

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

Tammy Ganster, Trier University (Germany)

ganster@uni-trier.de

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
áanalyze	áanalyzable	analýzable
compáre	compáritable	cómparable
célebrate	célebratory	celebrátory
artícuate	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)

- ▶ 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 ~ justifiáble

Structural approaches
(Trevian 2003, 2007, Bauer, Lieber & Plag 2013, Newell 2020)

- ▶ **segmental phonological features** of derivative assumed to influence stress position
 - ▶ célebrate > célebr[ə]tory ~ celebr[éɪ]tory

Paradigmatic approaches
(Steriade 1999a, 1999b, Stanton & Steriade 2014, 2021, Breiss 2021)

- ▶ effect of **broader paradigmatic relationships?**
- ▶ what should we take as the **base of a complex word?**
- ▶ —démonstrate démonstrative > démonstrable ?

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 (*oscillatory* ~ *óscillatory*)

Structural accounts

- ▶ **effect** said to be **variable** (*áanalyze* > *áanal[ai]zable* ~ *anal[ái]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? → How do speakers make decisions about appropriate related forms? What is the **role of lexical frequency**?
- ▶ 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* → *idéntifiable*
→ stress **preservation**
- ▶ the **more frequent the derivative**, the more likely a speaker is to take the **whole-word route**
 - ▶ *justifiable* = *justifiable* (~~*jústify* + *-able*~~) → *justifíable*
→ 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**
- ▶ **individual differences marginalized**, to date mainly only looked at in reading acquisition (e.g. McCutchen et al. 2009) and second language acquisition (e.g. Coxhead et al. 2015)
- ▶ **exclusive reliance on corpus frequencies to account for processing effects** (that are assumed to be individual though)

Towards more individual models of morphological processing

- ▶ **more individual measures of morphological 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

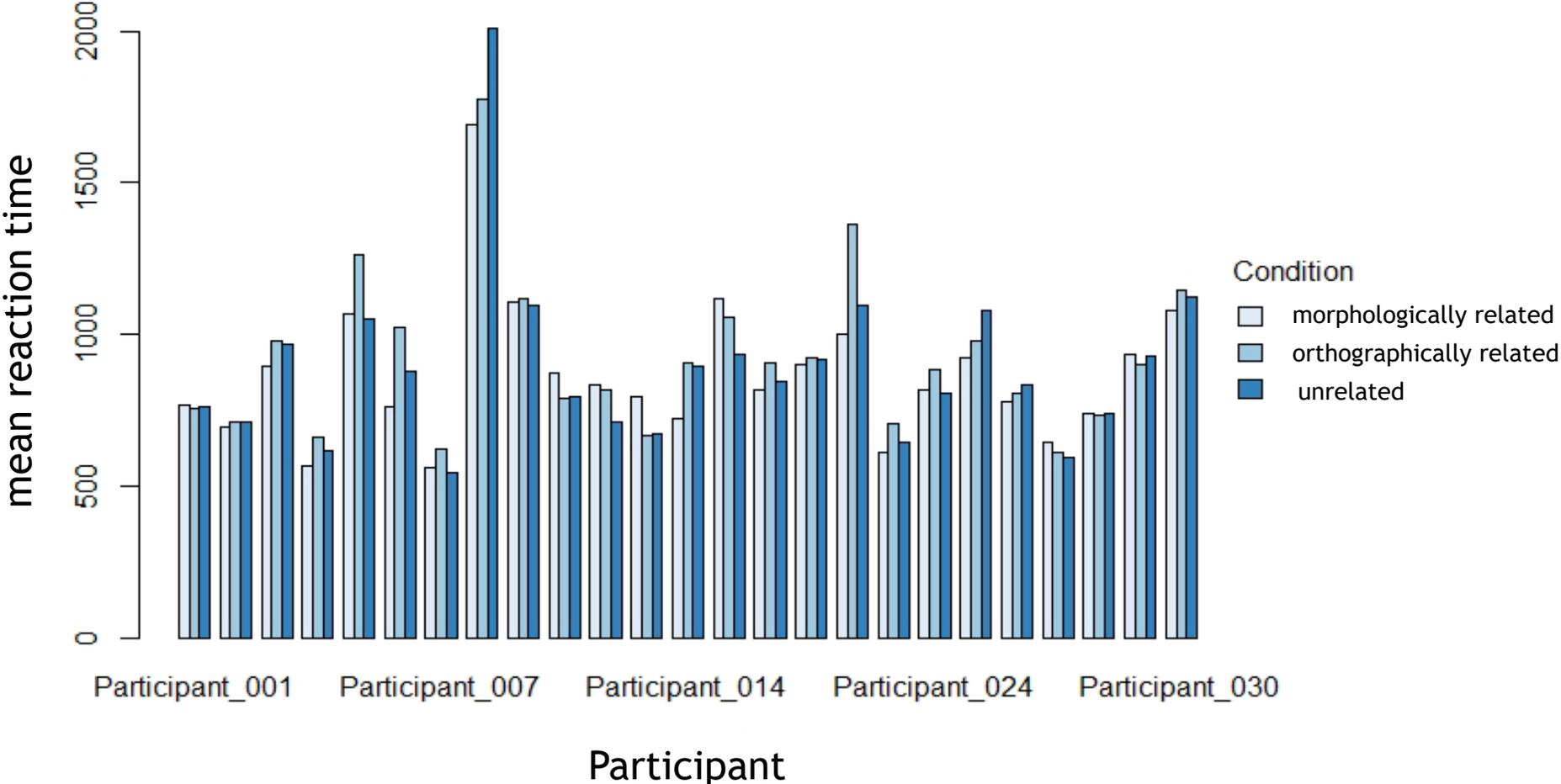
- ▶ remote online experiment
- ▶ 153 native speakers of British English
 - ▶ age: 17-77 yrs, mean: 25, median: 29.98 / 93 females, 60 males
 - ▶ recruited via the online platform Prolific
- ▶ multi-task experiment
 - ▶ **PROCESSING**
 - ▶ morphological sensitivity task (masked priming with lexical decision)
 - ▶ 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

