Words in the World
International Conference 2021 (WOW 2021)

November 26-27, 2021

Abstract Book
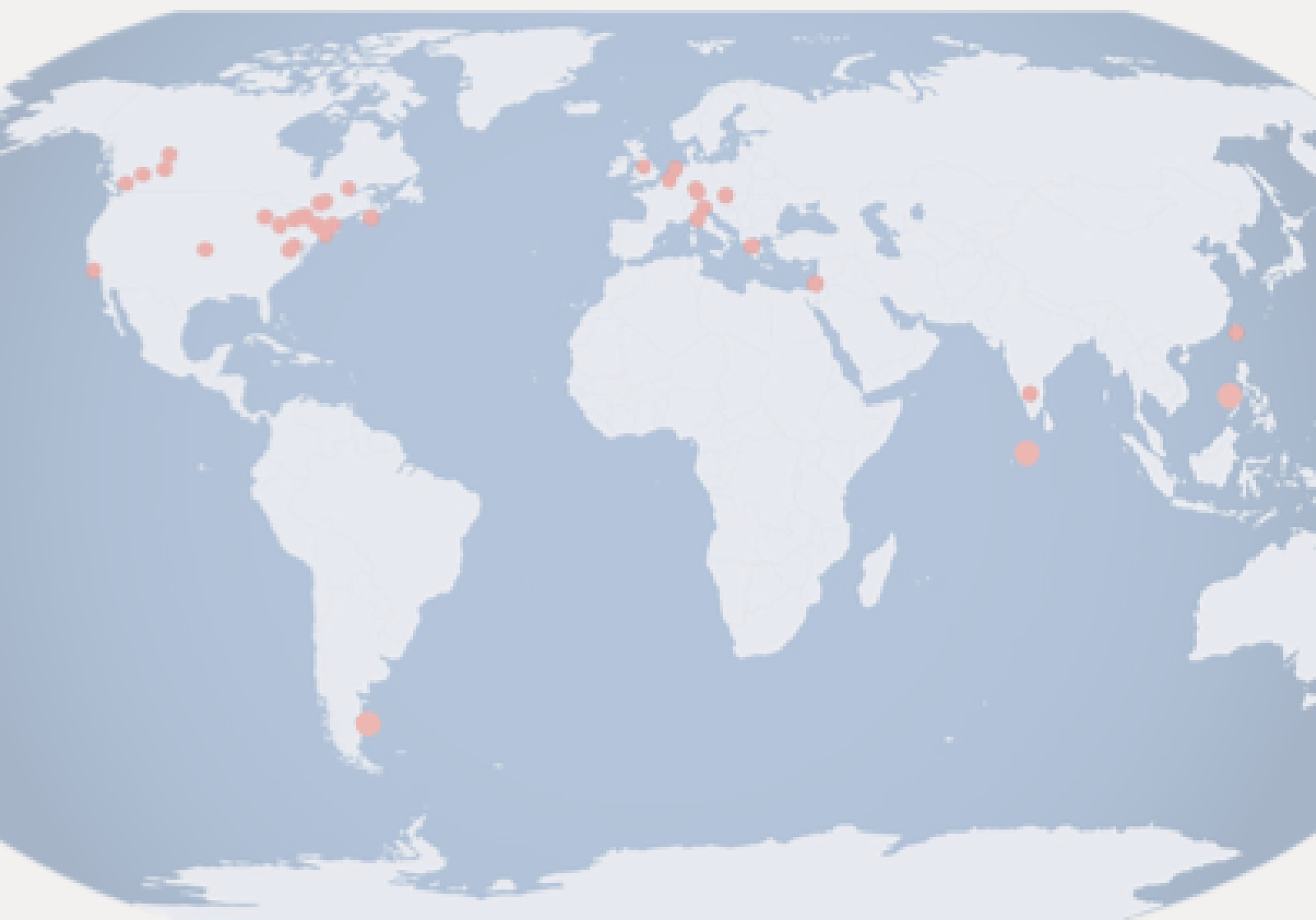
Conference Schedule

Words in the World International Conference 2021 (WOW 2021) will be held November 26 – 27, 2021, between 9:45 – 16:00 EST (Montreal time). Welcoming remarks begin at 9:45 EST on November 26. Conference talks will be held via Zoom, and poster sessions will be hosted using gather.town. There will be no parallel sessions.

Friday, November 26

9:45 – 10:00	Welcome: Nancy Azevedo
Talks 1	Naomi Vingron, Nancy Azevedo, Gonia Jarema, Joyce Fung, Gianluca Sorrento, Sarah Lee, Anouk Lamontagne, Ruthann Atchley, Paul Atchley, Juhani Järvikivi, Debra Titone, Gary Libben and Eva Kehayia *The impact of visual distraction on lexicality judgements in single and multitask settings*
10:00 – 10:35 Chair: Nancy Azevedo, McGill University	Alexia Antzaka and Marie Lallier *Contribution of alpha-rate visual attentional tracking to reading acquisition* Daniil Gnetov, Noam Siegelman, Sascha Schroeder and Victor Kuperman *Word length, frequency, and predictability effects in eye-movements in reading: systematic comparison of 12 languages*
	BREAK
	Kaidi Lõo, Pärtel Lippus, Fabian Tomaschek and Benjamin Tucker *Morphological effects in the comprehension of Estonian spontaneous speech* Dominic Schmitz, Marie Engemann, Ingo Plag and Dinah Baer-Henney *Subtle morpho-phonetic differences in English stems and word-final /s/ influence listeners' comprehension*
Talks 2 10:45 – 11:45 Chair: John Gamboa, TU Kaiserslautern	Elnaz Shafaei-Bajestan, Masoumeh Moradipour-Tari, Peter Uhrig and R. Harald Baayen. *Inflectional analogies with word embeddings: there is more than the average* Mohen Zhang, Nicola Dawson and Kate Nation *Effects of suffix familiarity and reading ability on morphological processing* Katherine J. Hill and Laura M. Gonnerman *Implicit and explicit morphology measures: Toward a unified approach*

to morphological awareness

11:45 – 12:30   POSTER SESSION 1 – Poster Room 1

BREAK

Merel Muylle, Eva Van Assche and Robert Hartsuiker
Comparing the cognate effect in spoken and written L2 word production

Nadine Charanek, Vegas Hodgins and Olessia Jouravlev
How prevalent are bilingual costs during native (L1) speech production?

Talks 3

12:45 – 13:45   Yanran Chen and Kathleen Eberhard
The role of lexical stress in spoken-word recognition – evidence from English monolinguals and Chinese-English bilinguals

Chair: Regina Hert,
University of Alberta

Nick Reid, Huilan Yang and Yuru Mei
Conceptual Metaphor activation in Chinese-English bilinguals

Kaja Gregorc and Theo Marinis
The role of input variability in vocabulary learning in proficient L2 learners

BREAK

14:00 – 14:45   POSTER SESSION 2 – Poster Room 2

BREAK

Patience Stevens and David C. Plaut
Simulating dynamics of morphological processing in visual word recognition with a neural network model

Talks 4

Jonathan Geary
Orthographic neighborhood density effects in a Maltese visual lexical decision megastudy

15:00 – 15:50

Chair: Daniil Gnetov,
McMaster University

Shaina Benjamin and Daniel Schmidtke
Conceptual combination during novel and existing compound word reading: a self-paced reading study

Evonne Syed
How do we learn the meanings of words? Investigating semantically related vs. unrelated novel word learning

Saturday, November 27

Talks 5

Georgia Roumpea, Katarina Marjanovič, Tjaša Mlinarič, Zvezdan Pirtošek, Jure Bon and Christina Manouilidou

10:00 – 10:35   *Repetitive Transcranial Magnetic Stimulation treatment improves*

Chair: Bryor Snefjella, UCLA

language performance in different stages of Alzheimer's disease

María Fernández-López, Manuel Perea and Marta Vergara-Martínez
Are letter detectors resilient to rotations during word recognition? A masked priming ERP investigation

Juliana Novo Gomes, Marije Soto, Aniela Improta França, Julia Cataldo and Aline Gesualdi Manhães
Comparing ERP and the Divided Visual Field paradigm to explore Hemispheric Specialization as a Predictive and Descriptive Tool for grapheme and word processing

BREAK

TRAINING WORKSHOP

10:45 – 11:45

Shanley Allen
Scientific Writing (Part 1)*: Developing a storyline*

11:45 – 12:30

POSTER SESSION 3 – Poster Room 3

BREAK

Jessica Nieder, Fabian Tomaschek and Ruben van de Vijver
The process behind production: Inflection of Maltese pseudo words is based on discriminative learning

Daria Gvozdeva, John Cristian Borges Gamboa, Juhani Järvikivi and Shanley E. M. Allen
Talks 6

How does context affect the perceived difficulty of long nominal compounds?

12:45 – 13:45

Fernanda Marabelly de Oliveira Veras and Gustavo Lopez Estivalet
Chair: Maria Heitmeier, *Deriving word Portuguese semantic variables from English metrics*
University of Tübingen

Laura Schwalm and Ralph Radach
Desirable difficulty in reading- the curious case of Sans Forgetica

Elizaveta Kovalenko and Daria Chernova
The Robustness of Graphic Representation of a Word in the Mental Lexicon: an Experimental Study with Reference to French

BREAK

Ana Baciero, Pablo Gomez, Jon Andoni Duñabeitia and Manuel Perea
Talks 7
Letter similarity effects in braille word recognition

14:00 – 15:00

Annika Tjuka, Robert Forkel and Johann-Mattis List
Chair: Naomi Vingron, *Comparing word properties across languages: A case study on ratings*
McGill University *for arousal and valence*

Roya Khalili, Eva Kehayia and Marc Roig
Can exercise improve language functions in older adults? Evidence from a Scoping Review

Jordan Gallant and Gary Libben
Psycholinguistic perspectives on power and positivity in Canadian parliament

Kasandra Calkins, Jiseung Kim, Veranika Puhacheuskaya and Juhani Järvikivi
Labels speak volumes: the role of intergroup membership in accent perception
Closing remarks

Poster Sessions

Poster sessions will be organized in gather.town. Posters will be displayed in designated poster rooms, with authors available to talk during their scheduled time. You can think of this as a 'normal' poster session – like the ones we used to have at in-person conferences -just in a virtual space this time. These sessions are not chaired. When you visit a poster, you will be able to see and hear the presenter, and they will be able to answer your questions or walk you through their study. You can control whether your video and microphone are on.

Here's a brief tutorial: https://www.youtube.com/watch?v=IdRi0CPohYA

Poster Session 1

01. Narissa Byers, Veronica Whitford, Clarice Yeen and Sarah MacIssac
An Investigation of the Relationship between Reading Abilities and Schizotypal Traits in a Neurotypical Adult Sample

02. Farah Almohammed, Tala Al Otaibi, Hessa Alraqbani and Juana Park.
Is the past on the right for Arabic speakers?

Poster Room 1

Friday 11:45 – 12:30

03. Tami Sabag Shushan and Tami Katzir
The Contribution of Emotion Vocabulary to Reading Comprehension Processes at the Text and the Task Level

04. Aysegul Ozkan, Bilal Kırkıcı and Cengiz Acarturk
Phonological Mediation in Reading: A Theoretical Framework

05. Sangyub Kim, Satoru Saito and Kichun Nam
Syllabic constraint effect on the serial order control revealed by Korean non-word speech production

06. Joonwoo Kim and Kichun Nam

Morpho-semantic analysis of morphologically complex Korean words

07. Christina Manouilidou, Michaela Nerantzini, Katarina Marjanovič, Georgia Roumpea, Zvezdan Pirtošek and Jure Bon
Sentence comprehension improvement in early Alzheimer's disease as a result of transcranial magnetic stimulation coupled with behavioral intervention.

08. Maria Heitmeier, Yu-Ying Chuang and R. Harald Baayen
Modeling German nonword plural productions with Linear Discriminative Learning

09. Nancy Azevedo, Gonia Jarema, Christine Alary Gauvreau, Guylaine Le Dorze, Stéfanie Beaulieu, Marc Yvon, Christel Beaujard and Eva Kehayia
What do people with aphasia and their family members think of communication aids? Focus group findings on users' experiences

10. Elena Pozdnyakova
Cognitive-pragmatic study of inferences in ad hoc meaning creativity task

11. Julia Carden, Camila Stecher and Virginia Jaichenco
Category-based licensing in complex word recognition

12. Rita Mathur
Cognitive Processes in the Acquisition of English as a Second Language by College Students

13. Yousri Marzouki, afra Al Marri and Ali Idrissi
Morphological Family Size in Arabic

Poster Session 2

01. Alexander Taikh, Christina Gagne and Thomas Spalding
Influence of morphological information on letter position coding.

02. Gabriela Mariel Zunino
(Un)known semantic relations in Spanish: how syntax may condition the comprehension?

Poster Room 2

Friday 14:00 – 14:45

03. Taylor Melvie, Alexandre Taikh, Christina Gagné and Thomas Spalding
The effects of masked pseudo-compound and compound words on constituent processing

04. Juliet Huynh and Naoko Witzel
Translation priming in Vietnamese heritage language speakers: The role of language dominance

05. Melanie Labusch, Stéphanie Massol, Ana Marcet and Manuel Perea
Are goats chèvres, chévres, chēvres, or chevres? – Cracking the orthographic

code of diacritical vowels

06. Zhiyi Wu
Native Processing of Mandarin Separable Compounds: An Anti-frequency Effect in Visual Lexical Decision?

07. Daniel Schmidtke, Sadaf Rahmanian and Anna Moro
Reading experience drives L2 reading development: a longitudinal study of EAL reading habits

08. Patience Stevens and David C. Plaut
Orthographic-semantic consistency as a measure of graded morphological information

09. Owen Kapelle and Simone Sprenger
On the Nature of a Metrical Frame in the Lexicon: A pupillometric study on how the word production process is affected by incongruent word stress distractors

10. Fabian Tomaschek, Madeline Philipsen and Marlene Zimmermann
Massive Variation in Spontaneously Spoken German due to strong Coarticulation in Relation to Lexical and Phonetic Predictors

11. Bryor Snefjella and Idan Blank
The English Lexicon Imputation Project

12. Jordan Gallant, Gary Libben and Laurie Beth Feldman
Spaced-out compounds: What orthographic alteration can and cannot tell us about morphological processes in production

Poster Session 3

01. Hanne Surkyn, Reinhild Vandekerckhove and Dominiek Sandra
The impact of analogical effects and social factors on the spelling of partially homophonous verb forms

02. Dilsah Kalay
Word Knowledge Gains via Conceptual Approach

Poster Room 3

Saturday 11:45 – 12:30

03. Alexandra Schmitterer and Garvin Brod
Connected Neighborhoods are more Competitive: The Influence of Connectivity on Lexical Competitiveness in Children's Decisions About Thematic Relations

04. Angelika Golegos and Theo Marinis
Pronoun resolution in monolingual German adults

05. Annika Schebesta and Gero Kunter
Phonetic variation in NNN compounds: acoustic duration and plosive reduction

06. Ellen Taylor, Kate Nation and Yaling Hsiao
Context availability and sentence availability ratings for 3,000 English words and their association with lexical processing

07. Solbin Lee, Eun Ha Lee, Jinwon Kang, Jeahong Kim, Sangyub Kim, Changwhan Lee and Kichun Nam
Comparison type and token syllable effect in Korean morphologically complex words

08. Joohee Ahn, Jaehee Ryu, Jinwon Kang, Seonghak Jo, Junghye Choi and Sun-Young Lee
An fMRI study on morphological processing of Sino-Korean derivational prefix

09. Jugyeong Sun and Kichun Nam
Which flicker frequency is more useful than others?

10. Regina Hert, Juhani Järvikivi and Anja Arnhold
Er or der? The influence of information structure on referent selection

11. Bahareh Yousefzadeh, Gary Libben and Sid Segalowitz
Persian compounds in the mental lexicon

12. Julia Cataldo and Aniela França
Friend or foe: the morphological kinship between words

13. Stephen Politzer-Ahles, Julie Siying Chen and Ka Keung Lee
A failure to replicate the Ganong effect for tone continua

Friday, November 26

Talks 1

Naomi Vingron, Nancy Azevedo, Gonia Jarema, Joyce Fung, Gianluca Sorrento, Sarah Lee, Anouk Lamontagne, Ruthann Atchley, Paul Atchley, Juhani Järvikivi, Debra Titone, Gary Libben and Eva Kehayia

The impact of visual distraction on lexicality judgements in single and multitask settings

Walking is a common daily activity for most, yet it is a complex process that involves the ongoing integration of visual, proprioceptive, and vestibular sensory information. Daily activities present numerous situations in which walking is done concurrently with another activity such as reading signs or messages on a cell phone. As such, most walking done in our daily lives effectively constitutes multitasking.

While walking, reading signs and managing attention to distractions largely appear effortless, evidence on texting and walking that points to a cost incurred by these activities when done simultaneously raises the question of the potential cost of processing words while walking with or without distractors on the scene. This question becomes all the more prominent when a person living with language limitations following stroke resumes daily activities in the community. Before we can address the reality of clinical populations, it is necessary to understand lexical processing in dual and multitask conditions in young, healthy adults.

In our ongoing work, we examine how healthy young adults manage demands of lexical processing, gait and visual distraction in a multitask context. The research questions in this exploratory study are twofold: (1) Are the speed or accuracy of making lexicality judgements and gait variables affected in a dual-task condition compared to a single-task condition? (2) Is there an effect of additional visual distraction on lexical processing (or cognitive-motor interference) in single- (and multi-) task lexicality decisions? To address these questions, we created an immersive virtual urban environment using custom-made virtual reality (VR) technologies and a self-paced treadmill synchronized to visual projections. Participants are asked to complete two sessions: (1) a single task session, involving a lexical decision task (consisting of words, nonwords and pseudowords) performed while seated facing the stationary virtual urban scene, and (2) a dual-task session, involving the same lexical decision task performed while walking on a self-paced treadmill through the virtual environment. Additionally, across both sessions, some trials include visual distractors in the form of flashing red squares appearing simultaneously with the lexical item.

In this abstract, we present preliminary data from seven young adults who completed the single lexical decision task. The reaction times and error rate when making lexical decisions were measured as outcomes. We used linear and generalized linear mixed effects models to assess whether the presence of a visual distractor modulated the pattern of single-task lexical decision performance commonly observed in the literature. As expected, responses were slowest and accuracy was lowest for pseudowords compared to words and nonwords. Furthermore, we found that across all word types the presence of a distractor did not significantly impact reaction times, however, participants responded less accurately when lexical stimuli appeared along with a visual distractor (see Figures 1 & 2).

These findings point to a potentially complex role of visual distraction in the context of other cognitive tasks. We plan to further investigate this in the dual-task session of this experiment, where participants will be asked to walk on a treadmill while performing the same

task. This novel and innovative study combining VR, walking, and processing lexicality will constitute a first step in understanding the combined dual-task effects of the lexical recognition and gait processes, and how these processes can be adapted as a function of varying cognitive demands.

Figure 1. Correct reaction times on trials with and without a visual distractor
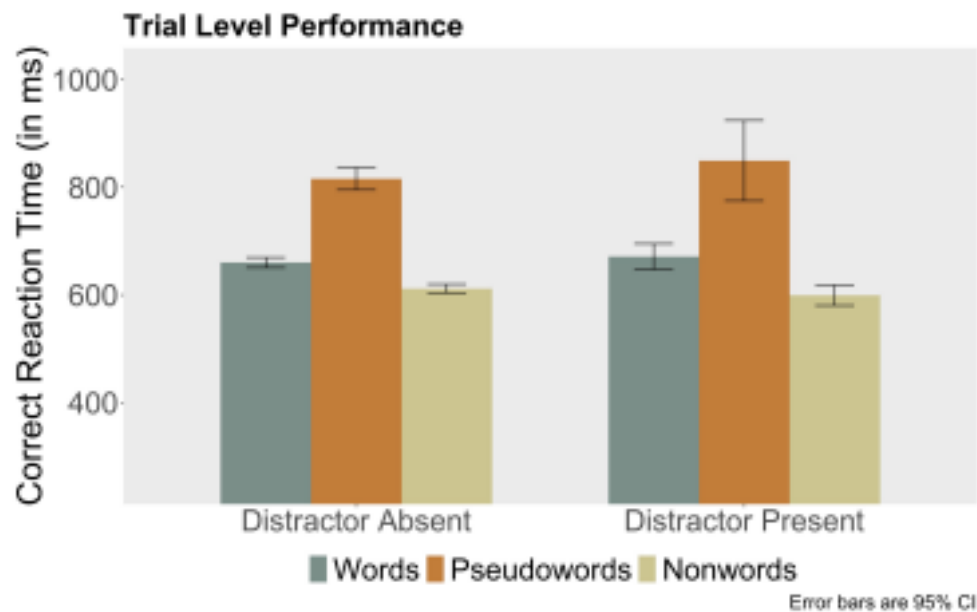
Figure 2. Error rates on trials with and without a visual distractor
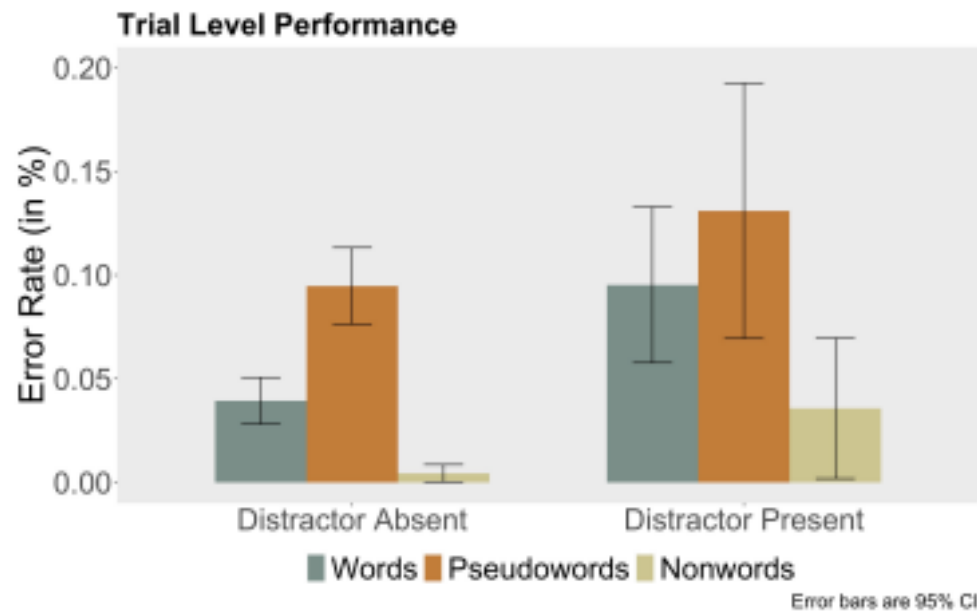
Alexia Antzaka[1] and Marie Lallier[1]

Poster contribution
Contribution of alpha-rate visual attentional tracking to reading acquisition.

