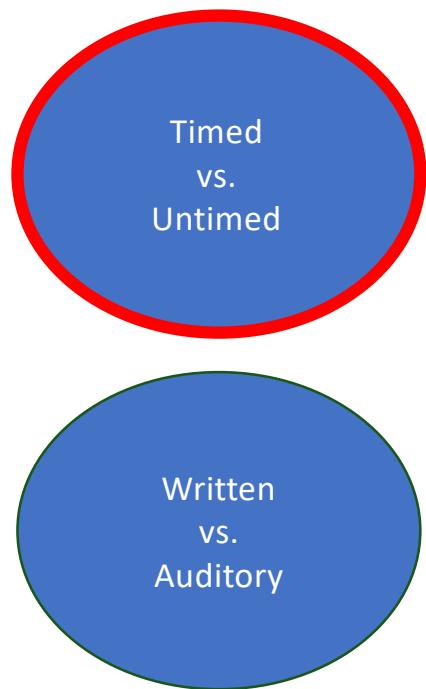
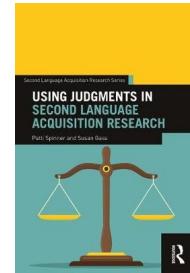


Does automaticity moderate different types of knowledge use in grammaticality judgments?

An Eye-Tracking Study

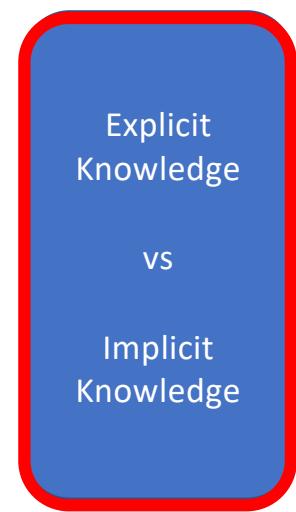
Ryo Maie
Michigan State
maieryo@msu.edu

Grammaticality Judgment Task



Yes

No

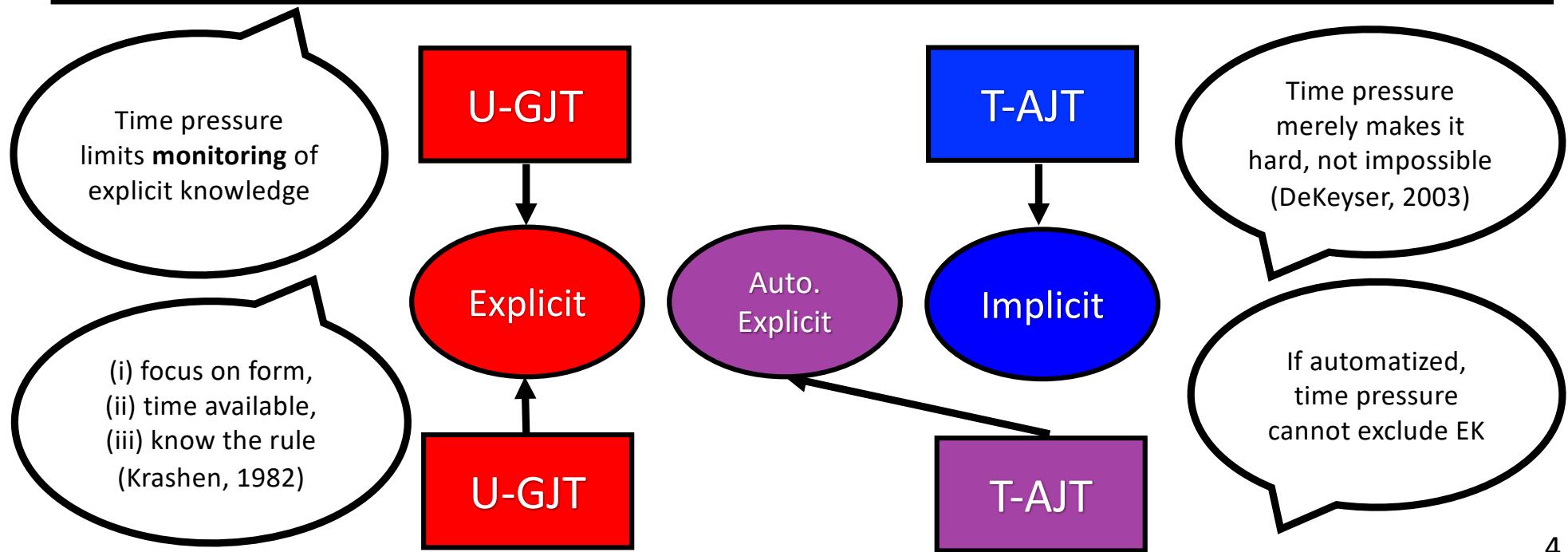
Two rectangular buttons, one labeled "Yes" and one labeled "No", are positioned below the computer monitor. They are enclosed in thin black borders and are aligned horizontally.

Explicit and Implicit Knowledge

	Explicit Knowledge	Implicit Knowledge
Awareness	Conscious awareness	Intuitive awareness
Type	Declarative	Procedural
Systematicity	Analogous and inconsistent	Variable but systematic
Access	Controlled processing	Automatic processing
Use	During planning difficulty	During fluent performance
Self-report	Verbalizable	Nonverbalizable

R. Ellis (2005, 2015)

Ellis (2005), Bowles (2011), Ellis & Loewen (2007), Spada et al. (2010), Gutiérrez (2013), Zhang (2015)

