
What if we are missing
the point? What if
difficulty processing
suffixes is not about
suffixes?

Prof. Nuria Sagarra

ANTICIPATION



ANTICIPATION

According to current top-down models of human information processing, we constantly make probabilistic predictions based on previously encountered information and memory : from estimating how to move our hands when making a sandwich to predicting what a speaker is likely to say next (Barr, 2007; Clark, 2013).

ANTICIPATION IN MONOLINGUALS

Monolinguals use a vast array of cues to predict non-linguistic and linguistic information at all levels of representation (see Huettig et al., 2011; Kamide, 2008, for a review). For example:

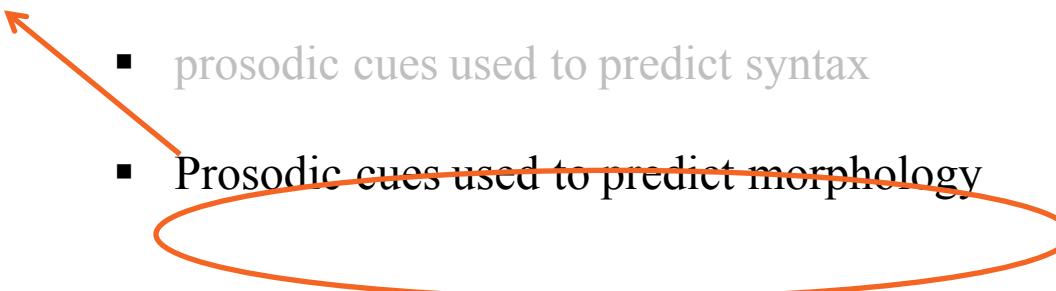
- morphological cues used to predict morphosyntax
 - prosodic cues used to predict syntax
 - prosodic cues used to predict morphology
-

ANTICIPATION IN MONOLINGUALS

Swedish monolinguals use word tones to predict bound morphology in nouns, verbs, and pseudowords (Roll, 2015; Roll et al., 2010; Söderström et al., 2012, 2017).

They use a vast array of cues to predict non-linguistic and linguistic information at all levels of representation (see Huettig et al., 2011; Kamide, 2008, for a review). For example:

- morphological cues used to predict morphosyntax
- prosodic cues used to predict syntax
- Prosodic cues used to predict morphology



ANTICIPATION IN L2 LEARNERS

Intermediate L2 learners have difficulty using:

- discourse cues (e.g., Grüter et al., 2017)
- syntactic cues (e.g., Grüter & Rohde, 2013)
- morphological cues (e.g., Foucart et al., 2016; Grüter et al., 2010; Hopp, 2015; Lew-Williams & Fernald, 2007)

Unless the two languages are typologically similar (e.g., Liburd, 2014; Dussias et al., 2013; Foucart et al., 2014)

ANTICIPATION IN L2 LEARNERS

Advanced L2 learners → unclear:

✓ **Can** use:

morphological cues to predict morphosyntax (e.g., Marull, 2017)

morphological cues to predict syntax (e.g., Kaan et al., 2010; Kaan, 2014)

✗ **Cannot** use:

morphological cues to predict morphosyntax (e.g., Hopp, 2015; Martin et al., 2013)

prosodic cues to predict morphology (Rehrig, 2017)

ANTICIPATION IN L2 LEARNERS

Advanced L2 learners → unclear:

✓ Can use:

morphological cues to predict morphosyntax (Marull, 2017) and syntax

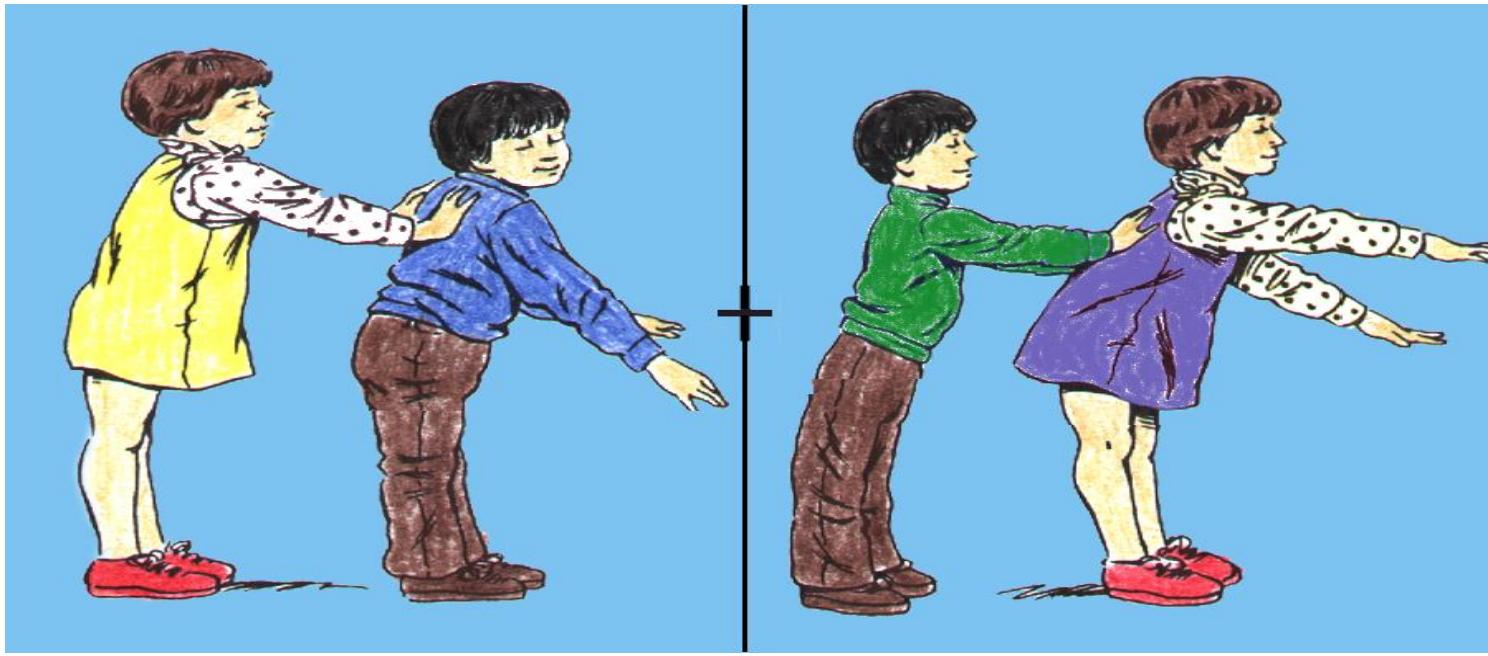
(Dussias et al., 2013; Kaan, Dallas, & Wijnen, 2010; Kaan, 2014)

✗ Cannot use: morphological cues to predict:

morphological cues to predict morphosyntax (Hopp, 2015; Martin et al., 2013)

prosodic cues to predict morphology (Rehrig, 2017)





*The girl was **pushing** the boy* 2 syllables → Shorter vowel

*The girl was **pushed** by the boy* 1 syllable → Longer vowel



Monolinguals guessed before the suffix but advanced adult Chinese learners of English did not.

LIMITATIONS:

- Proficiency measured through subjective self-ratings, so maybe intermediate instead of advanced level.
 - Passive acquired later than active in SLA.
 - Conflicting cues bc did not control syllable structure
-

OUTLINE OF STUDIES

- Early bilinguals (HS) (stress)
- Late bilinguals (L2 learners) (stress)
- Late bilinguals with extensive anticipatory experience (interpreters) (stress)
- Late bilinguals with extensive anticipatory experience (interpreters) (duration)

Lexical stress

-
- Lexical stress (henceforth stress) is the relative prominence of a syllable with respect to other syllables in a word (PApa – paPA).
 - Stress = F0 (Hz) + duration (ms) + intensity (dB)
 - Stress can be:
 - Fixed (predictable) (e.g., Czech, Finnish, Icelandic, Hungarian: first syllable almost always stressed)
 - Variable (non-predictable) (e.g., English, Spanish)
 - No stress (non-predictable) (e.g., French, Mandarin)
-

-
- Stress is variable and contrastive in both English and Spanish:

| | |
|-------------------------------|-------------------|
| PApa – paPA “potato – father” | PREsent - preSENT |
|-------------------------------|-------------------|

- Still, Anglophones have trouble with L2 Spanish stress in:
production (Bullock & Lord, 2003; Lord, 2007)
perception (Face, 2000, 2006; Ortega Llebaria et al., 2013; Saalfeld, 2012)

- **WHY?** Because...