Basque Center on Cognition Brain and Language, San Sebastián, Spain

The visual attention span (VA span) deficit hypothesis has been proposed to explain some subtypes of dyslexia (Bosse et al., 2017). The VA span is defined as the number of visual elements that can be processed simultaneously in a multi-element configuration, such as multi-letter arrays. The more VA span resources, the more homogeneous their distribution for letter string identification "as a whole". VA span resources are thought to contribute to the   adequate development of lexical reading skills. Therefore, a reduced VA span is assumed to generate deficits in the acquisition of lexical knowledge and reading. In Lallier et al (2017), we   propose that VA span resources are indexed by gamma-related activity, controlled by alpha rate oscillations. This attentional alpha control would be critical in freeing the resources for an efficient simultaneous processing of the visual information that falls under the attentional   focus (i.e., VA span). In fact, there is some evidence suggesting that the alpha-gamma   oscillatory code contributes to the simultaneous processing of multiple visual stimuli (Roux et al., 2012; Roux & Uhlaas, 2014; Jensen et al., 2014). Here, we will test the hypothesis that   the contribution of VA span skills to reading development possibly reside in attentional alpha rate oscillations (8-12 Hz).

We tested 45 Grade 2 and 45 Grade 5 children to measure whether their attentional tracking of alpha-rate visual stimuli would contribute to their multi-element sequence processing (or VA span skill). The task of the children was to decide whether a target symbol was part of a previously briefly presented (200ms) 3-symbol string. Importantly, the 3-symbol strings were presented either in- or out-of-phase with a preceding alpha-rate dot sequence. Our hypothesis was that symbol strings presented in phase with the alpha-rate dot sequence would be associated with the highest target detection rate if the entrainment to alpha oscillatory rate enhances visual resources for the simultaneous identification of multiple visual stimuli. We also tested children's´ visual attentional shifting speed to be able to investigate whether children could entrain to the alpha-rate dot sequence. Finally, children were also tested on their word and pseudoword reading skills.

Results showed that children were more accurate at identifying target symbols when they were presented in phase with the alpha-rate dot sequence. This was particularly true for the targets that were presented in the first and last position of the string (i.e., not central targets presented on fixation), suggesting that the phase effect on identification of target symbols is observed only when processing is more challenging. A follow-up analysis indicated that the pattern of results tended to be clearer in children who were faster at visual attentional shifting, i.e., in children that had faster visual attentional shifting skills and were able to entrain better to the alpha-rate dot sequence. Critically, the individual benefit in target identification   when targets were presented in phase with the alpha-rate dot sequence correlated negatively with children's' reading speed, particularly for pseudowords. This result indicated that more   fluent readers had a larger target identification benefit for symbol strings presented in phase with the dot train.

Overall, our results suggest that the processing of non-verbal multi-element arrays,

and therefore VA span skills, is modulated by alpha-rate oscillations. In particular, they indicate that efficient alpha entrainment (indexed by the beneficial phase effect on target symbol identification) is linked better visual simultaneous attentional skills (VA span), and faster
reading. We conclude that an adequate control over alpha-rate attentional resources is critical for learning to read.

References

Bosse, M. L., Tainturier, M. J., & Valdois, S. (2007). Developmental dyslexia: The visual attention span deficit hypothesis. *Cognition*, *104*(2), 198-230.

Jensen, O., Gips, B., Bergmann, T. O., & Bonnefond, M. (2014). Temporal coding organized by coupled alpha and gamma oscillations prioritize visual processing. *Trends in neurosciences*, *37*(7), 357-369.

Lallier, M., Molinaro, N., Lizarazu, M., Bourguignon, M., & Carreiras, M. (2017). Amodal atypical neural oscillatory activity in dyslexia: A cross-linguistic perspective. *Clinical Psychological Science*, *5*(2), 379-401.

Roux, F., Wibral, M., Mohr, H. M., Singer, W., & Uhlhaas, P. J. (2012). Gamma-band activity in human prefrontal cortex codes for the number of relevant items maintained in working memory. *Journal of Neuroscience*, *32*(36), 12411-12420.

Roux, F., & Uhlhaas, P. J. (2014). Working memory and neural oscillations: alpha–gamma versus theta–gamma codes for distinct WM information?. *Trends in cognitive sciences*, *18*(1), 16-25.

Daniil Gnetov, Noam Siegelman, Sascha Schroeder and Victor Kuperman

Word length, frequency, and predictability effects in eye-movements in reading: systematic comparison of 12 languages.

The eye-movement literature, as the reading literature in general, has traditionally been centered around English and alphabetic languages of Europe (cite MECO L1; Share, 2014). For this reason, even the most robust "benchmark" lexical effects on eye-movements -- i.e., effects of word length, frequency, and predictability (Kliegl, 2004) -- have mainly been examined in a small set of European languages. This empirical gap leaves open the question of cross-linguistic universality of those effects. In this study we aim to compare effects of word length, word frequency, and word predictability on eye movement control during text reading in 12 alphabetic and abjad languages (Dutch, English, Estonian, Finnish, German, Greek, Hebrew, Italian, Norwegian, Russian, Spanish, Turkish). We further aim to link the expected cross-linguistic variability in these effects to statistical properties of specific written languages under investigation.

We used eye-movement data from the Multilingual Eye-Movement COrpus (MECO L1, www.meco-read.com), collected from over 450 participants in 12 countries reading Wikipedia-style texts in their L1. Since frequency measures are not readily available for most of the MECO languages, we extracted word frequency counts from state-of-the-art word vector models (fastText) trained on Wikipedia corpus in respective languages. Using the same models, we obtained predictability estimates for each word (in each language) by calculating the cosine distance between a given word and previous context.

Analyses of the word length effect on eye-movements demonstrated a strong correlation between mean word length in a given written language and mean skipping rate and fixation duration in that language (written languages with shorter words show more skipping and shorter reading times). Further comparative analyses of the word frequency effect suggested a link to the language's morphological type: e.g., agglutinative languages (Finnish, Turkish, Estonian) that have larger inflectional families show a stronger negative word frequency effect on reading times than less morphologically productive languages. Analyses of the predictability effects are in progress.

This study offers a new perspective on lexical effects on eye-movements across languages with different writing systems and linguistic features.

References

Kliegl, R., Grabner, E., Rolfs, M., & Engbert, R. (2004). Length, frequency, and predictability effects of words on eye movements in reading. European journal of cognitive psychology, 16(1-2), 262-284.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. Psychological bulletin, 124(3), 372.

Share, D. L. (2014). Alphabetism in reading science. Frontiers in psychology, 5, 752.

Siegelman, N., Schroeder, S., Kuperman, V. Expanding horizons of cross-linguistic research on reading: The Multilingual Eye-Movement Corpus (MECO). Submitted to the Behavior Research Methods.

Talks 2

Kaidi Lõo, Pärtel Lippus, Fabian Tomaschek and Benjamin Tucker

Morphological effects in the comprehension of Estonian spontaneous speech

Spontaneous speech can be characterized by a large amount of variation in pronunciation (see e.g., Ernestus & Warner 2011). For example, in speech, the four syllable Estonian word *inimesed* 'people' may be reduced to a one syllable word *inmst* as most vowels may be dropped. Previous research has indicated that the more reduced words are, the more difficult it is to comprehend them. Critically, this process is particularly difficult when words are presented out of context (Ernestus et al. 2002, Arnhold et al. 2017). With studies showing systematic effects of morphological structure on phonetic characteristics (e.g. Plag et. al 2017), the question arises how word-internal and word-external morphological properties influence comprehension of reduced words.

The aim of the current study is to investigate morphological effects in the comprehension of spontaneous speech in Estonian, a morphologically rich Finno-Ugric language. More specifically, we were interested in the following research questions: 1) Is the perception of less reduced forms easier than that of more reduced (quantified as the difference in segments between the actual pronunciation and the dictionary form)? 2) Does reduction interact with word internal structure, i.e., does reduction in the affix influence comprehension differently than reduction in the stem? 3) How do word-external morphological properties such as the inflectional paradigm size (i.e., the number of attested inflected forms given an inflectional paradigm, Lõo et al. 2018) affect spontaneous speech comprehension?

To investigate these questions, we conducted a web-based word identification experiment with 125 native speakers of Estonian (92 females and 33 males, age range 18-65 years) and 1000 randomly selected isolated inflected nouns varying in reduction rate (excluding foreign, compound, abbreviated words etc) from the Estonian spontaneous speech corpus (Lippus et al. 2020). Listeners were first asked to listen to the stimuli and then type in what they heard.
The data was analysed using binomial generalized additive mixed effects models (Wood, 2017).
The overall accuracy rate for the word form was 54.7% and for the lemma 75.7%. Preliminary results indicate that less reduced words (β=-1.68, *z*=-14.83, *p*<0.001) with fewer paradigmatic neighbours (β=-1.18, *z*=-65.95, *p*<0.001) were recognized with a higher accuracy than more reduced words with more paradigmatic neighbours. Further, the word form was less likely accurate when reduction occurred both in the stem and in the affix, whereas the lemma accuracy was only influenced by reduction occurring in the stem.
In summary, research on morphologically complex lesser-studied languages such as Estonian complements the field of speech perception with typological diversity. Our results show that the perception of Estonian inflected words is affected by a variety of complex factors. We explored in

particular the relationship between morphology and spontaneous speech. Further analyses will be conducted to investigate stimuli more in-depth regarding the phonetic characteristics as well as in the sentence context.

References

Arnold, D., Tomaschek, F., Sering, K., Lopez, F., & Baayen, R. H. (2017). Words from spontaneous conversational speech can be recognized with human-like accuracy by an error-driven learning algorithm that discriminates between meanings straight from smart acoustic features, bypassing the phoneme as a recognition unit. *PloS One*, 12(4), e0174623.

Ernestus, M., Baayen, H., & Schreuder, R. (2002). The recognition of reduced word forms. *Brain and Language*, 81(1-3), 162-173.

Ernestus, M., & Warner, N. (2011). An introduction to reduced pronunciation variants. *Journal of Phonetics*, 39(SI), 253-260.

Lippus, P., Tuisk, T., Ots, N., Teras, P. (2020). Phonetic corpus of Estonian spontaneous speech v.1.0.6 [online]. Available at: https: //doi.org/10.15155/1-00-0000-0000-0000-0012BL.

Lõo, K., Järvikivi, J., Tomaschek, F., Tucker, B. V., and Baayen, R. H. (2018). Production of Estonian case-inflected nouns shows whole-word frequency and paradigmatic effects. *Morphology*, 28:71–97.

Plag, I., Homann, J., and Kunter, G. (2017). Homophony and morphology: The acoustics of word-final s in English. *Journal of Linguistics*, 53(1):181–216.

Wood, S. N. (2017). *Generalized additive models: an introduction with R*. CRC press.

Dominic Schmitz, Marie Engemann, Ingo Plag and Dinah Baer-Henney

Subtle morpho-phonetic differences in English stems and word-final /s/ influence listeners' comprehension

Recent research has shown that phonologically identical morphological entities in English show systematic differences in their phonetic realization. For example, stems of morphologically complex words are longer than stems of mono-morphemic words (Engemann & Plag, 2021; Seyfarth et al., 2017), and word-final /s/ is longest as a non-morphemic segment, shorter as suffix, and shortest as clitic (Plag et al., 2017; Schmitz et al., 2021). While such morpho-phonetic effects in production are well-established by now, it is still unclear whether such differences also play a role in speech perception and language comprehension.

To investigate whether listeners perceive such differences and whether they make use of them in comprehension, we conducted two kinds of experiments. The first involved a more meta linguistic task, i.e. a same-different task, where participants hear two words and need to decide whether they heard the same recording twice, or whether there was a difference. The second kind of experiment is less metalinguistic and involves a mouse-tracking setup comparable to that of Blazej & Cohen-Goldberg (2015). Participants listened to a recording and were shown two options on the computer screen (e.g. *days* and *daze*). They were asked to use their mouse to click on the word that they think they heard, and the track of the mouse was recorded. In each experimental paradigm we carried out two experiments, investigating stems and word-final /s/, respectively.

In the same-different tasks, listeners showed large inter-individual differences. For stems, listeners started perceiving differences a 25 ms difference, while for word-final /s/ listeners showed less sensitivity, and only indicated differences reliably beyond a threshold of 75 ms.

Two kinds of spliced stimuli were used in the mouse-tracking experiments, matched and mismatched. Matched forms consisted of stems and endings from one category (a plural stem glued to a plural ending, or a mono-morphemic substring glued to a the final /s/ of a mono-morphemic word). Mismatched forms combined a substring from one category (e.g. a plural stem) with the ending from the other category (the final /s/ of a mono-morphemic word form). The expectation was that, if phonetic detail influences processing, the mouse tracks of the mismatched items should be different from those of the matched items. Using smooth additive quantile regression models
(Fasiolo et al., 2017), we found that indeed the type of matching significantly affected the comprehension of stems, leading to a detour of the mouse-track for mismatched stimuli. This also holds for word-final /s/.

Our results demonstrate that listeners indeed are affected by the subtle acoustic differences in

the stimuli. Listeners can perceive morpho-phonetic information and make use of such information in comprehension. This result has important theoretical implications. In most extant models of language production and language comprehension morpho-phonetic effects are unexpected and unexplained (e.g. Roelofs & Ferreira 2019, Turk & Shattuck-Hufnagel 2020, Cutler 2021). This paper adds to the literature that calls for more adequate models.

References

Blazej, L. J., & Cohen-Goldberg, A. M. (2015). Can we hear morphological complexity before words are complex? *Journal of Experimental Psychology: Human Perception and Performance*, *41*(1), 50–68. https://doi.org/10.1037/a0038509

Cutler, A. 2012. *Native Listening: Language Experience and the Recognition of Spoken Words*. MIT

Press.

Engemann, U. M., & Plag, I. (2021). Phonetic reduction and paradigm uniformity effects in spontaneous speech. *The Mental Lexicon*.

Fasiolo, M., Goude Y., Nedellec R., & Wood, S. N. (2017). Fast calibrated additive quantile regression. URL: https://arxiv.org/abs/1707.03307

Plag, I., Homann, J., & Kunter, G. (2017). Homophony and morphology: The acoustics of word final S in English. *Journal of Linguistics*, *53*(1), 181–216. https://doi.org/10.1017/S0022226715000183

Roelofs, A. P. A. & V. S. Ferreira. 2019. The architecture of speaking. In P. Hagoort (ed.), Human language:

From genes and brains to behavior, 35–50. Cambridge, MA: MIT Press.

Schmitz, D., Baer-Henney, D., & Plag, I. (2020). Schmitz, D., I. Plag, D. Baer-Henney & S. Stein. 2021. Durational differences of word-final /s/ emerge from the lexicon: Modeling morpho phonetic effects in pseudowords with Linear Discriminative Learning. Frontiers in Psychology 12. 680889

Seyfarth, S., Garellek, M., Gillingham, G., Ackerman, F., & Malouf, R. (2017). Acoustic differences in morphologically-distinct homophones. *Language, Cognition and Neuroscience, 33*(1), 32–49. https://doi.org/10.1080/23273798.2017.1359634

Turk, Alice & Stefanie Shattuck-Hufnagel. 2020. *Speech Timing: Implications for Theories of Phonology, Speech Production, and Speech Motor Control.* Oxford University Press, USA.

Elnaz Shafaei-Bajestan, Masoumeh Moradipour-Tari, Peter Uhrig and R. Harald Baayen.

Inflectional analogies with word embeddings: there is more than the average

It has long been assumed that English plural formation amounts to adding an abstract se mantic feature of plurality to a singular word (see, e.g., Haspelmath and Sims, 2010). In distributional semantics, this idea has been worked out by means of proportional

analo gies. A well-known semantic analogy, $\overline{}\rightarrow$

$$king - \overline{}\rightarrow$$
$$man + \overline{}\rightarrow$$
$$woman = \overline{}\rightarrow$$
$$queen \ (Mikolov\ et\ al.,\ 2013)$$

can be extended to inflectional

morphology$\overline{}\rightarrow kings - \overline{}\rightarrow$

$$king + \overline{}\rightarrow$$
$$queen = \overline{}\rightarrow$$
$$queens.$$

Various implementations of this idea have been worked out, but performance varies extensively depending on the type of analogical relation: semantic, derivational, or in flectional. For English, analogical reasoning with embeddings is most successful for in flection (Rogers et al., 2017). According to the method proposed by Drozd et al. (2016), 3CosAvg, pluralisation is operationalised by the addition of one vector that we refer to as the *average shift vector*. It is defined as the difference vector between the average of plural vectors and the average of singular vectors. This vector is added to the vector of a singu lar word to obtain its plural vector. A similar idea is incorporated into the discriminative lexicon model proposed by Baayen et al. (2019), and average vectors have also been used by Westbury and Hollis (2019). Although appealing, upon closer inspection, it turns out that the semantics of pluralization in English is substantially more complex, and requires more subtle and refined semantic operations.

We illustrate a core problem with these approaches to noun pluralization on the basis of 14,699 singular-plural noun pairs in the NewsScape English Corpus (Uhrig, 2018). For each pair, using word2vec semantic vectors, an individual shift vector is constructed by subtracting the singular vector from the plural vector. Whereas the L2 norm of individual shift vectors ranges from 1.1 to 6.8, with a mean of 2.9, the average shift vector (as used in 3CosAvg) has an L2 norm of only 0.64. When such a small vector is added to the singular, it is hardly distinguishable from the singular vector, and at a large distance from its actual plural vector.

The collective of individual shift vectors, by contrast, exhibits structure. For instance, the length of plural vectors increases with the length of their singular vectors, and like wise, the length of shift vectors increases with the length of the singular vectors. In other

words, the semantics of shift vectors is changing in close association with the semantics of the singular and plural words. Upon closer inspection, it turns out, that the orien tation of shift vectors depends on the semantics of its singular. These findings dovetail well with the insight from usage-based grammar and corpus linguistics that individual words, including inflected words, often have their own highly specific usage profiles (see, e.g., Sinclair, 1991). In our presentation, we will clarify whether our results for inher ent inflection generalize to contextual inflection (see Booij, 1996, for this distinction). We will also discuss the consequences of our empirical results for our understanding of productivity in inflection, and argue that the average vector represents a 'distributional default'. We will also show that by integrating WordNet with distributional semantics, much more precise word-specific analogies can be constructed that can be integrated into the discriminative lexicon model.

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References

Baayen, R. H., Chuang, Y.-Y., Shafaei-Bajestan, E., and Blevins, J. (2019). The discrimina tive lexicon: A unified computational model for the lexicon and lexical processing in comprehension and production grounded not in (de)composition but in linear discrim inative learning. *Complexity*, pages 1–39. https://doi.org/10.1155/2019/4895891.

Booij, G. E. (1996). Inherent versus contextual inflection and the split morphology hy pothesis. In Booij, G. E. and Marle, J. v., editors, *Yearbook of Morphology 1995*, pages 1–16. Kluwer Academic Publishers, Dordrecht.