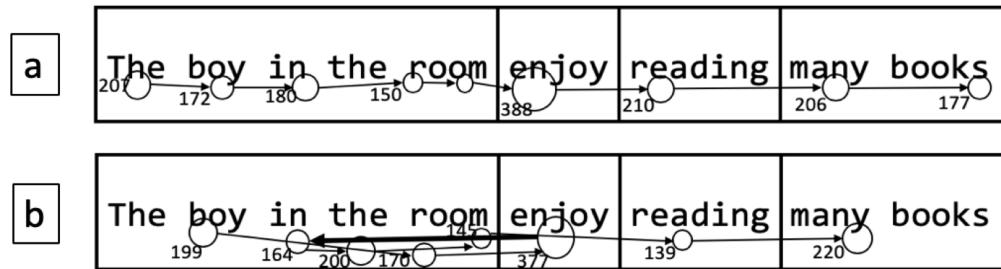


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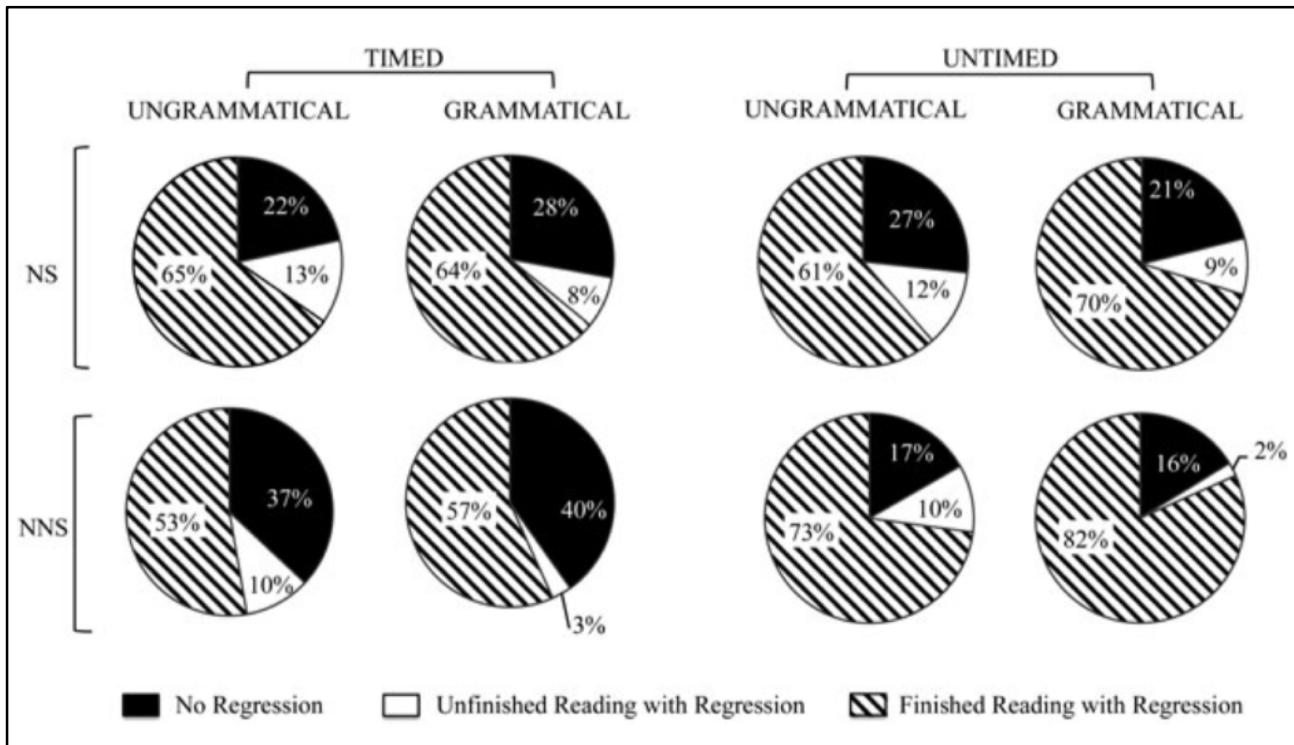
Suzuki (2017), Suzuki & DeKeyser (2017), Vafaee et al. (2017)

Godfroid et al. (2015)

- My study replicates and extend this one
- Virtually **nobody** looks at processing during GJTs
- **Nobody** tests whether monitoring is restricted
- Only one study of GJTs from a processing perspective
 - An eye-tracking study
 - Specifically looked at **regression of eye-movements**
 - Regression at or immediately after problematic elements indicates **structural reanalysis** and **controlled processing** (Von der Malsburg & Vasishth, 2011)



Godfroid et al. (2015)



"[O]ur data suggested that timed and untimed GJTs ... measure different things." (p. 291)

Whether T-GJT measures implicit or automatized explicit knowledge depends on one's theoretical orientation

Leading Up to My Study

- Conceptual and methodological verification needed
 - Regression = controlled processing (Von der Malsburg & Vasishth, 2011)
 - “**Monitoring by feel**” = checking of one’s production or input he/she perceives
 - “**Monitoring by rule**” = the process of drawing on explicit knowledge
 - Godfroid et al. (2015) wants to associate regression with **the latter** but what eye-tracking literature shows is **the former** (with L1 speakers)
 - *Regression alone cannot provide sufficient evidence*
- The role of (lexical) processing automaticity
 - Monitor by rule: (i) focus on form, (ii) time available, and (iii) know the rule
 - (i) and (iii) can be assumed for advanced L2 speakers
 - (ii) **only if they can read sentences very quickly**
 - Importance of automaticity in lexical decoding skills
 - If slow, L2 speakers can break down (Hopp, 2014)

The Study

1. *Analyzed both temporal and spatial measures of eye movements*
 - Does time pressure consistently suppress fixations/regressions across the eye-movement measures, and if so, how does it differ between L1 and L2 speakers?
 - If L2 speakers not only regress less, but also fixate shorter and less often, there seems to be a good (or better) evidence that time pressure limits **monitoring by rule**
2. *Examined the moderating role of (lexical) processing automaticity*
 - Does processing automaticity moderate the degree to which L1 and L2 speakers are affected by time pressure, and if so, how does it differ between L1 and L2 speakers?
 - If those fast readers can perform similarly in timed GJT as in untimed GJT, they can outstrip the effect of time pressure, therefore can use **explicit knowledge**

Participants



	L1 speakers (<i>n</i> = 27)				L2 speakers (<i>n</i> = 27)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Age (years)	24.11	6.97	19	39	29.76	6.74	21	49
Age of arrival (years)	–	–	–	–	24.53	4.79	15	34
Length of residence (months)	–	–	–	–	50.15	42.94	12	216
TOEFL iBT	–	–	–	–	103.30	8.93	92	116

- All advanced L2 speakers of English
 - L1 speakers of Mandarin Chinese (*n* = 5), Hindi(*n* = 3), Malay(*n* = 3), Marathi (*n* = 3), Spanish (*n* = 3), Russian (*n* = 2), Thai (*n* = 2), Bengali, Dutch, Japanese, Portuguese, Singhala, Thai, and Uzbek

GJTs



- **96 test sentences**

- (a) third-person singular -s, (b) mass vs. count, (c) passives, (d) verb complements, (e) embedded questions, and (f) comparatives
- A half grammatical and the other half ungrammatical
- Sentence length: *Mean* = 10.68 words, *Min* = 8, and *Max* = 13

