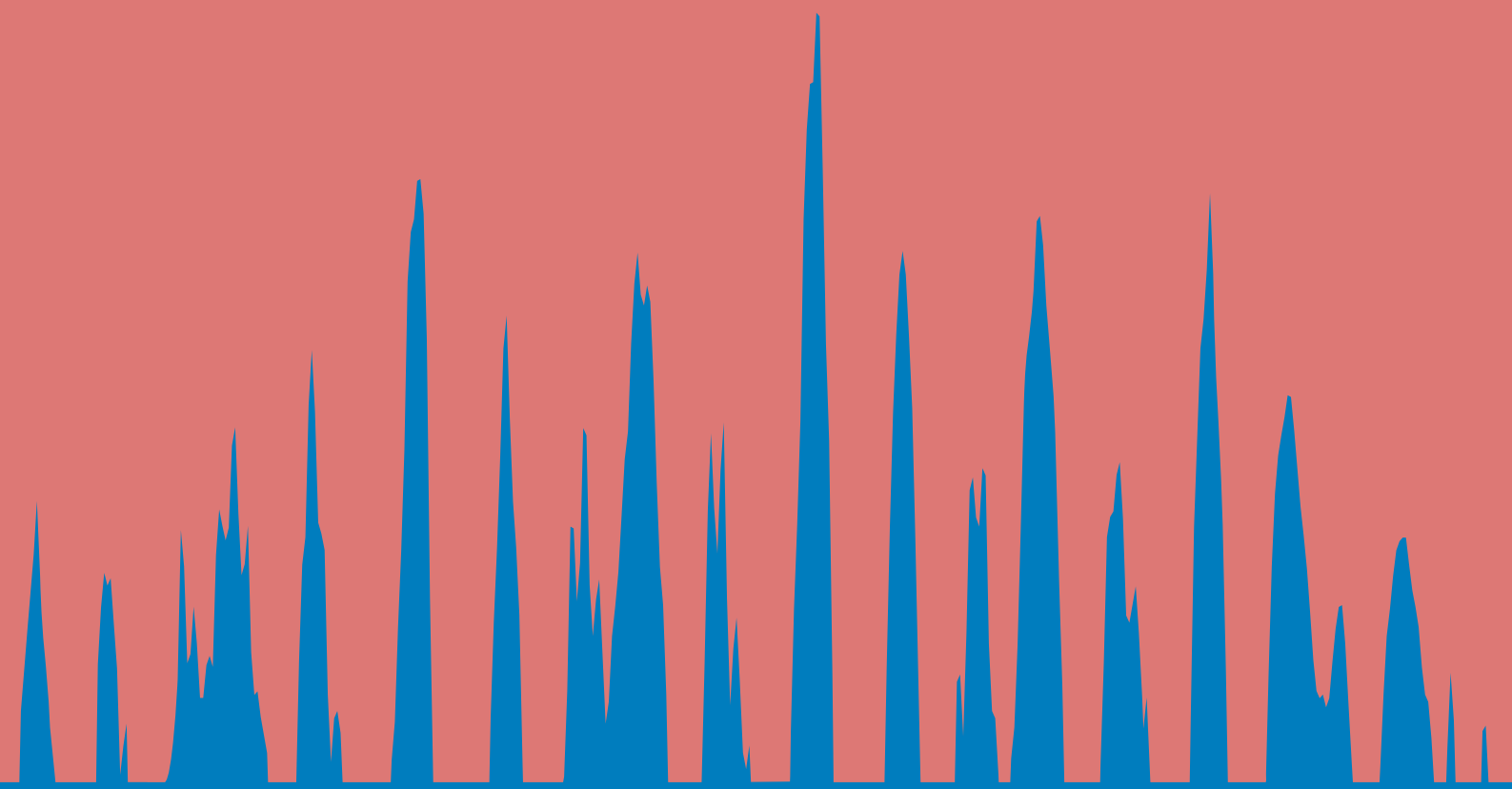
August 7–11, 2023 — Prague, Czech Republic

ICPhS 2023

CONGRESS PROCEEDINGS



ICPhS 2023
August 7–11, 2023
Prague Congress Center, Czech Republic

20th International Congress of Phonetic Sciences (ICPhS)

August 7–11, 2023
Prague Congress Center, Czech Republic

ELSEVIER

Title:Proceedings of the 20th International Congress of Phonetic Sciences, Prague 2023
Publisher: GUARANT International spol. s r.o.
Edited by Radek Skarnitzl and Jan Volín
Edition: second
Prague, August 2023
ISBN 978-80-908 114-2-3

To cite papers in this volume:
Author Name(s) (2023). Paper title. In: Radek Skarnitzl & Jan Volín (Eds.), *Proceedings of the 20th International Congress of Phonetic Sciences* (pp. XX–YY). Guarant International.

WELCOME TO ICPhS 2023

Welcome from the Chair of the Organizing Committee for ICPhS 2023

Welcome everyone to the 20th International Congress of Phonetic Sciences. I am happy to welcome all of you here in Prague, in the heart of Europe, and I am truly honoured to host what some people call the "phonetic Olympics", the congress during which we discuss the latest developments in the broad field of speech sciences.