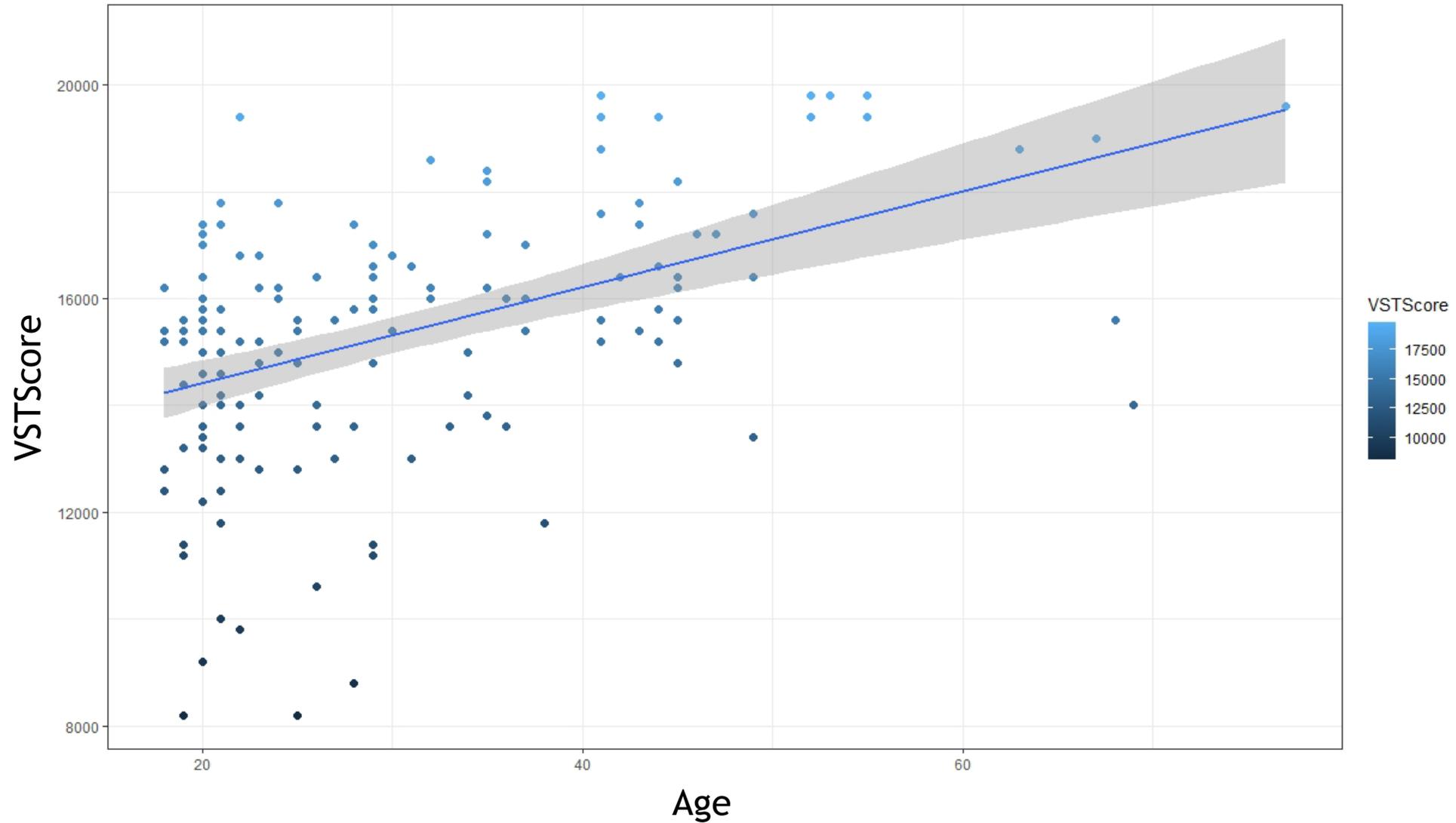
morphological sensitivity task	vocabulary size test	production task
<p>3,467 observations</p> <p>masked priming experiment with lexical decision task</p> <p>measured reaction time to three different priming conditions:</p> <p>complex words primes - simplex words targets</p> <ul style="list-style-type: none">▶ morphologically related prime-target pairs (<i>subversion</i> - <i>subvert</i>)▶ orthographically related prime-target pairs (<i>chargeable</i> - <i>charisma</i>)▶ unrelated prime-target pairs (<i>inventive</i> - <i>remorse</i>)	<p>15,300 observations</p> <p>standardized and multiply validated forced choice test (Nation & Beglar 2007)</p> <p>100 questions</p> <p>Example</p> <p><i>see: They SAW it.</i></p> <ul style="list-style-type: none"><i>a) closed it tightly</i><i>b) waited for it</i><i>c) looked at it</i> <p>score from 0 - 20,000 (estimates number of known word families)</p>	<p>will be explained later</p>

