

# Cross-linguistic Perception of Phonotactics in Bilinguals



NORTHWESTERN UNIVERSITY



Max R. Freeman & Viorica Marian  
Northwestern University

## Abstract

Do bilinguals perceive their native language (L1) when processing their second language (L2)? To answer this question, we examined whether Spanish-English bilinguals listening to English words perceived them according to Spanish rules (i.e., phonotactic constraints, such as Spanish requiring a vowel onset to precede s+consonant clusters; *strict* vs. Spanish "estricto"). English monolinguals and Spanish-English bilinguals were tested in English and asked if they heard a vowel at the onset of a word (e.g., *strict*) or a non-word (e.g., *spift*) (vowel detection task). Participants decided if they heard a word or a non-word (lexical decision task). Results indicated that bilinguals were slower to respond to Spanish-conflicting stimuli (e.g., *strict/spift*) than to control stimuli (e.g., *can/nulse*). Monolinguals did not show such differences across either task. We conclude that bilinguals perceptually repair L2 auditory input to conform to L1 phonotactic constraints in a top-down manner, with rules affecting how sound sequences are perceived. Overall findings demonstrate that bilinguals are influenced by the L1 at the sub-lexical level during L2 processing.

## Introduction

### Bilinguals activate both languages simultaneously at various linguistic levels:

- Phonological (Marian & Spivey, 2003)
- Lexical (Bartolotti & Marian, 2012)
- Semantic (Martín, Macizo, & Bajo, 2010)
- Syntactic (Kootstra, van Hell, & Dijkstra, 2012)
- **Phonotactic constraints** (rules for combining speech sounds) (Freeman, Blumenfeld, & Marian, 2016)

### Phonotactic constraint example:

- In Spanish, words with s+consonant cluster onsets cannot exist, and the phonotactic constraint of prothesis (addition of a vowel at the onset) is required:

English	Spanish
spiral	espiral /espiral/
strict	estricto /estrikto/

### Perceptual repair resolves this issue:

- Nonsense sounds which conflict with L1 phonotactic constraints are perceptually repaired, or assimilated to the closest sound that exists in the L1 (e.g., Carlson et al., 2016).
- Spanish *monolinguals* repaired Spanish-like non-words, like *special* (/spesjal/) to *especial*, conforming to Spanish vowel onset rule (Cuetos et al., 2011; Hallé et al., 2008).
- Spanish-dominant *bilinguals* repaired nonsense sounds that conflicted with their L1 when tested in the L1 (Carlson et al., 2016).

## Question & Prediction

Do bilinguals perceptually repair sound sequences in their L2 (words and non-words) that conflict with L1 rules (e.g., spiral -> espiral /espaɪrəl/)?

Bilinguals are expected to show greater reaction time differences between English s+consonant onset words and non-words versus control words and non-words relative to monolinguals in vowel detection and lexical decision.