It seems like a lifetime away when, on the 9th of August 2019, the 19th ICPhS was concluded in Melbourne, Australia. Four years, nearly 1,500 days during which the world has changed beyond recognition. It was only a few months after the last ICPhS that the new strain of coronavirus started spreading, eventually throwing the whole world into chaos, a series of lockdowns, and the omnipresence of facemasks. The covid pandemic has also changed the way we – scientists and academics – operate. Indeed, the facemask has triggered an avalanche of research of various facets of speech communication – searching Google Scholar for the combination of the terms "speech" and "facemask" yields thousands of entries, and several presentations at this congress will also be dedicated to what, for many of us, was a new phenomenon in our lives. However, while the pandemic has brought a number of positive changes into our world, precious little positive can be found in other developments over the past four years – such as the senseless aggression which has been going on in Ukraine, merely several hundred kilometres from here for the past 18 months.

Phonetic sciences have a long tradition in the Czech Republic. The phonetic laboratory in Prague was established in 1916, making it one of the oldest laboratories in central Europe and the prime centre of phonetic sciences in the Central European area for several decades. The birth of the lab is closely linked to Josef Chlumský, an experimental phonetician who studied under Abbé Rousselot in Paris. True to his experimental upbringing, Chlumský dedicated a lot of effort to obtaining modern laboratory equipment – the most prized being a set of tuning forks, the tonometre, which was used to identify resonance frequencies of speech sounds. And it is my pleasure to invite those who would like to see our humble collection of historical phonetic instruments to visit the Faculty of Arts, in the very centre of Prague, on Wednesday between 5.30 and 7 pm – the historian of our institute, Pavel Šturm, will be there to show you around. This is not on the official programme, but ask one of the student helpers, they will point you in the right direction.

You will have read that this is the second time that the Institute of Phonetics in Prague is hosting ICPhS. It was Chlumský's successor, Bohuslav Hála, who was the chair of the sixth congress in 1967. It seems fitting that I show you several comparisons of the two congresses, which are based on a comparison which was conducted by Pavel Šturm for the 2015 ICPhS.

There were nearly 600 registered participants and 237 presentations in 1967, and 1,144 participants and 869 presentations this year. An interesting detail concerns authorship: 87%

of papers were written by a single author for the 1967 congress, while the same applies only to 18% of papers in 2023. The comparison of participants according to country is as follows:

6th ICPhS 1967 (active part.)		20th ICPhS 2023	
Czechoslovakia	37	United States	198
Soviet Union	35	Germany	167
United States	31	United Kingdom	105
Germany (East)	25	France	72
Germany (West)	21	Japan	66
Netherlands	10	Canada	64
Poland	10	Hong Kong	40
Romania	9	Czech Republic	38
United Kingdom	9	Netherlands	38
France	6	China	33
Italy	6	Australia	30
Yugoslavia	6	Switzerland	25
		Korea	24
		Taiwan	22
		Sweden	20
		Poland	20
		Spain	19
		Italy	17
		Austria	15
15 other countries	33	36 other countries	131

I hope you will agree with me that the comparison is a strong indication that phonetic sciences are a thriving interdisciplinary area, and I would like to think that professors Chlumský and Hála would be proud of what the entire field of phonetic sciences, and our institute have achieved.

Let us add a few statistics which are specific to this congress. The acceptance rate was slightly below 85%, and there are 266 oral presentations and 603 posters on the programme.

Of course, organizing a congress is an undertaking which has many people in the background, and it would not be possible to thank all of them. However, I would like to thank the most important ones: my colleagues from the Scientific Programme Committee (Tomáš Bořil, Katka Chládková, Jonáš Podlipský and Jan Volín), the representative of Guarant International, the professional congress organizer, Romana Kluková, and for the army of volunteers, Míša Svatošová. Naturally, this congress would not take place without the International Phonetic Association, and I would particularly like to thank its President, Michael Ashby, for support. And most of all, thank you, all of you – authors for submitting your contributions and for coming to Prague, to the reviewers and scientific area chairs who helped us with selecting the contributions!

I hope you will enjoy your stay in Prague and the Czech Republic, I hope you will be able to explore some of the beautiful things this city and country have to offer. And most importantly, I wish all of us a fruitful congress – five days of exciting presentations, stimulating discussions, chatting with old friends and meeting new ones – simply a very successful ICPhS!

Radek Skarnitzl
Chair of the 20th ICPhS 2023

Welcome from Michael Ashby, President of the International Phonetic Association 2019–2023

As President of the International Phonetic Association I have the privilege and the pleasure of welcoming you all to this historic twentieth International Congress of Phonetic Sciences. We have a full and exciting programme ahead of us, much to see, much to learn, friendships to renew, and no doubt new ones to make. But before we look ahead, it is appropriate that we should spend a few moments remembering those of our colleagues who have, sadly, died in the last 4 years or so.

They include:
Luc van Buuren, Anne Cutler, Grzegorz Dogil, Anthony Fox, Erik Fudge, Wiktor Jassem, Hermann Künzel, John Laver, Philip Liberman, Robert Mannell, Silvia Moosmüller, Terrance Nearey, John Ohala, Włodzimierz Sobkowiak, Elmar Ternes, Hans Tillmann, Jack Windsor Lewis, John Woodhead.

