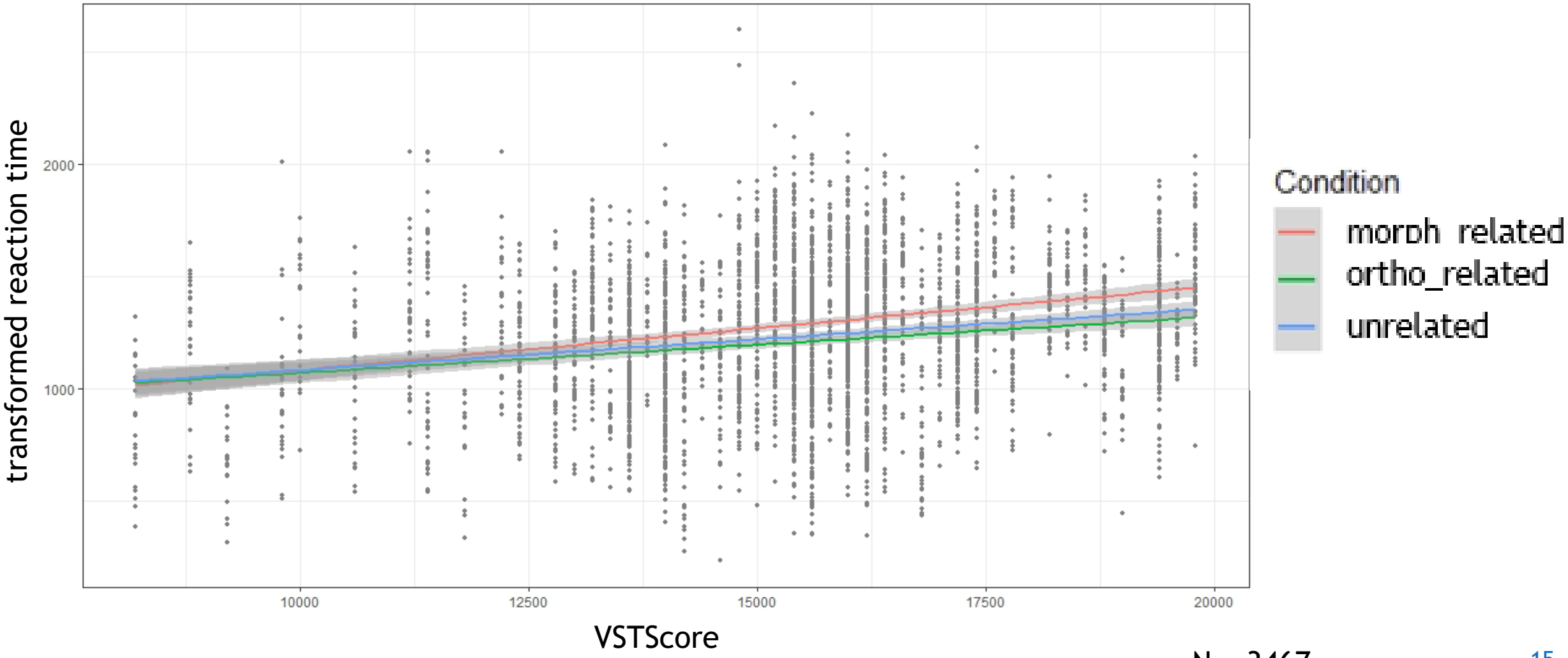
Individuality in morphological processing

- **random slopes** for **effect of priming condition across participants**
- generally: **positive slopes for morphologically related** condition, **negative slopes** for **orthographically related**
- **effect of morphologically related condition varies more strongly** than that of orthographically related condition
- **effect of morphologically related condition is more individual** → individual morphological processing

	(Intercept) unrelated	ortho_related	morph_related
Participant_001	959.7475	-30.01292	56.623834
Participant_002	933.7001	-29.88158	56.243287
Participant_003	695.9116	-28.6826	39.306188
Participant_004	1101.7955	-30.72916	77.529265
Participant_005	575.0771	-28.07332	28.386424
Participant_006	768.9771	-29.05101	52.418902
Participant_007	1312.6265	-31.79221	87.939234
Participant_008	195.9878	-26.16187	-3.664134
Participant_009	562.7826	-28.01133	25.566735
Participant_011	874.9415	-29.58531	45.894731
Participant_012	975.9947	-30.09484	51.038665
Participant_013	1022.3805	-30.32873	54.236331
Participant_014	831.5816	-29.36668	57.798891
Participant_015	604.4891	-28.22162	24.070865

coef(MS2.lmer1)$Participant, coefficients sample: slopes of first 14 participants out of 129
N = 3467
model: lmer(trRT ~ PrimingCondition + VSTScore + (1+ PrimingCondition | Participant) , data = MSfinal)