Individuality in morphological sensitivity

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

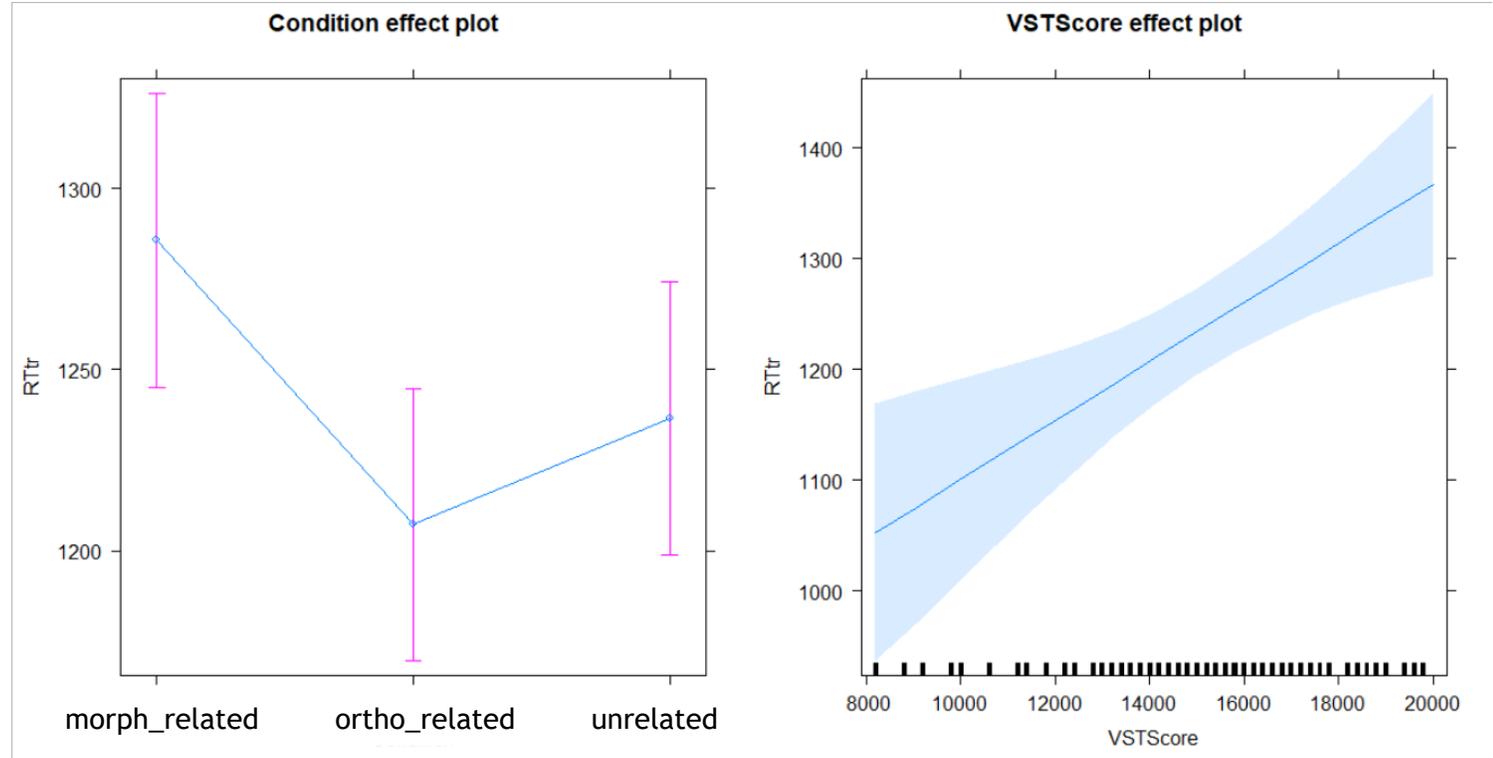


Variation in vocabulary size



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
- ▶ large range in slopes for morphologically related condition
- ▶ effect of morphologically related condition is more individual → individual morphological processing