Drozd, A., Gladkova, A., and Matsuoka, S. (2016). Word embeddings, analogies, and machine learning: Beyond king - man + woman = queen. In *Proceedings of COLING 2016, the 26th International Conference on Computational Linguistics: Technical Papers*, pages 3519–3530, Osaka, Japan. The COLING 2016 Organizing Committee. https: //aclanthology.org/C16-1332.

Haspelmath, M. and Sims, A. D. (2010). *Understanding Morphology*. Understanding Lan guage Series. Hodder Education, London, second edition.

Mikolov, T., Sutskever, I., Chen, K., Corrado, G. S., and Dean, J. (2013). Distributed representations of words and phrases and their compositionality. In *Advances in neural information processing systems*, pages 3111–3119.

Rogers, A., Drozd, A., and Li, B. (2017). The (too many) problems of analogical reasoning with word vectors. In *Proceedings of the 6th Joint Conference on Lexical and Compu tational Semantics (*SEM 2017)*, pages 135–148, Vancouver, Canada. Association for Computational Linguistics. https://aclanthology.org/S17-1017.

Sinclair, J. (1991). *Corpus, concordance, collocation*. Oxford University Press.

Uhrig, P. (2018). Newsscape and the distributed little red hen lab – a digital infrastructure for the large-scale analysis of tv broadcasts. In Anne-Julia Zwierlein,

Jochen Petzold, K. B. and Decker, M., editors, *Anglistentag 2017 in Regensburg: Proceedings. Proceedings of the Conference of the German Association of University Teachers of English*, pages 99– 114, Trier. Wissenschaftlicher Verlag Trier.

Westbury, C. and Hollis, G. (2019). Conceptualizing syntactic categories as semantic categories: Unifying part-of-speech identification and semantics using co-occurrence vector averaging. *Behavioral Research Methods*, 51:1371–1398. https://doi.org/10. 3758/s13428-018-1118-4.

Mohen Zhang, Nicola Dawson and Kate Nation

Effects of suffix familiarity and reading ability on morphological processing

Skilled readers rapidly decompose letter strings with morphological structure into component morphemes during visual word processing (e.g., Rastle, & Davis, 2008). Evidence for this comes in part from the morpheme interference effect (e.g., Crepaldi et al., 2010) in which nonwords with pseudo-morphological structure (e.g., 'earist') are more difficult to reject as words than nonwords without a morphological structure (e.g., 'earilt'). It is only by mid-to-late adolescence that people fully show this effect (Dawson et al., 2018) suggesting that extended reading experience is required for morphological effects to emerge in word recognition. As individual differences in reading experience and reading ability reflect accumulated exposure to words over years (Nation, 2017), we predict that experience and ability are critical for the emergence of morphological effects, rather than chronological age (see also Beyersmann et al., 2015).

We used the morpheme interference paradigm to examine whether morphological processing is modulated by differences in individual reading ability and experience of suffixes. At an item level, suffix familiarity is based on the frequency of suffixes derived from a large developmental corpus of children's reading materials. At a participant level, we indexed reading ability using a modified version of the Rapid Online Assessment of Reading Ability (ROAR; Yeatman, et al., 2021). The experiment is pre-registered with Open Science Framework. Participants comprised 57 adults aged 18-40 years ($M = 29.09$, $SD = 6.95$) and 184 young people aged 16-18 ($M = 16.84$, $SD = .39$). All participants spoke British English as their first language.

Data were collected online via Gorilla Experiment Builder (https://gorilla.sc/). The morpheme interference task was lexical decision with pseudo-morphological ($N = 96$) and control nonwords ($N = 96$), along with 192 real words. Suffix familiarity was sampled continuously, using frequency estimates derived from a developmental corpus. High frequency of occurrence within the corpus is taken as a proxy for high familiarity.

Analyses show that participants were slower and less accurate to reject nonwords with a pseudo-morphological structure, replicating the morpheme interference effect. Significant interactions were found between nonword type and reading ability as well as between nonword type and suffix familiarity, indicating that reading ability and suffix familiarity influence the strength of the morpheme interference effect. The interference effect was larger for participants with greater reading ability, as measured by ROAR, and was stronger for nonwords containing more familiar suffixes. The effect of suffix familiarity on the morpheme interference effect did not vary depending on reading ability or age group.

These results show that by mid-to-late adolescence, the reading system has become sensitive to morphological structure such that orthographic processing is influenced by apparent morpho- orthographic regularities. The influence of suffix familiarity on the morpheme interference effect suggests that morphological processing is based at least partially on the orthographic properties of words. This is consistent with reading experience shaping the orthographic processing system. Similarly, reading experience had an effect at the participant

level, with greater sensitivity to morpho-orthographic structure in individuals with stronger reading ability. These findings will be discussed in the context of reading experience providing the substrate from which print-meaning mappings are established.

Reference

Beyersmann, E., Grainger, J., Casalis, S., & Ziegler, J. (2015). Effects of reading proficiency on embedded stem priming in primary school children. *Journal of Experimental Child Psychology*, 139, 115–126.

Crepaldi, D., Rastle, K., & Davis, C. J. (2010). Morphemes in their place: Evidence for position-specific identification of suffixes. *Memory & cognition*, 38(3), 312-321.

Dawson, N., Rastle, K., & Ricketts, J. (2018). Morphological effects in visual word recognition: Children, adolescents, and adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *44*(4), 645.

Nation, K. (2017). Nurturing a lexical legacy: Reading experience is critical for the development of word reading skill. *npj Science of Learning*, 2(1), 1-4. Rastle, K., & Davis, M. H. (2008). Morphological decomposition based on the analysis of orthography. *Language and Cognitive Processes*, 23(7-8), 942-971.

Yeatman, J. D., Tang, K. A., Donnelly, P. M., Yablonski, M., Ramamurthy, M., Karipidis, I. I., Caffarra, S., Takada, M. E., Kanopka, K., Ben-Shachar, M., & Domingue, B. W. (2021). Rapid online assessment of reading ability. *Scientific reports*, 11(1), 1-11.

Katherine J. Hill and Laura M. Gonnerman

Implicit and explicit morphology measures: Toward a unified approach to morphological awareness

Morphological awareness (MA) has been shown to support literacy development (see Carlisle, 2010 for review). While MA is regarded as an important metalinguistic skill, its definition is not universal and its measurement is not standardized (Apel, 2014). Various tasks are used to measure this ability, but they appear to measure slightly different things; thus, for researchers, it is important to think critically about which MA tasks are appropriate given their specific research question.

This exploratory study examines three commonly used MA measures: an analogies task, a non-word completion task, and a production task. We examine whether each of these measures is a good predictor of literacy skills such as spelling, reading accuracy, reading comprehension, and receptive vocabulary. Additionally, we ask whether these explicit MA tasks are predictive of a novel implicit morphological processing score, which would indicate whether they predict morphological processing ability itself.

The MA measures examined in this study were tailored to the participants: French speaking school-aged children. The first was an analogies task in which participants were asked to provide an analogous word following the pattern provided by the experimenter (*e.g. Rond : rondeur :: frais : fraîcheur*). The second MA task was a nonword completion task in which children selected a nonword with a derivational suffix to fit within a sentence (*e.g. Mon père **bire** dans ses temps libres. Quelqu'un qui **bire** est; un bireur, un birologue, un birage*). The third MA task was a production task in which students were asked to fill in missing morphologically complex words within a sentence, provided a stem to build upon (*e.g. On s'entend tous pour dire que cette journée s'est terminée en beauté (beau)*).

The implicit morphological processing measure was taken from responses to a lexical decision task with cross-modal priming; items were morphologically related word pairs. Children's responses were compared with adult means to give a measure of how adult-like their morphological processing is.

First, we examined whether scores on the MA tasks were correlated, which would indicate that they measure similar aspects of MA, some measures are correlated to varying degrees, see Figure 1 for a visualization. Second, we examined whether these measures are predictive of literacy measures, and if so, which MA tasks predict which aspects of literacy. Findings revealed that the production task predicted a significant amount of variance in reading accuracy, spelling, and receptive vocabulary tasks, while the non-word completion measure is predictive of the reading comprehension task, and the analogies task was predictive of the receptive vocabulary task. Third, we looked at whether any of the MA tasks were predictive of children's morphological processing. Here, again we found that the production task scores were predictive of their implicit morphological processing.

When evaluating these results, one must consider the modality of each task and what effect that has on the results. For instance, it could be the case that the morphological production task predicts the spelling task because both involve producing a word. Similarly, the non-word completion task predicts scores on the reading comprehension task and both involve demonstrating reading comprehension. Overall, these results show that a production task may be a robust measure of MA as it

predicts implicit morphological processing, as well as predicting success on various literacy measures regardless of modality. Further testing is required to develop and standardize a MA task and to tease apart effects of task modality versus morphological awareness.
References

Apel, K.. (2014). A Comprehensive Definition of Morphological Awareness. *Topics in Language Disorders*, *34*(3), 197–209. https://doi.org/10.1097/tld.0000000000000019 Carlisle, J. F. (2010). Effects of instruction in morphological awareness on literacy achievement: An integrative review. *Reading research quarterly*, *45*(4), 464-487.
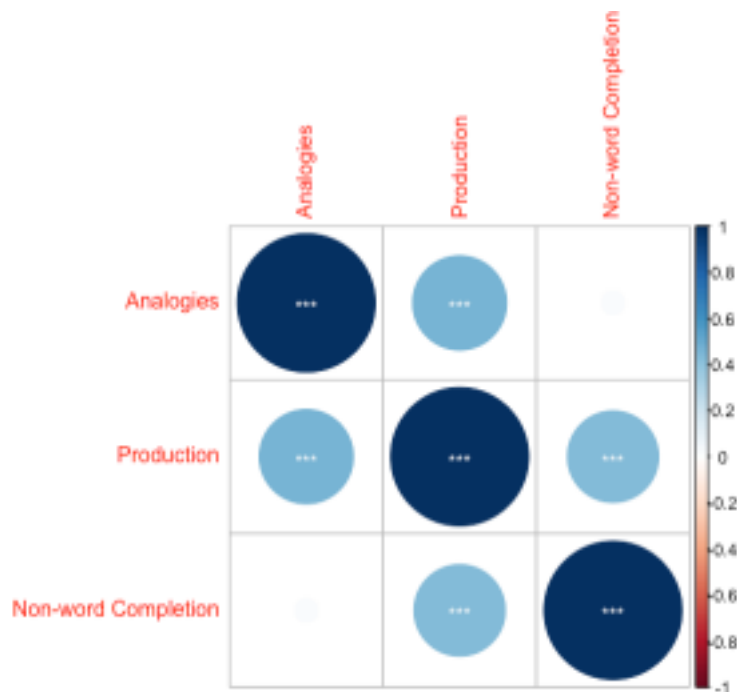

Figure 1. Correlation matrix of morphological awareness scores as measured by three tasks: analogies, production, and non-word completion.

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Words in the World Conference 2021 (WOW2021)

Title: An Investigation of the Relationship between Reading Abilities and Schizotypal Traits in a Neurotypical Adult Sample

Introduction: Despite being clinically distinct disorders, there is growing evidence that schizophrenia and developmental dyslexia involve genetic and pathophysiological overlap, as well as similar deficits in reading and reading-related processes (e.g., oculomotor control, auditory/phonological processing, executive functioning; reviewed in Whitford et al., 2018). For example, studies have found an increased prevalence of schizotypal traits (i.e., a continuum of symptoms similar to those experienced in the schizophrenia-spectrum disorders) among people with dyslexia (Richardson, 1994; Richardson & Stein, 1993), as well as increased prevalence of dyslexia among family members of people with schizophrenia (Roberts et al., 2013). This suggests that schizophrenia and dyslexia may share a common neurodevelopmental basis.

Research Question: Here, we wanted to further this line of research by investigating whether the relationship between schizotypal traits and reduced reading (and reading-related) abilities extends to neurotypical individuals.

Methods: Forty-three neurotypical young adults (aged 18-35) completed a battery of standardized reading, language, and executive functioning tasks, as well as the Schizotypal Personality Questionnaire (SPQ; Raine, 1991).

Results: Linear regression models revealed two main findings. First, a negative association between constricted affect scores and non-word decoding skills on both the WIAT (β = -0.35, *SE* = 0.16, *t* = -2.17, *p* = .0364) and TOWRE (β = -0.31, *SE* = 0.15, *t* = -2.02, *p* = .0507). Second, a positive association between both total SPQ scores (β = 0.32, *SE* = 0.15, *t* = 2.06, *p* = .0465) and odd speech scores (β = 0.34, *SE* = 0.15, *t* = 2.44, *p* = .0196) and working memory capacity (backward digit span).

Discussion: Our first main finding suggests that restricted emotionality and expression, key components of language and communication, relate to reduced word reading skills, especially those involved in phonological processing (i.e., phonemic decoding). Our second main finding suggests that higher schizotypal traits overall, as well as more abnormal speech, relate to higher executive functioning. Though unexpected, this finding may be driven by the fact that our participants were primarily young adult university students, who are at their peak in terms of executive functioning performance.

Summary: Taken together, our study indicates that reduced reading abilities, even among typical readers, are associated with more schizotypal traits—a relationship that has been previously found in people with dyslexia. Thus, commonalities between schizophrenia

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Is the past on the right for Arabic speakers?

The conceptual metaphor theory (Lakoff & Johnson, 1980) states that metaphors help us understand very complex abstract concepts, such as time and relationships, by representing them in terms of more concrete concepts (e.g., people talk about relationships as if they were journeys, and talk about time in terms of space). We investigated the embodiment of the conceptual metaphor TIME IS SPACE among Arabic speakers by analyzing the hand gestures that accompany their talking about the past, the present and the future. Given that Arabic is written from right to left, we expect Arabic speakers to use gestures pointing towards the right when they talk about the past, and more gestures pointing towards the left when they talk about the future.

Tami Sabag Shushan and Tami Katzir

The Contribution of Emotion Vocabulary to Reading Comprehension Processes at the Text and the Task Level

Vocabulary knowledge has a distinct and unique contribution to different types of texts and to different levels of comprehension (Eason, Goldberg, Young, Geist., & Cutting, 2012). However, wide range of literature refers to vocabulary as a single general structure without addressing different types of vocabulary. However, research that is more linguistic by nature suggests different taxonomies of words. For example, Ravid and Egoz-Liebstein (2012) distinguished between different types of mental vocabulary and addressed emotion vocabulary, which refers to words that directly describe emotions (e.g. sad, happy) and to cognitive vocabulary, which describe cognitive thinking processes or the product of thinking and information processes (e.g. remember, think) .

For the present study, a novel test was developed to assess vocabulary of various types: emotion vocabulary versus academic vocabulary (which includes general and cognitive words) in the fourth and fifth grades. The purpose of the present study is to evaluate the contribution of different types of vocabulary to reading comprehension in different types of texts (narrative vs. informative) and different levels of understanding: simple understanding and complex understanding (the higher level which requires familiarity with the text and the ability to find explicit information).

To answer the research question, the research participants consisted of 1,333 Hebrew-speaking students from 21 elementary schools in the fourth and fifth grades. The participants were assessed by two vocabulary assessment tasks as well as by a reading fluency measure and reading comprehension task that consisted of various types of texts (informative and narrative) and various types of questions (simple and complex comprehension).

A hierarchical regression analyses were performed: According to the simple reading model, reading fluency was introduced into the model first. But, because this research is unique and the topic was not previously investigated. Two types of vocabulary words (emotion vs. academic) were introduced into the model in a second step using the stepwise method. The findings showed that all variables (reading fluency, academic words, and emotion words) were found to significantly contribute to reading comprehension. However, in simple comprehension, the emotion words contributed 8.6% to the explained variance while in complex understanding, the emotion words contributed 30.3% to reading comprehension. In narrative texts, emotion words contributed 30.6% to reading comprehension to the variance in reading comprehension, while in informative text, the emotion words contributed 8.3% to the variance in reading comprehension.

The findings show that emotion and academic vocabulary have been found to contribute to different types of texts and to different levels of comprehension, but the contribution is expressed differently: Emotion vocabulary is found to be more conducive to narrative (compared to

informative) text as well as to complex (compared to simple) comprehension. The results demonstrate that vocabulary is not a single general construct and offer a taxonomy of words that identifies emotional vocabulary as distinct from academic vocabulary. In addition, the findings attest to a unique and varying contribution among different types of texts and at different levels of comprehension. It is also important, in teaching emotion vocabulary, to adapt pedagogical knowledge to reader variables, text variables, and tasks. Developing these elementary school skills may promote students' reading comprehension ability.

Eason, S. H., Goldberg, L. F., Young, K. M., Geist, M. C., & Cutting, L. E. (2012). Reader–text interactions: How differential text and question types influence cognitive skills needed for reading comprehension. Journal of Educational Psychology, 104(3), 515-528..

Ravid, D. & Egoz-Liebstien, T. (2012). Mental state verbs in Hebrew Lexical. Chelkat Lashon, 43-44, 241-224. [in Hebrew].

Aysegul Ozkan, Bilal Kırkıcı and Cengiz Acarturk

Phonological Mediation in Reading: A Theoretical Framework

The complexity of reading as a cognitive process has led reading researchers to concentrate on various aspects of the phenomenon, from skilled reading to reading skill acquisition. Over the past few decades, reading research has focused on various levels of the underlying processes ranging from prelexical and lexical processing to discourse comprehension. The diversity of the research interests has also been observed in the techniques employed in reading research, such as behavioral experiments, neuroimaging techniques, and computational models of reading. Since the late 1990s, reading research has dwelt on investigating the validity of eye-movement control models of reading and their predictions. With their theoretical explanation of the eye mind link, these models have provided an account for counterintuitive findings and novel predictions. In parallel, several experimental paradigms that have been employed to study the role of sound coding in skilled reading have provided converging evidence that sound coding *does* play a role in the reading process (Rayner, 1998; 2009a; 2009b; Frost 1998; Rayner et al., 2012; Leinenger, 2014). However, the current computational models of reading either provide an account for phonological processing during single word recognition without an account for eye movements(e.g., Coltheart et al., 2001) or account for eye-movement control during text reading without taking phonological processing into account (e.g., Reichle et al., 2009; Engbert et al., 2005).

In the present study, we propose a theoretical framework for including into existing eye movement control models early phonological processing during word recognition and phonological representations during postlexical processing. The Phonological-Mediation in Guidance by Attentional Gradient (P-GAG) model of reading, which we propose , is an example model that incorporates the proposed roles of sound coding into the SWIFT model of reading (Engbert et al., 2005), which the assumes parallel processing of words. In P-GAG, prelexical phonological processing influences parafoveal and early foveal lexical processing and the saccade selection process. The prelexical characteristics of words that represent the phonotactics of Turkish (Acartürk et al., 2017) were used to test the aforementioned influences. An additional component, the *memory buffer*, is a short-term store that includes postlexical processing and motor planning for articulation in oral reading, as proposed in Laubrock and Kliegl (2015). The time interval between the beginning of the first fixation on a word and the beginning of its articulation (*Fixation Speech Interval* – FSI – following Inhoff et al., 2011) is assumed to reflect the time course from prelexical phonological processing to the postlexical integration of a word.

The assumptions of the framework were tested through seven linear mixed models (LMMs) with data from a Turkish Reading Corpus (196 participants, *M* = 22.72, *SD* = 2.64 years old, 93 females; 192 texts that include one target word each): an LMM of FSI, six LMMs of eye movement measures among oral and silent reading data (i.e., first fixation duration, gaze duration, and relative first landing position separately for both modalities). In addition to canonical word characteristics (i.e., word length, frequency, and predictability), several covariates were included in the LMMs to test the P-GAG assumptions (e.g., trigram frequency and vowel harmony for prelexical influences). The results of the LMMs were compatible with

the canonical findings frequently reported in the literature. Influences of the neighboring words on eye movement measures in the current study were mixed. The results indicated an effect of prelexical phonological processing on eye movements and the involvement of phonological representations in postlexical processing.

References

Acartürk, C., Kılıç, Ö., Kırkıcı, B., Can, B., & Özkan, A. (2017). The role of letter frequency on eye movements in sentential pseudoword reading. In G. Gunzelmann, A. Howes, T. Tenbrink, & E. Davelaar (Ed.), *Proceedings of the 39th Annual Conference of the Cognitive Science Society* (pp. 1495-1500). London: Cognitive Science Society. Retrieved from https://cognitivesciencesociety.org/wp content/uploads/2019/01/cogsci17_proceedings.pdf

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review, 108*(1), 204-256. doi:10.1037/0033-295X.108.1.204

Engbert, R., Nuthmann, A., Richter, E. M., & Kliegl, R. (2005). SWIFT: A Dynamical Model of Saccade Generation During Reading. *Psychological Review, 112*(4), 777-813. doi:10.1037/0033-295X.112.4.777

Frost, R. (1998). Toward a strong phonological theory of visual word recognition: True issues and false trails. *Psychological Bulletin, 123*(1), 71-99.