This list is certainly incomplete, and I apologise for omissions. But it is already a soberingly long list, no doubt in part on account of the Covid pandemic. And as you look though it you will notice several particularly prominent names: Anne Cutler (1945–2022), who was formerly a member of both the IPA Council and the Permanent Council for ICPhS; and two former Presidents of the IPA, John Laver (1938–2020), and John Ohala (1941–2020). There is a story to tell about each one on this list, and I am not going to hurry through all the names, but rather invite you to spend a few moments in silence, remembering them all.

The International Congress is only one of the IPA's many activities. Our central concern is of course the protection and maintenance and development of the International Phonetic Alphabet, by virtue of which the IPA serves effectively as an international standards organisation. But we support phonetic research in numerous other ways. I am proud of the fact that no fewer than 69 student researchers from around the world are here at the Congress with substantial financial support from the IPA. At the same time we are supporting important language documentation work. And, of course, we publish a major journal, The Journal of the International Phonetic Association (JIPA), which began in 1886 and continues to grow in significance and impact.

Why am I boasting about the IPA's achievements and activities? Well, I want to draw your attention to two forthcoming meetings. In the lunch break tomorrow (Tuesday) there will be a meeting devoted to JIPA, and on Wednesday at the same time we have the four-yearly General Meeting of the IPA, at which we will hear reports from the Association's committees and officers, and welcome the newly-elected Council and Executive. Both of these meetings are open to all, whether members or not, and I encourage you to attend.

So, again a warm welcome from the IPA, and I return you to the capable hands of our hosts here in Prague.

Michael Ashby
President of the International Phonetic Association

Scientific area Chairs for ICPhS 2023 congress

Scientific Area	Area Chairs
1. Speech Perception	Joseph Casillas
1. Special Session - Interplay or intermezzo? Structures and processes in prosody and music	Jianjing Kuang, Oliver Niebuhr
2. Speech Acoustics	Adrian Simpson
2. Special Session - Bridging linguistic and clinical perspectives through computational models of speech production	Ben Parrell, Doris Mücke, Antje Mefferd, Sarah Harper
3. Speech Production and Speech Physiology	Peter Birkholz
3. Special Session - Novel approaches to studying vocal development	Kasia Hitczenko , Marisa Casillas, Alejandrina Cristia, Meg Cychosz , Amanda Seidl
4. Speech Prosody	Plínio Barbosa
4. Special Session - The pedagogy of the Laryngeal Articulator Model	John Esling, Lise Crevier-Buchman, Míša Hejná, Scott Moisik
5. Phonation and Voice Quality	Heriberto Avelino
5. Special Session - Qualitative research in phonetics	Joe Pearce , Nate Lindgren Haj Bakir
6. Tone	Liquan Liu
6. Special Session - Changing research culture - Toward big team speech science	Timo Roettger, Joseph Casillas, Stefano Coretta
7. Syllable	Pavel Šturm
7. Special Session - The sounds of ageing	Míša Hejná, Anna Bothe Jespersen
8. Laboratory Phonology	Eva Reinisch
8. Special Session - The history of phonetic sciences	Michael Ashby, Rüdiger Hoffmann, Jürgen Trouvain
9. Phonology-Phonetics Interface	Elizabeth Zsiga
9. Special Session - Acoustic manifestations of speech register	Melanie Weirich, Stefanie Jannedy
10. Phonetics of First Language Acquisition	Nikola Paillereau

Scientific area Chairs for ICPhS 2023 congress

Scientific Area	Area Chairs
10. Special Session - Prosody Visualization Challenge	Katie Jepson, Debbie Loakes, Olga Maxwell
11. Phonetics of Second and Foreign Language Acquisition	Šárka Šimáčková
12. Bilingual/Multilingual Phonetics	Charles Chang
13. Phonetic Universals and Typology	Jeff Mielke
14. Phonetics of Sound Change	Marton Soskuthy
15. Speech Evolution	Bart de Boer
16. Speech Technology	Barbara Schuppler
17. Speech Corpora and Big Data	Adrian Leemann
18. History of Phonetics	Ruediger Hoffmann
19. Phonetics of Lesser Documented and Endangered Languages	Rachid Ridouane
20. Field Methods in Phonetics	Gareth Walker
21. Phonetics of Conversation	Martin Kohlberger
22. Sociophonetic Variation	Melanie Weirich
23. Forensic Phonetics and Speaker Characteristics	Gea de Jong-Lendle
24. Clinical Phonetics and Speech Disorders	Mathias Scharinger
25. Phonetic Neurolinguistics	Mirjam Broersma
26. Phonetic Psycholinguistics	Sona Patel
27. Phonetics of Affective Speech	Lise Crevier-Buchman
28. Multimodal Phonetics	Pilar Prieto
29. Phonetics Pedagogy	Kristýna Červinková Poesová

Native-Language Phonotactic Processing in Bilinguals

Max R. Freeman[1] & Viorica Marian[2]

[1]St. John's University, [2]Northwestern University
freemanm@stjohns.edu, v-marian@northwestern.edu

ABSTRACT

Bilinguals are prone to competition from similar sounding words across their two languages (e.g., *strict* activates Spanish *estricto*). In three experiments, we relied on phonotactic constraints (i.e., rules for combining speech sounds) to examine how experience with multiple languages transforms the way in which speech sounds are processed. In Experiment 1, we found that Spanish-English bilinguals accessed the L1 Spanish vowel+s+consonant constraint (Spanish *estricto*) during L2 English processing (English *strict*) when performing a cross modal phonological priming lexical decision task. In Experiments 2 and 3, we found that bilinguals processed L2 auditory and/or visual inputs in line with the L1 constraint (*strict* as *estrict*) in a vowel detection task and a sound recognition task (visual world paradigm). We conclude that bilinguals access L1 phonotactic constraints during L2 processing and that L1 representations for sounds and words influence how L2 input is perceived.