- **Time pressure**

- Pilot with 10 L1 English speakers
- Median RT x 1.2 as time limit for L2 speakers (R. Ellis, 2005; Godfroid et al., 2015; Loewen, 2009)
- Time limits ranged from 2172ms to 7850ms
- **Reliability (alpha):** L1 T-AJT = **.77**, L1 U-AJT = **.76**, L2 T-AJT = **.87**, L2 U-AJT = **.88**

Semantic Classification



- **As a measure of lexical processing automaticity**
- Judging a series of English words as animate or inanimate
 - 50 nouns (25 animate and 25 inanimate)
 - Mean frequency (BNC) = 181.50 per million ($SD = 208.99$)
 - Mean length = 5.45 letters ($SD = 3.07$)
- All are taken from sentence stimuli of GJTs (Lim & Godfroid, 2015)
- **Coefficient of variation (SD/Mean)** of RT was calculated
 - Hulstijn et al.'s (2009) five-step data cleaning procedure was applied
 - **Reliability** (Spearman-Brown) $\rho = 0.89$ for L1 and $\rho = 0.88$ for L2 speakers

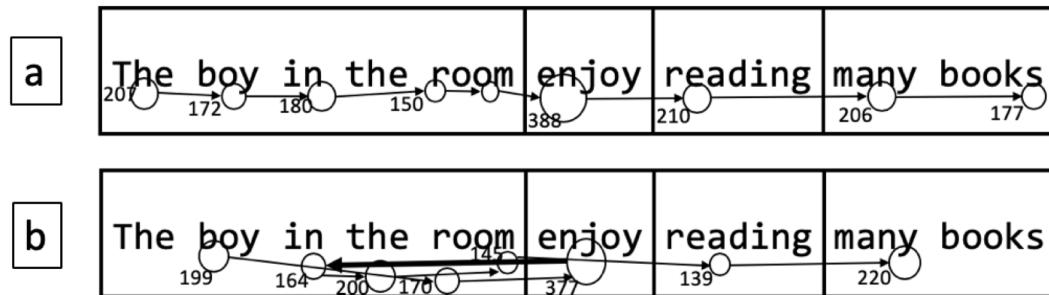


Eye-tracking



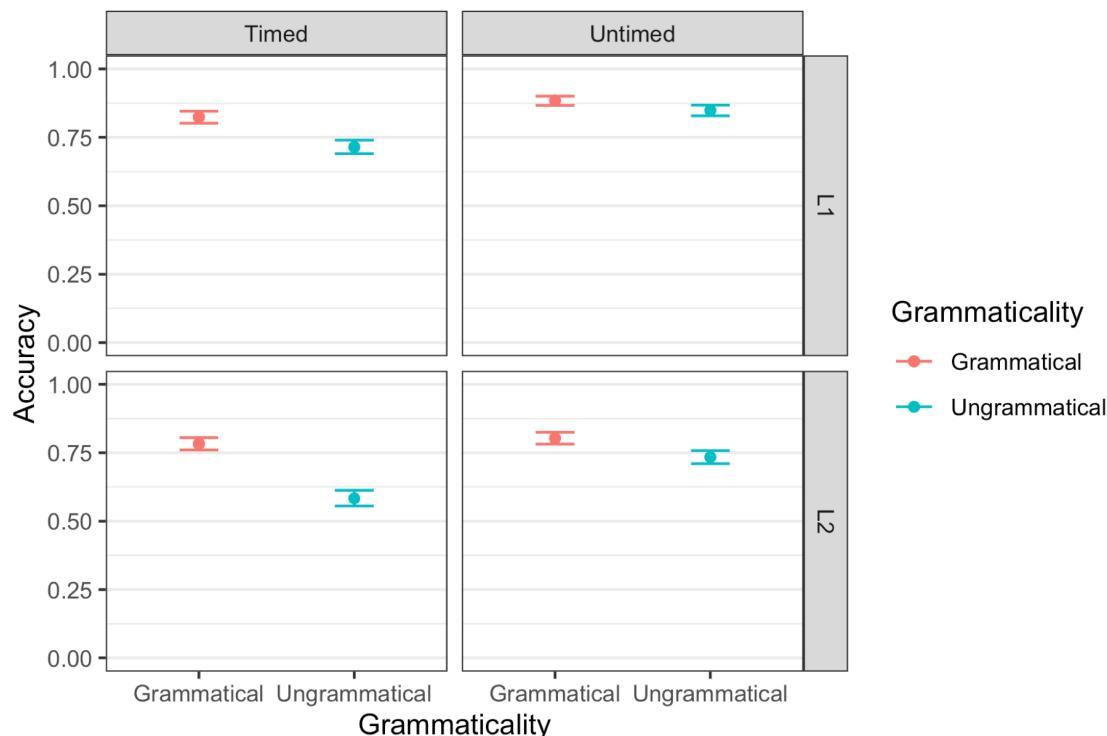
- Eye-Link 1000 Plus
 - Details of set-up and presentation in the supplementary handout

Mean Fixation Duration	Mean Fixation Count	Regression	Total Reading Time
<ul style="list-style-type: none">• Temporal• Mean of all fixations across the sentence• Lexical level measure• The average speed readers retrieve lexical information• Log-transformed	<ul style="list-style-type: none">• Spatial• Mean of the number of fixations across the sentence• Sentence level measure• How detailed readers process	<ul style="list-style-type: none">• Spatial• Next slide• Sentence level measure• Information and structural analysis due to processing problems• Binary	<ul style="list-style-type: none">• Temporal• Sum of all fixations across the sentence• Sentence level measure• The time with which readers read a sentence (roughly equivalent to RT)• Log-transformed



Mean Fixation Duration	Mean Fixation Count	Regression	Total Reading Time
<ul style="list-style-type: none"> Temporal Mean of all fixations across the sentence Lexical level measure The average speed readers retrieve lexical information 	<ul style="list-style-type: none"> Spatial Mean of the number of fixations across the sentence Sentence level measure How detailed readers process 	<ul style="list-style-type: none"> Spatial Sentence level measure Information and structural analysis due to processing problems 	<ul style="list-style-type: none"> Temporal Sum of all fixations across the sentence Sentence level measure The time with which readers read a sentence (roughly equivalent to RT)