Inhoff, A. W., Solomon, M., Radach, R., & Seymour, B. A. (2011). Temporal dynamics of the eye voice span and eye movement control during oral reading. *Journal of Cognitive Psychology, 23*(5), 543-558. doi:10.1080/20445911.2011.546782

Laubrock, J., & Kliegl, R. (2015). The eye-voice span during reading aloud. *Frontiers in Psychology*, *6*, 1432. doi:10.3389/fpsyg.2015.01432

Leinenger, M. (2014). Phonological coding during reading. *Psychological Bulletin, 140*(6), 1534-1555. doi:10.1037/a0037830

Reichle, E. D., Warren, T., & McConnell, K. (2009). Using E-Z Reader to model the effects of higher level language processing on eye movements during reading. *Psychonomic Bulletin & Review, 16*(1), 1-21. doi:10.3758/PBR.16.1.1

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*(3), 372-422.

Rayner, K. (2009a). Eye movements and attention in reading, scene perception, and visual search. *Quarterly Journal of Experimental Psychology, 62*(8), 1457–1506. doi:10.1080/17470210902816461

Rayner, K. (2009b). Eye movements in reading: Models and data. *Journal of Eye Movement Research, 2*(5), 1-10. doi:10.16910/jemr.2.5.2

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C. (2012). *Psychology of reading* (2nd ed.). New York: Taylor & Francis.

Sangyub Kim, Satoru Saito and Kichun Nam

Syllabic constraint effect on the serial order control revealed by Korean non-word speech production

Abstract

Patterns of speech errors are assumed to reflect the structure of the given language and mechanisms of speech production. Previous studies have researched the similarity principles of the serial order control in speech production (phonological similarity principle, temporal distance principle, edge principle, primacy principle) in producing smaller speech units such as phonemes in English or morae in Japanese. However, syllabic constraints may contribute to generate speech in some languages, where the syllable functions more importantly than other possible units in a word (i.e., Korean language). Thus, the purpose of this study was to investigate the influences of syllabic constraints on the serial order control by a speech error induction technique and whether this syllabic constraint works continuously even though repeatedly practiced. In the speech error induction technique, participants were exposed to an auditory distractor nonword immediately before the utterance of a target nonword. It has been already known that a phonologically similar distractor to a target effectively induces speech errors in the utterances in Japanese. An advantage using this technique is to target on specific positions to induce errors. For example, a distractor "넌룸큥긷" (pronounced /nun lum kung gid/) to a target utterance "런눔큥긷" (pronounced /lun num kung gid/), which aims to induce an exchange of the onsets of the first and second syllable in the target word, led to a speech error "넌룸큥긷" (pronounced /nun lum kung gid/). Through this speech production paradigm, we tested a hypothesis that onset-vowel combinations are more strongly connected than vowel-coda combinations within CVC syllables in Korean, expecting more speech errors by auditory distractors in vowel-coda combinations than in onset-vowel combinations. In this study, native Korean participants were required to utter a four-syllable nonword repeatedly in each trial. The distractor nonwords triggered an exchange of phonemes between two adjacent syllables (exchange of onset, vowel, or coda). The result showed that when analyzing only pure speech errors, codas slipped more than onsets, suggesting that the phonological structure of Korean syllable has effects on the serial order control of speech production. Therefore, this study contributes to understand the interaction of the serial order control in speech production with language environment.

Keywords: Speech error, Speech error induction technique, Syllabic constraint, Transposition, Korean

Joonwoo Kim and Kichun Nam

Morpho-semantic analysis of morphologically complex Korean words

Korean language is a morphologically rich language, in which substantial information concerning the arrangement of words into syntactic as well as semantic units, is expressed at

word level. For example, Korean inflected word '먹었고' (ate and) is composed of the stem unit '먹-' (to eat), which contains the core meaning and two syntactic units, '-었-' and '-고', which function as a past tense inflection suffix, and a conjunction, respectively. The current study presented here aimed to investigate morpho-semantic interaction in the processing of morphologically complex word. Homonyms have multiple unrelated meanings which share a single form and pronunciation, thus serve as a useful tool for investigation of retrieval and selection of semantic representation independent of orthography and phonology. In this regard, the present study examined whether morphological effect due to inflection is modulated by lexical ambiguity of a stem during visual word recognition. The morphological effect was examined by manipulating morphological complexity as follows: (1) basic form (e.g., '씹다', to chew), (2) inflection with simple suffix addition (e.g., '꽂고' – '꽂- + -고', plug and), (3) inflection with transformation of stem (e.g., '썼고' – '쓰- + -었- + -고', write/use and). Each target word had either a single-meaning or a homonymous stem. 20 healthy adults participated in the visual lexical decision task, in which stimuli set consisted of a total of 240 targets; 20 words per each condition and 120 pseudowords. 2 (ambiguity: homonym vs. single-meaning word) X 3 (morphological complexity: basic vs. simple inflection vs. complex inflection) repeated measures analyses of variance (ANOVAs) on reaction times (RTs) and error rates (ERs) demonstrated that morphological complexity showed significant main effect both RTs and ERs, while ambiguity effect was not significant. More critically, the morphological complexity X ambiguity interaction showed significance. A post-hoc pairwise *t* test showed that homonyms yielded significantly more error and longer latencies compared to single-meaning words in simple inflected form, while homonyms yielded significantly less error, and marginally faster RTs in basic form. Our results suggest that morphological complexity demands processing cost in visual word recognition, and that this morphological effect modulates processes of retrieval and selection of multiple meaning candidates of homonym. The morpho-semantic processing of morphologically complex Korean words is discussed in terms of current theories on visual word recognition.

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Sentence comprehension improvement in early Alzheimer's disease as a result of transcranial magnetic stimulation coupled with behavioral intervention.

We present preliminary results on the application of behavioral language intervention coupled with repetitive transcranial magnetic stimulation (rTMS) in one individual with mild and two individuals with moderate Alzheimer's disease (AD), all of them native speakers of Slovenian.

Behavioral language intervention has traditionally been focused on improving communication abilities in patients with aphasia by alleviating symptoms both at lexical or sentence level. Treatment of Underlying Forms (TUF, Thompson & Shapiro, 2005), is a linguistic behavioral approach to treatment of sentence deficits primarily in PWA, but also in patients with the agrammatic variant of primary progressive aphasia (Barbieri, Mack et al., 2019), which focuses on complex, non-canonical sentence structures and operates on the premise that training underlying, abstract, properties of language will allow for effective generalization to untrained structures that share similar linguistic properties, particularly those of lesser complexity. Transcranial Magnetic Stimulation (TMS) is a promising tool for neurorehabilitation that has utilized to target pathologies for therapeutic gains, including therapy for acquired disorders. Combined with behavioral treatment, in particular TUF, TMS could substantially amplify the beneficial effect of behavioral therapy alone (Thiel et al., 2013).

The current study investigates the combined effect of these two methods in neurodegenerative conditions. We use TUF and placebo-controlled rTMS over the left and right dlPFC in Slovenian-speaking individuals with AD. Participants are randomized to groups A (high frequency 10-Hz rTMS) and B (placebo), followed by 60min of behavioral treatment (5 session/week, 4 weeks), using the TUF method. They are trained in comprehension of centre embedded relative clauses of the type *The girl who the mom kissed holds the mirror*. Up to now preliminary data (Fig. 1) from 3 participants (1 with mild dementia, and 2 with moderate dementia) all of them from group A, showed a therapy effect for the participant with mild dementia both immediately as well as 2 weeks after therapy ($z=2.58$, $p=.01$). Participants with

moderate dementia did not show any effect in the tested structures (overall main effect of therapy: $\chi 2$ =1.62, p=.44 for the first patient and overall main effect of therapy: $\chi 2$ =2.25, p=.32 for the second participant). The results are promising for the beneficial effects of behavioral therapy and rTMS in complex sentence comprehension, at initial stages of dementia, something which is demonstrated in the literature for the first time.

Figure 1
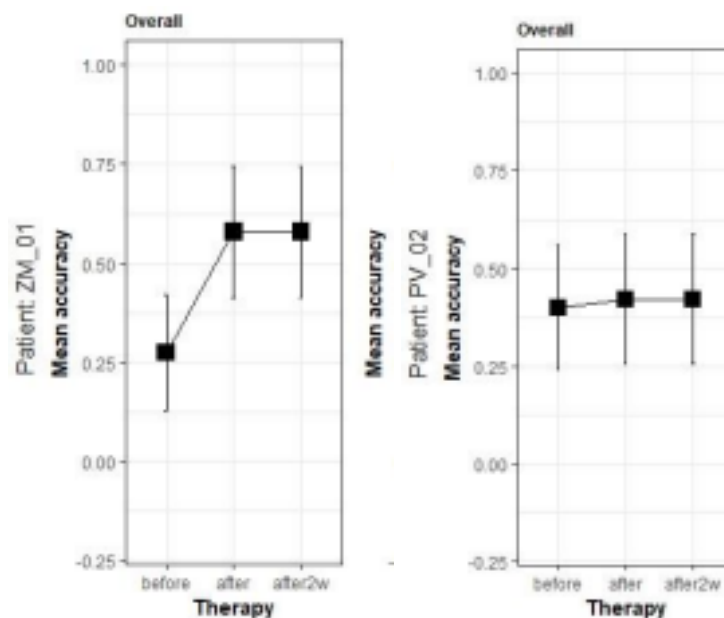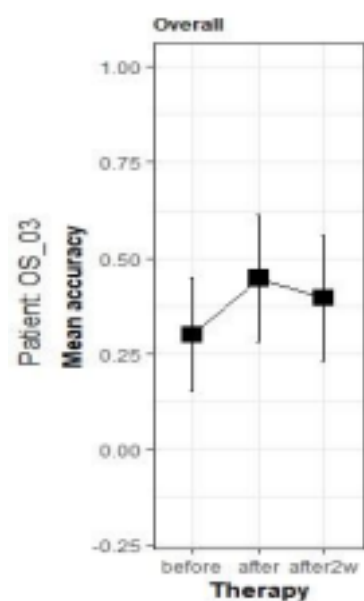
P1: mild dementia P2: moderate dementia P3: moderate
dementia

References

Barbieri, E., Mack, J., Chiappetta, B., Europa, E., & Thompson, C. K. (2019). Recovery of offline and online sentence processing in aphasia: Language and domain-general network neuroplasticity. Cortex, 120, 394-418. DOI: 10.1016/j.cortex.2019.06.015

Thiel, A., Black, S., Rochon, E., Lanthier, S., Hartmann, A., Chen, J., Mochizuki, G., Zumbansen, A., Heiss, W-D., & I. Rubi-Fessen. (2014). NOn-invasive Repeated Therapeutic STimulation for Aphasia Recovery (NORTHSTAR) A multilingual, multicenter aphasia trial. *Journal of Stroke and Cerebrovascular Diseases*. 24. 10.1016/j.jstrokecerebrovasdis.2014.10.021.

Thompson, C. K., & Shapiro, L. P. (2005). Treating agrammatic aphasia within a linguistic framework: Treatment of Underlying Forms. *Aphasiology*, 19(10-11), 1021-1036. PMC1847567.

Maria Heitmeier, Yu-Ying Chuang and R. Harald Baayen

Modeling German nonword plural productions with Linear Discriminative Learning

Linear Discriminative Learning (LDL) models the mental lexicon as two simple mappings between form and meaning for comprehension and production (Baayen et al., 2019). This talk proposes a method to model the so-called wug task with LDL. In a wug task, speakers are asked to inflect nonwords. While in previous work it was found that measures derived from LDL are predictive for reading latencies and auditory lexical decision reaction times of nonwords (Chuang et al., 2020), the present study focuses on nonword *productions*. It takes as example the semi-productive German noun system, which has comparatively complex, but "degenerate" (Bierwisch, 2018, p. 245) morphology (e.g. K¨opcke, 1988). In previous wug experiments with German speakers, plural productions for nonce nouns were found to be highly variable across speakers and items (K¨opcke, 1988; McCurdy et al., 2020). Various attempts have been made to model participants' responses, such as with a deep learning Encoder-Decoder architecture. However, productions of the model failed to model the variability observed in native speakers (McCurdy et al., 2020).

Previous work mostly modeled nonword productions as form-to-form mappings (e.g. McCurdy et al., 2020; Belth et al., 2021). In the present work we take into account the finding that semantics play a role in nonword processing (Chuang et al., 2020; Hendrix and Sun, 2021) and propose a method to model nonword productions as form-meaning-form mappings. The lexicon is initialised with full inflectional noun paradigms for German, including all three grammatical genders, as well as number and all cases. Meanings are represented by real-valued random vectors. We explore different parameters of the model and compare our results to productions by German speakers in McCurdy et al. (2020), with stimuli from Marcus et al. (1995). The model is able to generate a diverse set of plural forms, but still has a bias towards certain forms (see Table 1), which might be due to the lack of real-world representation of semantics and frequencies in the current model. Our study stresses the importance of meaning for morphology and shows that the simple algorithm of LDL in which all computations are transparent and interpretable is able to go a long way at modeling the semi-productive system of German noun morphology.

References

Baayen, R. H., Chuang, Y.-Y., Shafaei-Bajestan, E., and Blevins, J. (2019). The discriminative lexicon: A unified computational model for the lexicon and lexical processing in comprehension and production grounded not in (de)composition but in linear discriminative learning. *Complexity*.

Bral Pind

Kach	Klot	Mur	Nuhl
Kachen Kach Kacher Kache *Kachern	Klot *Klotten *Klotte *Klotter *Klieloten	Muren Murn Mur *Murn en Murer	Nuhlen Nuhl Nuhle *Nuhl ern *Nuhl ere

Bralen Pinden
Bral Pind

*Bralenen Pinder
*Bralern Pinde

Braler *Pindern

Pisch Vag

Pund	Raun	Spand	Spert
Punden *Punend Pund Punde *Punden e	Raunen Raun *Raun ern Raune r Raune	*Spanend Spand *Spanende *Spanen den *Spatend	Sperten Sperte Sperter *Sperer ten *Sperer te

Pischen Vag

Pisch Vagen
Pischer Vage Pische Vager *Pischern *Vagern

Table 1: First five candidates for the plural forms of nonwords as generated by the LDL model (stimuli taken from Marcus et al. (1995)). Forms that are implausible as plurals are marked with an asterisk.

Belth, C., Payne, S., Beser, D., Kodner, J., and Yang, C. (2021). The greedy and recursive search for morphological productivity. *arXiv preprint arXiv:2105.05790*.

Bierwisch, M. (2018). *Syntactic features in morphology: General problems of so-called pronominal inflection in German*. De Gruyter Mouton.

Chuang, Y.-Y., Vollmer, M.-l., Shafaei-Bajestan, E., Gahl, S., Hendrix, P., and Baayen, R. H. (2020). The processing of pseudoword form and meaning in production and comprehension: A computational modeling approach using linear discriminative learning. *Behaviour Research Methods*, 53:945–976.

Hendrix, P. and Sun, C. C. (2021). A word or two about nonwords: Frequency, semantic neighborhood density, and orthography-to-semantics consistency effects for nonwords in the lexical decision task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 47(1):157.

K̈opcke, K.-M. (1988). Schemas in german plural formation. *Lingua*, 74(4):303–335.

Marcus, G. F., Brinkmann, U., Clahsen, H., Wiese, R., and Pinker, S. (1995). German inflection: The exception that proves the rule. *Cognitive psychology*, 29(3):189–256.

McCurdy, K., Goldwater, S., and Lopez, A. (2020). Inflecting when there's no majority: Limitations of encoder-decoder neural networks as cognitive models for German plurals. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, pages 1745–1756. Association for Computational Linguistics.

Nancy Azevedo, Gonia Jarema, Christine Alary Gauvreau, Guylaine Le Dorze, Stéfanie Beaulieu, Marc Yvon, Christel Beaujard and Eva Kehayia

What do people with aphasia and their family members think of communication aids?
Focus group findings on users' experiences

Background: Approximately one-third of stroke survivors, or more than 100,000 Canadians, live with aphasia[1]. Word finding difficulties (WFDs) are common in aphasia and cause the person to have trouble retrieving the correct words when they want to express themselves. As a result, a person with WFDs will often struggle when communicating with others and this affects not only the individual, but may also affect their communication partners who in turn may avoid certain situations that could trigger WFDs[2]. Consequently, aphasia and WFDs have a negative impact on social participation[3] and quality of life[4]. While people with aphasia can make use of currently available communication aids, clinical experience suggests that the learning process is arduous, and inconveniences associated with their use can outweigh potential benefits.

Aims: The goal of this research was to explore the experiences and needs of users of communication aids and/or applications: people with aphasia (PWA) and their family members (FM).

Method: We held two focus groups, one English and one French, at a large rehabilitation hospital in the Greater Montreal region. Each was led by a speech-language pathologist (SLP) with support from a second SLP with expertise in communication aids. The groups involved both PWA and FM, participants were five PWA (3F) and five FM (2F) with experience with different communication aids or applications that ranged from "beginner" to "extensive". The questions probing participants' or partners' experience with communication aids or applications included: "*In your opinion, what is a communication aid?*", "*What are your experiences with communication aids*?", and "*What would you like your (or a) communication aid to do for you that it currently does not do*?". The sessions were transcribed verbatim then the English and French transcripts were combined and were coded and analysed thematically using qualitative content analysis[5] by two researchers.

Results: The synthesis of information from the focus groups revealed **four themes** related to the experience of the PWA and to what FMs experience or witness in everyday life: **(1) Benefits**: ways that using the device or application produces good/helpful results). **(2) Barriers**: circumstances or obstacles preventing the user from using the communication device or application). **(3) Facilitators**: circumstances or features making it easier to use the device or application or make them work better).**(4) Optimal Features**: features available in a device or application that they would like to see included or improved).

Discussion: While most participants expressed that having access to a communication aid or application does benefit them to some degree, they could not always use them as they wished and

some elected not to use them in certain circumstances, thus confirming clinical experience. Participants also offered suggestions improvement. These findings, in combination with forthcoming results of a focus group conducted with SLPs, are being used to create a prototype of a novel communication application that will use artificial intelligence (AI) that will better address users' needs.

References:

[1] The Heart & Stroke 2017 Stroke Report.

[2] Le Dorze, G., & Brassard, C. (1995). A description of the consequences of aphasia on aphasic persons and their relatives and friends, based on the WHO model of chronic diseases. *Aphasiology, 9*(3), 239- 255.

[3] Dalemans, R. J., De Witte, L. P., Beurskens, A. J., Van Den Heuvel, W. J., & Wade, D. T. (2010). An investigation into the social participation of stroke survivors with aphasia. *Disability and Rehabilitation, 32*(20), 1678-1685.

[4] Lam, J. M., & Wodchis, W. P. (2010). The relationship of 60 disease diagnoses and 15 conditions to preference-based health-related quality of life in Ontario hospital-based long-term care residents. *Medical Care, 48*(4), 380-387.

[5] Braun & Clarke (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.

Elena Pozdnyakova

Cognitive-pragmatic study of inferences in ad hoc meaning creativity task

In this paper, we explore the interaction between creativity and conventionality in words. We analyze how speakers generate ad hoc senses for a traditional form of a word in a rule-governed and, at the same time, creative process. The opposition 'conventionality vs creativity' is based on two concepts: analogy and deviation. We assume that deviation is the main driving force for creativity, although it should be stressed that not every analogy is conventional and not every deviation is creative.

It is common knowledge that inference is a conclusion drawn from one or more assumptions. Following Traugott and Dasher (2002), we distinguish three levels of meaning relevant to a lexeme: coded meanings (this is a convention of a language at a given time); utterance-token meanings (these are invited inferences (IIN) that have not been crystallized into commonly used implicatures); utterance-type meanings (these are generalized invited inferences (GIIN) which are crystallized invited inferences associated with certain lexemes or constructions that are specific to a linguistic community) (Traugott and Dasher, 2002).

Objective. The goal of the study is to explore the interrelation of language use with the process of inferencing.

Research design. This paper proposes an approach to the study of inferences that subjects have produced in writing. The stimulus material (idiomatic compound words, unfamiliar to the   Russian subjects who are English language advanced learners) was presented on computer.   There was neither context nor co-text. The instruction was to write down the meaning of the   word, judging by its parts and personal language experience. The time of presentation was 30   sec., the time of writing was limited to 5 minutes for each card. The words on the cards were   *salad-dodger; gift*-card *laundering; bean counter; eye-opener; globetrotter; hairsplitter; headbanger.*

The hypothesis is that in case language learners encounter a new idiomatic word or expression,   they face a double challenge of decoding the information encoded in the sign (word) and applying pragmatic inferencing ability to create a word's pragmatically specified meaning. The decoding process will be more complicated for language learners, but advanced language   learners are language-competent enough to "invent" or hypothesize a word meaning.

Results. On the preliminary stage of the results analysis the pragmatic inferences were studied and grouped to the type of invited inferences. The concluding stage of the subjects' answers analysis was aimed at a cognitive-pragmatic explanation of the results. At this stage, we also considered interrelations between invited pragmatic inferencing and meaning creativity. Cards with idiomatic compounds proved to be fruitful stimulus materials to investigate the process of individual pragmatic inferences. However, as the number of absolutely correct guesses, coinciding with the conventional meanings of the words, was considerably low (10% - 15% on average), the number of phrases that could be investigated as research material on individual pragmatic inferences comprised 273 answers.