Keywords: bilingualism, phonotactic constraints, phonology, visual world paradigm, speech perception

1. INTRODUCTION

What if we hear a sequence of phonemes that conflicts with how sounds are typically combined within our language? For example, a rule for combining speech sounds in Spanish is that a vowel must precede word-initial s+consonant clusters (s+c), as in *estricto* (English: "strict"). In English, however, s+c onsets with and without an initial vowel are abundant. For a native Spanish speaker learning English, s/he may experience competition from the Spanish vowel+s+consonant cluster (v+s+c) rule when speaking English. Herein lies the reason native Spanish speakers often produce English s+c words with a vowel at the onset, such as *estudy* and *espring* [26]. And, while prothesis (i.e., the addition of a vowel at a word's onset) is commonly observed in Spanish-English bilinguals' accented English speech, the current investigation examines whether bilinguals implement rules of their native language (L1) when processing their second language (L2). Do non-native speakers perceive speech differently than L1 speakers of a given language?

Bilingualism provides a unique tool to examine perception of non-native sounds that conflict with L1 rules. Interestingly, when monolinguals hear nonsense sounds that contrast with the rules of their language, they repair the sound sequences to conform to the rules [8,11,12,14]. For example, Spanish monolinguals repair the Spanish-like non-word *special* (/spesjal/) to *especial*, the latter conforming to Spanish's v+s+c rule [8,14]. Spanish-dominant bilinguals also repair sounds that do not align with their L1 when they are in an L1 testing environment [5,6]. Here, we examine how bilinguals process L2 sound sequences that conflict with L1 rules. Bilinguals have demonstrated parallel activation of the L1 when comprehending in the L2, across phonotactic-constraint [13], phonological-word [2,3,9,20], lexical [1,18], semantic [21], and syntactic levels [16,18]. The current experiments provide further evidence for parallel processing in bilinguals, with perception of L1 phonotactics during L2 processing.

Moreover, this investigation provides insight into the structure of acoustic space and the phonological system within the bilingual mind by characterizing new cross-linguistic interactions at the sub-lexical level. If bilinguals process L2 input (e.g., English s+c word or non-word: *strict*/*spelg*) in accordance with L1 phonotactic constraints (e.g., Spanish-like v+s+c word or non-word: *estrict*/*espelg*), then bilinguals might perceive an illusory vowel onset due to L1 constraints on how phonetic categories are represented.

The purpose of this investigation is twofold. First, we examine *whether* bilinguals access L1 phonotactic constraints during L2 comprehension. When examining between-language co-activation in bilinguals, previous studies have identified that bilinguals process auditory and visual input through a combination of bottom-up (e.g., *plum* activates Spanish *pluma* (English: *pen*) and top-down pathways (e.g., inhibitory control of the irrelevant language allows for lexical selection) [2,3,20]. As speech unfolds through time, for example, hearing the word *strict*, neighbors that share phonology become activated (e.g., within-language neighbor: *string*, between-language Spanish neighbor *estudio*). Second, we investigate *the extent to which* bilinguals

process L1 phonotactic constraints while listening to and/or reading the L2. For example, a Spanish-English bilingual hearing and/or reading *strict* may process it as *estrict*, since their L1 (Spanish) contains the v+s+c rule. We tested the following two hypotheses: (1) Bilinguals experience L1 cross-linguistic influences during L2 sub-lexical processing, and (2) Bilinguals access L1 sounds during L2 audio-visual and visual-only (orthographic) processing.

2. EXPERIMENT 1

Learning a new set of phonotactic constraints is challenging for L2 learners, especially when an L2 phonological structure is not present in the L1 [4]. For example, in Spanish, s+cs cannot exist at word onsets and a vowel, usually 'e' must be added (e.g., English *strict,* Spanish *estricto*). In language production, native-Spanish speakers may at times produce English words such as *estudy* ("study"), adding an 'e' onset [26], which suggests that bilinguals access and apply Spanish constraints when speaking English. During receptive language processing, Spanish monolinguals report hearing the 'e' onset when primed with a Spanish word that has the 'e' removed (e.g., *stricto*) [14]. For bilinguals, when hearing *strict,* they may activate phonological cohorts that overlap with Spanish through phonotactic constraints and phonological form (e.g., *estándar*/standard) and potentially even cohorts that overlap with Spanish through phonotactic constraints only (e.g., *edad*/age) through cross-linguistic activation. Therefore, it was hypothesized that Spanish-English bilinguals accessed Spanish (L1) phonotactic constraints during English (L2) comprehension.