Variation in the effect of vocabulary size



N = 3467

Relating individual differences in morphological processing to stress variation

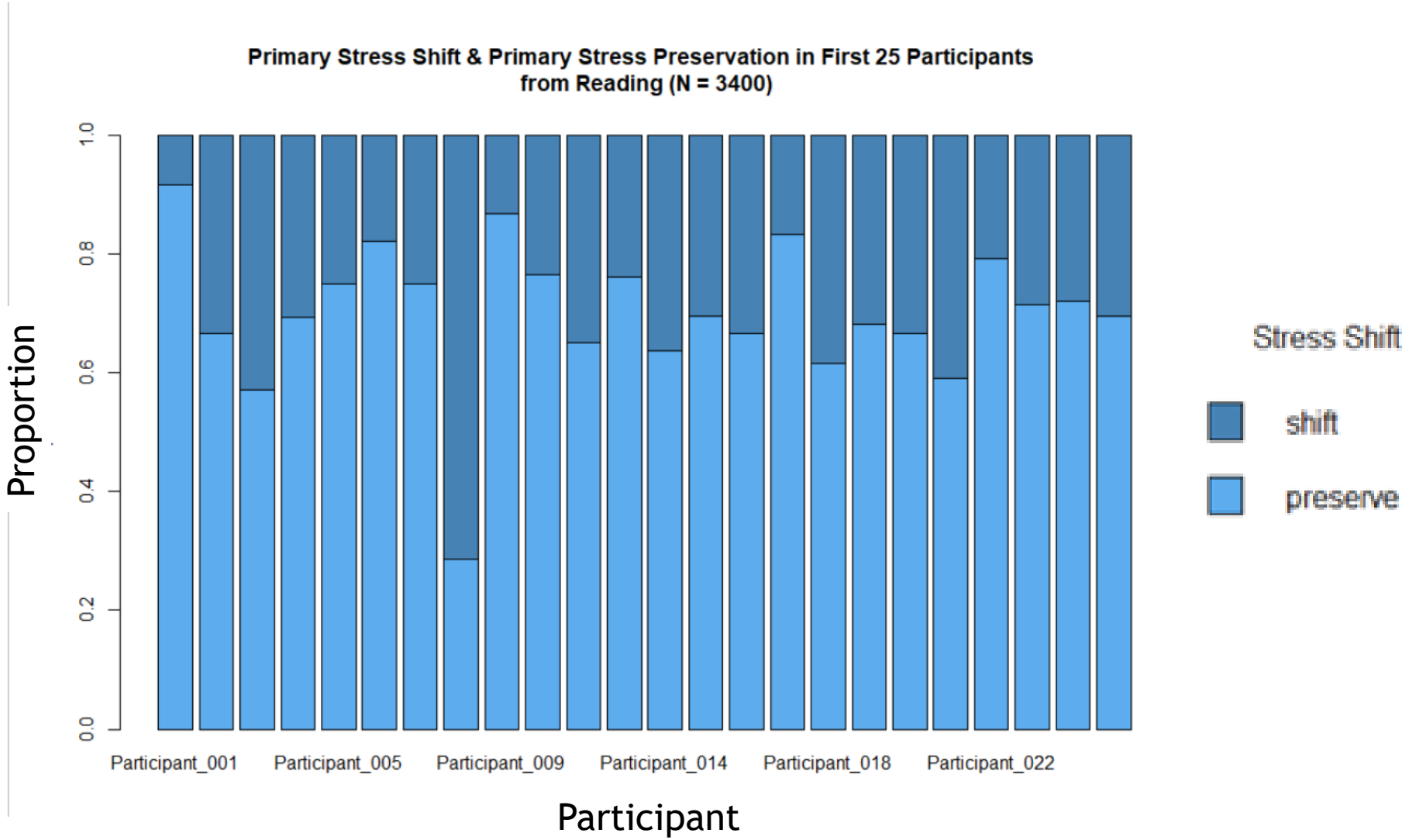
Hypotheses

- **Hypothesis 1: greater sensitivity to morphological structure** → stronger paradigmatic effects → **more stress preservation**
- **Hypothesis 2: greater vocabulary size** → stronger paradigmatic effects → **more stress preservation**