English = stress-timed BUT Spanish = syllable-timed

L1 STUDIES:

Cross-modal priming experiments with Spanish (Soto-Faraco et al., 2001) and English monolinguals (Cooper et al. 2002) show that both use lexical stress to guess word endings, but they use it differently:

Spanish monolinguals = match facilitation and mismatch inhibition

English monolinguals = only match facilitation

The functional load of stress is different in the two languages

OUTLINE OF STUDIES

- Early bilinguals (HS) (stress)
- Late bilinguals (L2 learners) (stress)
- Late bilinguals with extensive anticipatory experience (interpreters) (stress)

Anticipation in early heritage bilinguals

Sagarra, Casillas, & Rodriguez
(2017)

Presentation at *HLS*.

Early heritage bilinguals have been repeatedly found to differ from late bilinguals and from monolinguals (e.g., Montrul, 2008; 2011).

WHY?

-
- AOA can explain differences between HS and late L2 learners.
 - But AOA cannot explain differences between HS and monolinguals, because HS are NS of their heritage language.
-

WHAT MAKES HS UNIQUE?

LIMITED QUALITY INPUT

Montrul (2008)

Pires & Rothman (2009)

Rothman (2007)

GRADUAL ATTRITION & GRAMMATICAL REANALYSIS

Polinsky (2011)

FREQUENCY OF ACTIVATION

Putnam & Sánchez
(2013)

IMPOVERISHED ANTICIPATORY ABILITIES

Sagarra & Casillas
(under review)

GOAL

To investigate how and when monolinguals, HS,
and L2 learners use prosodic cues (lexical stress)
to pre-activate morphological information during
spoken word recognition.

Qualitative
differences

Quantitative
differences

qualitative
differences



quantitative
differences



qualitative
differences



quantitative
differences



1. Do monolinguals, HS, and L2 learners use lexical stress to anticipate morphological information to make lexical predictions? If yes, do the make predictions equally fast?

2. Is working memory associated with how and when they make these predictions?



PARTICIPANTS

- 25 Spanish monolinguals
- 27 Spanish HS
- 28 Spanish L2 learners (L1 English)

Participants born and raised in a monolingual region in Spain (monolinguals) or in the U.S. (HS, L2ers).

3 groups matched in WM span.

HS and L2 groups matched in L2 proficiency.

METHOD

- Spanish proficiency test (DELE) (learners).
 - Language background questionnaire.
 - Visual-world eye-tracking task.
 - Working memory task.
 - Phonological STM task.
 - Gating task
 - Production task.
-

EYE-TRACKING TASK

Eye-Link 1000 Plus eye-tracker (SR-Research)



There were 66 sentences:

- 18 practice
- 16 experimental (8 paroxytones, 8 oxytones)
- 32 fillers

Task: listen to sentences in Spanish and choose one of two words in the screen ASAP by pressing a key.

firma

firmó

Audio



firma

firmó

El director firma la factura

firma

firmó

El director firmó la factura

+

1,000 ms (no audio)

250 ms

WORKING MEMORY

Adapted from a subtest of the Wechsler Adult Intelligence Scale test
(Wechsler, 1997).

Task:

1. Listen to a mixed series of letters and numbers
2. Type them, numbers first in ascending numerical order, then letters in alphabetical order.

Listen: 7-C-3-A

Answer: 37AC

Scoring: 1 pt per correct series recalled, to a max of 21 pts.

Results

Three analyses

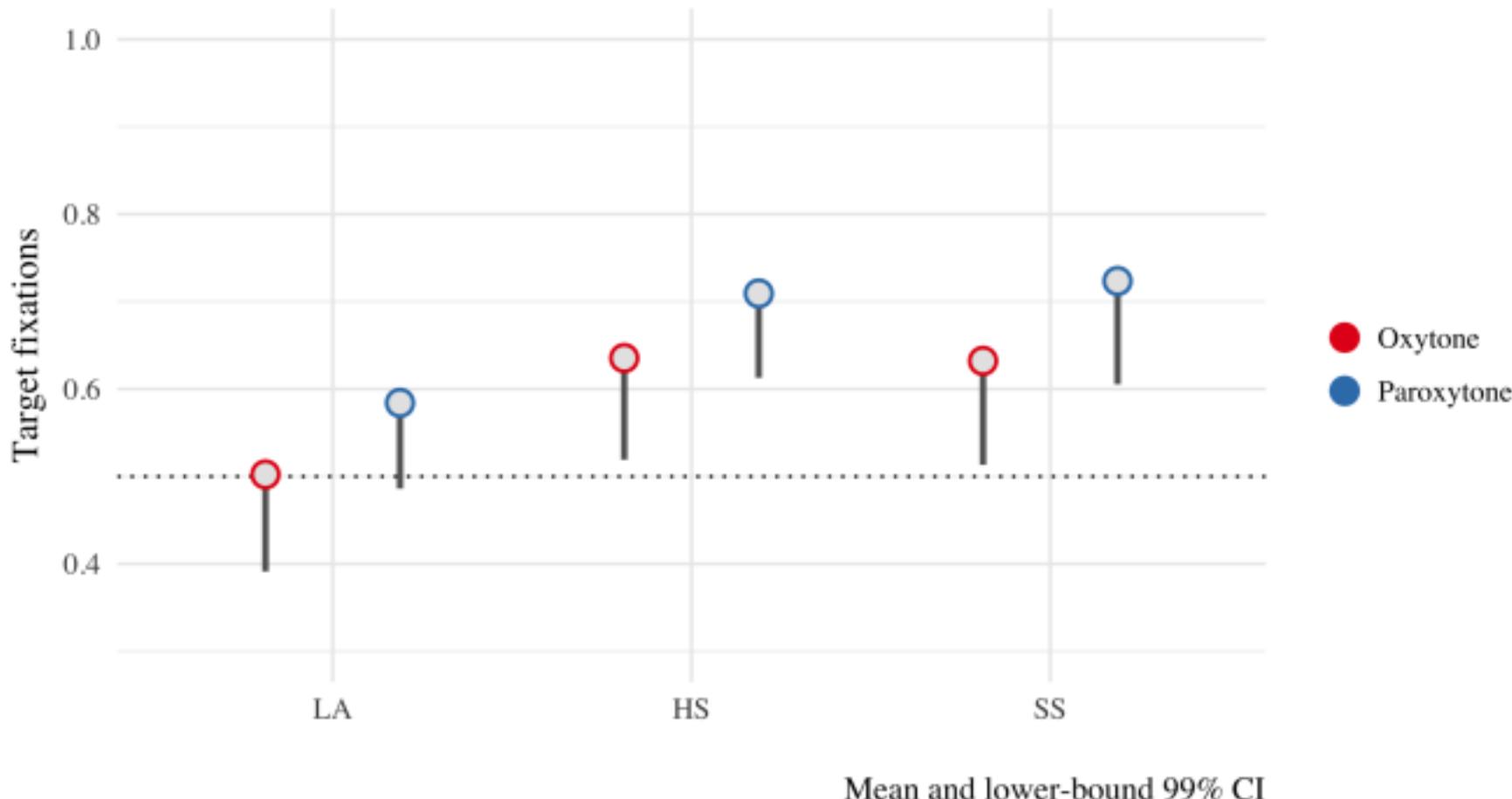
- One tailed t-tests
 - Test whether fixations on targets are above chance
- GLMMs
 - Establish group differences
- Growth Curve Analyses
 - Evaluate group differences over time course

HOW
Do they use
stress to guess
word ending?

WHEN
If yes, how early
can they guess
the word ending?

Single sided t -tests to compare each group in each condition against chance.