2.1. Method

In Experiment 1, bilingual Spanish-English (n=22) adult participants were tested. Proficiency was measured with *Language Experience and Proficiency Questionnaire* [19]. Bilinguals acquired English at age 6 or later and were exposed to Spanish a minimum 30% daily. In a cross-modal phonological priming lexical decision task, English primes included words with 'st' and 'sp' onsets, and fillers, controlled on lexical characteristics (e.g., frequency). Lexical decision targets included English words, or English-like non-words with 'es' and 'e' onsets, control non-words, and fillers. Participants heard English primes with initial s+c (*strict*) and controls without initial s+c (*workers*). Immediately after hearing the prime, participants performed a lexical decision on visual targets: English-like 'es' non-words (*estomb*), 'e' non-words (*entaty*), non-word controls (*atters*), and English word controls (*rising*). If English primes containing s+c onsets activated Spanish phonological rules, then faster responses to 'e' onset target non-words were expected.

2.2. Results

A 2(prime: s+c, control) x 4(target: 'es' non-word, 'e' non-word, non-word control, word control) repeated-measures ANOVA was conducted on lexical decision targets. There was a main effect of target condition, $F(3,129)=16.02$, $p<.001$, $\eta_p^2=.27$. Bonferroni-corrected pairwise post hoc comparisons indicated that bilinguals were faster to respond to 'es' overlap non-word targets (*estomb*) *and* 'e' non-word targets (*entaty*) preceded by s+c primes (*strict*; M = 876.33ms, SE = 61.85; M = 881.14ms, SE = 62.67, respectively) than to non-word controls preceded by s+c (M = 944.39ms, SE = 72.11), $t(21) = -4.63$, $p < 0.001$; $t(21) = -3.56$, $p < 0.01$, respectively. The results demonstrate significant effects of Spanish phonotactic constraint activation during English comprehension. Bilinguals demonstrated faster reaction times, relative to control conditions, to 'es' overlap non-words and 'e' overlap non-words when primed with s+c onset words.

2.3. Discussion

Experiment 1's findings demonstrate that during single-language comprehension, bilinguals access phonotactic constraints of the other language (Spanish) to comprehend words in the relevant language (English). Bilinguals were faster to respond to 'e' onset non-words than to controls without 'e' onsets when primed with s+c words, suggesting that bilinguals co-activated English and Spanish lexica containing words with 'e' onsets. We extend previous findings examining cross-linguistic phonological access in bilinguals [2,3] to suggest that phonotactic constraints of the non-target language, in addition to phonological representations, are accessed during comprehension. Experiment 1 established that bilinguals access L1 phonotactic constraints during L2 processing. Experiments 2 and 3 examine the extent to which parallel processing of phonotactic constraints occurs.

3. EXPERIMENT 2

To follow up on the findings of Experiment 1, as well as on the findings of Carlson et al. [6], Freeman et al. [13], Lentz and Kager [17], and Weber and Cutler [25], we examined the extent to which bilinguals engaged parallel processing of L1 phonotactic constraints during L2 comprehension. Our objective was to determine whether bilinguals *perceived* L1 phonotactics when hearing L2 sound sequences

(auditory input). Previous evidence demonstrates that bilinguals perceptually repair L2 syllable sequences that are illicit in the L1 to conform to the L1 [25]. The hypothesis was that Spanish-English bilinguals relied on parallel processing to perceive English and English-like sounds as Spanish-like, assimilating English (L2) sound sequences to Spanish (L1) phonotactic constraints.

3.1. Method

Participants included a new group of 26 Spanish-English bilinguals (native Spanish speakers), ages 18-34. The vowel detection task measured perception of the 'e' onset in s+c words and non-words. Perception of this phonotactic constraint was examined in the presence of s+c that conflicted with the Spanish 'e' onset vowel rule. Accuracy and reaction times to identifying whether a vowel was present were measured. We used a mix of words and non-words that conflicted with the 'e' onset constraint. With a non-word, participants may have been more likely to report hearing a vowel, as lexical status, and therefore the language to which the non-word could belong, were unclear.

In the vowel detection task, we asked participants if they heard a vowel at the onset of English s+c words (*strict*) and English-like s+c non-words (*spelg*), as well as word and non-word controls (*can, nulse*). Bilinguals were expected to demonstrate differences in reaction times to s+c words and non-words relative to control words and English-like non-words.

3.2. Results

Two 2(onset type: s+c onset, control) by 2(lexical status: word, non-word) mixed effects logistic regression models were used to analyze accuracy and reaction time data. The accuracy model failed to converge due to ceiling effects; therefore, we only report reaction time data. There was a main effect of Onset Type, $\beta = -0.04$, $SE = 0.02$, $t = -2.00$, $p < 0.01$; and a marginal interaction between Lexical Status and Onset Type, $\beta = 0.06$, $SE = 0.02$, $t = 1.50$, $p = 0.07$. Bilinguals responded more slowly to non- words ($M = 1133.11$ms, $SE = 30.76$) than to words ($M = 1076.03$ms, $SE = 22.88$), $\beta = 0.05$, $SE = 0.02$, $t = 2.40$, $p = 0.02$. Bilinguals showed slower response times to s+c words ($M = 1112.85$ms, $SE = 30.29$) than to control words ($M = 1039.09$ms, $SE = 28.98$), $\beta = -0.07$, $SE = 0.03$, $t = -2.4$, $p = 0.03$. Bilinguals' response times to s+c non-words ($M = 1136.03$ms, $SE = 35.45$) relative to control non-words ($M = 1130.17$ms, $SE = 47.47$) were similar, $\beta = -0.01$, $SE = 0.03$, $t = -0.42$, $p = 0.10$. Therefore, bilinguals demonstrated slower response times to Spanish-conflicting words relative to control words, suggesting L1 cross-linguistic influence on L2 s+c words. This pattern did not hold true for Spanish-conflicting non-words relative to control non-words.