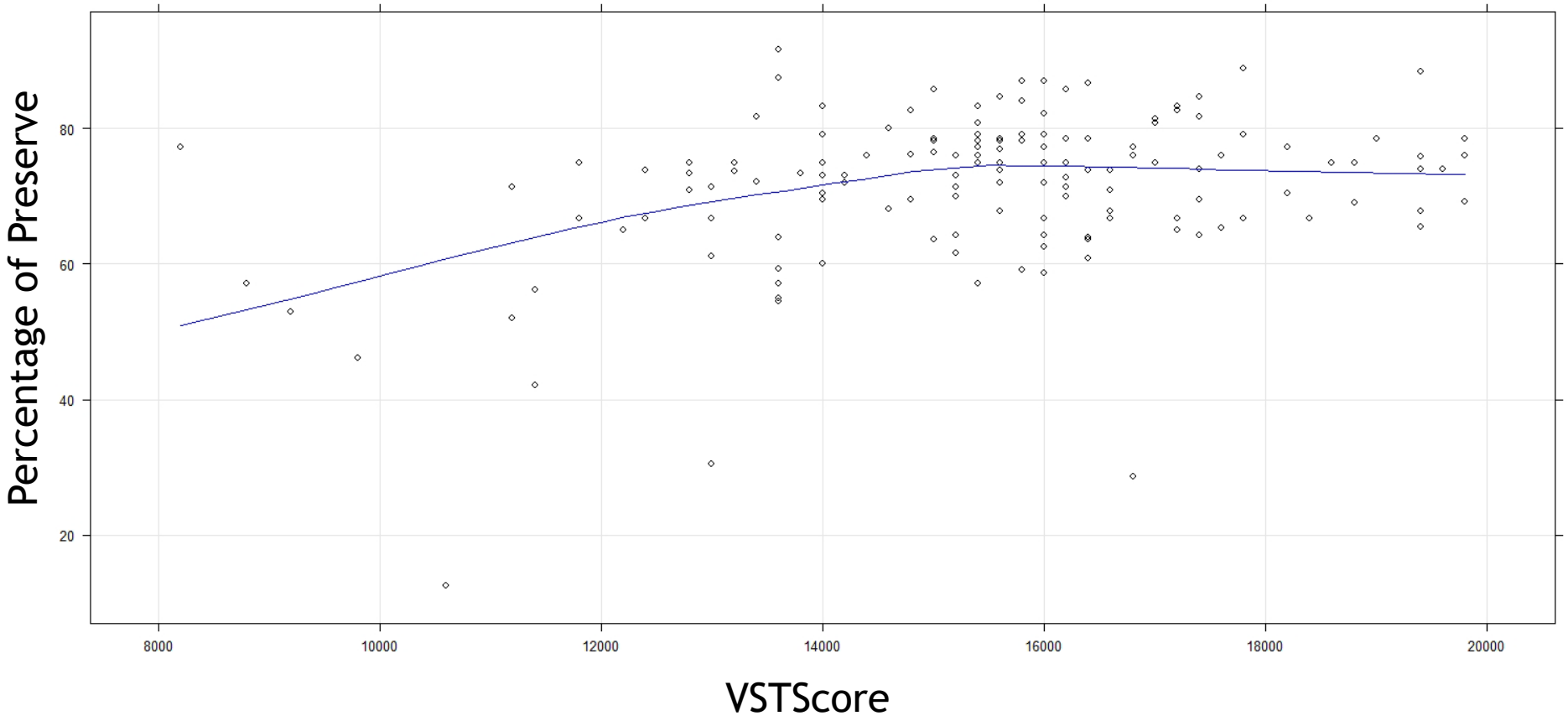
Experiment: Stress production

- **production task**
- **3,400** observations
- test sentences from **Corpus of American Soap Operas** (Davies 2011) with complex ***-able*, *-ant* , *-ative*, *-ive*, *-ory* adjectives**
- each participant read out **30 test sentences**
  - **Examples**
  - *We're trying to do something a little more innovative.*
  - *Well, actually, this move was anticipatory.*
  - *Is there an address or a name or something else that's identifiable?*
- each recording **assessed by three trained raters** (raters **agree in 77% of cases**, **only agreement cases taken into account** in analyses)