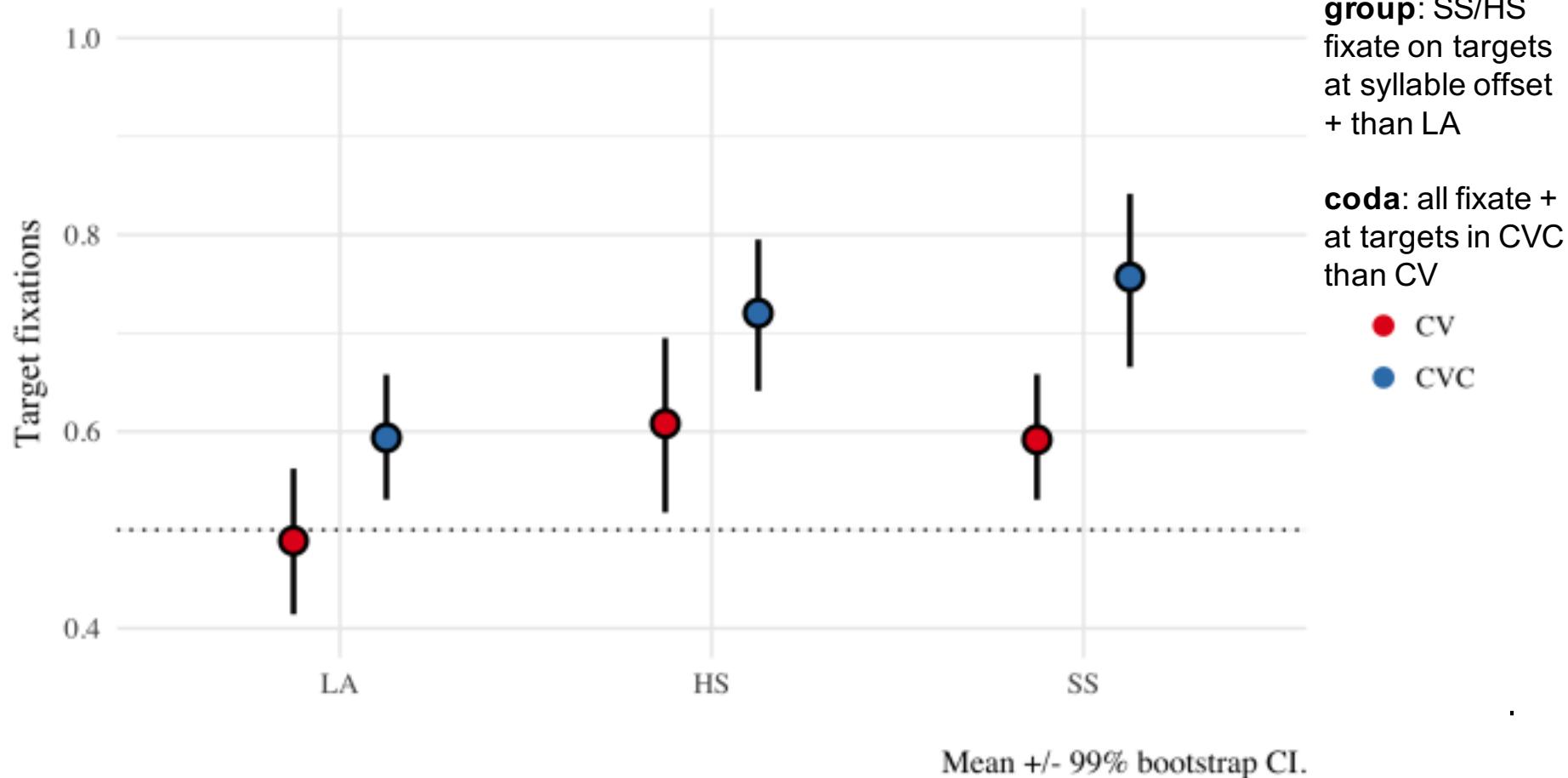
Mean fixations at target syllable offset



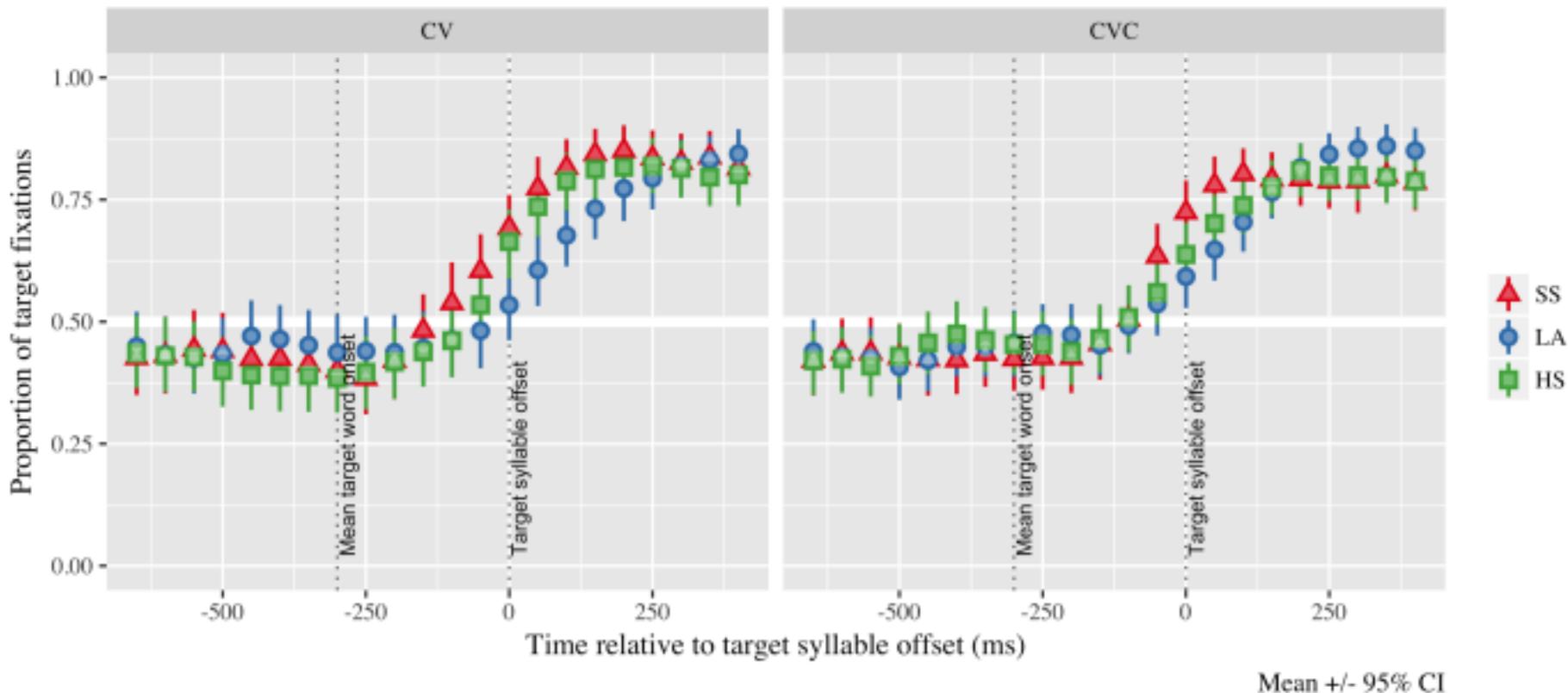
GLMM random intercept for subject/item, random slope for stress, and WM as a covariate.

Main effect of:

Mean fixations at target syllable offset



Growth curve analysis of time course (data downsampled to 50 ms bins and adjusted 200 ms).