Although the study demonstrated advanced English - language learners limitations in drawing inferences for unknown words, it could not be explained by insufficiency of language competence alone. The low number of correct guesses explicates the "cognitive dead-lock", that is the insufficiency of cultural and general-knowledge context for decoding.

The answers of subjects demonstrated the prevalence of individual invited inferences based both on encyclopaedic knowledge and on the form of the stimulus. IINs were pragmatically

charged, demonstrating strong "user-sign" relation.

REFERENCES

Traugott, Elisabeth C. and R. Dasher. 2002. Regularity in Semantic Change. (Cambridge Studies in Linguistics 97.) Cambridge: Cambridge University Press

Julia Carden, Camila Stecher and Virginia Jaichenco
Category-based licensing in complex word recognition

Several psycholinguistic models state that the recognition of printed polymorphemic words takes place through the decomposition of such words into their constituent morphemes, followed by the activation of the stored representations of these constituents and, finally, their recombination into a complex whole word. However, while a large amount of experimental data supporting the existence of an early stage of morpho-orthographic segmentation is available (Rastle & Davis, 2008), post-decomposition processes have been far less researched (Stockall, Manouilidou, Gwilliams, Neophytou, & Marantz, 2019).

The aim of our study is to examine category licensing, a post-decomposition process proposed by Schreuder and Baayen (1995) that consists in the assessment of whether co-activated representations can be integrated on the basis of their subcategorization properties. To that end, we designed a lexical decision task whose critical stimuli consist of Spanish, morphologically structured pseudowords in two conditions: one in which the stem and suffix combination does not violate the subcategorization frame (e.g., *tontitud*, where the suffix *-itud* is attached to an adjective stem, as required) and another one in which it does (e.g., *silbitud*, where *-itud* is attached to a verb stem). Each critical stimulus has its corresponding orthographic control, obtained by changing a letter of the suffix (e.g., *tontited* and *silbited*, respectively). All conditions are matched for length, MLBF, stem frequency, suffix frequency, and orthographic neighbourhood size. Participants are randomly assigned to one of two experimental lists, so that no one sees the same stem more than once, and instructed to indicate as fast and as accurately as possible whether the items are real Spanish words.

Although data is still being collected, reaction times and error rates from available participants are reported in Table 1 and were analyzed by fitting linear mixed effects models. Suffix (presence/absence) and Combination (appropriate/inappropriate) were included as fixed effects, as well as their interaction. Subjects and Items were included as random intercepts. The RT analysis revealed a significant interaction between Suffix and Combination ($t = 2.31$, $p = .02$). A closer inspection of the interaction showed that the presence of a suffix produced a greater increase in latencies when it was attached to a stem of an appropriate grammatical category. The error analysis also revealed a significant interaction between Suffix and Combination ($z = -2.45$, $p = .01$), reflecting the fact that the decrease in response accuracy produced by the presence of a suffix was larger when it was attached to a category licit stem.

While this is a study in progress, pilot results suggest that pseudowords consisting of two morphemes that can be integrated on the basis of their subcategorization properties produce a stronger interference effect than those that cannot. This difference can be interpreted as evidence in favour of a category-based licensing process in morphologically complex word recognition, such as the one proposed by Schreuder and Baayen (1995).

(Presentation format: poster)

References

Rastle, K., and Davis, M. H. (2008). Morphological decomposition based on the analysis of orthography. *Language and Cognitive Processes, 23*, 942–971.

Schreuder, R, and Baayen, R. H. (1995). Modeling morphological processing. En L. Feldman (Ed.), *Morphological aspects of language processing* (pp. 131-154). Hillsdale, NJ: Erlbaum.

Stockall, L.; Manouilidou, C.; Gwilliams, L.; Neophytou, K., and Marantz, A. (2019). Prefix Stripping Re-Re-Revisited: MEG Investigations of Morphological Decomposition and Recomposition. *Frontiers in Psychology, 10*, 1-17

Table 1. Mean (and SD) reaction times (in ms) and error rates in the lexical decision task

	Suffix Appropriate	**(*tontitud*) Control Appropriate (*tontited*)**	**Suffix Inappropriate (*silbitud*) Control**	**Inappropriate (*silbited*)**
RT	928 (269)	833 (221) 873 (240) 817 (220)		
ER	0.17 (0.38)	0.01 (0.12) 0.05 (0.22) 0.01 (0.11)		

and dyslexia may extend to healthy individuals who do not meet diagnostic criteria for either condition.

References

Raine, A. (1991). The SPQ: A Scale for the Assessment of Schizotypal Personality Based on DSM-III-R Criteria. *Schizophrenia Bulletin, 17*(4), 555–564. https://doi.org/10.1093/schbul/17.4.555

Richardson, A.J., & Stein, J.F., (1993). *Personality characteristics of adult dyslexics. In: Wright, S.F., Groner, R. (Eds.),* Facets of Dyslexia and Its Remediation. Elsevier/North-Holland Science Publishers, Amsterdam.

Richardson, A.J., (1994). Dyslexia, handedness and syndromes of psychosis-proneness. *International Journal of Psychophysiology, 18*(3)*,* 251–263. https://doi.org/10.1016/0167-8760(94)90011-6

Roberts, E. O., Proudlock, F. A., Martin, K., Reveley, M. A., Al-Uzri, M., & Gottlob, I. (2013). Reading in schizophrenic subjects and their nonsymptomatic first-degree relatives. *Schizophrenia Bulletin*, *39*(4), 896-907. https://doi.org/10.1093/schbul/sbr191

Whitford, V., O'Driscoll, G. A., & Titone, D. (2018). Reading deficits in schizophrenia and their relationship to developmental dyslexia: A review. *Schizophrenia Research, 193,* 11–22. https://doi.org/10.1016/j.schres.2017.06.049

Rita Mathur

Cognitive Processes in the Acquisition of English as a Second Language by College Students

The purpose of this research was to look into cognitive aspects of college students learning English as a second language. The participants of the research, studied English at school, but all of their other subjects were taught in Hindi. In India, the education system allows students to choose between English medium schooling and state - language - medium schooling, such as Hindi, Marathi, Tamil or Telugu etc. Though they learn English as a subject in state-medium schools, their writing and fluency skills remain at the basic level. Higher education, particularly professional education, is, on the other hand, delivered in English. Many students find it difficult and work hard to improve their English skills.

Most college students who are learning English as a second language replicate lexical and grammatical levels. In the literature, the process of replication is studied from both a cognitive and contact perspectives. Replication can also be viewed as a contact-induced modification caused by 'borrowing' with 'interference' of first language (L1) on second language (L2), (Weinreich 1953; Winford 2003).

With this background, the research attempted to investigate the cognitive processes involved in learning English as a second language, as well as to provide instances of common learning mechanisms such as replication, transfer and generalization. The purpose of our research questions was to find out if college students employ replication as a tactic? Do they replicate only lexical level or they also replicate morphosyntactic/grammatical level?

In order to collect data, 45 undergrads in their first year bachelor's degree programme were enlisted. They all went to Hindi medium schools and studied English as a subject. All of the participants were enrolled in a Bachelor of Science (B.Sc.) degree at the university.

Selected participants were invited to write in English and Hindi on a narrative visual. The image depicted a beach setting with numerous activities; swimming, basking, sailing, fun fair with shops and rides and so forth.

The textual description of the picture was assessed for factors such as acceptable verb use, preposition use, and use of copula verb. The purpose of Hindi written description was to evaluate and compare writing ability.

According to the findings 65 percent of errors were related to agreement, 60 percent were related to copula verb, 50 percent were related to improper verb, only 30 percent were related to preposition and 40 percent sentence constructs were fragmented.

The impact of L1 Hindi on L2 English was perceptible. As a result during the learning process lexical and grammatical systems are replicated or duplicated. Before mastering a second language, college students develop their 'interlanguage' through transference and generalization.

Yousri Marzouki, afra Al Marri and Ali Idriss i
Morphological Family Size in Arabic

It has been shown in various studies that family size modulates reactions times (see Baayen et al., 1997; De Jong et al., 2000; Schreuder & Baayen, 1997, for Dutch; de Jong et al., 2002, for English; and Moscoso del Prado et al., 2005, for Hebrew). The present study explores the effects morphological family size and word frequency in Arabic, a language with a highly non

concatenative word structure. We take morphological family size to be a function of the number of words that share both the consonantal root and meaning (we exclude words that share the same root but are semantically related). We hypothesize that high frequency words that belong to large morphological family (e.g., كاتب] kaatib] 'writer') should elicit faster response time than low frequency words that belong to a small morphological family (e.g., مبرمج] mubarmiž] 'programmer').

Thirty-one Qatar University undergraduate students, all native speakers of Arabic exposed to written Arabic on a daily basis, performed a lexical decision task on a set of stimuli consisting of 120 different Arabic words and 120 pseudo-words. The root type frequency for each root was extracted from Aralex database (Boudelaa & Marslen-Wilson, 2010). The experiment was designed on OpenSesame software and run online through OSW and JATOS platforms.

The results showed a marginal effect of family size: participants responded relatively faster to words that belonged to a larger morphological family than to words that belonged to a smaller one. Additionally, a significant effect of word frequency was observed: participants responded faster to high-frequency words than they did to low-frequency words. However, no significant interaction was found between family size and word frequency.

The absence of significant effect of family size suggests that the root may not be the most relevant information that Arabic speakers rely on to organize their metal lexicon at this stage of processing. We discussed these results in light of previous findings from Hebrew and their implication for the organization of the Semitic mental lexicon.

References

Baayen, R. H., Lieber, R., & Schreuder, R. (1997). The morphological complexity of simplex nouns. 35(5), 861–878.

Boudelaa, S., & Marslen-Wilson, W. D. (2010). Aralex: A lexical database for Modern Standard Arabic. Behavior Research Methods, 42(2), 481–487. De Jong, N. H., Feldman, L. B., Schreuder, R., Pastizzo, M., & Baayen, R. H.

(2002). The Processing and Representation of Dutch and English Compounds: Peripheral Morphological and Central Orthographic Effects. Brain and Language, 81(1–3), 555– 567.

De Jong, N. H., Schreuder, R., & Harald Baayen, R. (2000). The morphological

family size effect and morphology. Language and Cognitive Processes, 15(4–5), 329–365. Moscoso del Prado, F., Deutsch, A., Frost, R., Schreuder, R., de Jong, N., & Baayen, H. (2005). Changing places: A cross-language perspective on frequency and family size in Dutch and Hebrew. Journal of Memory and Language, 53, 496–512.

Schreuder, R., & Baayen, R. H. (1997). How Complex Simplex Words Can Be. Journal of Memory and Language, 37(1), 118–139.

Talks 3

Merel Muylle, Eva Van Assche and Robert Hartsuiker

Comparing the cognate effect in spoken and written L2 word production

Studies involving cognates – words that share form and meaning between two or more languages such as English SHIP and Dutch SCHIP – provide important insights about the bilingual mind. The cognate effect, the finding that cognates are faster accessible than words that are different across languages, suggests that bilingual speakers activate both their L1 and L2 during language processing (e.g., Costa et al., 2000; Van Hell & Dijkstra, 2002). This robust phenomenon has been observed in several language modalities such as reading (e.g., Duyck et al., 2007), listening (Woutersen et al., 1995) and speech production (e.g., Costa et al., 2000), but has not yet been investigated in written production. In addition, it remains unclear whether the cognate facilitation effect is merely lexical in nature (e.g., Costa et al., 2017) or whether it cascades to phonological/orthographic (i.e., sub-lexical) processes (e.g., Christoffels et al., 2007)? Comparing cognate effects in spoken and typewriting production may be elucidating in this matter given that both modalities share lexical, but not sub-lexical processes (e.g., Bonin et al., 2015).

The current study directly compares cognate effects in spoken and typewritten picture naming. Dutch-English bilinguals ($N = 80$) produced English names for pictures representing Dutch-English cognates ($N = 48$), matched control words ($N = 48$), or filler words ($N = 42$). Half of the participants performed the task in the spoken and the other half in the typewritten modality. First keystroke latencies (in the written condition) and voice onset times (in the spoken condition) were registered and interpreted as indicators for lexical processing, whereas total latency was taken as a measure for sub-lexical processing.

Analyses with linear mixed effects models showed a main effect of cognate status, with onset latencies being shorter and accuracy being higher for cognates vs. control words and a main effect of modality, with responses being slower in general in the written vs. the spoken condition (see Fig 1). Furthermore, there was no interaction between cognate status and modality, which indicates that the cognate facilitation effect was similar in both modalities (this was further confirmed by Bayesian analyses). No cognate effects were found in total latencies, but compared to controls, total latencies in the written modality were similar for cognates with much cross-linguistic orthographic overlap (measured by Levenshtein distance), but longer for ones with less overlap (see Fig 2). Additionally, error analyses showed that cognates were more affected by L1 interference than controls.

In sum, the current study shows that the cognate facilitation effect at the onset of bilingual word production is largely modality-independent, in line with a central locus for cognate facilitation in bilinguals (e.g., Costa et al., 2017). In addition to this lexically situated cognate effect, there are also sub-lexical cognate effects (at least in writing): cognates with large orthographic overlap across languages show no effect, whereas cognates with less overlap show interference effects. Finally, the analyses of the errors indicate that bilinguals activate both their L1 and L2 during L2 speech and writing, which contradicts Costa et al.'s (2017) interpretation of the cognate facilitation effect as a learning artefact.
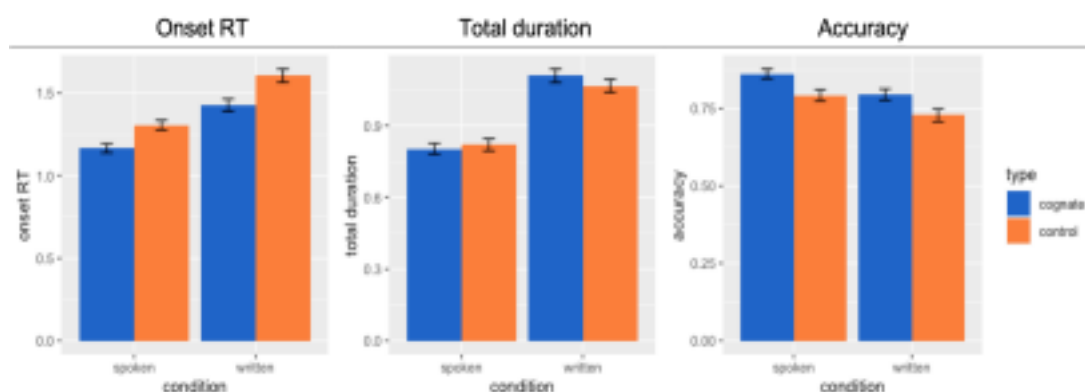
Fig 1. *Cognate effects in onset RTs, total duration and accuracy for the spoken and written modality.*
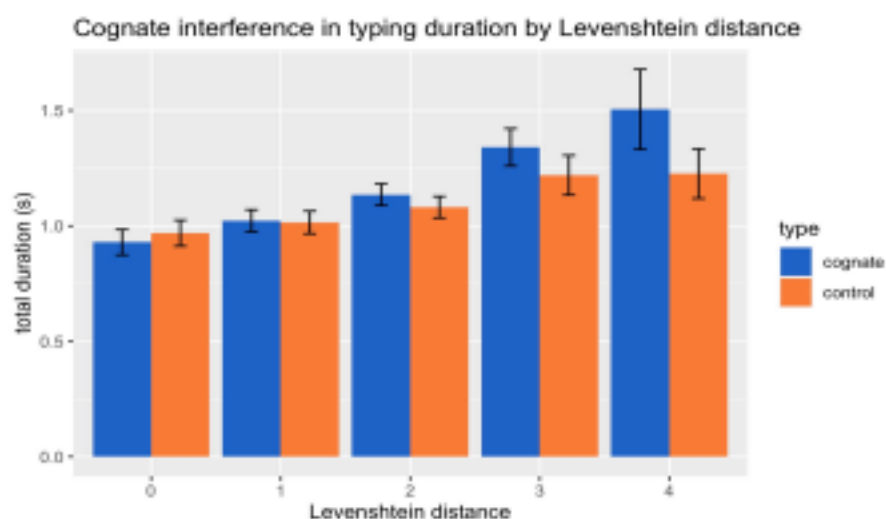

Fig 2. *Cognate interference effects in typing duration as function of Levenshtein distance (LD) between cognates and their translations (e.g., "ship"-"schip" has LD 1, whereas "cookie"-"koek" has LD 4).*

References

Bonin, P., Méot, A., Lagarrigue, A., & Roux, S. (2015). Written object naming, spelling to dictation, and immediate copying: Different tasks, different pathways? *Quarterly Journal of Experimental Psychology*, *68*, 1268–1294.

Christoffels, I. K., Firk, C., & Schiller, N. O. (2007). Bilingual language control: An event related brain potential study. *Brain Research*, *1147*, 192–208.

Costa, A., Caramazza, A., & Sebastian-Galles, N. (2000). The Cognate Facilitation Effect: Implications for Models of Lexical Access. *Journal of Experimental Psychology: Learning Memory and Cognition*, *26*, 1283-1296.

Costa, A., Pannunzi, M., Deco, G., & Pickering, M. J. (2017). Do Bilinguals Automatically Activate Their Native Language When They Are Not Using It? *Cognitive Science*, *41*, 1629-1644.

Duyck, W., Van Assche, E., Drieghe, D., & Hartsuiker, R. J. (2007). Visual word recognition by bilinguals in a sentence context: Evidence for nonselective lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*, 663–679.

Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin and*

Review, *9*, 780-789.

Woutersen, M., De Bot, K., & Weltens, B. (1995). The bilingual lexicon: Modality effects in processing. *Journal of Psycholinguistic Research*, *24*, 289–298.

Nadine Charanek, Vegas Hodgins and Olessia Jouravlev
How prevalent are bilingual costs during native (L1) speech production?

Knowledge of multiple languages has some clear benefits for one's personal and professional lives. However, managing multiple languages in one mind is associated with some costs in the language domain. Indeed, infants growing in bilingual environments are often delayed in language acquisition (Genesee et al., 2004). Adult bilinguals make more speech errors, have smaller vocabularies, and are slower in naming pictures and reading words than monolinguals (e.g., Gollan et al., 2005; Gollan et al., 2007). Further, there are some claims that bilinguals experience communicative challenges not only in their second language, but also in their native language (e.g., Sadat et al., 2016).

In this project, we asked two questions about prevalence of bilingual costs during native speech production:
(1) Are bilingual costs present equally for all items? and
(2) Are bilingual costs present equally in bilinguals of diverse linguistic background?

To answer these questions, we examined picture naming performance of 65 English monolinguals and 72 English-French bilinguals. The participants named images of objects in English. The objects to be named were selected by crossing two factors. The first factor was a cognate status of a corresponding word (cognate (ball/balle) vs. non-cognate(cake/gateau)). The second factor was lexical frequency of a corresponding word (high frequency (ball/balle) vs. low frequency (cactus/cactus).

The results revealed a Group by Cognate status interaction: Bilinguals were slower to name objects compared to monolinguals if corresponding words were non-cognates. For cognate words, no group differences were observed. Further, there was a significant Group by lexical Frequency by Cognate Status interaction. Bilingual naming costs were higher for high frequency than for low frequency words, but this effect was restricted to non-cognates. Finally, in the exploratory examination of individual differences in bilingual naming costs, we observed that balanced bilinguals were more likely to show evidence for slower L1 naming latencies than bilinguals with more dominant L1.

These results are consistent with the view that bilingual costs arise due to competition between activated lexical items. First of all, bilingual costs do not arise for cognates because the same lexical item is activated across two languages. Secondly, these costs are higher for high frequency words because the corresponding words from two languages are more likely to get activated at approximately the same time and compete for selection. Finally, balanced bilinguals

are more likely to activate competing lexical items from their two languages at closer temporal resolution compared to unbalanced bilinguals who will activate lexical items from their dominant language first. These results inform models of bilingual speech production.

Yanran Chen and Kathleen Eberhard

The role of lexical stress in spoken-word recognition – evidence from English monolinguals and Chinese-English bilinguals

Our study investigated the acoustical features involved in recognizing spoken words from the perspective of lexical stress. Previous studies show that recognizing a spoken word is delayed by the presence of a "competitor" object whose name begins with the same syllable (Spivey et al., 2002). Subsequent studies have shown asymmetric competition when the initial syllables of the target and competitor differ with respect to stress: recognizing a stressed initial syllable target is delayed by the presence of an unstressed competitor, but not vice versa (Eberhard et al., 1997; Reinisch et al., 2010). The asymmetry is attributed to the stressed vowel's acoustic features subsuming those of the unstressed vowel.