Accuracy



Error bars = 95% CIs

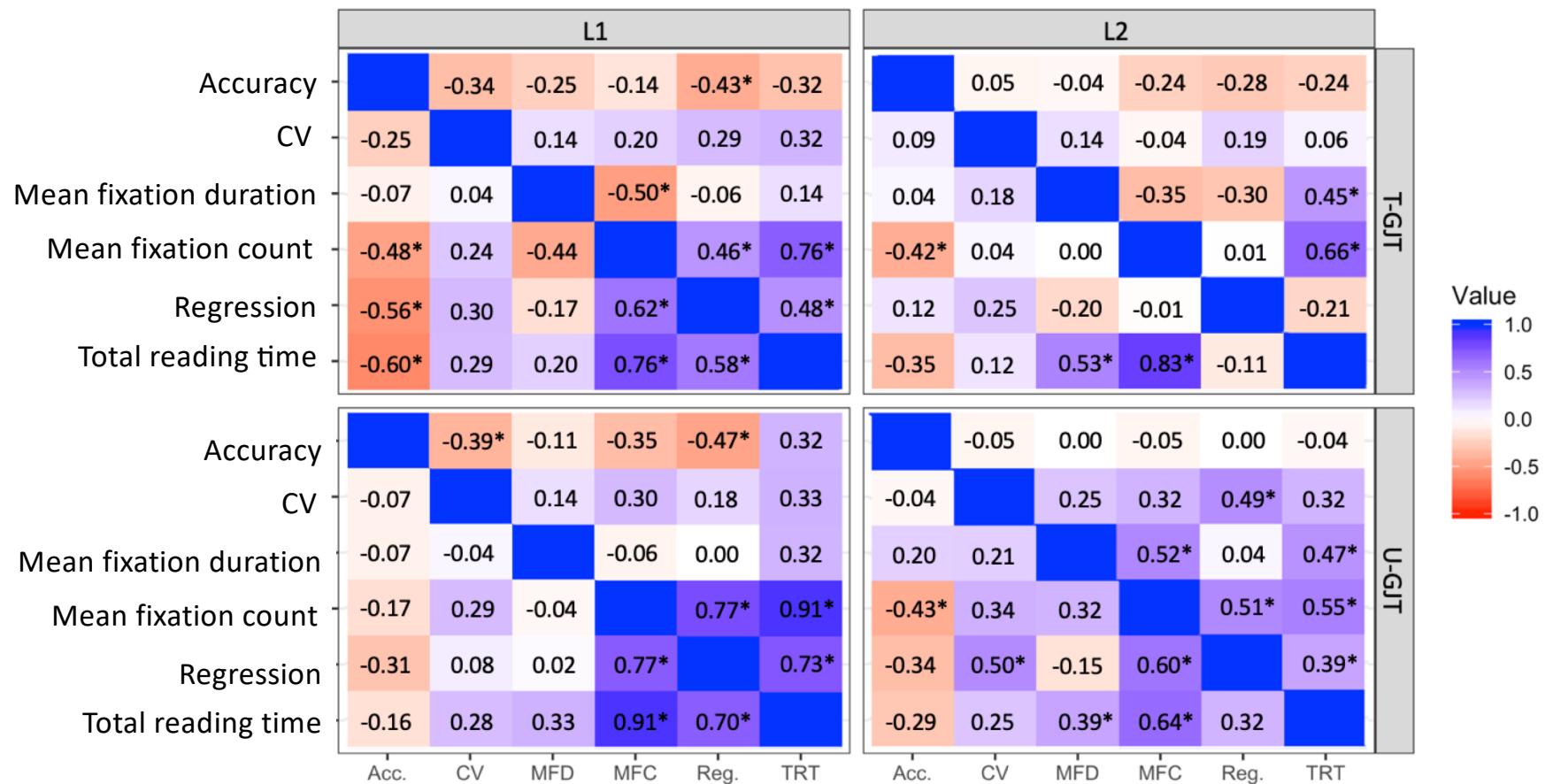


- L1 > L2
- Timed < Untimed
- Gram > Ungrammatical

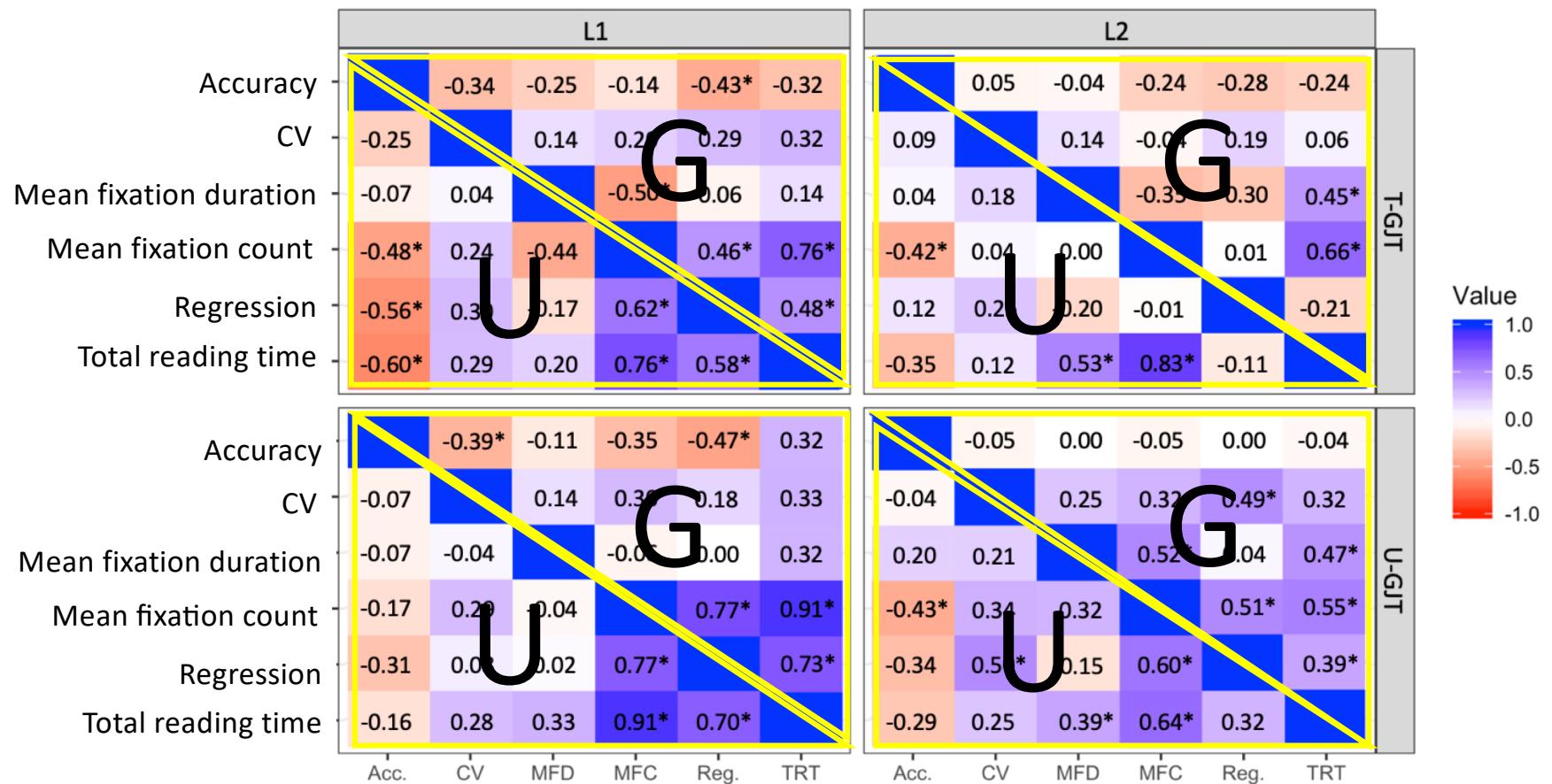
Mixed-design ANOVA

- Main effect of
 - Group
 - Condition
 - Grammaticality
- 2-way interaction
 - Condition x Grammaticality