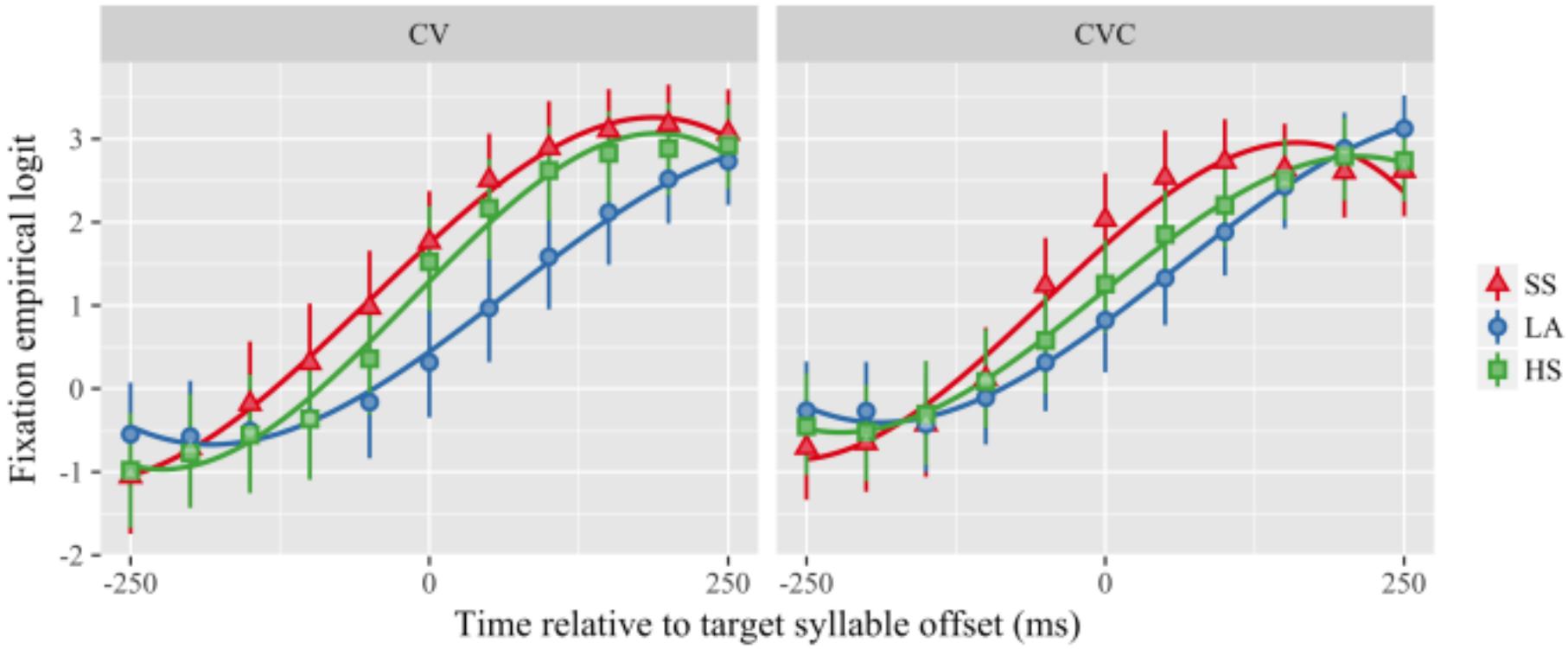


In general, fixations to targets increase as a function of time.

Monolinguals and HS fixate on targets earlier than L2ers (in CV and CVC).

In CVC, LA fixate on targets before suffix, but in CV they don't fixate on targets above 50% chance after suffix.

Growth curve analysis: multi-level regression to account for time course and longitudinal data. We fit 3rd order orthogonal polynomials to the data to report group and coda effects on the Intercept, Linear, Quadratic, and Cubic time variables.



Main effect of quadratic time term on LA: slower fixation rate than monolinguals.

Group x coda interactions for LA: LA fixate on targets earlier CVC, but no anticipation before suffix in CV.

Monolinguals = HS in CV, but monolinguals anticipate slightly earlier than HS in CVC.

Mean +/- 95% CI

Conclusions

1. CAN THEY PREDICT? (above chance)

- Monolinguals: YES
- HS: YES
- L2ers: NO

HOW DO THEY PREDICT?

- All fixate more on targets in CVC (*firma-firmó*) than CV (*lava-lavó*).
- Monolinguals and HS fixate on targets more than L2ers.

2. WHEN DO THEY PREDICT?

- Monolinguals & HS fixate on the targets earlier than L2ers.
- L2ers can predict if CVC, but can't if CV.
- Monolinguals = HS in CV, but monolinguals predict earlier than HS in CVC.

3. DOES WM MEDIATE IF, HOW, OR WHEN THEY PREDICT?

Nope

Theoretical implications (aka take home message)

1. MODELS OF L1 LEXICAL ACCESS

Our findings support models advocating that suprasegmental integration is part of spoken word recognition, and go against models claiming that suprasegmental integration and word recognition are separate mechanisms (see Roll, 2015, for a review).

2. MODELS OF L2 PROCESSING

Our findings support recent proposals that explain late learners' difficulty acquiring inflectional morphology and morphosyntax in terms of impoverished abilities to integrate morphological cues to make predictions (Hopp, 2015). We show that L2 learners also exhibit limited abilities at integrating prosodic cues to make predictions.

Importantly, L2 learners can develop anticipatory patterns qualitatively similar to those of monolinguals, but they cannot match the monolinguals quantitatively (monolinguals always predict earlier than L2ers).

3. MODELS OF HS PROCESSING

Our findings propose additional explanations to HS' uniqueness in terms of integration of prosodic cues to make predictions.

| | Qualitatively native-like | Quantitatively native-like |
|-----------|------------------------------|-------------------------------|
| HS CVC | YES | NO |
| HS CV | | YES |
| L2ers CVC | | NO |
| L2ers CV | NO | |

OUTLINE OF STUDIES

- Early bilinguals (HS) (stress)
- Late bilinguals (L2 learners) (stress)
- Late bilinguals with extensive anticipatory experience (interpreters) (stress)

Anticipation in late bilinguals

Sagarra & Casillas
(under review)
Journal of L2 Studies

PARTICIPANTS

25 Spanish monolinguals born and raised in a monolingual region in Spain.

38 English adult learners of Spanish:

12 beginners

26 advanced

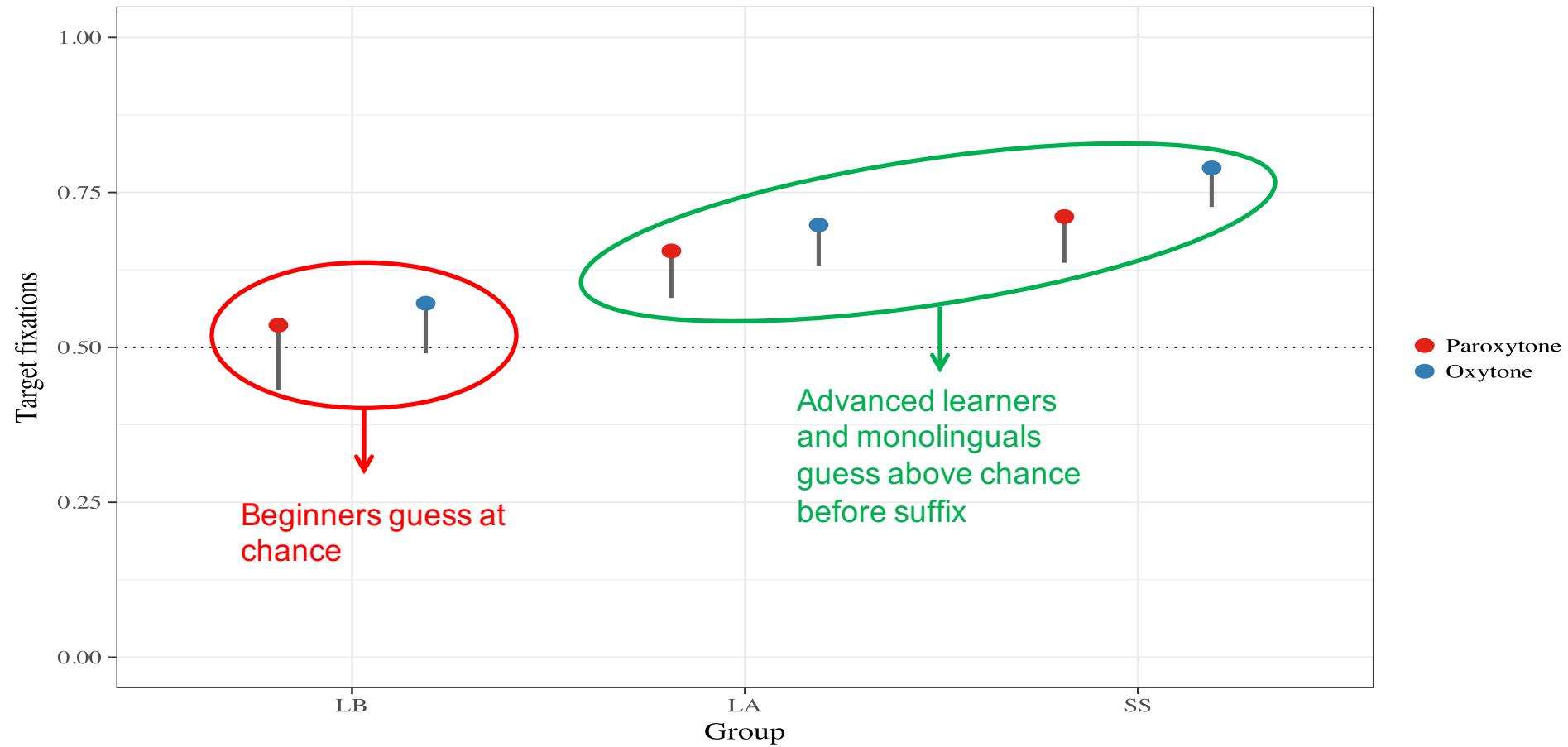
EYE-TRACKING RESULTS

You already know the results for the Spanish monolinguals and the advanced L2 learners from the study with HS. What about the beginning L2 learners? Do you think they were able to use stress (FIR vs fir) to predict the end of the word (firma vs firmó)?