However, whether this set/subset relation exists appears to depend on whether stress is contrastive in one's language (Warner & Cutler, 2017). Our study tested Chinese English bilinguals as well as English monolinguals because stress is not used contrastively in Chinese. We presented words in isolation to eliminate expectancy effects from the prosody of a carrier sentence (Brown et al., 2015).

200 English monolinguals, 114 simultaneous bilinguals, and 89 sequential bilinguals participated in our online experiment. They were presented with a 3x3 grid with 4 images and instructed to click on the object that they hear. Three factors were manipulated: 1) target words with either stressed or unstressed initial syllable; 2) normal versus edited recordings where a stressed initial syllable replaces the original unstressed one and vice versa; 3) displays where a competitor object is either present or absent. Response times were recorded as the time to click on an object from the onset of the recording minus the duration of recording.

We used linear mixed modeling which specified random intercepts for subjects to examine the strengths of competition under different conditions. For English monolinguals, we replicated the asymmetrical competition with normal recordings found in previous studies: recognizing a stressed initial syllable target was delayed when the competitor was present but recognizing an unstressed initial syllable target was unaffected. The competition for edited recordings, however, was symmetrical: recognizing either a stressed or unstressed initial syllable target was longer when the competitor was present. For Chinese-English bilinguals, results showed symmetrical competition with normal recordings and asymmetrical competition with edited recordings: there was a larger competitor effect when stressed initial syllable targets began with an unstressed syllable.

Our results support the hypothesis that English monolinguals' mental representations of stressed vowels consist of acoustic features that subsume the features of contrasting

phonemic representations of unstressed vowels. It also suggested that Chinese-English bilinguals' phonemic representations of stressed/full English vowels' acoustic features do not contrast with phonemic representations of unstressed/reduced vowels.

References

Brown, M., Salverda, A. P., Dilley, L. C., Tanenhaus, M. K. (2015). Metrical expectations from preceding prosody influence perception of lexical stress. *Journal of Experimental Psychology: Human Perception and Performance, 41*, 306-323.

Eberhard, K. M., Madden, C., Zahn, C. (1997). The use of metrical prosody to segment continuous speech. Poster presented at the *19th Annual Conference of the Cognitive Science Society,* Stanford, CA.
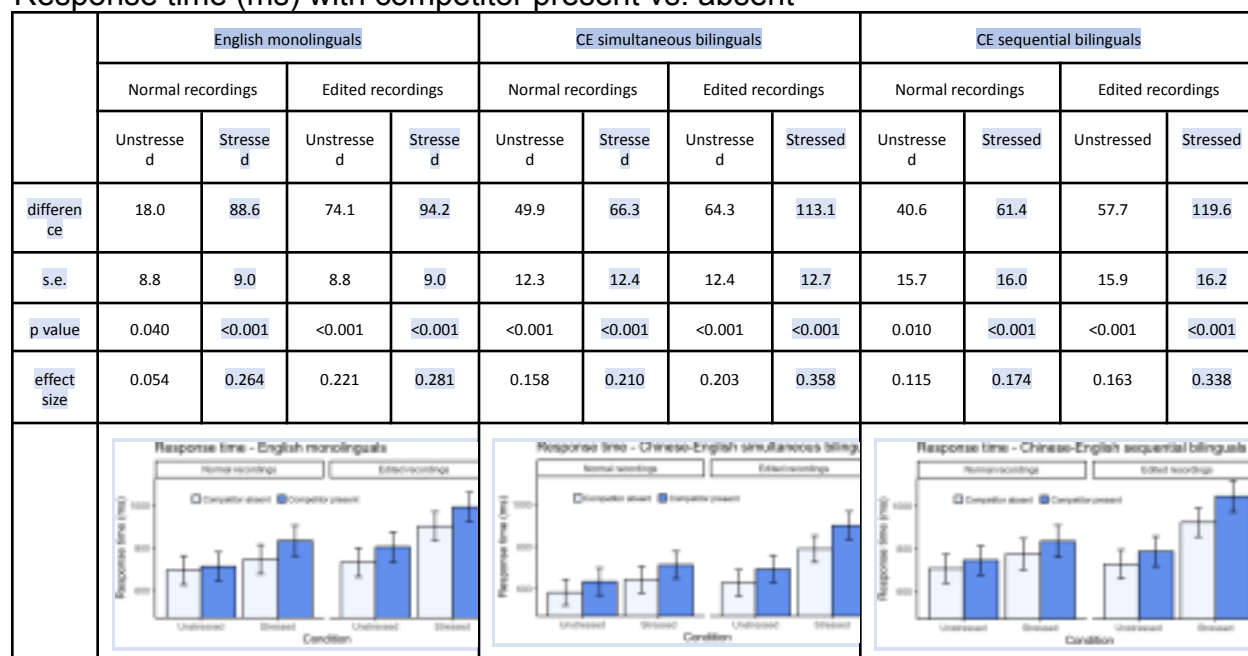
Reinisch, E., Jesse, A., & McQueen, J. M. (2011). Speaking rate affects the perception of duration as a suprasegmental lexical-stress cue. *Language and Speech, 54,* 147–165.

Spivey, M. J., Tanenhaus, M. K., Eberhard, K. M., & Sedivy, J. C. (2002). Eye movements and spoken language comprehension: Effects of visual context on syntactic ambiguity resolution. *Cognitive Psychology*, *45*(4), 447–481.

Warner, N. and Cutler, A. (2017). Stress effects in vowel perception as a function of language-specific vocabulary patterns. *Phonetica*, *74*, 81-106.

Figure

Response time (ms) with competitor present vs. absent

	English monolinguals				CE simultaneous bilinguals				CE sequential bilinguals			
	Normal recordings		Edited recordings		Normal recordings		Edited recordings		Normal recordings		Edited recordings	
	Unstressed	Stressed	Unstressed	Stressed	Unstressed	Stressed	Unstressed	Stressed	Unstressed	Stressed	Unstressed	Stressed
difference	18.0	88.6	74.1	94.2	49.9	66.3	64.3	113.1	40.6	61.4	57.7	119.6
s.e.	8.8	9.0	8.8	9.0	12.3	12.4	12.4	12.7	15.7	16.0	15.9	16.2
p value	0.040	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.010	<0.001	<0.001	<0.001
effect size	0.054	0.264	0.221	0.281	0.158	0.210	0.203	0.358	0.115	0.174	0.163	0.338

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Nick Reid, Huilan Yang and Yuru Mei

Conceptual Metaphor activation in Chinese-English bilinguals

Conceptual Metaphor Theory posits that much of our language and knowledge is structured through "conceptual metaphors" – broad mappings in which information from a "source" domain is used to talk and reason about a dissimilar "target" domain (Lakoff & Johnson, 1980). These mappings are thought to underlie most idiomatic expressions and explain their systematicity.

Reid and Katz (2018) examined the psychological reality of conceptual metaphors using a false memory task. Participants read lists of expressions putatively based on the same conceptual metaphor. For example, the TIME IS MONEY list consisted of expressions such as "that *cost* me a day", "you need to *budget* your hours", and "*invest* your time wisely". Following a short math distractor task, participants were asked to recognize the expressions from a list. In addition to the old items, the recognition test included new expressions based on the same conceptual metaphor (e.g., "that *cost* me a day") as well as new metaphorical and literal control items. The metaphorical controls were expressions that involved the same target domain, but mapped to a different source (e.g., "the weekend seems so *far away*", which is based on a spatial metaphor for TIME), whereas the literal controls were sentences about the source domain (e.g., "he makes biweekly payments", a literal statement regarding MONEY). Reid and Katz found that participants were more likely to falsely recognize the new expressions that were based on the same conceptual metaphor as the study list than controls. This supported the psychological reality of conceptual metaphors as it demonstrated they can influence memory.

In the current study, we extended the research of Reid and Katz (2018) and examined conceptual metaphor activation in Chinese-English bilinguals when they read, 1) Chinese (Mandarin) expressions in their native language, and 2) English expressions in their second language. In both cases, the false memory effect was replicated, suggesting that these findings generalize to other languages and cultures, and that they are evident even when participants are reading in their non-native language. Interestingly, the only significant difference between the Chinese and English conditions was for the literal control items – participants falsely recognized more literal expressions associated with the source domain of the conceptual metaphors when they were reading in their second language. This is consistent with previous findings that when learning a second language, people have difficulty suppressing literal meaning and often interpret metaphorical statements literally (Chen, Peng & Zhao, 2013; Heredia & Cieślicka, 2016; Picken, 2005; Siyanova-Chanturia, Conklin, & Schmitt, 2011). These data have implications for second language learning and suggest that highlighting the conceptual mappings that underlie idiomatic expressions may increase the salience of metaphorical meaning for learners, possibly reducing confusions between literal and non-literal meaning.

References

Chen, H., Peng, X., & Zhao, Y. (2013). An ERP study on metaphor comprehension in the bilingual brain. *Chinese Journal of Applied Linguistics, 36*(4), 505-517.

Heredia, R. R., & Cieślicka, A. B. (2016) Metaphoric reference: An eye movement analysis of Spanish–English and English–Spanish bilingual readers. *Frontiers in Psychology, 7*, 439.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by.* Chicago, IL: University of Chicago Press.

Picken, J. D. (2005). Helping foreign language learners to make sense of literature with metaphor awareness-raising. *Language Awareness, 14*(2-3), 142-152.

Reid, J. N., & Katz, A. N. (2018). Something false about conceptual metaphors. *Metaphor and Symbol, 33*(1), 36-47

Siyanova-Chanturia, A., Conklin, K., & Schmitt, N. (2011). Adding more fuel to the fire: An eye-tracking study of idiom processing by native and non-native speakers. *Second Language Research, 27*(2), 251-272.

Kaja Gregorc and Theo Marinis

The role of input variability in vocabulary learning in proficient L2 learners

Previous research has demonstrated that in monolingual children (Richtsmeier, Gerken, Goffman, and Hogan, 2009; Rost & McMurray, 2009) and beginner second language (L2) learners (Barcroft & Sommers, 2005; Sommers & Barcroft, 2011) input variability facilitates vocabulary acquisition. In our study we wanted to investigate if input variability also facilitates vocabulary learning in proficient L2 learners.

Based on exemplar-based models, learners should be able to make use of indexical information (e.g., rate or voice of a speaker) to create lexical representations (Goldinger, 2007). These are more widely distributed representations, leading to easier retrieval of words learned from a more variable compared to less variable input (Barcrof and Sommer, 2011). Recently, two studies investigated if proficient L2 learners benefit from novel items being produced by multiple speakers (Uchihara, Webb, Saito, and Trofimovich, 2021; Bulgarelli & Weiss, 2021). In both studies no facilitative effects of multiple speakers compared to a single speaker could be found. This could indicate that input variability facilitates only beginner L2 learners. However, these studies did not counterbalance the speaker in the single speaker condition (Uchihara et al., 2021) and only used female speakers (Bulgarelli & Weiss, 2021). We wanted to test if a set up more similar to Barcroft and Sommer'sstudies(2005, 2011) who found an effect of input variability in beginner L2 learners, would show a facilitative effect of input variability in proficient speakers. In the Barcroft and Sommer studies, beginners participated in a one-, three-, and six-speaker vocabulary training experiment counterbalanced for speaker in the one-speaker condition.

24 proficient L2 English speakers with German as their first language participated in our study. They completed a picture selection training session where they were exposed to 24 novel words that followed English phonotactics. In the low variability condition, the participants were exposed to 12 words produced by one speaker and in the high variability condition to 12 words produced by four different speakers (2 male and 2 female). In total there were four training rounds. We counterbalanced for novel words in the two conditions, object-novel word matching, and speaker. After the training session, the participants completed an immediate and delayed (3 days later) comprehension, translation, and production task. Statistical analyses showed that the participants improved after each training round reaching very high scores in the fourth training round (mean correct = 94%). No differences between the low and high variability speaker training condition could be found in all three tasks. Additionally, no differences were found between the immediate and delayed tasks, except for comprehension, where participants performed better immediately after training vs. in the delayed task (p=0.01).

Our study together with the results from Bulgarelli and Weiss (2021), and Uchihara et al. (2021) provide evidence against an only exemplar-based approach in lexical acquisition. In proficient learners, input variability does not seem to facilitate nor hinder vocabulary learning while in beginner learners it facilitates vocabulary learning. The findings speak in favor of a hybrid model for lexical storage where both abstract and exemplar representations coexist.

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References

Barcroft, J., & Sommers, M. S. (2005). Effects of acoustic variability on second language vocabulary learning. *Studies in Second Language Acquisition*, 27(3), 387–414. Bulgarelli, F., & Weiss, D. J. (2021). Desirable Difficulties in Language Learning ? How Talker Variability Impacts Artificial Grammar Learning. *Language Learning*.

Goldinger, S. D. (2007). A complementary-systems approach to abstract and episodic speech perception. *16th International Congress of Phonetic Sciences*, August, 49–54. Nijveld, A., Bosch, L., and Ernestus M. (2015). Exemplar effects arise in a lexical decision task, but only under adverse listening conditions. *Proceedings of the International Congress of Phonetic Sciences 2015*, Glasgow, Scotland.

Richtsmeier, P. T., Gerken, L. A., Goffman, L., & Hogan, T. (2009). Statistical frequency in perception affects children's lexical production. *Cognition*, 111(3), 372–377. Rost, G. C., & McMurray, B. (2009). Speaker variability augments phonological processing in early word learning. *Developmental Science*, 12(2), 339–349.

Sommers, M. S., & Barcroft, J. (2011). Indexical information, encoding difficulty, and second language vocabulary learning. *Applied Psycholinguistics*, 32(2), 417–434. Uchihara, T., Webb, S., Saito, K., & Trofimovich, P. (2021). The Effects of Talker Variability and Frequency of Exposure on the Acquisition of Spoken Word Knowledge. *Studies in S*econd *Language Acquisition*, 1-24.

Alexander Taikh, Christina Gagne and Thomas Spalding

Influence of morphological information on letter position coding.

Constituent morphemes are thought to contribute to the processing of multimorphemic words (e.g., Gagné et al., 2018), where constituent representations are accessed to help access the representation of the whole word. The letters straddling the morphemic boundary are thought to play a critical role in accessing the constituent morphemes relative to constituent internal letters (e.g., Lemhöfer et al., 2011). Across four experiments, we examined whether boundary letters contribute more to morphological decomposition of compounds than constituent internal letters. We use the transposed-letter priming effect, which refers to the finding that masked primes with transposed letters (e.g., higlhight) facilitate their targets (highlight) compared to primes with replaced letters (higmkight) (e.g., Perea & Carreiras, 2006), to examine the role of the boundary bigram in morphological decomposition of compounds.

In Experiment 1, masked compound primes with a letter transposition (vs. letter replacement) facilitated lexical decision responses to their compound targets (highlight) when the manipulation was at the boundary (higlhight vs. higmkight) but not when the letter manipulation was inside of the first constituent (hgihlight vs. hbohlight). In Experiments 2 and 3, we examined the effect of location on letter replacement and transposition. In Experiment 2, replacing letters at the boundary (vs. inside of the first constituent) of a masked compound prime interfered to a greater extent with recognizing the target compound. In contrast, in Experiment 3, transposing letters at the boundary (vs. inside of the first constituent) did not slow down recognition of the target. The findings of Experiments 1-3 suggest that replacing letters at the boundary, but not inside of the first constituent, interferes with processing of the compound, suggesting that letters at the morphemic boundary play a key role in morphological decomposition.

In Experiment 4, we examine the possibility that the findings of Experiments 1-3 could be driven by the degree of orthographic overlap between the masked compound primes and their targets. In Experiment 4, we replicate the findings of Experiment 1 with first constituent targets, suggesting that the replacing letters at the boundary influences activation of the constituents. inside of the compound prime.

References
Gagné,C. L., Spalding, T. L., Nisbet, K. A., & Armstrong, C. (2018). Pseudo-morphemic structure inhibits, but morphemic structure facilitates, processing of a repeated free morpheme. Language, Cognition and Neuroscience, 33, 1252-1274.
Lemhöfer, K., Koester, D., & Schreuder, R. (2011). When bicycle pump is harder to read than bicycle bell: effects of parsing cues in first and second language compound reading. Psychonomic Bulletin & Review, 18, 364-370.
Perea, M. & Carreiras, M. (2006). Do transposed-letter effects occur across lexeme boundaries? Psychonomic Bulletin & Review, 13, 418-422.

Gabriela Mariel Zunino

(Un)known semantic relations in Spanish: how syntax may condition the comprehension?

Temporality and causality are central conceptual dimensions for sentence and text comprehension (Zwaan & Radvansky, 1998). This type of semantic relations can be expressed through different syntactic constructions (Engelkamp, Rummer & Konieczsy, 2003; Rummer & Engelkamp, 2002). In addition, in a previous study that tried to investigate the effect of prior knowledge of the world during comprehension, we were able to notice that the processing pattern changes when the reader cannot involve their previous knowledge, an effect that is also found in several languages (Cozijin et al., 2011; Martins et al., 2006; Zunino, 2017). It is, then, to be expected that syntactic information and prior knowledge about the world is articulated during the understanding of semantic relationships.

We present here the results of a task that analyze the effect produced by the impossibility of involving prior world knowledge during the comprehension of sentences that express specific semantic relations (causal and temporal) with explicit semantic marks and if this effect is different for sentences that present different syntactic structures. That is, if simpler syntactic structures, both in their hierarchical complexity characteristic or in their linear distributional characteristic (Culicover, 2013) can facilitate the comprehension process in cases in which the semantic scaffolding provided by the prior knowledge is absent. Our two general hypotheses are: 1. Differences in syntactic structure will not generate effect when the semantic scaffolding of world knowledge is available; 2. Syntactic structure will have an effect when semantic scaffolding of world knowledge is not available.

We collected data of 287 participants (196 women; age: M=34,64.; SD=12,84). We presented a 2x2x2 design: Type of information (familiar vs. unfamiliar); Semantic relation (causal and temporal); Syntactic structure (coordination vs subordination). The items were organized into 12 counterbalanced lists of 16 experimental items and 12 fillers (Table 1). In order to evaluate this, we programmed and performed a sentence comprehension task in PCIbex (Zehr *et al.* 2018). Sentence reading times, response types and times were recorded.

We used Generalized Linear Models and Linear Mixed Models for the analysis. The results show that for the response accuracy (Figure 1) there is a main effect of Type of information (�� = 1.98; z = -9.37; p <0.001) and Semantic relation (�� = 0.49; z = -2.39; p = 0.001). The syntax shows a significant effect for temporal items (for familiar information: �� = 0.85; z = -1.96; p = 0.04; for unfamiliar information: �� = -1.83; z = -5, 79; p <0.001). For reading times (Figure 2), we found both main effects of Type of information (�� = 0.53; t = 2.85; p <0.001) and Semantic relationship (�� = 0.09; t = 3, 89; p <0.001), and an interaction between them (�� = 0.14; t = 2.98; p = 0.003).   The effect of Syntactic structure nested in Semantic relation was verified. For response times (Figure 3), the pattern is similar although inverse (in favor of temporal relations) and without any effect of Syntactic structure on causal relations.

The data presented here only partially support our initial hypotheses showing a complex picture that will require specific confirmatory studies. Especially, we found that coordinated structures, syntactically simpler, also show less processing complexity; that is, certain syntactic structures could better scaffold the process of comprehension of certain semantic relations that are unknown or new to the reader. In this work, unlike those that present sentences with pseudo-words (jabberwocky), we were able to analyze the problem with greater ecological validity and begin to

study one of the many obstacles that we may find when we learn about unknown topics from texts.
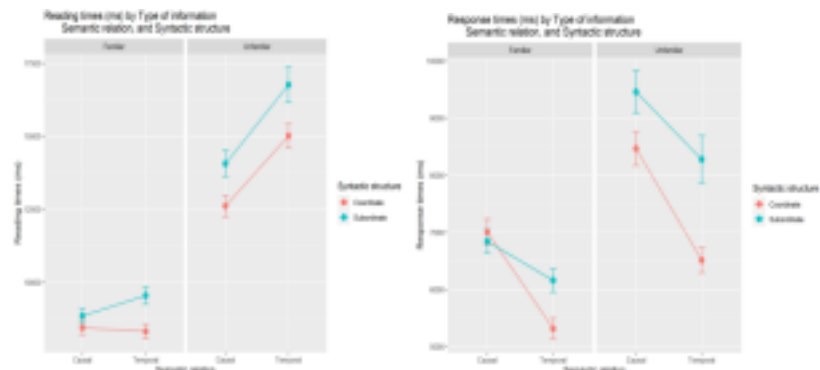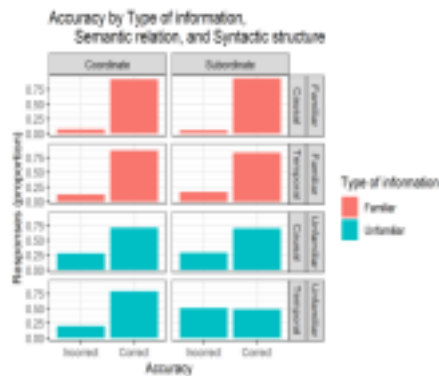

Figure 1 Figure 2 Figure 3

Table1

Familiar-Causal-Coordinate	*Rafael tiene un trabajo muy estresante, entonces a mitad de año ya está terriblemente cansado. [Rafael has a very stressful job, so by the middle of the year he is already terribly tired.]*
Familiar-Causal-Subordinate	*A mitad de año Rafael ya está terriblemente cansado debido a que tiene un trabajo muy estresante.*
Familiar-Temporal-Coordinate	El carpintero reparó los muebles viejos de la cocina, después Martina reorganizó la vajilla de su madre. [*The carpenter repaired the old kitchen furniture, then Martina rearranged her mother's dishes.*]
Familiar-Temporal-Subordinate	Martina reorganizó la vajilla de su madre después de que el carpintero reparó los muebles viejos de la cocina.
Unfamiliar-Causal-Coordinate	*El análisis de la superficie se realizó mediante fractografía, entonces proporcionó datos sobre la dirección de propagación. [The analysis of the surface was performed by fractography, then it provided data on the direction of propagation.]*
Unfamiliar-Causal-Subordinate	*El análisis de la superficie proporcionó datos sobre la dirección de propagación debido a que se realizó mediante fractografía.*
Unfamiliar-Tempora-Coordinate	Las ciclinas se unen con quinasas, después se activan otras proteínas a través del proceso de fosforización. [*Cyclins bind with kinases, then other proteins are activated through the phosphorization process.*]

Unfamiliar-Temporal-Subordinate	Se activan otras proteínas a través del proceso de fosforización después de que las ciclinas se unen con quinasas.