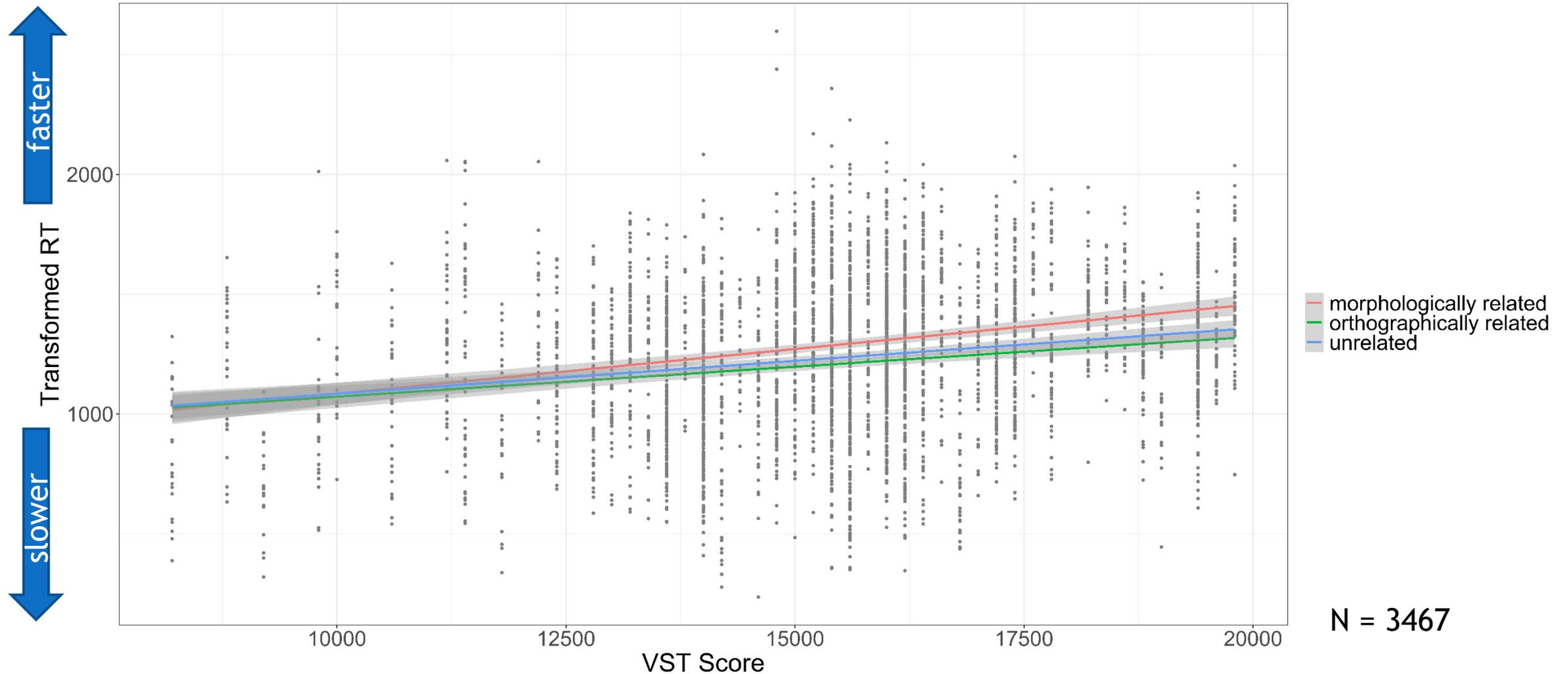
	(Intercept) unrelated	ortho_related	morph_related
Participant_001	959.7475	-30.01292	56.623834
Participant_002	933.7001	-29.88158	56.243287
Participant_003	695.9116	-28.6826	39.306188
Participant_004	1101.7955	-30.72916	77.529265
Participant_005	575.0771	-28.07332	28.386424
Participant_006	768.9771	-29.05101	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