## Methods & Procedure

**Participants:** 8 Spanish-English bilinguals, 17 English monolinguals^

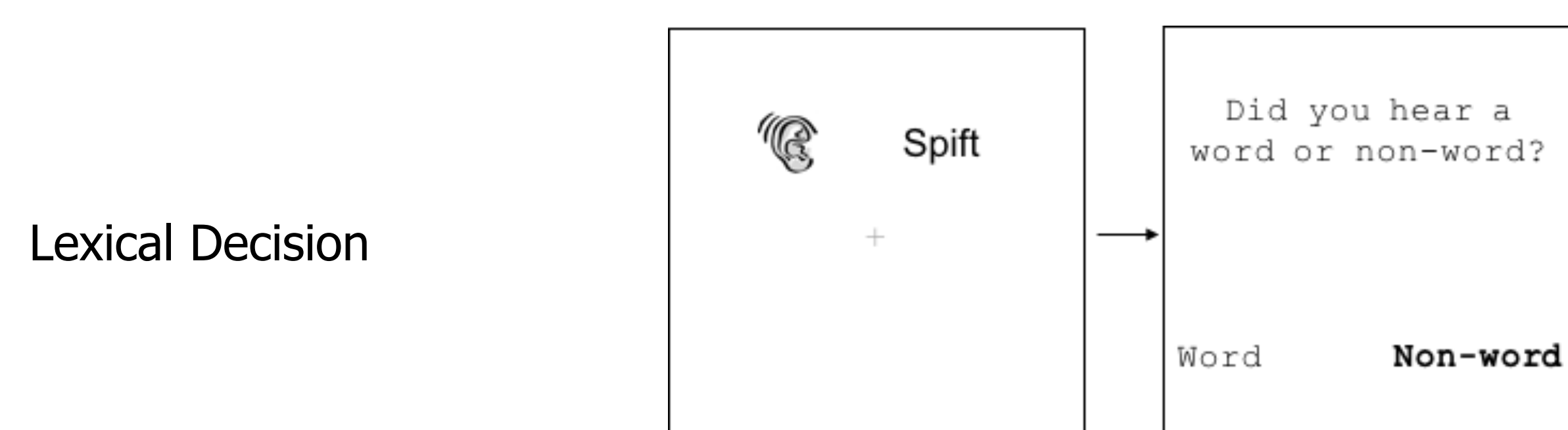
	Bilinguals Mean (SE)	Monolinguals Mean (SE)
Age	21.00 (2.05)	23.29 (1.12)
English receptive vocabulary (PPVT: standard score)	105.63 (3.25)	105.82 (3.16)
Spanish receptive vocabulary (TVIP: standard score)	113.63 (3.72)	-
Non-verbal reasoning (WAST)	29.88 (0.78)	28.71 (0.78)
Working Memory (Backward Digit Span)	7.33 (0.36)	11.23 (1.13)
English age of acquisition	5.50 (1.26)	0
Spanish age of acquisition	0	-
Current English exposure	69.88% (8.07)	99.19% (0.36)
Current Spanish exposure	30.13% (5.83)	-
Foreign accent in English (self-reported 1-10 scale)	3.66 (1.97)	-
Foreign accent in Spanish (self-reported 1-10 scale)	1.67 (0.71)	-
English Proficiency (self-reported 1-10 scale)	9.00 (0.52)	9.52 (0.19)
Spanish Proficiency (self-reported 1-10 scale)	9.40 (0.40)	-