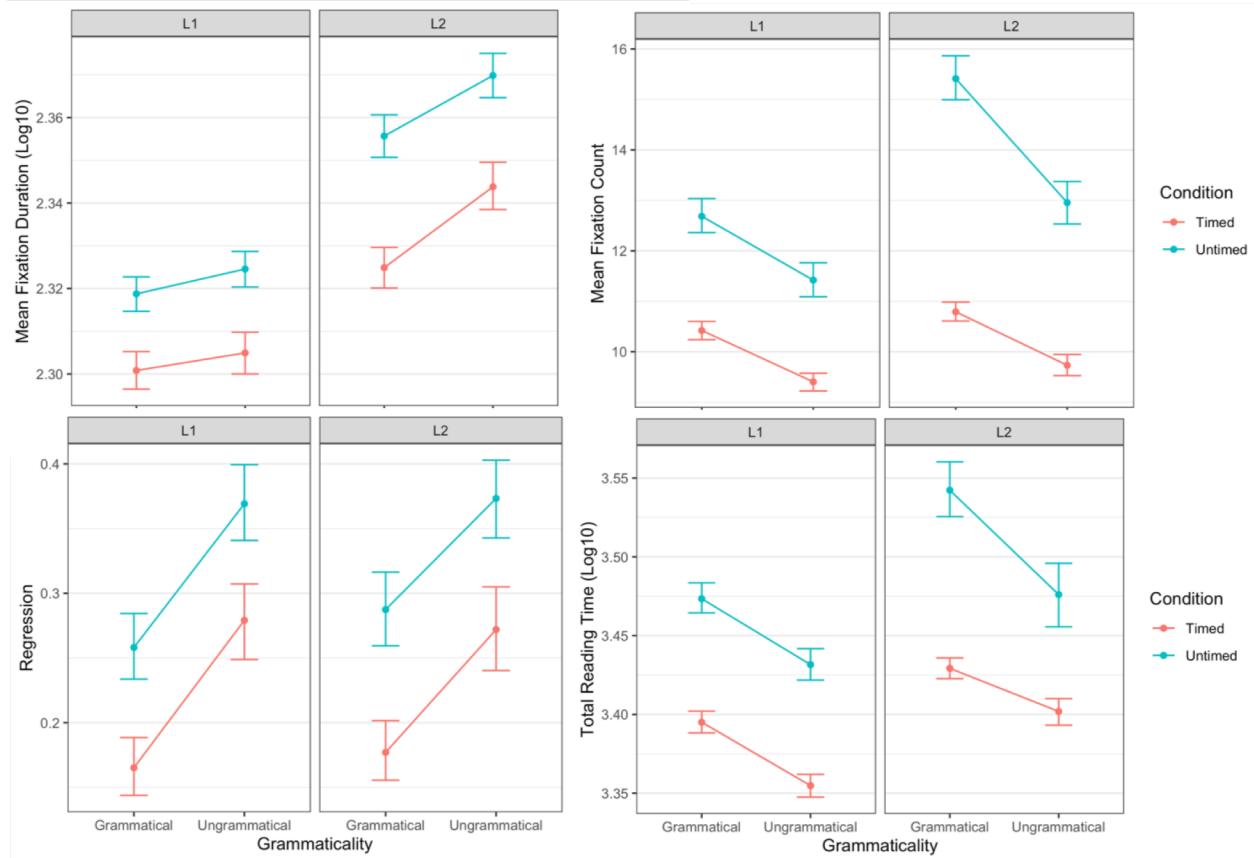
Correlations



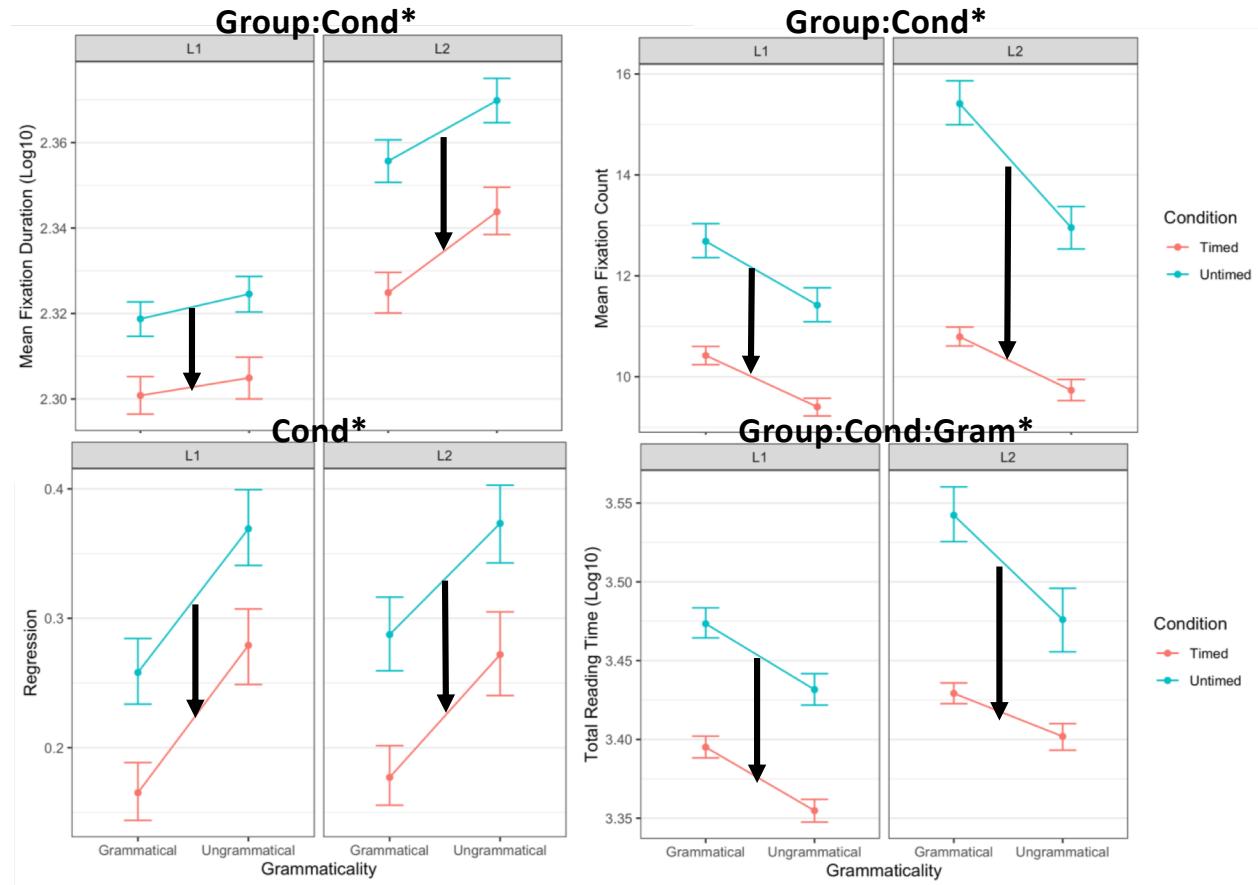
Correlations



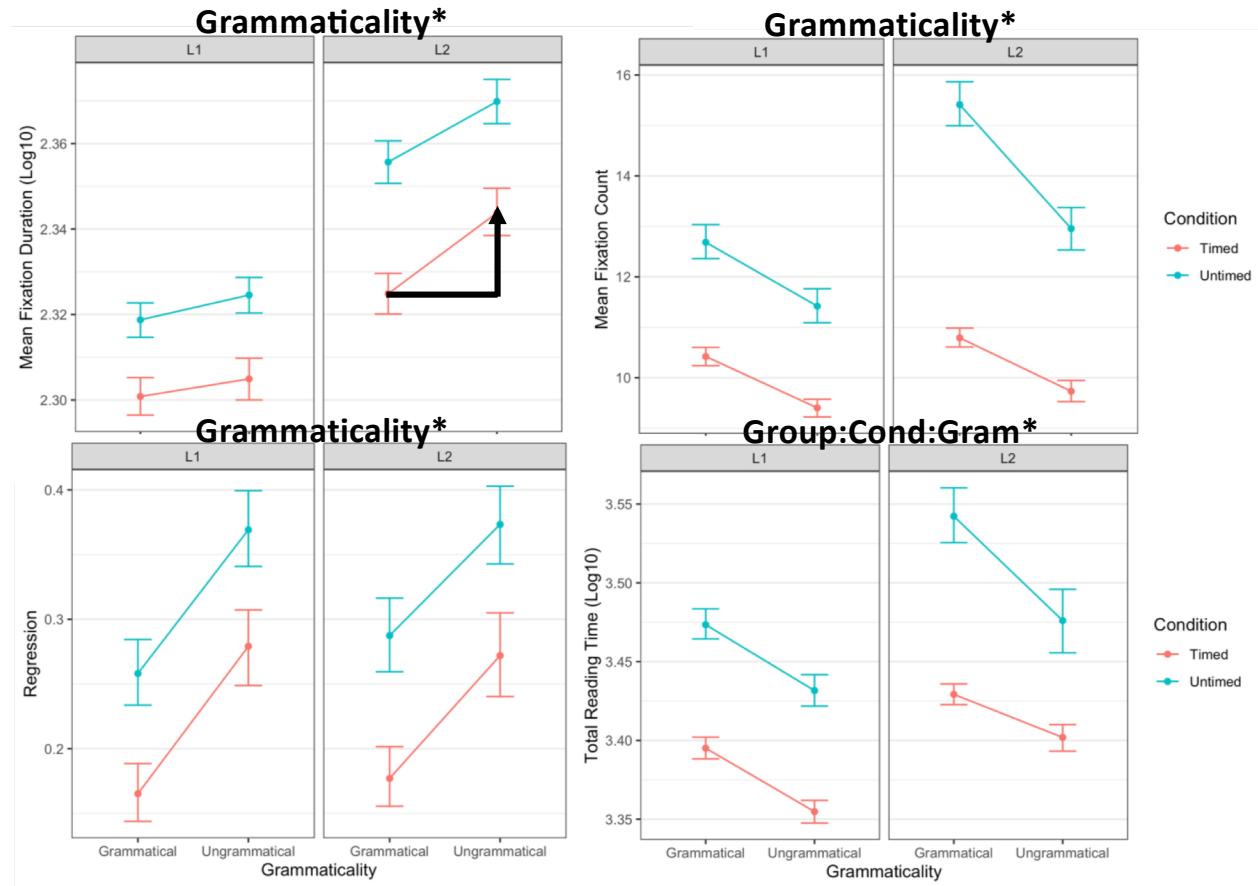
Effect of Time Pressure



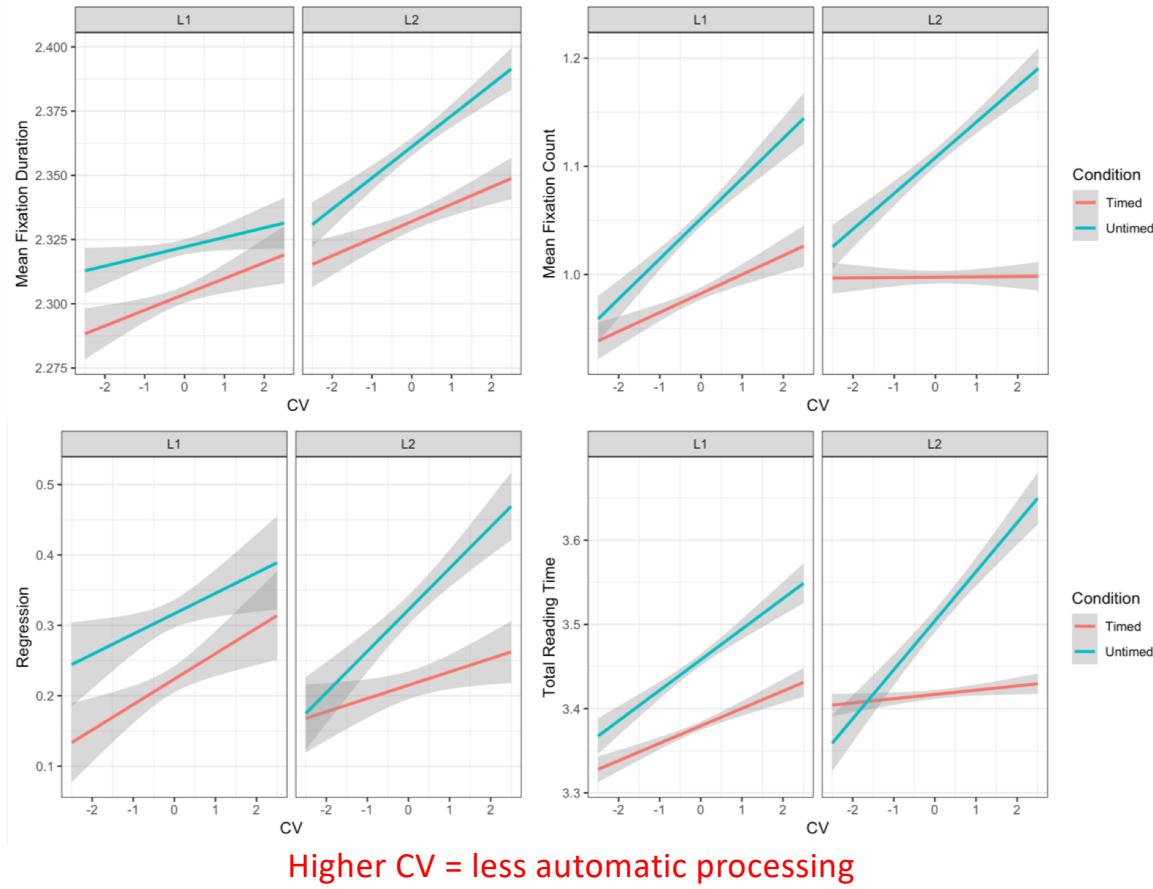
Timed vs Untimed



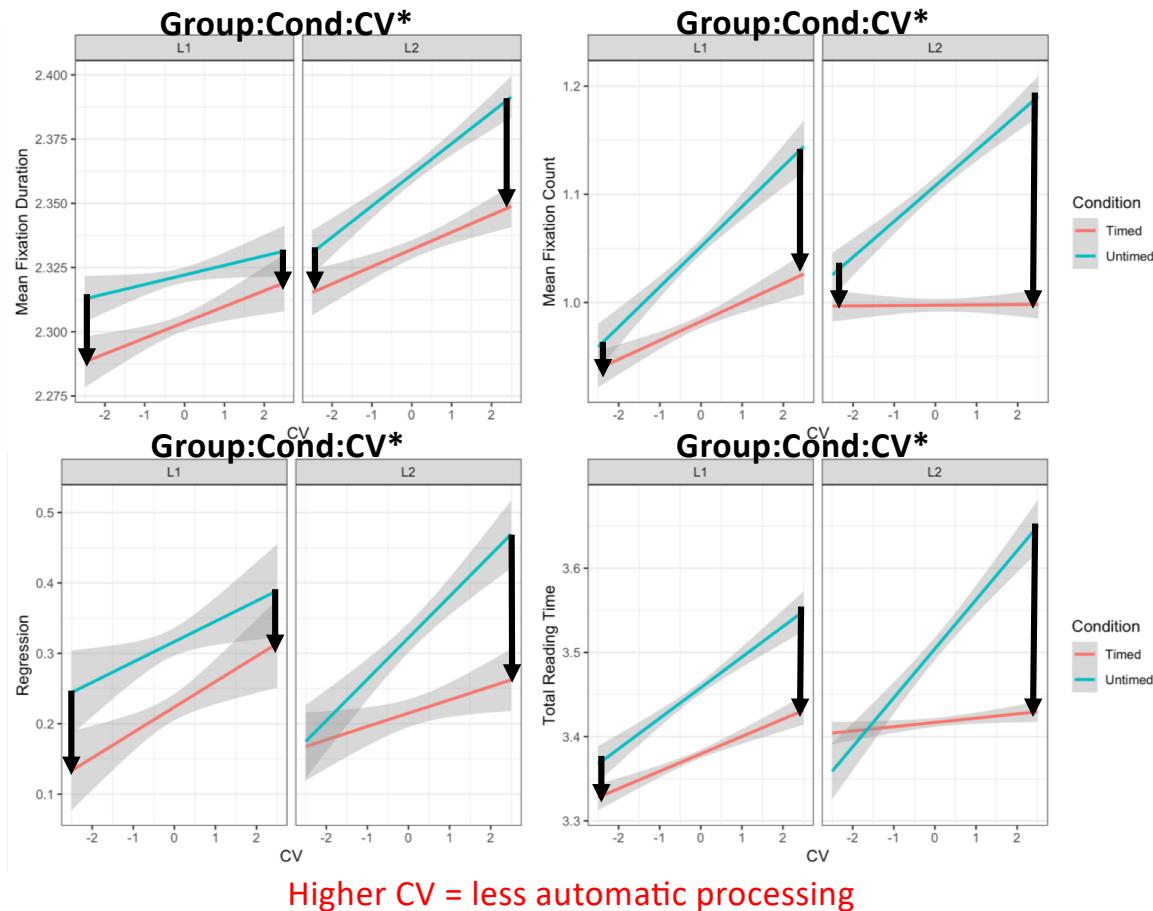
Grammatical vs Ungrammatical



The Role of Processing Automaticity



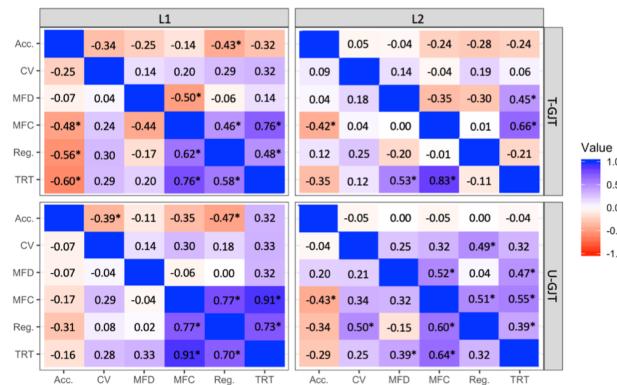
The Role of Processing Automaticity



Discussion



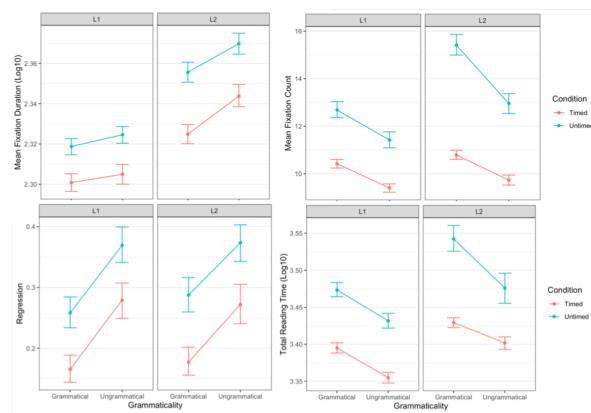
- Different correlational patterns among L1 and L2 speakers
 - Regression x Accuracy
 - For L1, regression is consistently negatively related to accuracy
 - For L2, very weak or no relationship