Relating individual differences in morphological processing to stress variation

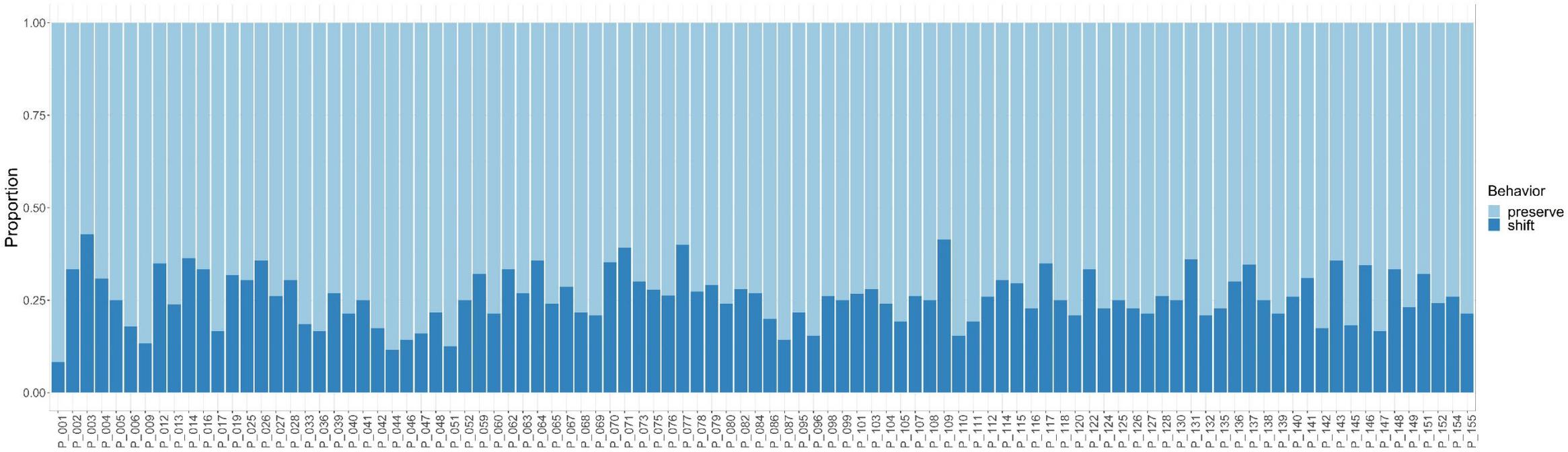
Hypotheses

- ▶ 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



For all 98 participants who have lived in the UK all their lives

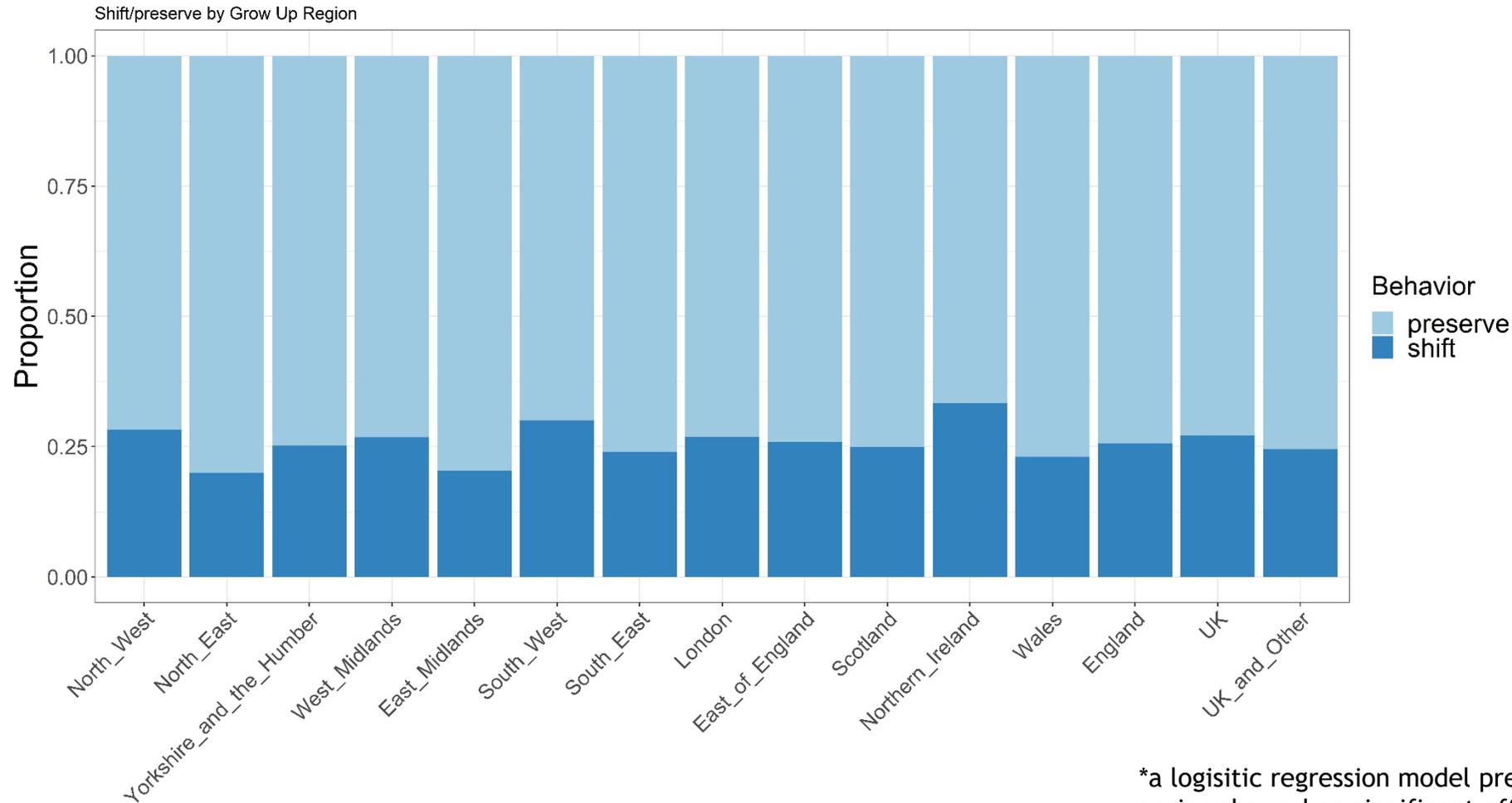
N = 2316

min proportion of shift = 8%

max proportion of shift = 43%

SD in proportion of shift = 7%

Region of origin makes virtually no difference



N = 2316

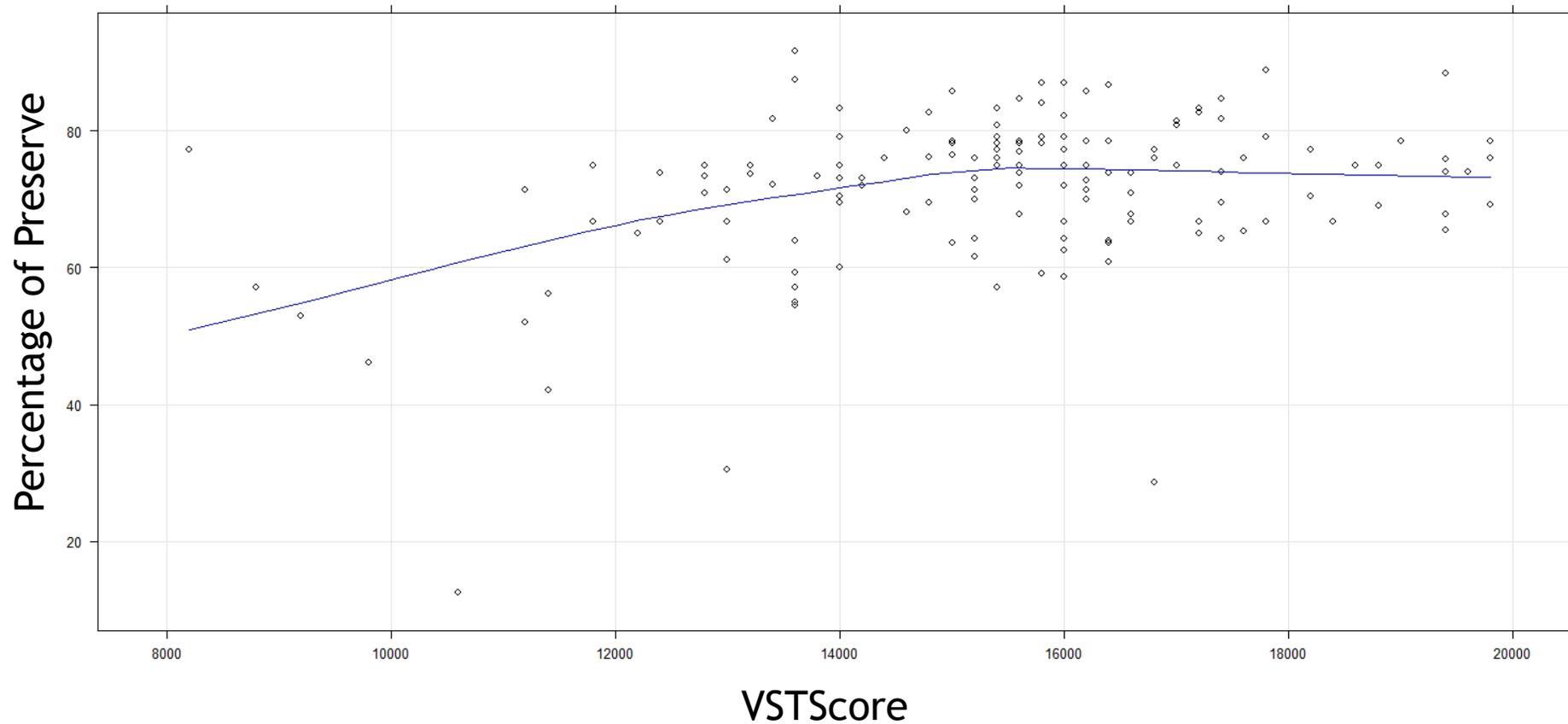