Individuality in stress variation



Vocabulary size and stress shift/preserve preference



N = 3400

Conclusion

- **individual differences in both** morphological processing and vocabulary size
- evidence for **relationship between morphological processing and vocabulary size**
  - **vocabulary size facilitates** morphological processing
- **outlook: relating these results** to how speakers **stress morphologically complex words**
  - first indication of effect of vocabulary size
  - morphologically processing → more analyses needed

Thank you/ευχαριστώ
for your attention!

Feel free to contact me: ganster@uni-trier.de

My special thanks to our wonderful student assistants Zarah Breitbarth, Jakob Engel, Aaron Seiler and Charlie Sloykowski!

References

Arndt-Lappe, S., & Sanz, J. (2017, June 21). *Stress Variability in English -able and -ory Adjedctives: Markedness, Faithfulness, and Usage*. 11th Mediterranean Morphology Meeting, Nicosia, Cyprus.

Baayen, H., & Milin, P. (2010). Analyzing Reaction Times. *International Journal of Psychological Research*, *3*(2), 12–28.

Bauer, L., Lieber, R., & Plag, I. (2013). *The Oxford Reference Guide to English Morphology*. Oxford University Press.

Brysbaert, M., Stevens, M., Mandera, P., & Keuleers, E. (2016). How Many Words Do We Know? Practical Estimates of Vocabulary Size Dependent on Word Definition, the Degree of Language Input and the Participant's Age. *Frontiers in Psychology*, *7*.

Collie, S. (2008). English stress preservation: The case for "fake cyclicity." *English Language and Linguistics*, *12*(3), 505–532.

Coxhead, A., Nation, P., & Sim, D. (2015). Measuring the Vocabulary Size of Native Speakers of English in New Zealand Secondary Schools. *NZ J Educ Stud*, *50*, 121–135.

Davies, M. (2011). *Corpus of American Soap Operas*. https://www.english-corpora.org/scotus/

Fudge, E. (1984). *English Word Stress*. G. Allen & Unwin.

Hay, J. (2001). Lexical frequency in morphology: Is everything relative? *Linguistics*, *39*(6), 1041–1070.

Hay, J. (2003). *Causes and Consequences of Word Structure*. Routledge.

Kiparsky, P. (2005). *Paradigm Uniformity Constraints*. https://web.stanford.edu/~kiparsky/Papers/LexConservatism.pdf

Kiparsky, P. (2015). Stratal OT: A synopsis and FAQs. In Y. E. Hsiao & L. H. Wee (Eds.), *Capturing Phonological Shades* (pp. 2–44). Cambridge Scholars Publishing.

References

Mainz, N., Shao, Z., Brysbaert, M., & Meyer, A. S. (2017). Vocabulary Knowledge Predicts Lexical Processing: Evidence from a Group of Participants with Diverse Educational Backgrounds. *Frontiers in Psychology*, *8*(1164).

McCutchen, D., Logan, B., & Biangardi-Orpe, U. (2009). Making Meaning: Children's Sensitivity to Morphological Information During Word Reading. *Reading Research Quarterly*, *44*(4), 360–376.

Nation, P., & Beglar, D. (2007). A vocabulary size test. *The Language Teacher*, *31*(7).

Stanton, J., & Steriade, D. (2021). *Markedness drives base selection: Experimental evidence*. The 28th Manchester Phonology Meeting, Manchester, England.

Steriade, D. (1999a). Lexical Conservatism. *Linguistics in the Morning Calm - Selected Papers from SICOL 1997*, 157–179.

Steriade, D. (1999b). Lexical Conservatism in French Adjectival Liaison. In B. Bullock, M. Authier, & L. Reed (Eds.), *Formal Perspectives in Romance Linguistics* (pp. 243–270). John Benjamins Publishing Company.