References

Cozijn, R., Noordman, L. Vonk, W. (2011). Propositional Integration and World-Knowledge Inference: Processes in understanding *because* sentences. *Discourse Processes,* 48(7), 475-500. Culicover, P. (2013). *Grammar and Complexity. Language at the interception of Competence and Performance.* Oxford: Oxford University Press.

Engelkamp, R., Rummer, J. & Konieczsy, L. (2003). The subordination effect: Evidence from Self-paced reading and recall. *European Journal of Cognitive Psychology*, 15(4), 539-566.

Martins, D., Kigiel, D., Jhean-Larose, S. (2006). Influence of Expertise, Coherence, and Causal Connectives on Comprehension and Recall of an Expository Text. *Current psychology letters*, 20 (3), 1-13. Rummer, J. & Engelkamp, R. (2002). Subordinating conjunctions as devices for unifying sentences in memory. *European Journal of Cognitive Psychology*, 14(3), 353-369.

Zunino, G. M. (2017). Procesamiento de causalidad y contracausalidad: interacciones entre estructura sintáctica   y conocimiento del mundo en la comprensión de relaciones semánticas. *Signos. Revista de Lingüística*, 50(95), 472-491.

Zwaan, R.& Radwansky, G. Situation Models in Language Comprehension and Memory. *Psychological Bulletin*, 123, 162-185, 1998.

Taylor Melvie, Alexandre Taikh, Christina Gagné and Thomas Spalding

The effects of masked pseudo-compound and compound words on constituent processing

As shown in constituent repetition priming studies (Gagné et al., 2018), readers access morphemic information from pseudo-constituents in pseudo-compound words and constituents in compound words (e.g., they access the pseudo-morpheme *sea* in *seabird* and the morpheme *sea* in *season*). Across four masked priming lexical decision experiments, we examine whether readers also access the semantics of these pseudo-constituents and constituents. Experiments 1 and 2 show that masked pseudo-compound and compound primes do not influence lexical decision responses to semantic associates of their first pseudo-constituents or constituents (e.g., *seabird* and *season* do not influence the ease of processing *ocean*, an associate of *sea*). Experiments 3 and 4 show that an associate of the first constituent does facilitate the response to the compound but does not influence response times to the pseudo-compound (*ocean* facilitates recognition of *seabird* but not *season*). Our results suggest that the semantics of the pseudo-constituents and constituents are not necessarily accessed even if the morphemes are accessed. Exposure to a pseudo-compound did not influence the processing of a semantic associate of an embedded morpheme, nor did exposure to that associate influence the processing of the pseudo-compound. Compounds, on the other hand, appear to show a directional difference. Although exposure to a compound did not influence the processing of a semantic associate of the first constituent, the semantic associate of the first constituent did facilitate processing of the compound. We confirmed that the processing of ocean was aided by the presentation of sea, yet this benefit was not observed when sea was embedded as part of a pseudo-compound (e.g., *season-ocean* and *ocean-season*) or following the presentation of a

compound (e.g., *seabird-ocean*), but was observed when the compound was the target (e.g.,

ocean-seabird).

Juliet Huynh and Naoko Witzel
Translation priming in Vietnamese heritage language speakers: The role of language dominance

Much of our understanding on how bilinguals organize their two languages have been based on evidence from masked translation priming studies. These studies have consistently shown priming in the L1-L2 direction but not as consistently in the L2-L1 direction. When bilinguals that are tested have a more dominant L1, L2-L1 priming fails to be obtained (Gollan et al., 1997; Jiang, 1999). However, when the bilinguals tested are balanced (Duñabeitia et al., 2010; Sabourin et al., 2014; Wang, 2013), early (Sabourin et al., 2014), L2-dominant (Basnight-Brown & Altarriba, 2007), or very highly-proficient in their L2 (Nakayama et al., 2018), then L2-L1 translation priming is observed. This observation seems to suggest that the relative dominance between the L1 and the L2 plays a crucial role in whether a word in one language can prime its translation in another language. This study examines the translation priming pattern in heritage language (HL) speakers, whose relative language proficiency between the L1 (in this case, Vietnamese) and the L2 (English) has completely switched. HL speakers have an L1/HL that is not dominant because of its minority status in the place of residence, and they are more proficient in their L2 because of its majority status. If relative proficiency plays a critical role, then there should only be L2-L1/HL priming since these speakers are more dominant in their L2.

Vietnamese heritage language speakers performed lexical decision tasks (LDT) that employed the regular three-field masking procedure in two experiments. In Experiment 1 (N=26), participants were presented with L1/HL Vietnamese targets (*MẮT*, translation: "eye") that were preceded by primes that were either a repetition of the target (*mắt*) or an L2 English translation of the target (*eye*). Conversely, in Experiment 2 (N=24), participants were presented with L2 English targets (*EYE*) that were presented by primes that were either a repetition of the target (*eye*) or the L1/HL translation (*mắt*).

In both Experiments 1 (Vietnamese) and 2 (English), priming was found in the repetition condition. The priming found in the repetition condition suggests that participants were able to process the prime in the LDT. As for the translation condition, priming was only found in the L2-L1/HL direction which can be expected since these participants were dominant in their L2. The lack of priming in the L1/HL-L2 direction was surprising since previous literature has shown L1-L2 priming consistently. Additionally, studies that included L2-dominant bilinguals were able to observe priming in both L1-L2 and L2-L1 directions (Basnight-Brown & Altarriba, 2007). It seems to be the case that the bilinguals in this study must have a weak L1/HL that cannot prime translations in the other language when the masked priming procedure is used. However, their L2 is dominant enough to prime its L1 translations. Hence, it seems as though

relative proficiency of bilinguals' two languages affect the pattern of translation priming results. These results will be interpreted within current bilingual lexical processing models.

References:

Basnight-Brown, D. M., & Altarriba, J. (2007). Differences in semantic and translation priming across languages: The role of language direction and language dominance. *Memory & Cognition, 35,* 953-965.

Dubey, N., Witzel, N., & Witzel, J. (2018). Script differences and masked translation priming: Evidence from Hindi-English bilinguals. *Quarterly Journal of Experimental Psychology*, *71*, 2421-2438.

Duñabeitia, J. A., Perea, M., & Carreiras, M. (2010). Masked translation priming effects with highly proficient simultaneous bilinguals. *Experimental Psychology*, *57*, 98-107.

Fricke, M., Zirnstein, M., Navarro-Torres, C., Kroll, J. F. (2019). Bilingualism reveals fundamental variation in language processing. *Bilingualism: Language & Cognition*, *22*, 200-207.

Gollan, T., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and non-cognates in Hebrew and English. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*, 1122-1139.

Jiang, N., & Forster, K. I. (2001). Cross-language priming asymmetries in lexical decision and episodic recognition. *Journal of Memory and Language*, *44*, 32-51.

Nakayama, M., Lupker, S. J., & Itaguchi, Y. (2018). An examination of L2-L1 noncognate translation priming in the lexical decision task: insights from distributional and frequency-based analyses. *Bilingualism: Language and Cognition, 21*, 265-277.

Sabourin, L., & Haverkort, M. (2003). Neural substrates of representation and processing of a second language. *Language Acquisition and Language Disorders*, *30*, 175-196.

Wang, X. (2013). Language dominance in translation priming: Evidence from balanced and unbalanced Chinese-English bilinguals. *Quarterly Journal of Experimental Psychology, 66*, 727-743.

Witzel, N. (2019). Can masked synonym priming replicate masked translation priming? *Quarterly Journal of Experimental Psychology*, *72*, 2554-2562.

Melanie Labusch, Stéphanie Massol, Ana Marcet and Manuel Perea

Are goats chèvres, chévres, chēvres, or chevres? - Cracking the orthographic code of diacritical vowels

An often overlooked but critical issue of visual word recognition and reading in the vast majority of Latin-based languages, English being a rare exception, is how the word recognition system encodes diacritical marks. As they were postulated for English, most computational and neurally-inspired models of visual word recognition do not mention how diacritical vowels are represented in the mental lexicon (e.g., Davis, 2010; Dehaene, Cohen, Sigman, & Vinckier 2005). Do vowels diacritical and non-diacritical vowels share the same abstract letter units? Recent research in Spanish, a language in which diacritics indicate lexical stress, has shown that the omission of these marks does not hinder word recognition. In contrast, in German, a language in which diacritics indicate vowel quality, the deletion of diacritics hinders word recognition (Perea, Labusch, & Marcet, 2021). To further examine the role of diacritical marks on lexical access, we conducted two blocks of experiments with a semantic categorization task (animal vs. non-animal). We chose French because it contains a richer set of diacritical vowels than Spanish or German. In the first block of experiments (Experiments 1-3), we selected diacritical words (e.g., `chèvre` [goat]), whereas, in the second block (Experiments 4-5), we selected a set of non-diacritical words (e.g., `cheval` [horse]). In the first block, we compared performance in the intact condition (i.e., diacritical words) relative to a condition where the diacritics were omitted (e.g., `chevre`; Experiment 1), replaced with another existing diacritic (e.g., `chévre`; Experiment 2), or replaced with a non-existing diacritic (e.g., `chēvre`, Experiment 3). In the second block, we compared the intact condition (non-diacritical words) relative to a condition where an existing (e.g., `chèval`; Experiment 4) or non-existing diacritic was added (e.g., `chēval`; Experiment 5). Results showed a reading cost, relative to the intact condition, for non-diacritical words with the extra diacritics. For the diacritical words, there was no reading cost when the diacritics were omitted or when they were replaced with a non

existing diacritic, but a reading cost occurred when there was a change of diacritics with a different phonology (e.g., `chévre` slower than `chèvre`; é /e/, but è /ɛ/). We discuss how future implementations of computational models of visual-word recognition may account for these findings.

References

Davis, C. J. (2010). The spatial coding model of visual word identification. Psychological Review, 117, 713–758. https://doi.org/10.1037/a0019 738

Dehaene, S., Cohen, L., Sigman, M., & Vinckier, F. (2005). The neural code for written words: A proposal. Trends in Cognitive Sciences, 9, 335–341. https://doi.org/10.1016/j.tics.2005.05.004

Perea, M., Labusch, M., & Marcet, A. (2021). How are words with diacritical vowels

represented in the mental lexicon? Evidence from Spanish and German. *Language, Cognition, and Neuroscience.*

Zhiyi Wu

Native Processing of Mandarin Separable Compounds: An Anti-frequency Effect in Visual Lexical Decision?

As a phenomenon that exists in almost all languages, compounding has received lots of attention in research over many decades. One major issue that has been questioned for decades is whether compound words are processed as a whole or via their components. As traditional inseparable compound words have dominated this subfield, little attention has been given to a unique type of two-character verb + noun compound verbs in Mandarin Chinese, whose two characters are regularly separated by different types of information without changing their one-unit meanings or parts of speech. For instance, the word "离婚" (to divorce) can be separated by "了两次" (past tense + twice) and become "离了两次婚" (divorced twice) without losing the compound word's original meaning or part of speech. With this special feature, these separable compounds have the potential to provide new insights for our understanding of the processing of morphologically complex words.

The current project aims to find out how these separable compounds are processed by both native speakers (NS) and non-native speakers (NNS). As the starting point of this ongoing project, we analyzed the RT data of separable compounds found in an existing small-scale corpus study collected in a Lexical Decision Task for the SUBTLEX-Ch corpus (Cai & Brysbaert 2010). In this corpus study, the researchers used 400 real two-character words, 27 of which are separable compounds. Here, we report preliminary results on how the RT of the separable compounds correlate to their whole-word frequencies, character frequencies, character family sizes, and separability in order to explore how Mandarin NS process separable compounds.

Twelve native Mandarin speaking participants participated in the study, which included a visual lexical decision task in which participants saw a series of combinations of two characters on the screen. They were asked to press respective keys to decide whether each stimulus was a real Chinese word or a made-up combination of two characters. We analyzed whether the RT of these separable words correlated with the frequencies and the family sizes of both characters, whole word frequency, and their separability. It was found that the first character frequency (r=-0.397; p=0.04) and whole word frequency (r=-0.413; p=0.032) are both negatively correlated with RT, while the others have no significant correlation with RT. In other words, the more frequent the first character frequency and the whole word frequency, the slower the participants respond to the words.

This preliminary result is surprising, as it is against the facilitative frequency effects that have been supported many times by a multitude of studies. If the pattern of this result is upheld once our own data collection is complete and analyzed, it may suggest that not only native Mandarin speakers tend to process words character by character as well as on a whole-word basis, but also higher frequency words may create more burden, resulting in the slowed-down responses.

Moreover, the result also provides support for the dual-route models, suggesting that these compounds are accessed through decomposition and whole words in parallel (e.g., Caramazza et al. 1988).

Daniel Schmidtke, Sadaf Rahmanian and Anna Moro

Reading experience drives L2 reading development:
a longitudinal study of EAL reading habits

Background

International university students who speak English as an additional language (EAL) account for a large proportion of students in English-speaking Western universities (Juffs, 2020). In Canada, international students made up 14% of all enrolments in higher education in 2017-2018, with students from China making up the largest share of international students (28%) out of all countries
(Statistics Canada, 2020). A recent study showed that higher literacy skills explained almost 10% of the variance in EAL students' grades, but only 0.05% in those of domestic students (Trenkic & Warmington, 2019). It is therefore crucial to understand the factors that contribute to second language (L2) reading ability in EAL students to gain insight into how to support their reading development.

Current study

The present study addresses an under-researched aspect of EAL reading: namely, the impact of reading experience on the development of EAL reading efficiency. We collected week-by-week longitudinal data on the reading habits of Chinese-speaking EAL students enrolled in a university bridging program. Two research questions were addressed: (i) *what is the impact of 26 weeks of language instruction on developmental change in reading speed?*, and (ii) *do individual differences in reading experience translate into individual variability in reading speed gains?*
Theoretical accounts of reading development propose that practice with reading promotes greater reading fluency, either via the development of word decoding skills through self-teaching (Share, 1995), or through more efficient word identification resulting from stronger mappings between orthographic form and meaning (Lexical Quality Hypothesis; Perfetti, 2007), or via a combination of both. We therefore expected that students would become faster readers over time as the instructional program progressed. Additionally, we expected that, within the same 26-week period, students who read more texts would enjoy additional advantages to reading speed gains.

Method

Data was collected from a total of 148 (61 Female, 79 Male, 8 undisclosed) EAL students enrolled in an eight-month university bridging program. Participants completed a reading habits survey twice a week for a total of 26 weeks, which asked participants to provide information about their weekly reading activities, such as the type of reading, the purpose of the reading, the number of pages they read and how long they read for. Reading speed was defined as the number of pages per reading activity divided by number of minutes per reading activity (minutes per page).

Results

Results showed that English language learners spent less time reading per page of text by program end, showing a significant linear weekly increase in reading speed (Figure 1).

Moreover, there was a significant effect of reading experience: learners who read more pages of text than their peers by the end of the bridging program also tended to make the largest net gains in reading speed (Figure 2). Moreover, both effects were present after controlling for vocabulary size measured at the outset of the program. The results support the idea that reading experience is a factor that contributes to reading development in English language learners. We discuss theoretical and pedagogical implications.
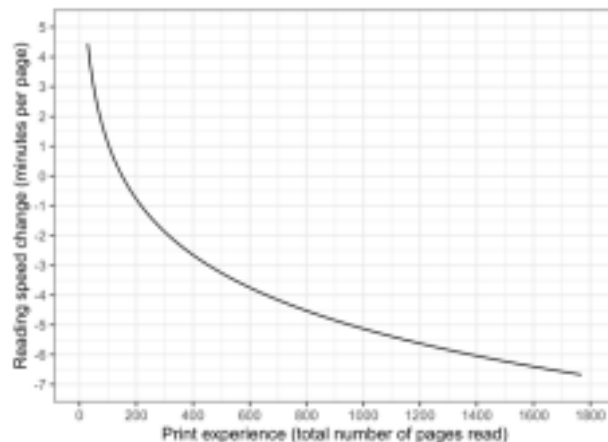
Figure 1. Observed mean reading speed and error bars representing 1 standard error across the duration of the study. Also shown is the best fitting partial regression slope for the effect of Week.
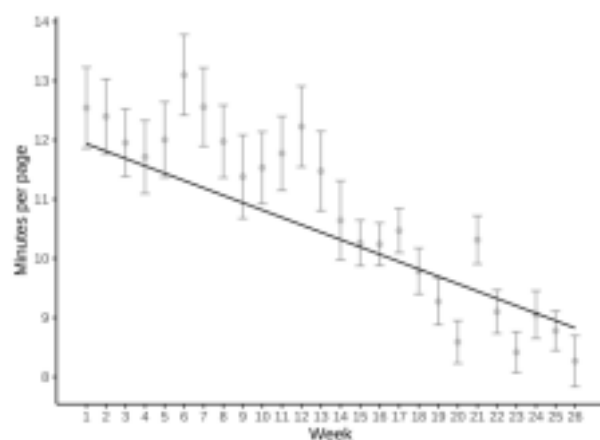
Figure 2. The partial effect of reading experience (linear scale) on change in reading speed. Change measure based on individual predicted growth curves.

References

Juffs, A. (2020). *Aspects of language development in an intensive English program*. Routledge: New York.

Perfetti, C. A. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading, 11*(4), 357-383.

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55*(2), 151-218.

Statistics Canada (2020). International student enrolments at Canadian public colleges and universities, 2017/2018. Retrieved from https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020006-eng.htm

Trenkic, D., & Warmington, M. (2019). Language and literacy skills of home and
    international university students: How different are they, and does it matter?
    Bilingualism: Language and Cognition, 22(2), 349-365.

Patience Stevens and David C. Plaut

Orthographic-semantic consistency as a measure of graded morphological information

How does morphological information impact how we recognize written complex words? In recent years, theorists have shifted away from the idea that morphemes are discretely represented via decomposition of complex words, in favor of more graded sensitivity to morphological information (e.g., Marelli et al., 2020; Baayen et al., 2011). If morphological information is viewed as a matter of degree, a key question becomes how to quantify the semantic consistency of a string of letters across words.

One candidate for such a metric is *orthographic-semantic consistency* (OSC; Marelli et al., 2018). OSC refers to the frequency-weighted semantic similarity between a standalone stem and the words containing it. For example, words that contain TRUST (DISTRUST, TRUSTEE) tend to be fairly similar in meaning to TRUST, whereas words that contain WHISK (WHISKER, WHISKEY) are less similar to WHISK. Thus, TRUST has high OSC and is more "morphological", whereas WHISK has low OSC and is less "morphological". However, the current OSC measure is limited in that it only applies to letter stringsthat also exist as standalone words. Additionally, the precedence given to the standalone word in this approach may be unwarranted. **The current work proposes a new way to calculate orthographic-semantic consistency to improve its utility as a morphological metric, and examines the empirical significance of this metric in the context of masked morphological priming.**

The new OSC calculation uses semantic distances relative to the centroid of the cluster of word meanings, rather than relative to the standalone stem's meaning. The validity of this metric was assessed using data from prior lexical decision studies (Balota et al., 2007; Rastle et al., 2000; Rastle et al., 2004; Andrews & Lo, 2013; Jared et al., 2017). The new OSC proved a stronger predictor of masked morphological priming, whereas the original better predicted unprimed stem lexical decision latencies. This suggests that the new metric more directly captures morphological information supplied by a letter string.