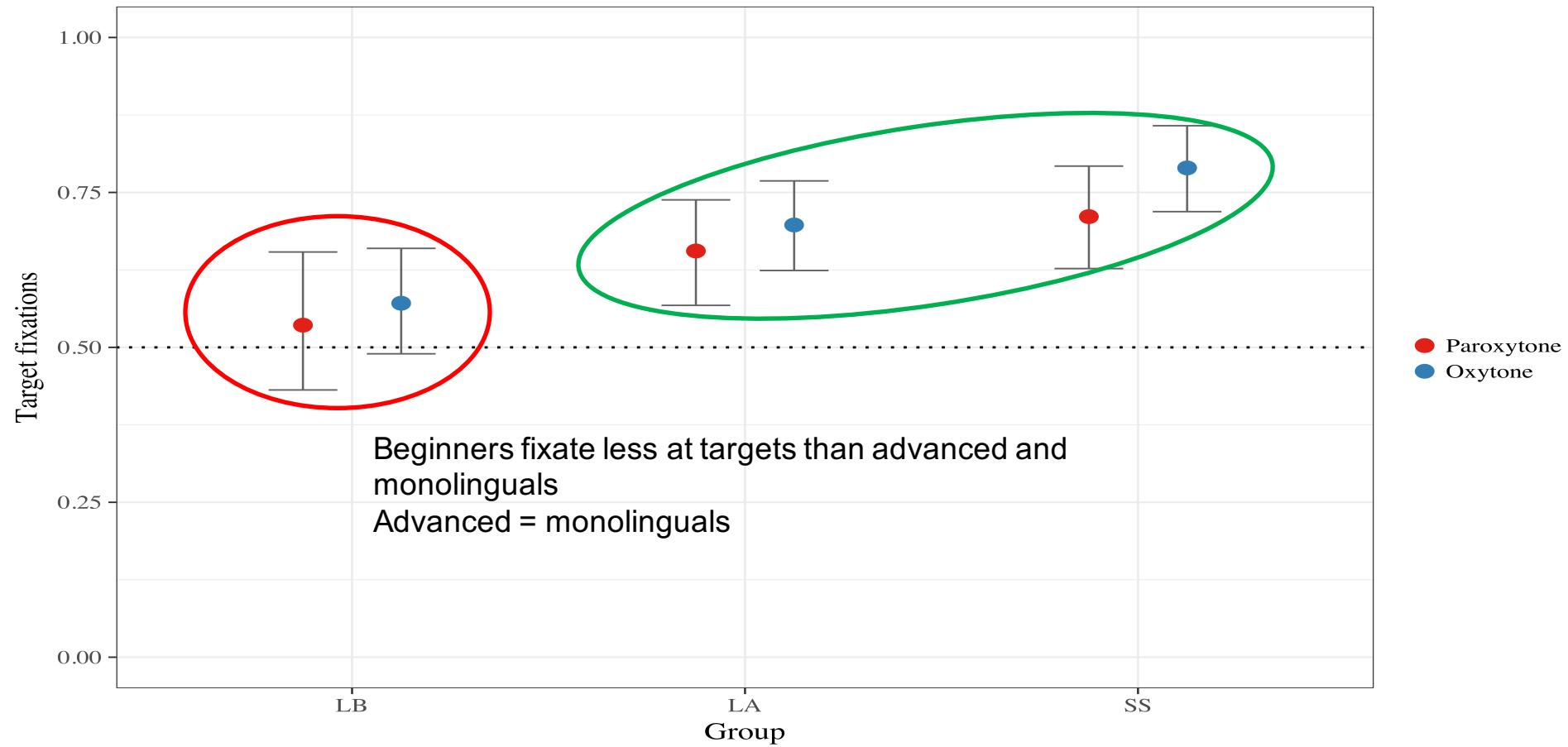
A large orange circle with a thin black outline. Inside the circle, the word "Think" is written in a white, sans-serif font.

Think

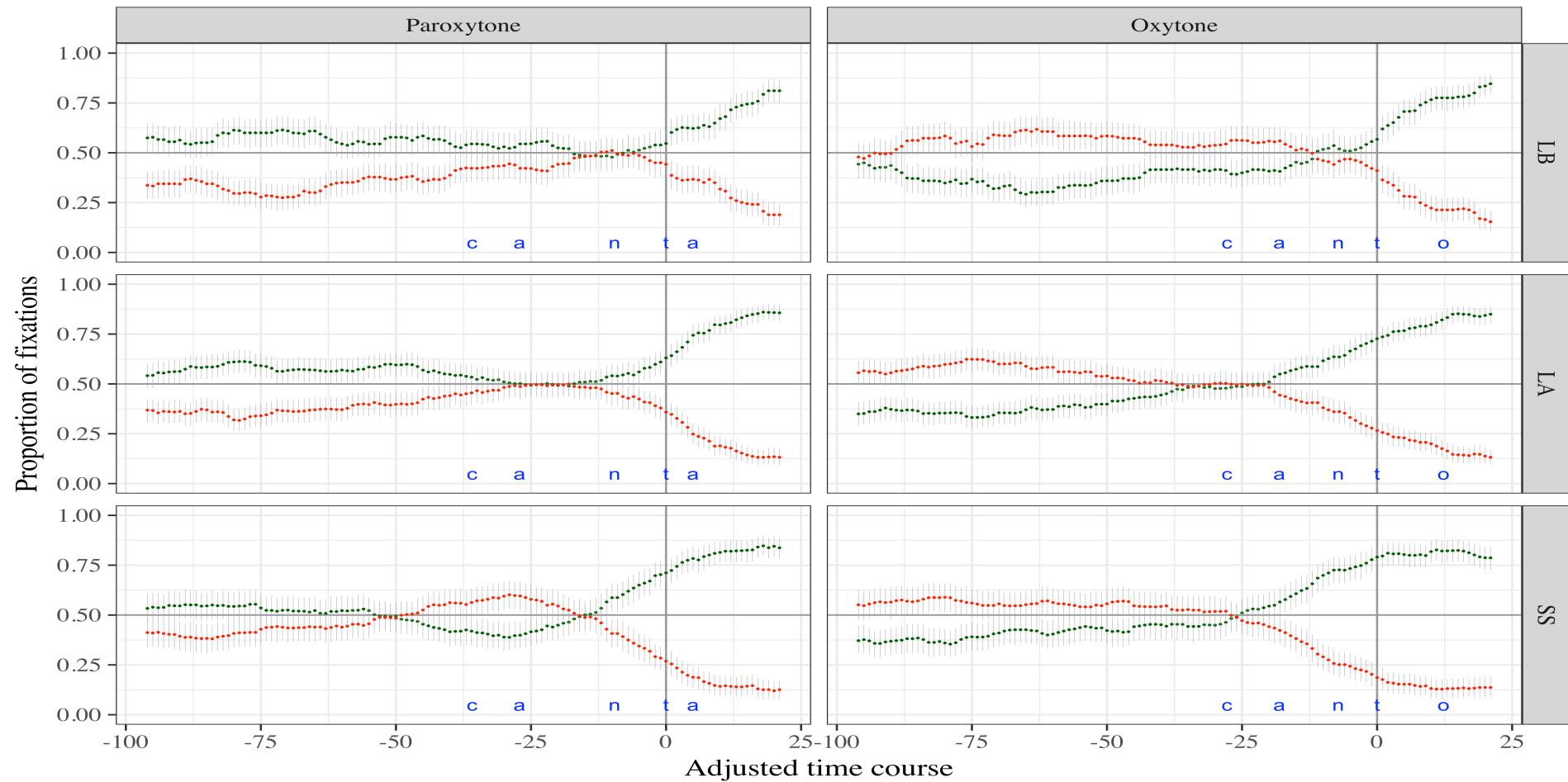
Mean target fixations and lower-bound 95% confidence interval