 - Mean fixation duration x Mean fixation count
 - For L1 speakers, negative (Timed) to none (Untimed)
 - For L2 speakers, none (Timed) to positive (Untimed)
 - ***Monitoring by feel (implicit) for L1 vs. Mixture for L2 (explicit and implicit)***



Discussion



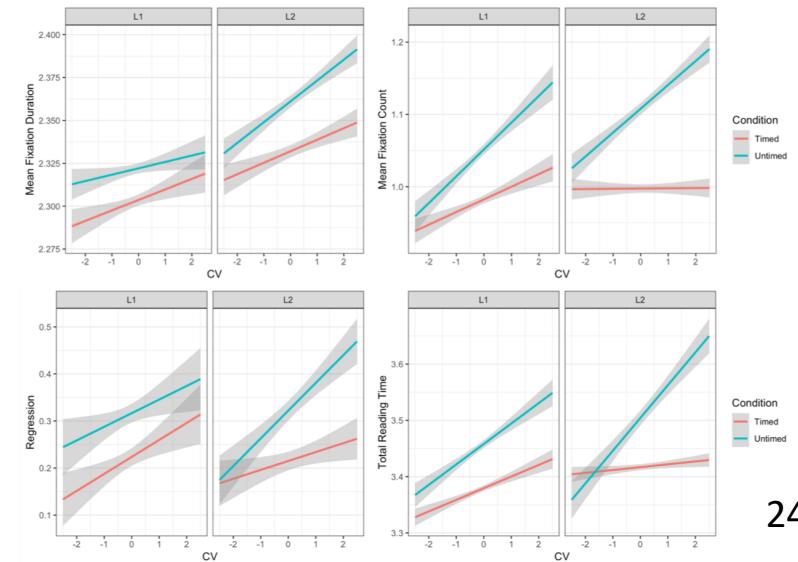
- The consistent effect of time pressure
 - Forcing to perform the task faster
 - Forcing to access knowledge **faster**
 - Lowering monitoring (different types for L1 and L2)
 - Across the board (initial to late stages of sentence processing)
 - Measuring (more or less) **automatized use of linguistic knowledge**



Discussion



- Lexical Processing automaticity mitigates the effect of time pressure