min proportion shift = 20%

max proportion shift = 33%

SD in proportion of shift = 3%

*a logistic regression model predicting stress shift by grow up region showed no significant effects for any region (glm(StrictShiftPreserve ~ GrowUpRegionSimpLabv, data = UK_lifelong, family = "binomial"))

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**
 - ▶ individual behavior → behavior not easily explained with more general feature such as grow up region
 - ▶ first indication of effect of vocabulary size
 - ▶ morphologically processing → more analyses needed

**Thank you/mulțumesc
for your attention!**

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

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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 *
```

```
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```

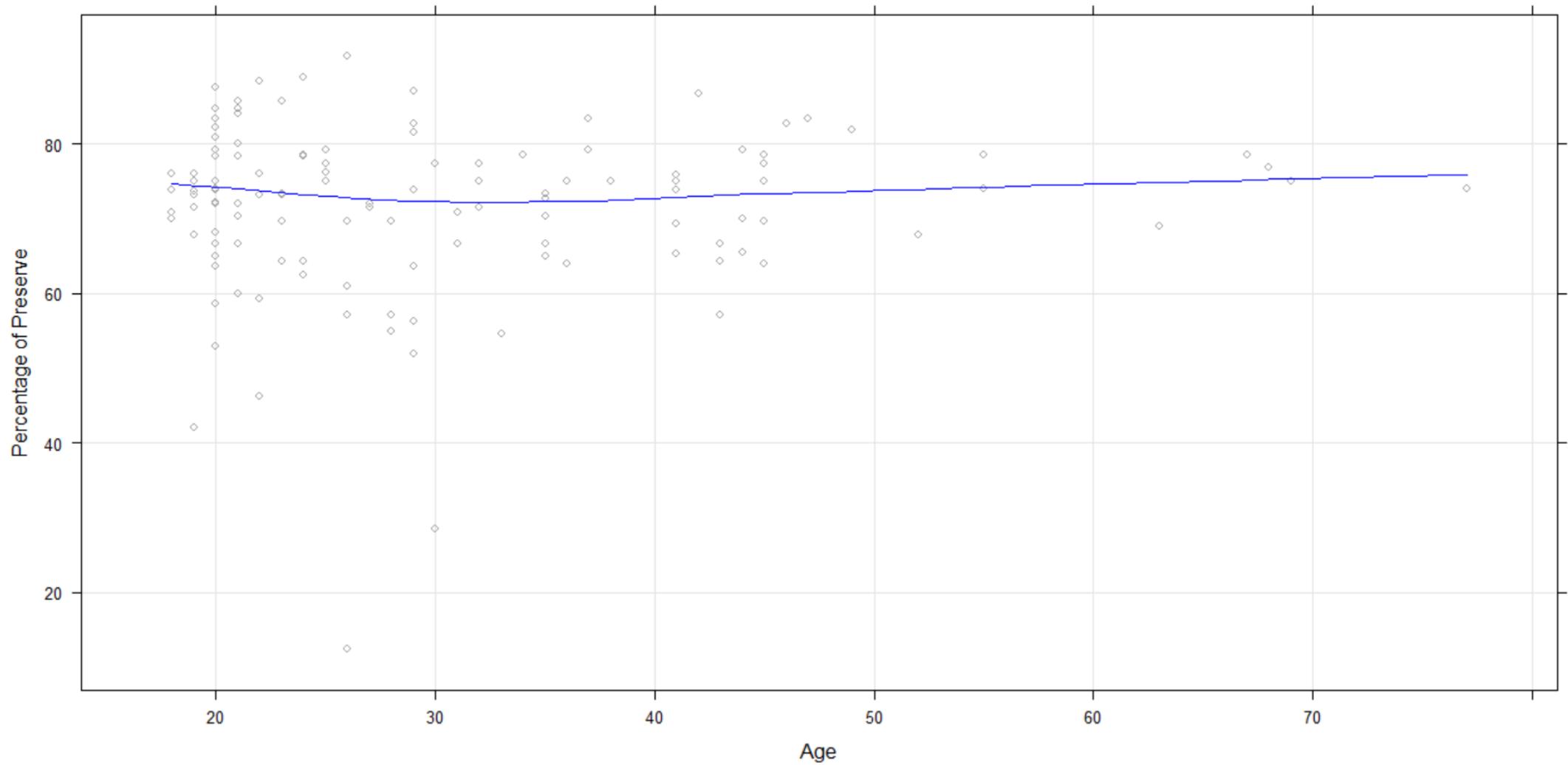
```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Condition
```