Trevian, I. (2003). *Morphoaccentologie et processus d'affixation de l'anglais*. Peter Lang.

Trevian, I. (2007). Stress-neutral endings in contemporary British English: An updated overview. *Language Sciences*, *29*, 426–450.

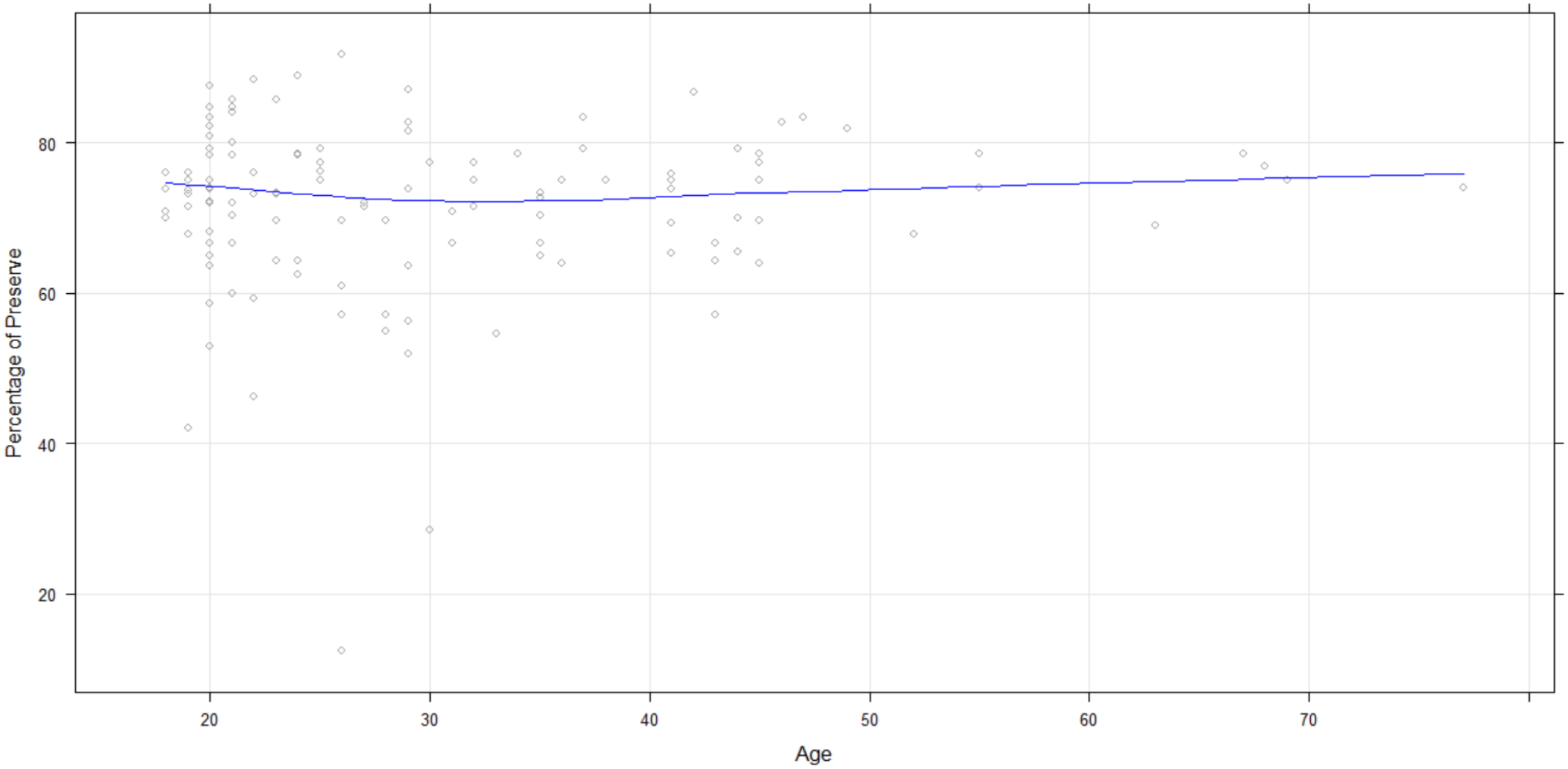
Appendix

- results of condition-specific effect of VSTScore also borne out by lmer model
  - formula: MS.lmer0 = lmer(RTtrZ ~ VSTz + (1+VSTz | Condition), data = MSfinal)

```
Fixed effects:
             Estimate Std. Error         df t value Pr(>|t|)
(Intercept) -0.0007769  0.0713691  2.0039344  -0.011   0.9923