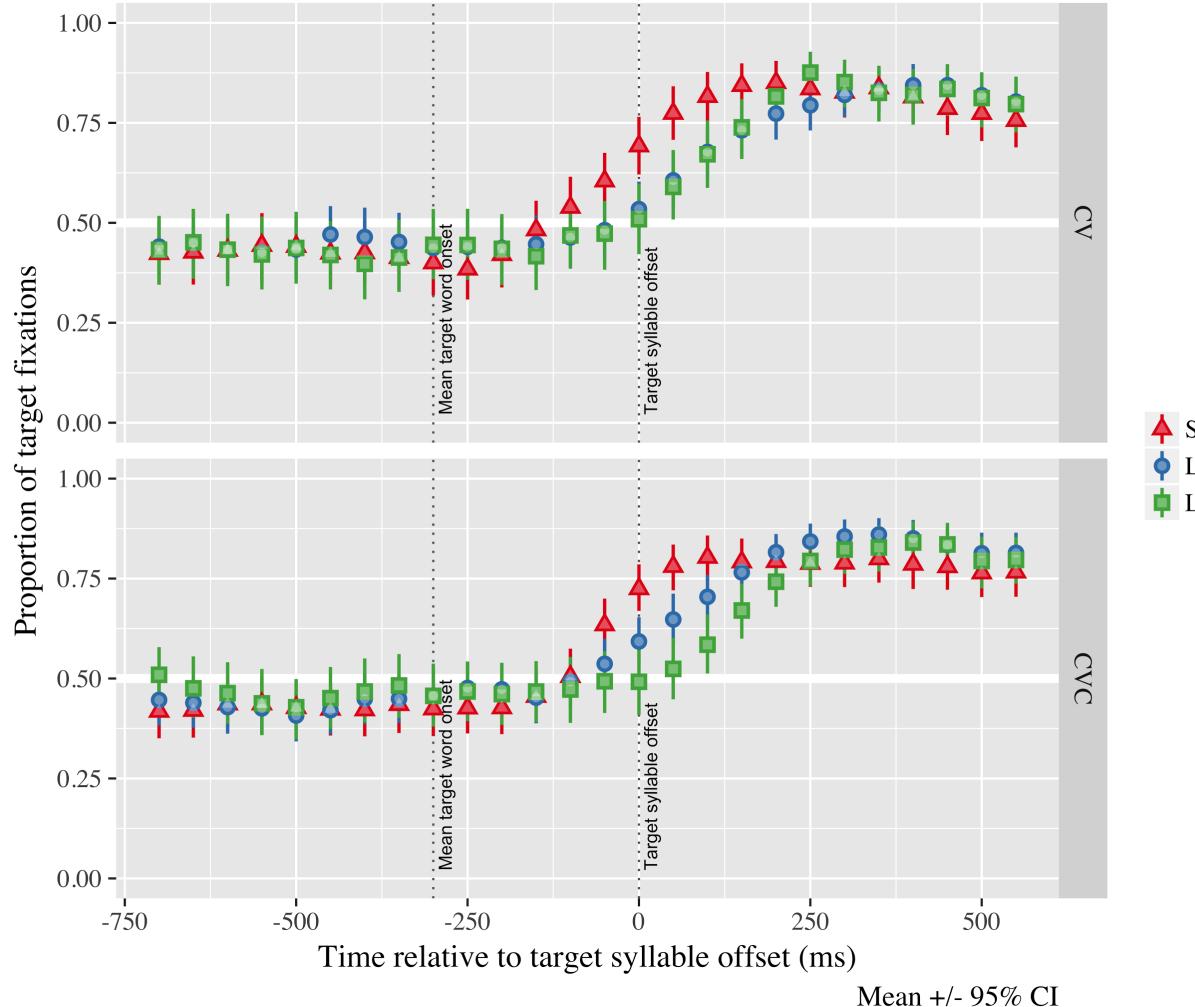


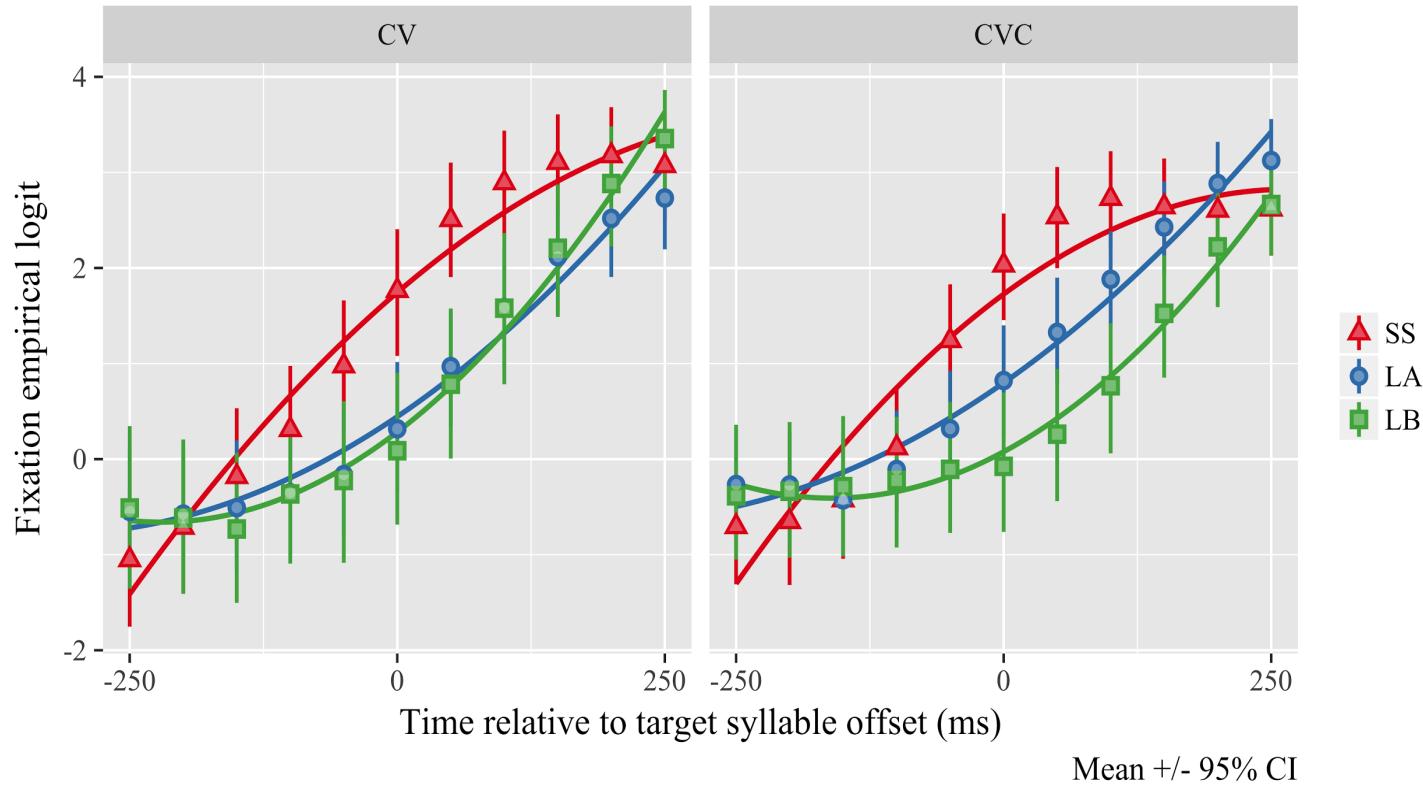
Mean target fixations as a function of group and target type



LB nothing. LA guessed if CVC, but not if CV. SS always guessed (CVC and CV).







Any WM effects?

Nope!

OUTLINE OF STUDIES

- Early bilinguals (HS) (stress)
- Late bilinguals (L2 learners) (stress)
- Late bilinguals with extensive anticipatory experience (interpreters) (stress)

Anticipation in late bilinguals with extensive anticipatory experience (interpreters) part I: lexical stress

Lozano, Sagarra & Casillas
(in progress)
*Bilingualism: Language and
Cognition.* Special issue on
interpreters.

—

Adult L2 learners have impoverished target-like anticipatory abilities.

DOES PRACTICE MAKING ANTICIPATIONS HELP?

Professional interpreters need to make predictions constantly and quickly.

Do you think that there is an interpreters' advantage? Will they be better than the non interpreters although the two have the same proficiency in Spanish?

A large orange circle with a thin black outline. Inside the circle, the word "Think" is written in a white, sans-serif font.