^data collection in progress

**Stimuli:** Example stimuli and number of each item type (vowel detection and lexical decision tasks)

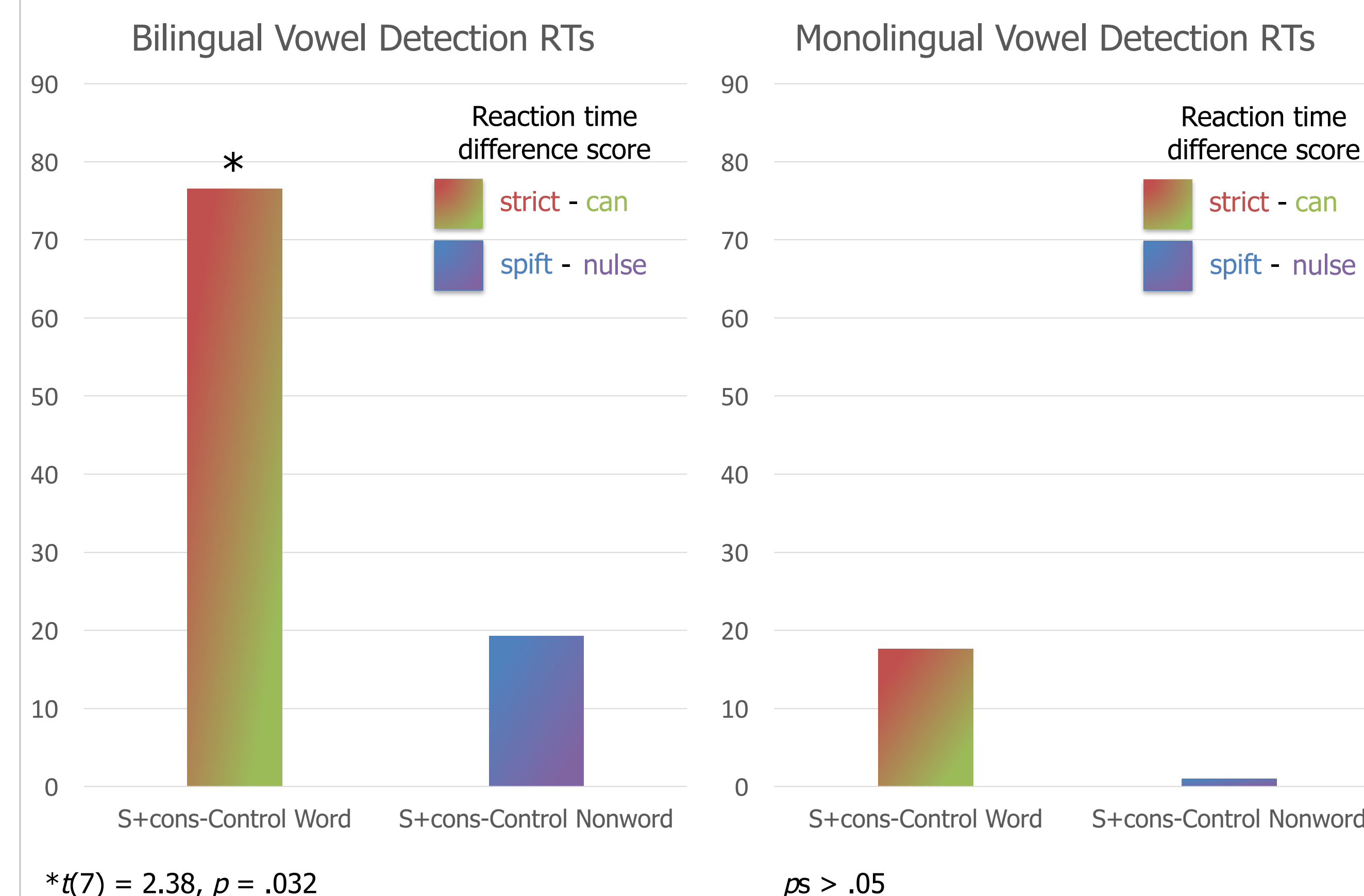
S + consonant word	Control word	S + consonant non-word	Control non-word
<i>strict</i>	<i>can</i>	<i>spift</i>	<i>nulse</i>
24	72	24	72