3.3. Discussion

In vowel detection, which is an explicit measure of vowel perception, Spanish-English bilinguals perceived an illusory 'e' onset when listening to L2 words that conflicted with the L1 v+s+c rule. An explanation as to why there were differential effects for words versus non-words on vowel detection is that with words, bilinguals recruited top-down perceptual knowledge of phonotactic constraints, as well as top-down lexical knowledge. This finding slightly contrasts with the stronger phonotactic effects for non-words in Experiment 1. Only non-words were used as visual targets in Experiment 1, and it appears that when the onset sound of a stimulus is the explicit focus (Experiment 2), a stronger perceptual representation exists for words than for non-words, likely due to differential recruitment of top-down processes. Interestingly, the result for words but not non-words suggests that Spanish-like phonotactic processing affected word learning in earlier stages of acquiring English, but it may no longer affect the learning of new s+c words in English for this population [10]. Experiments 1 and 2 established that bilinguals process L2 input in line with L1 phonotactics through audio-visual and auditory-only input. Experiment 3 further examines the extent to which bilinguals experience parallel processing of the L1 during L2 comprehension in the visual-only modality.

4. EXPERIMENT 3

When comprehending words in one language, words from the other, irrelevant language may be simultaneously accessed through parallel activation [18,20]. This cross-language interactivity within bilinguals is surprising given that individuals can only speak in one language at a time. In Experiment 3, we again examined whether bilinguals were influenced by L1 phonotactic constraints when processing the L2, but this time we further investigated the role of input modality. In Experiments 1 and 2, bilinguals processed the L2 according to L1 phonotactics audio-visually (Experiment 1) or auditorily (Experiment 2). In Experiment 3, the Spanish phonotactic violation occurred in the visual domain with eye-tracking to different words on a visual display (visual world paradigm). The visual target word was identified by hearing only the word onset (e.g., "Click on /s/" for *spa*), while viewing three other words as well (an e-onset competitor: *egg*, and two fillers: *work* and *can*).

It was hypothesized that activation of the Spanish (L1) phonotactic constraint could occur independently of auditory input, as parallel activation does not always rely on hearing words [7,15,24]. In addition, because bilinguals were tested in English, their L2, it was predicted that those with lower L2 proficiency would experience increased L1 phonotactic interference during L2 processing than bilinguals with higher L2 proficiency.

4.2. Method

Participants included 33 Spanish–English bilingual adults, ages 18-34. In the sound recognition task, Spanish-English bilinguals saw four words on a visual display while eye movements were tracked. Participants identified the target word by hearing its onset (i.e., "Click on /s/", target = *spa*). On critical trials, items included an English target word that conflicted with the Spanish phonotactic constraint of a vowel onset at the beginning of s+c words (*spa*) and a competitor word containing the presumably activated vowel onset (*egg*). Two filler words were also present that did not conflict or overlap with the Spanish constraint (*work* and *can*). If bilinguals accessed Spanish phonotactics during English comprehension, then more looks to 'e' onset competitors (*egg*) than fillers (*work*/*can*) were expected when presented with s+c onset targets.

4.2. Results

Growth-curve analyses (GCA; [22]) of fixation proportions were employed to examine the time course of phonotactic-constraint activation during visual word processing. A composite score was created for L2 proficiency comprising of objective (PPVT-3 standard score) and self-report measures (LEAP-Q averaged speaking, understanding, and reading proficiency ratings) and entered into the model. Visual fixations were analyzed from the auditory prompt onset until the point at which fixations to the target peaked, indicating final target selection, which was around 1100ms post-sound onset. The model revealed main effects of proficiency on the intercept term, $\beta = 0.69$, $SE = 0.37$, $t = -2.48$, $p = 0.01$ and on the quadratic term (i.e., the rise and fall rate of fixation proportions in the model curve), $\beta = 0.51$, $SE = 0.28$, $t = 2.53$, $p = 0.01$. There were also significant interactions of word type by proficiency on the intercept, $\beta = 0.32$, $SE = 0.12$, $t = 2.67$, $p < 0.0$, and on the quadratic terms, $\beta = 0.62$, $SE = 0.28$, $t = -2.51$, $p = 0.01$. The model demonstrated that bilinguals with lower L2 (English) proficiency produced a greater proportion of fixations to the "e"-onset word relative to filler words than did higher L2 proficiency bilinguals.

4.3. Discussion

Experiment 3 results suggest the Spanish phonotactic constraints influence bilinguals relatively early on during English comprehension, without hearing the conflicting word (in the visual modality). In addition, bilinguals with lower L2 proficiency were more likely to activate the L1 phonotactic constraint when viewing L2 words. In other words, decreased L2 proficiency results in increased L1 interference. Experiment 3 was unique in that, for the first time, evidence was found for phonotactic-constraint activation of the unintended language during visual word processing without auditory input of the constraint-conflicting structure (i.e., s+c; *spa*).