Think

Anticipation in interpreters

“The interpreter predicts the incoming text and produces a target text segment before it is uttered by the speaker based on **linguistic** cues and **knowledge** cues” (Li, 2015)

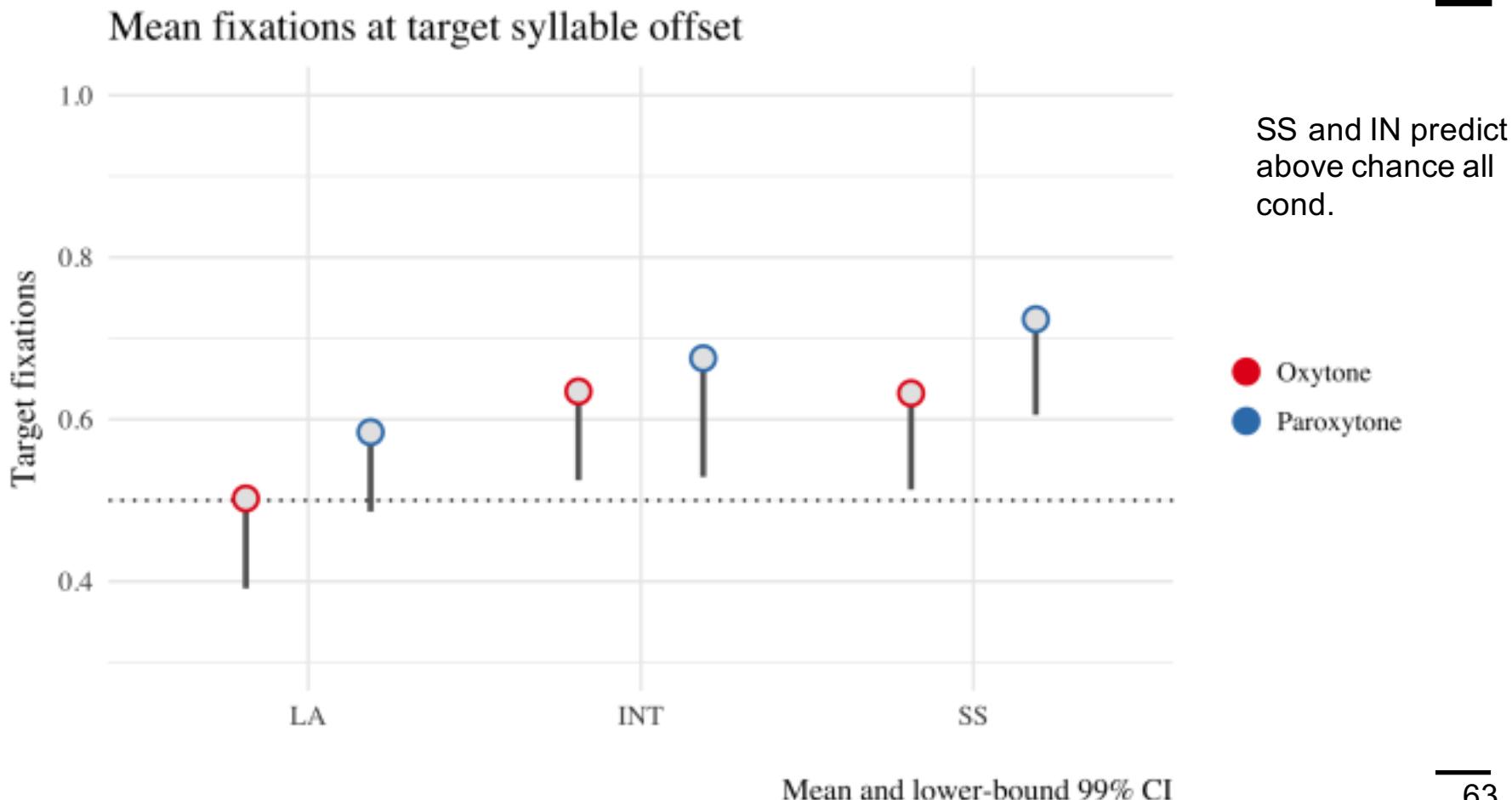
Why anticipating and not waiting? Because anticipating:

- is less demanding
- releases memory
- minimizes the lag between the speech uttered by the speaker and the interpretation (Seeber & Kerzel, 2011)

-
- Ability to predict upcoming words is one of the measures to test interpreting aptitude (Moser, 1978; Pöchhacker, 2015).
 - Anticipation studies with interpreters:
 - Interpreters make predictions very frequently: German-French (Van Besien, 1999); Japanese-English (Gile, 1992)
 - German-Greek corpus study (Liontou, 2012): anticipation is used 60% of the cases, and is used successfully in most of the cases
 - Despite the consensus that anticipation plays a crucial role in interpreting, there are no studies investigating what cues interpreters use to make their predictions.
-

Results

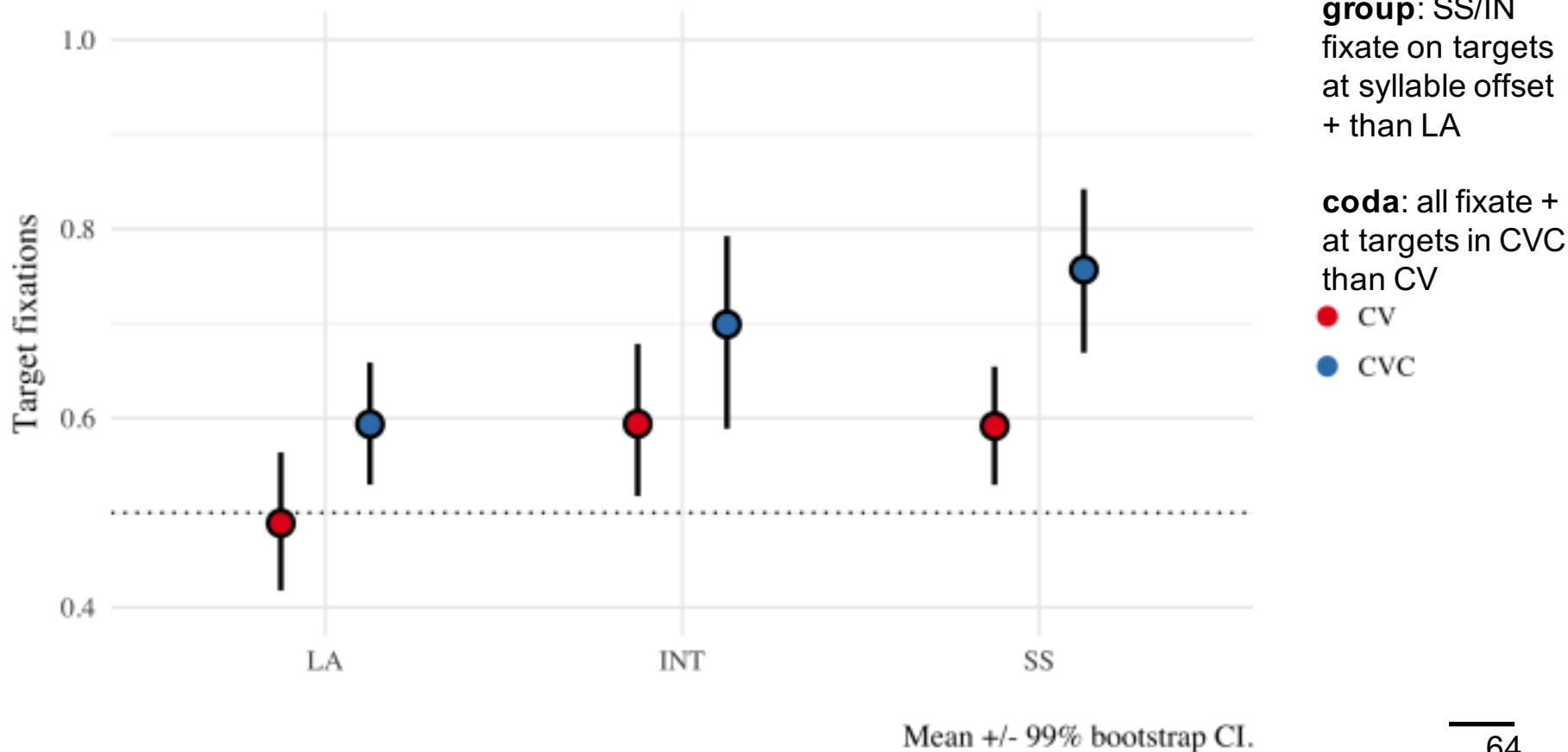
Single sided t -tests to compare each group in each condition against chance.