 - Unique or stronger CV moderation for L2 speakers
 - If automatic, Timed = Untimed
 - Assuming Untimed = explicit knowledge
 - Timed GJT measures **automatized explicit knowledge**
 - If non-automatic, Timed < Untimed
 - Timed GJT **does not function properly**
 - Timed GJT measures **implicit knowledge**





Limitations

- No triangulation with awareness
 - Addition of subjective measures of awareness may help
- Other individual difference factors unknown
 - Declarative vs. Procedural memory
 - Explicit vs. Implicit cognitive aptitudes
 - Different types of L1 scripts
- Small N (L1 = 27, L2 = 27)
 - Currently more data collection in progress (currently, L1 = 27, L2 = 33)
 - Aiming for 30 L1 and 40 L2 speakers (AAAL?)

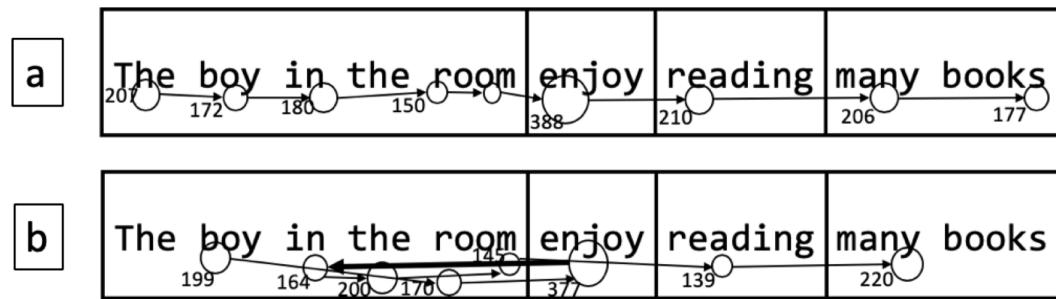
Thank you!

Acknowledgement

- **Aline Godfroid**, Michigan State
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- **Bronson Hui**, Michigan State
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- **Myeongeun Son**, Michigan State
- **Jongbong Lee**, Michigan State



Regression



- Sentences compartmentalized into four areas (Godfroid et al., 2015)
 1. First region
 2. Principle interest area (PIA)
 3. Spill-over region
 4. The rest of sentence
- Any right-to-left eye-movement that was launched
 1. From PIA or spill-over region
 2. To the first region