5. GENERAL DISCUSSION

The current investigation demonstrates that native-language phonotactic constraints influence how bilinguals processe their second language. The purpose of these experiments was to further characterize and understand the involvement of the L1 during L2 comprehension. Typically, as auditory input unfolds through the acoustic stream, bilinguals activate neighboring words within and between their languages [23]. As each phone is heard, neighboring words are eliminated that do not coincide with the input until the target representation is reached. This process of elimination explains how phonologically competing words are activated and suppressed. However, the findings of the current investigation suggest that when the L2 acoustic stream conflicts with L1 phonotactic constraints, or rules, then words that conform to this rule are activated as well.

Moreover, the findings that bilinguals access phonotactic constraints from the unintended language when receiving auditory and visual input (Experiments 1 and 2) and only visual input (Experiment 3) suggest that models of bilingual language activation should include phonotactic constraints as further evidence for the extent to which cross-linguistic structures can be activated. These results underscore the dynamic connections within the bilingual language system[27]. Bilinguals activate and perceive L1 sub-lexical structures, such as phonotactic constraints, during L2 processing. These results also contribute to understanding how the language system is organized in the bilingual brain.

6. REFERENCES

[1] Bartolotti, J., Marian, V. 2012. Language learning and control in monolinguals and bilinguals. *Cog. Sci.* *36*(6), 1129–47.