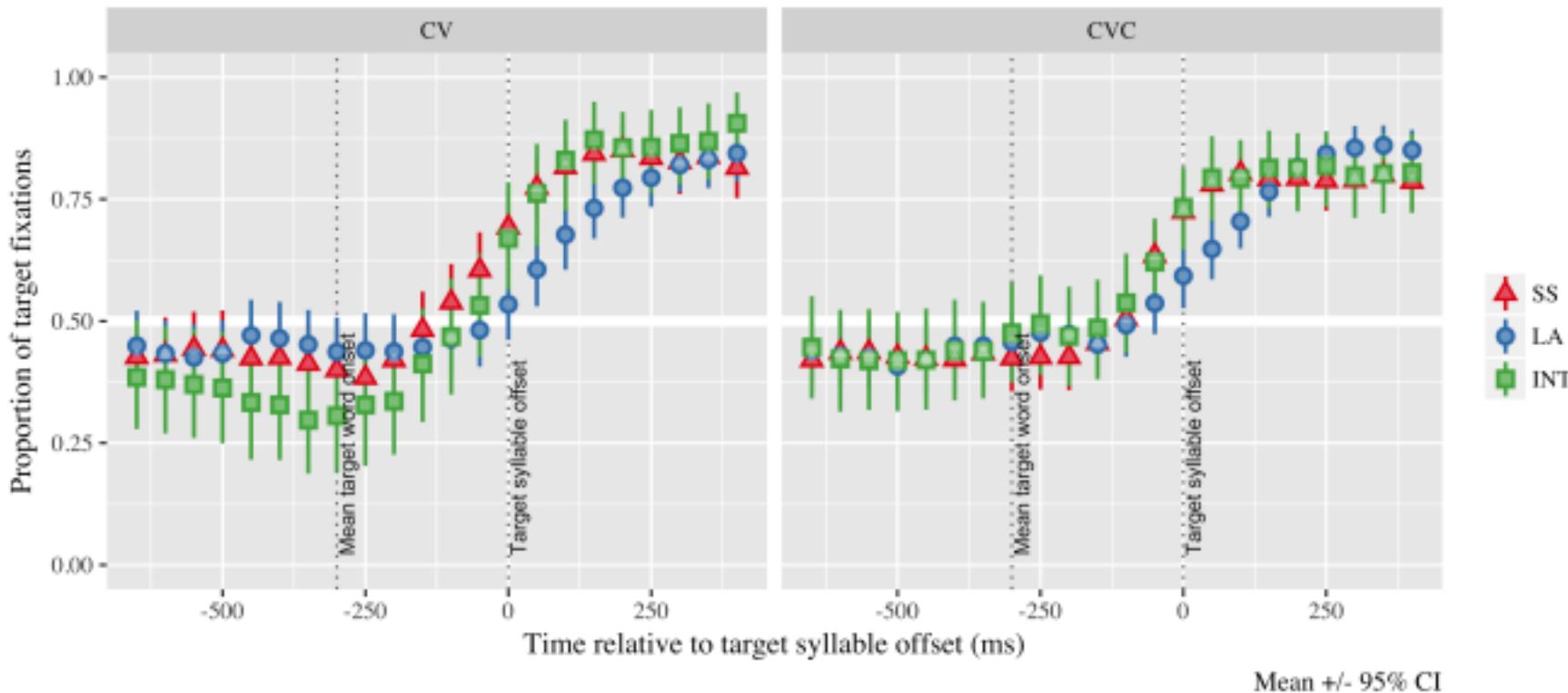
GLMM random intercept for subject/item, random slope for stress and syllable structure, and WM as a covariate. No effect of stress or WM, so excluded from graph.

Main effect of:

Mean fixations at target syllable offset



Growth curve analysis of time course (data downsampled to 50 ms bins and adjusted 200 ms).

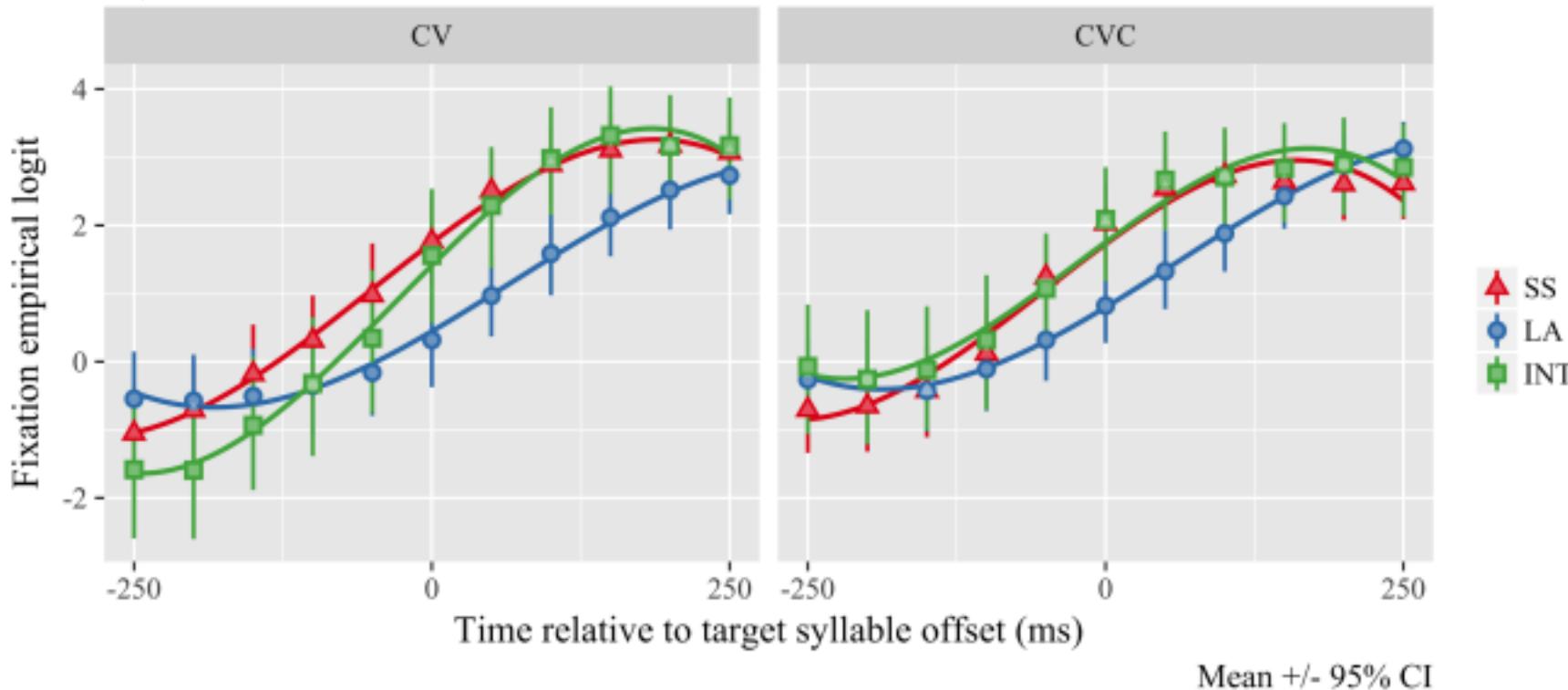


In general, fixations to targets increase as a function of time.

Monolinguals and IN fixate on targets earlier than L2ers (in CV and CVC).

In CVC, LA fixate on targets before suffix, but in CV they don't fixate on targets above 50% chance after suffix.

Growth curve analysis: multi-level regression to account for time course and longitudinal data. We fit 3rd order orthogonal polynomials to the data to report group and coda effects on the Intercept, Linear, Quadratic, and Cubic time variables.



LA fixate on targets earlier if CVC, but no anticipation if CV.

IN fixate at faster rate than SS, but later in time course (equal to SS by target offset). IN = SS in CVC cond

Discussion

1. CAN THEY PREDICT? (above chance)

- Monolinguals and interpreters: YES
- Non-interpreters (LA): NO
- All fixate more on targets in CVC (firma-firmó) than CV (lava-lavó).
- Monolinguals and interpreters fixate on targets more than non-interpreters → **INTERPRETER ADVANTAGE.**

2. WHEN DO THEY PREDICT?

- Monolinguals & interpreters fixate on targets earlier than non-interpreters → **INTERPRETER ADVANTAGE**.
- Non-interpreters can predict if CVC, but can't if CV.
- CV: Interpreters initially fixate less, but at a faster rate than natives (they get to the same point by target offset)
- CVC: interpreters = monolinguals

3. DOES WM MEDIATE IF, HOW, OR WHEN THEY PREDICT?

No

TAKE HOME MESSAGE

1. Our findings support models advocating that suprasegmental integration is part of spoken word recognition, and go against models claiming that suprasegmental integration and word recognition are separate mechanisms (see Roll, 2015, for a review).
 2. Qualitatively (can they do it?): it is possible to learn L2 anticipatory patterns (non-interpreters) post-puberty, and “practice makes you better” (interpreters).
 3. Quantitatively (how early they predict?): the monolinguals are the winners.
-



The End