### Procedure:

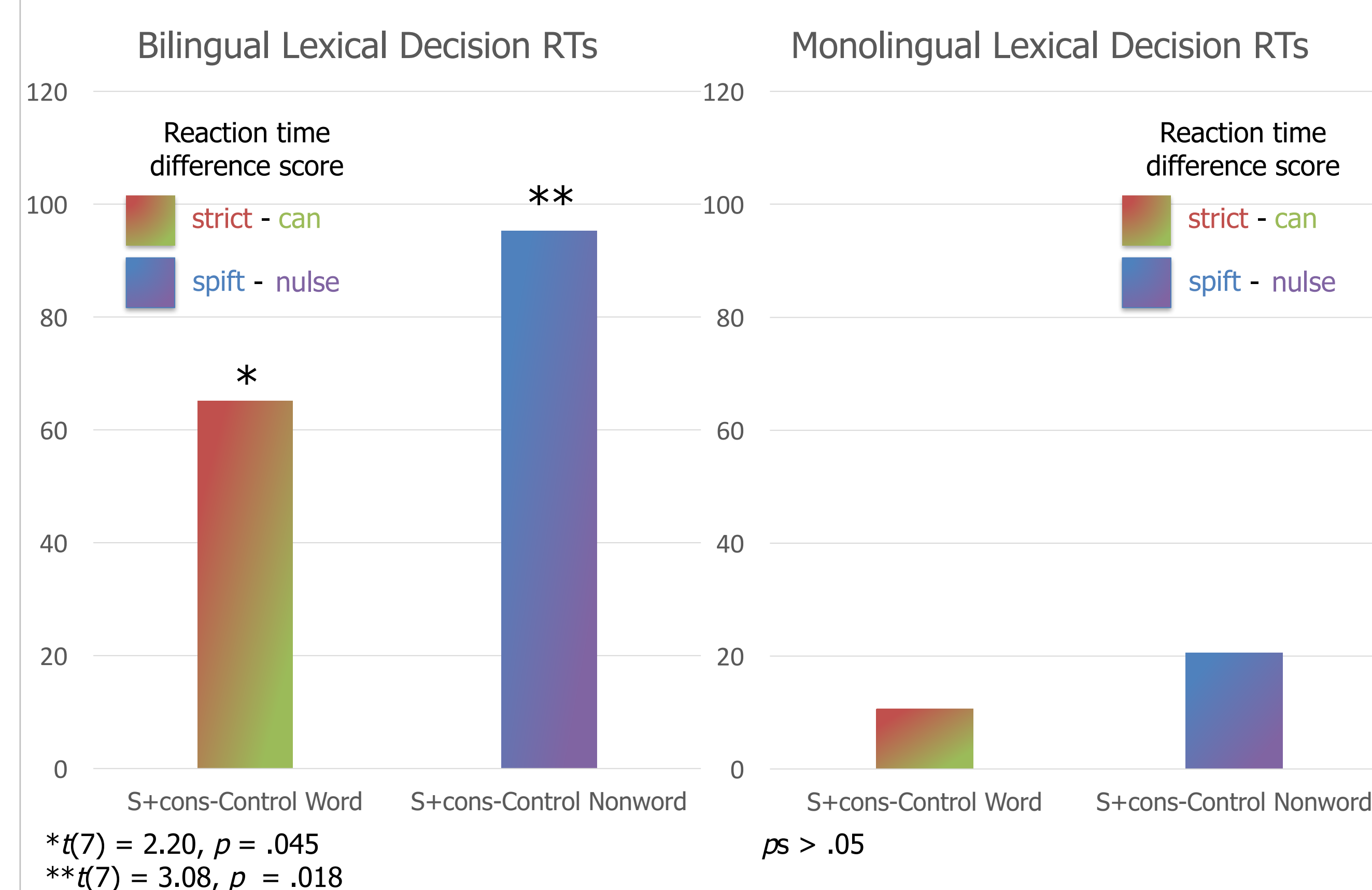


## Results

**1) Vowel Detection:** Bilinguals were slower to respond to Spanish-conflicting words (e.g., *strict*) than control words (e.g., *can*). Reaction time differences were significant for words only. Monolinguals did not show any differences across words and non-words.



**2) Lexical Decision:** Bilinguals were slowest when presented with Spanish-conflicting words and non-words relative to controls. Reaction time differences were significant. Monolinguals did not show such differences.



- These results suggest that bilinguals may perceive an illusory vowel upon hearing Spanish-conflicting words (vowel detection, lexical decision) and non-words (lexical decision).
  - It appears that bilinguals perceptually repair the s+consonant onset words to have an e-onset.
  - Reaction times to Spanish-conflicting words and non-words followed similar patterns on lexical decision within bilinguals, suggesting that lexical status did not modulate perceptual repair ( $ps > .05$ ).

## Discussion

### Perceptual repair in Vowel Detection:

- Bilinguals perceptually repaired sound sequences that conflicted with L1 rules when hearing L2 words.
- The significant reaction time effect with s+consonant words relative to controls (*strict/can*) suggests perceptual repair of English s+consonant cluster onsets to conform to Spanish 'e'-onset constraint.
- Stimulus lexibility (word vs. non-word) affected perceptual repair.
- When hearing an L2 word that conflicts with L1 phonotactics (Spanish vowel+s+consonant onset rule), bilinguals may perceive an illusory vowel at the onset (e.g., *strict/estricto*).

### Perceptual repair in Lexical Decision:

- Lexicality of the stimuli did not affect perceptual repair.
- Similar reaction time patterns for words and non-words across conditions.
- Bilinguals are equally likely to repair nonsense sound combinations and L2 words conflicting with L1 rules.

### Future Directions:

- Extend existing bilingual comprehension models that provide a theoretical framework for parallel processing to include perception of L1 phonotactics during L2 processing:
  - BIA+ (Dijkstra & van Heuven, 2002)
  - BLINCS (Shook & Marian, 2013)
- Design interventions to increase awareness of phonotactic-constraint differences across languages.

## Conclusions

- Bilinguals perceive English (L2) according to Spanish (L1) phonotactic constraints during auditory input.
- This perceptual repair likely occurred because English s+consonant words and non-words conflicted with Spanish phonotactics.
- Bilinguals are influenced by the native language when listening to second language words.
- Findings shed light on the extent to which cross-linguistic structures influence speech perception.