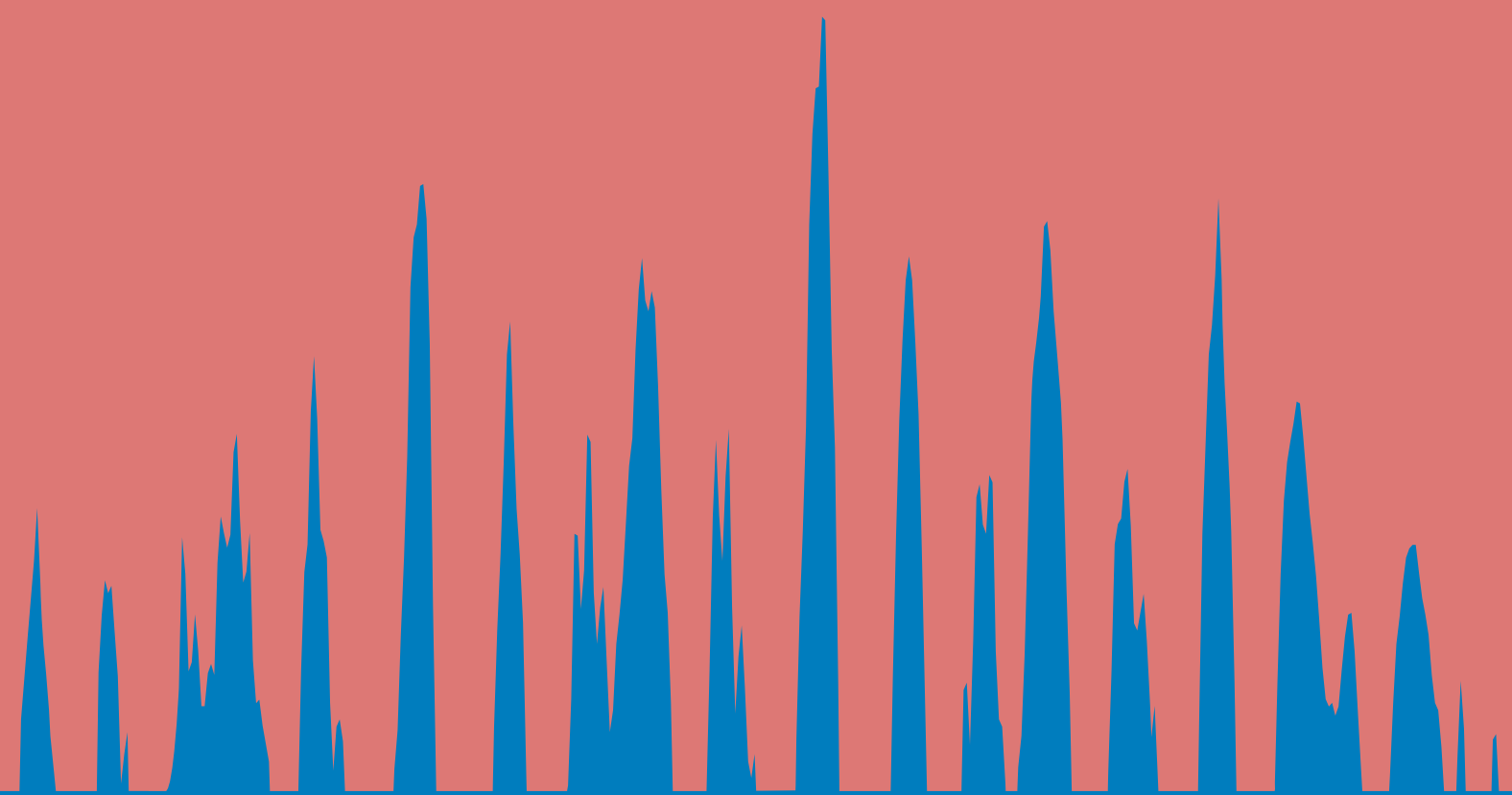
[2] Blumenfeld, H. K., Marian, V. 2007. Constraints on parallel activation in bilingual spoken language processing: Examining proficiency and lexical status using eye-tracking. *Lang. Cog. Proc. 2*(5), 633-660.
[3] Blumenfeld, H. K., Marian, V. 2013 Parallel language activation and cognitive control during spoken word recognition in bilinguals. *J. Cog. Psy. 25*(5), 547-567.
[4] Broersma, M., Cutler, A. 2011. Competition dynamics of second-language listening. *Q. J. Exper. Psy. 64*(1), 74-95.
[5] Carlson, M. T. 2018. Making room for second language phonotactics: Effects of L2 learning and environment on first language speech perception. *Lang. Spch. 61*(4), 598-614.
[6] Carlson, M. T., Goldrick, M., Blasingame, M., Fink, A. 2016. Navigating conflicting phonotactic constraints in bilingual speech perception. *BLC, 19*(5), 939-954.
[7] Chabal, S., Marian, V. 2015. Speakers of different languages process the visual world differently. *JEP. Gen. 144*(3), 539.
[8] Cuetos, F., Hallé, P. A., Dominguez, A., Segui, J. 2011. Perception of prothetic /e/ in #sC utterances: Gating data. *Proc. 17th ICPhS* 540-543.
[9] Darcy, I., Park, H., Yang, C. L. 2015. Individual differences in L2 acquisition of English phonology: The relation between cognitive abilities and phonological processing. *Learn. Indiv. Diffs. 40*, 63-72.
[10] Darcy, I., Thomas, T. 2019. When blue is a disyllabic word: Perceptual epenthesis in the mental lexicon of second language learners. *Bilingualism: Lang. Cog. 22*(5), 1141-1159.
[11] Dupoux, E., Kakehi, K., Hirose, Y., Pallier, C., Mehler, J. 1999. Epenthetic vowels in Japanese: A perceptual illusion? *JEP. HPP. 25*(6), 1568–1578.
[12] Flege, J. E. 2003. Assessing constraints on second-language segmental production and perception. In N. O. Schiller & A. S. Meyer (Eds.), *Phonetics and phonology in language comprehension and production: Differences and similarities.* Mouton de Gruyter, 319–355.
[13] Freeman, M. R., Blumenfeld, H. K., Marian, V. 2016. Phonotactic constraints are activated across languages in bilinguals. *Fron. Psy. 7*(702).
[14] Hallé, P. A., Dominguez, A., Cuetos, F., Segui, J. 2008. Phonological mediation in visual masked priming: Evidence from phonotactic repair. *JEP. HPP. 34*, 177–192.
[15] Kaushanskaya, M., Marian, V. 2007. Non-target language recognition and interference: Evidence from eye-tracking and picture naming. *Lang. Learn. 57(1),* 119–163.
[16] Kootstra, G. J., Van Hell, J. G., Dijkstra, T. 2012. Priming of code-switches in sentences: The role of lexical repetition, cognates, and language proficiency. *BLC. 15*(04), 797-819.
[17] Lentz, T. O., Kager, R. W. 2015. Categorical phonotactic knowledge filters second language input, but probabilistic phonotactic knowledge can still be acquired. *Lang. Spch. 58*(3), 387-413.
[18] Linck, J. A., Hoshino, N., Kroll, J. F. 2008. Cross-language lexical processes and inhibitory control. *Ment. Lex. 3*(3), 349-374.
[19] Marian, V., Blumenfeld, H. K., Kaushanskaya, M. 2007. The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *JSLHR. 50*(4), 940-967.
[20] Marian V, Spivey M. 2003. Competing activation in bilingual language processing: Within-and between-language competition. *BLC. 6*, 97–115.
[21] Martín, M. C., Macizo, P., Bajo, T. 2010. Time course of inhibitory processes in bilingual language processing. *Brit. J. Psy. 101*(4), 679–693.
[22] Mirman, D., Dixon, J. A., Magnuson, J. S. 2008. Statistical and computational models of the visual world paradigm: Growth curves and individual differences. *JML. 59*(4), 475-494.
[23] Shook, A., Marian, V. 2013. The bilingual language interaction network for comprehension of speech. *BLC. 16*(2), 304-324.
[24] Thierry, G., Wu, Y. J. 2007. Brain potentials reveal unconscious translation during foreign language comprehension. *Proc. Nat. Acad. Sci. 104,* 12530–12535.
[25] Weber, A., Cutler, A. 2004. Lexical competition in non-native spoken-word recognition. *JML. 50*, 1–25.
[26] Yavas, M., Someillan, M. 2005. Patterns of acquisition of /s/-clusters in Spanish-English bilinguals. *J. Multiling. Comm. Dis. 3*(1), 50-55.
[27] Marian, V. 2023. *The Power of Language: How the Codes We Use to Think, Speak, and Live Transform Our Minds.* New York: Dutton.

CONGRESS SECRETARIAT

GUARANT International spol. s r.o.

Českomoravská 19
190 00 Prague 9
Czech Republic
Tel.: +420 284 001 404

icphs2023@guarant.cz
www.icphs2023.org



ICPhS 2023
August 7–11, 2023
Prague Congress Center, Czech Republic

20th International Congress of Phonetic Sciences (ICPhS)

August 7–11, 2023
Prague Congress Center, Czech Republic