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

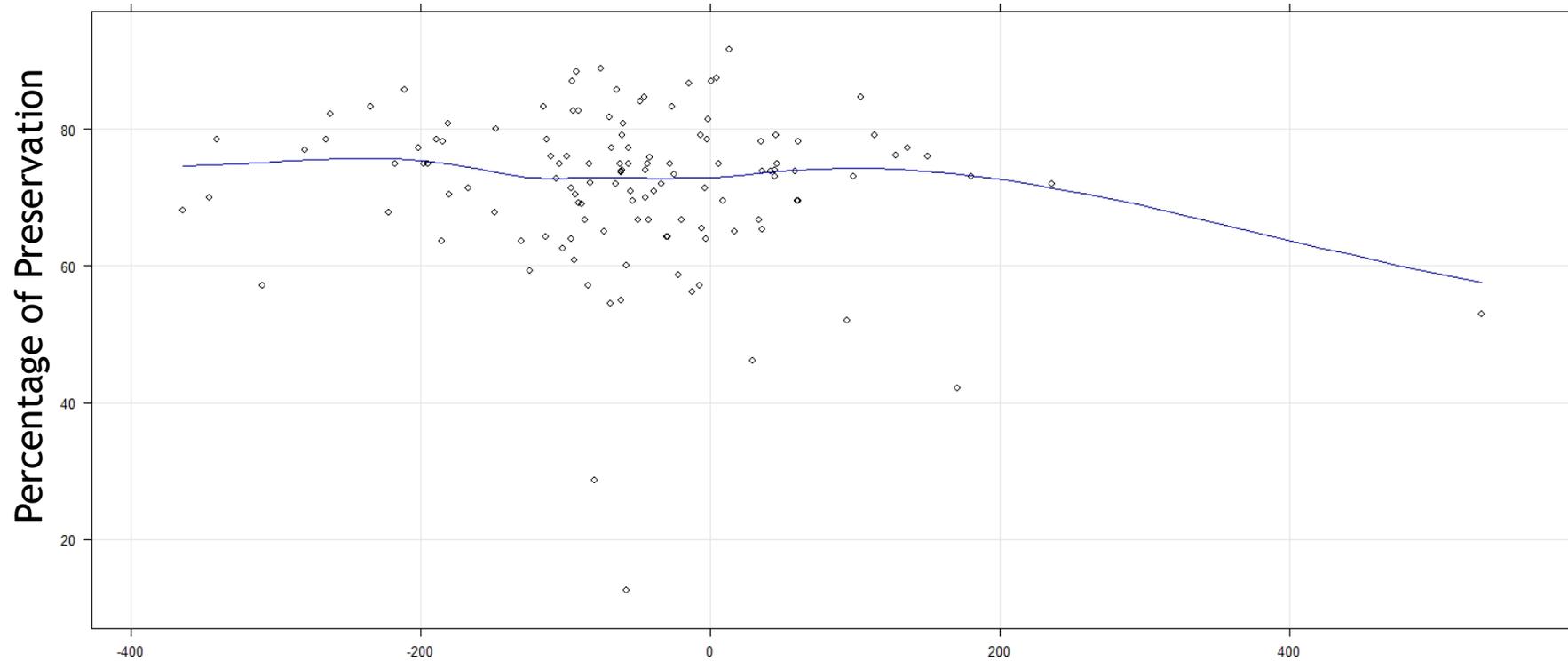
```
attr(,"class")
```

```
[1] "coef.lmer"
```



`xyloess.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