VSTz         0.2129719  0.0307776  2.1878644   6.920   0.0159 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

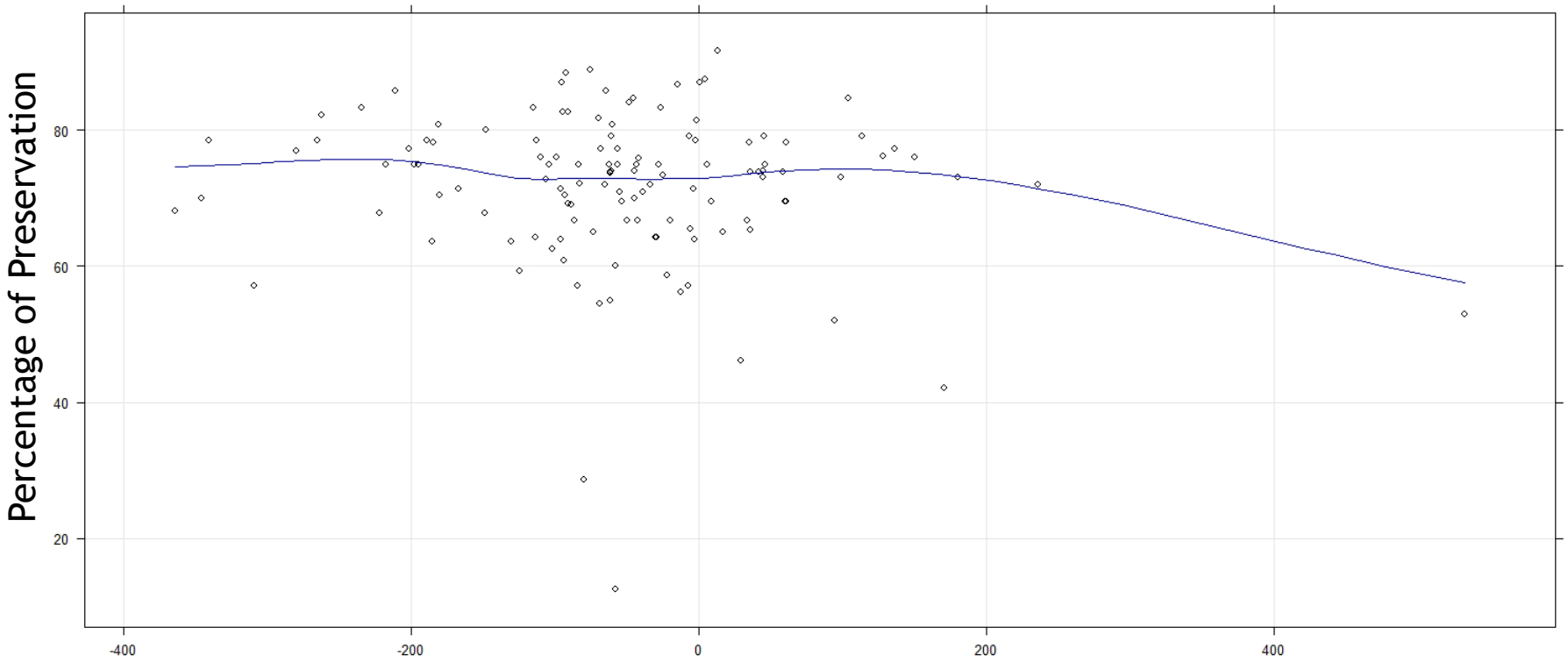
```
$Condition
     (Intercept)      VSTz
myoy  0.12858847 0.2613765
mnoy -0.10057338 0.1756310
mnon -0.03034574 0.2019081

attr(,"class")
[1] "coef.mer"
```



xylowess.fnc(PreservePercent ~ Age, data = RTan, ylab = "Percentage of Preserve"), N = 2879

Morphological sensitivity and stress shift/preserve preference



Difference between mean reaction times to morph. related and orth. related

morph. related faster

ortho. related faster

N = 2879