Next, a masked priming study was conducted with 44 college undergraduates to investigate whether the OSC metric is a stronger predictor of semantically *opaque* morphological priming (i.e., priming between seemingly related word pairs that are not similar in meaning, such as CORNER-CORN, DEPARTMENT-DEPART) than of *transparent* priming. Given that opaque priming appears to be due to the typically informative nature of the shared substring, with little support from shared semantics, high-OSC stems might yield stronger priming in this case. Prime-target pairs were selected so that OSC varied maximally within each condition (opaque and transparent), while minimizing correlations of OSC with other item characteristics such as frequency and family size. A significant interaction of relatedness and OSC was found ($t = -0.09$, $p = 0.01$). These interactions became marginal when separately considered for opaque ($t = -0.10$, $p = 0.09$) and transparent ($t = -0.08$, $p = 0.1$) items, and there was no evidence that OSC is a stronger predictor of opaque than of transparent morphological priming. This work will be continued with derived targets and bound stems.

The current work provides and assesses a valid and more flexible variation of orthographic-semantic consistency, to measure morphological information carried by any letter string. OSC is shown to predict morphological masked priming magnitudes for both

semantically opaque and transparent prime-target pairs, suggesting that early morphological processing is influenced more strongly by the shared morpheme's OSC than by prime transparency.

Figures

Effect of OSC on Morphological Priming in Adult Readers
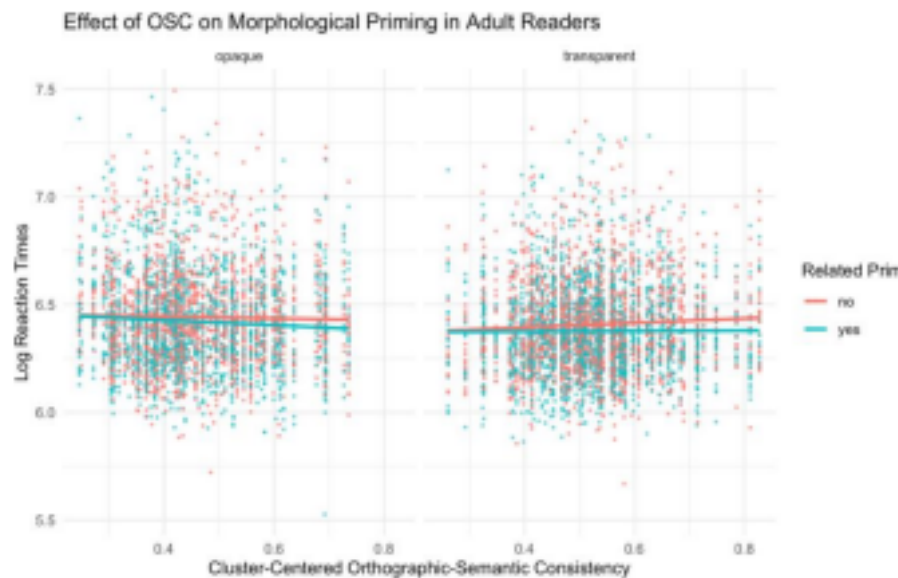
References

Andrews, S., & Lo, S. (2013). Is morphological priming stronger for transparent than opaque words? it depends on individual differences in spelling and vocabulary. *Journal of Memory and Language*, *68*(3), 279–296.

Baayen, R. H., Milin, P., Rević, D. F., Hendrix, P., & Marelli, M. (2011). An Amorphous Model for Morphological Processing in Visual Comprehension Based on Naïve Discriminative Learning. *Psychological Review*, *118*(3), 438–481.

Balota, D. A., Yap, M. J., Hutchison, K. A., Cortese, M. J., Kessler, B., Loftis, B., ... & Treiman, R.(2007). The English lexicon project. *Behavior research methods*, *39*(3), 445-459. Jared, D., Jouravlev, O., & Joanisse, M. F. (2017). The effect of semantic transparency on the processing of morphologically derived words: Evidence from decision latencies and event-related potentials. *Journal of Experimental Psychology: Learning Memory and Cognition*, *43*(3), 422–450.

Marelli, M., & Amenta, S. (2018). A database of orthography-semantics consistency (OSC) estimates for 15,017 English words. *Behavior research methods*, *50*(4), 1482-1495. Marelli, M., Traficante, D., & Burani, C. (2020). Reading morphologically complex words: Experimental evidence and learning models. In V. Pirrelli, I. Plag, & W. U. Dressler (Eds.), *Word knowledge and word usage: A cross-disciplinary guide to the mental lexicon* (pp. 553-592). de Gruyter Mouton.

Rastle, K., Davis, M. H., Marslen-Wilson, W. D., & Tyler, L. K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes*, *15*(4-5), 507–537.

Rastle, K., Davis, M. H., & New, B. (2004). The broth in my brother's brothel: Morpho orthographic segmentation in visual word recognition. *Psychonomic Bulletin and Review*,11(6), 1090–1098

Owen Kapelle and Simone Sprenger

On the Nature of a Metrical Frame in the Lexicon: A pupillometric study on how the word production process is affected by incongruent word stress distractors

According to a well-known model of language production by Levelt et al. (1999), word retrieval during language production is divided into a conceptual lexical processing stage and a word form stage. For words that do not adhere to the default stress pattern of a language, they postulate a 'minimal metrical frame' specifying the "lexical word's number of syllables and main stress position" (p. 21), which can be retrieved during form encoding. They define the default stress (that is, the most frequent stress pattern) in Dutch as the first syllable of the word with a full vowel (p. 22). However, there is little empirical evidence for both the existence of a minimal metrical frame and whether such a frame is stored only for non-default stress patterns. This definition of default stress (which explicitly does not feature syllable weight) has been debated (van Oostendorp, 2012). Furthermore, studies that assumed the same definition for default stress found no effect of stress placement on processing (Schiller et al., 2003). The current study tests the idea of the retrieval of a minimal metrical frame representation in the lexicon for words with the most robust definition of irregular word-stress: bisyllabic words with final superheavy syllables that are not stressed (van Oostendorp, 2012). To test the sensitivity of the lexical retrieval process to interference from incongruent rhythmic patterns of words as well as from more abstract stimuli intended to represent a metrical frame, a web-based picture-word-interference pilot was carried out. In the abstract stimuli, the metrical information (number of syllables and stress placement) of the word was maintained, but otherwise the word was synthesized into a tone not containing other linguistic information. Pilot results suggest an effect of congruency of the distractor sound on lexical retrieval time. The lexical retrieval process of a picture name is sensitive to rhythmic alterations in irregularly stressed words but not in regularly stressed words. This effect also results from abstract rhythmic distractors: Both the word and abstract tone conditions showed a similar interference effect of incongruent stress placement during picture naming compared to the non-rhythmic control condition, while congruent stress placement showed a facilitation effect. The current study aims to replicate the facilitative versus interference effect of such non-linguistic tones on irregularly stressed words during picture naming using pupillometry to identify the mental effort involved in processing incongruent stress patterns. Results will test the methodological validity of abstract stimuli as well as reveal more about the process of lexical retrieval and the nature of minimal metrical frames within the model of Levelt et al. (1999).

Keywords: *language production, pupillometry, word stress processing, picture-word-interference task, metrical frame*

Works Cited

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, *22*(1), 1–38. https://doi.org/10.1017/S0140525X99001776

van Oostendorp, M. (2012). Quantity and the Three-Syllable Window in Dutch Word Stress: Dutch Word Stress. *Language and Linguistics Compass*, *6*(6), 343–358. https://doi.org/10.1002/lnc3.339

Schiller, N. O., Fikkert, P., & Levelt, C. C. (2004). Stress priming in picture naming: An SOA study. *Brain and Language*, *90*(1–3), 231–240. https://doi.org/10.1016/S0093-934X(03)00436-X

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Massive Variation in Spontaneously Spoken German due to strong Coarticulation in Relation to Word Position and Word Frequency

It is widely accepted that the surface form of words shows tremendeous amount of variation that ranges on a continuum between enhancement, and phonetic and phono logical reduction. Sources of variation can be phonetic and phonological, such as hyper and hypoarticulation [8] or prosodic phrasing [e.g. 7]; or they can be lexical such that more frequent and more contextually predictable words are stronger reduced and have fewer segments than less frequent and less predictable words [e.g. 2, 3]. However, regard ing the effect of predictability and word frequency, the effect is not as crisp as typically assumed, since more frequent words are not simply stronger reduced than less frequent words. Rather they also exhibit more different word forms. For example, Greenberg [5] has identified over 80 (!) different forms for the high frequency English word 'and'. And at times, these word-form variants are not even predictable by general phonological rules [5, 6, 4]. Rather, their amount and form are strongly associated with their word class and, more importantly, with their collocate diversity, i.e. the amount of tokens a word occurs in the speech signal [9]. Previous studies on variation focused on whole word form and ignored the source of variation. A very likely soure of coarticulation, one that is typ ically captured by phonological rules, is preservatory and anticipatory coarticulation [e.g. ?]. Accordingly, the present study investigates the probability of coarticulation between neighboring segments. Moreover, according to the Discriminative Learning perspective [e.g. 10], word onsets predict different types of events than word centers and word offsets, which is why they should undergo different types of variation, e.g. due to coarticulation. This raises the question, to what degree variation depends on these position in the word.

This question was answered by investigating word material from narrowly annotated 5-minute-long-recordings of 49 speakers from the Karl-Eberhards-Corpus of spontaneous Southern German [1]. A qualitative analysis indicates that not only did speakers use phones typically not associated with German (such as [w] or [ì] and even [!]). The analysis also indicates that, as in English, word forms show massive variation in their phonetic forms. For example, the word 'irgendwie' *somehow* occurred 195 times in the annotated sample in 107 different phonetic forms. Critically, the amount of phonetic variants of a word is correlated with word frequency and, in line with Linke and Ramscar [9], collocate diversity.

At the segmental level this variation is systematic: it can be explained to result due to coarticulation between sounds in question and preceding and upcoming sounds in terms of their similarity of horizontal position, labialization, voicing phonetic features. The probability of coarticulation depends on a five-way interaction between a) the position in the word, b) word frequency, c) the place of articulation of preceding and following segments and d) by their sound class, i.e. whether they are vowels or consonants. The complexity of the interaction and the effects indicates that phonetic variation is hard to predict simply on the basis of phonological rules. Seen from a Discriminative Learning perspective [e.g. 10], the results indicate hat variation is strongly context dependent and optimized for predicting upcoming events.

References

[1] Arnold, D. and Tomaschek, F. [2016], The Karl Eberhards Corpus of spontaneously spoken Southern German in dialogues - audio and articulatory recordings, *in* C. Draxler and F. Kleber, eds, 'Tagungsband der 12. Tagung Phonetik und Phonologie im deutschsprachigen Raum', Ludwig-Maximilians-Universit¨at M¨unchen, pp.

9–11.

[2] Aylett, M. and Turk, A. [2004], 'The Smooth Signal Redundancy Hypothesis: A functional explanation for relationships between redundancy, prosodic prominence, and duration in spontaneous speech', *Language and Speech* 47(1), 31–56.

1

[3] Bell, A., Brenier, J. M., Gregory, M., Girand, C. and Jurafsky, D. [2009], 'Predictability effects on durations of content and function words in conversational English', *Journal of Memory and Language* 60(1), 92 – 111.

[4] Dilts, P. C. [2013], Modelling phonetic reduction in a corpus of spoken English using Random Forests and Mixed-Effects Regression, Thesis.
URL: *https://era.library.ualberta.ca/public/view/item/uuid:383d9a26-35f7-43f9-8624-25ce5d2011ed*

[5] Greenberg, S. [1999], 'Speaking in shorthand - A syllable-centric perspective for understanding pronunciation variation', *Speech Com munication* 29, 159–176.

[6] Johnson, K. [2004], Massive reduction in conversational American English, *in* 'Spontaneous speech: data and analysis. Proceedings of the 1st session of the 10th international symposium', The National International Institute for Japanese Language, Tokyo, Japan, pp. 29–54.

[7] Keating, P., Cho, T., Fougeron, C. and Hsu, C.-S. [2003], Domain-initial strengthening in four languages, *in* 'Papers in laboratory phonology VI: Phonetic interpretations', Cambridge, UK: Cambridge University Press, pp. 145–163.

[8] Lindblom, B. [1990], Explaining Phonetic Variation: A Sketch of the H&H Theory, *in* A. Marchal and W. Hardcastle, eds, 'Speech Production and Speech Modelling', Vol. 55, Springer Netherlands, pp. 403–439.

[9] Linke, M. and Ramscar, M. [2020], 'How the Probabilistic Structure of Grammatical Context Shapes Speech', *Entropy* 22(1), 90. Publisher: Multidisciplinary Digital Publishing Institute.

[10] Ramscar, M., Yarlett, D., Dye, M., Denny, K. and Thorpe, K. [2010], 'The Effects of Feature-Label-Order and their implications for symbolic learning', *Cognitive Science* 34(6), 909–957.

Bryor Snefjella and Idan Blank

The English Lexicon Imputation Project

The psycholinguistic study of word processing is severely hindered by missing lexical data: different datasets of lexical features rarely cover the same word and, for many features, coverage of the lexicon is far from exhaustive. We present the largest set of lexical features ever created, covering more than 400,000 orthographic forms, and more than 400 lexical features, generated via computational extrapolation. We call the resulting resource the English Lexicon Imputation Project (E-LIP).

Like previous attempts to replace empirical measurement of lexical features with statis tical estimation, E-LIP essentially comprises of two steps: (1) use the empirically measured features available for a subset of the lexicon to train a model that predicts those features from word embeddings; and (2) use this model to predict these features for words without empirical measurements, based on those words' embeddings. However, unlike all previously released resources, E-LIP is grounded in the statistical theory of missing data imputation, as recommended by Snefjella and Blank (2020). It uses a method known as multiple im putation, whose key insights informing our resource include: (1) Missing values should be imputed with random draws from a Bayesian posterior distribution conditioned on the ob served data; (2) Each missing value should be imputed $m > 1$ times, with a large m when more data is missing; (3) Analyses should be repeated over the $m > 1$ imputed datasets, and the results pooled, to incorporate the additional uncertainty that missing data implies; (4) The imputation model should be conditioned on any dependent variables of any subsequent analyses (e.g., lexical decision RTs); and (5) The imputation model must make compatible assumptions with any later analyses. Our extrapolations are unique in fulfilling these 5 criteria.

To meet these criteria, we use a deep neural network multiple imputation method, the multiple imputation importance weighted autoencoder (MI-WAE Mattei and Frellsen, 2019). This technique provides an efficient and flexible method for performing multiple imputation in high dimensions, as required in this context (given the high dimensionality of word em beddings). New imputations can be easily generated from the trained model, allowing easy fulfillment of criteria (1)-(3). Unlike all previous attempts to impute missing lexical features, we condition this model not only on pretrained word embeddings but, critically, on all extant, partially observed empirical lexical features, and a wide array of behavioural measurements in a variety of word processing tasks, including lexical decision, semantic decision, recog nition memory, self-paced reading, and eye-tracking, as required by criterion (4). Imputed lexical features include every semantic, orthographic, and single-word phonological feature we could locate open source data for in the psycholinguistics literature. The flexibility of MI WAE allows for E-LIP to be used in analyses that test for non-linearities and interactions, i.e. there is minimal risk of violation of criterion (5).

We present the resource, the architecture of the autoencoder, simulations of its efficacy as an imputation method, an example use case, and argue that multiple imputation is under used in word processing studies. We also discuss limitations of the resource and statistical estimation of lexical features in general. We argue that the use of imputed lexical features from E-LIP should replace the de-facto methodological default of complete case analyses (analyzing only words with existing complete lexical

features), as this practice is likely to yield biased and low-powered analyses.

1

References

Mattei, P.-A., & Frellsen, J. (2019). Miwae: Deep generative modelling and imputation of incomplete data sets. *International Conference on Machine Learning*, 4413–4423.
Snefjella, B., & Blank, I. (2020). Semantic norm extrapolation is a missing data problem.

Jordan Gallant[1,2], Gary Libben[2] & Laurie Beth Feldman[3]

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Spaced-out compounds: What orthographic alteration can and cannot tell us about morphological processes in production

During typed production, central linguistic processes interact with peripheral motor processes in a cascaded manner. The result is that the latency of individual keystrokes is not only affected by the letter being typed, but by the context in which that letter is embedded. Previous studies have shown that sub-lexical linguistic structures, such as compound constituency, influence typing latency (e.g., Libben & Weber, 2014). A common finding reported in this literature is elevated inter-keystroke intervals at constituent boundaries, which suggests that compound constituents function as production units. However, it is uncertain whether the role of constituents in production derives from their status as compound constituents or their status as whole-words. We sought to understand the interplay between constituent and whole-word factors by investigating the production of compounds that were highly controlled.

Our stimulus set contained 26 pairs of compounds, each of which shared the same head constituent (C2). The modifier constituents (C1) in each pair differed in their positional compound family size. One example of a compound pair is *'yearbook'* with a C1 family size of 2, and *'workbook'* with a C1 family size of 44.

We report two experiments. In Experiment 1, we investigated typing of these compounds in a type-to-copy task with 66 participants. In our analysis, we considered C1 positional family size, C1 whole-word frequency, C2 whole-word frequency, and compound word frequency as predictor variables. Our dependent variables were first keystroke latency, inter-keystroke interval, C1 typing time, and C2 typing time.

In Experiment 2, we sought to determine to what extent these properties are morphological and cognitive in nature and to what extent they are associated with the particular orthographic conventions of English (i.e., that these English compounds are written without spaces). To do this, we examined the typing of the same compounds with spaces inserted to determine whether these effects could be altered by accentuating their constituency (i.e., by changing *'yearbook'* to *'year book'*). A different group of 53 participants was tested. The same predictor variables and dependent variables were used.

The results across the two experiments revealed that typed production for both spaced and unspaced compounds was sensitive to similar variables. Both showed significant facilitatory effects of C1 positional family size, C1 whole-word frequency, and compound word frequency. An inhibitory effect of C2 whole-word frequency was observed at the constituent boundary for

unspaced compounds only. We conclude that compound production is sensitive to the distributional properties of the compound itself and its constituents. Thus, both the whole-word properties and morphological properties of compounds play a role in typing and their effects are robust in the face of orthographic manipulation.

References

Libben, G. & Weber, S. (2014). Semantic transparency, compounding, and the nature of independent variables. In Rainer, Franz, Dressler, Wolfgang U., Gardani, Francesco, Luschützky, Hans Christian, (Eds.) *Morphology and meaning*. Amsterdam: Benjamins.

Talks 4
Patience Stevens and David C. Plaut

Simulating dynamics of morphological processing in visual word recognition with a neural network model

Visual processing of complex words is attuned to morphological information. For example, morphologically related words (TEACHER and TEACH) have been shown to prime each other's recognition more strongly than words that are only related in form (BROTHEL and BROTH) or meaning (SKIP and MISS). In certain contexts, words that only appear morphologically related (DEPARTMENT and DEPART) also prime each other more strongly than form-related words, implying that morphological sensitivity can be over-generalized. This is referred to as *morphologically opaque priming*. In languages with highly systematic morphologies, opaque priming is easily detected (Frost et al., 2000; Smolka et al., 2009). However, in less systematic morphologies like English, opaque priming is observed only when the prime is shown briefly following a visual mask, and thus not consciously perceived (Rastle et al., 2004). One popular account of opaque morphological priming relies on the existence of a semantics-blind, morpho-orthographic decomposition mechanism, which decomposes complex words such as TEACHER as well as pseudo-complex words like DEPARTMENT into constituent morphemes early in processing (Rastle & Davis, 2008). However, recent proposals favor a more graded view in which no letter string is entirely a morpheme or a non-morpheme, and thus words cannot be neatly decomposed (e.g., Marelli et al., 2020; Baayen et al., 2011). Within this graded framework, how can we account for opaque morphological priming phenomena? Prior neural network simulations have demonstrated the occurrence of opaque priming in morphologically rich languages without the need to explicitly represent morphemes (Plaut & Gonnerman, 2000). However, the dynamics of opaque priming (its occurrence in masked but not overt priming contexts in languages like English) and its emergence only late in development have yet to be accounted for. **The current work uses neural network simulations to account for the dynamics and developmental emergence of opaque priming within a graded view of morphology.** Training examples were based on artificial languages, constructed to imitate morphologies of real languages while keeping the vocabulary small. Words were constructed by pairing stems and affixes, then assigning word meanings that aligned with the meanings of their constituents to varying degrees (Plaut & Gonnerman, 2000). A multilayer recurrent neural network was trained to map from orthography to semantics for these words, until the network could recreate all words' semantic representations with sufficient accuracy. The network had separate excitatory and inhibitory unit populations, and only excitatory between-layer connections, in accordance with known neurobiological constraints (see Song et al., 2016). Priming was then assessed by presenting orthographic representations for varying durations, followed by the target. The number of unit updates needed for the network to activate the target's semantic representation was used as a proxy for reaction time. Preliminary results demonstrate that opaque priming occurs initially, but diminishes with longer prime durations. This work supports an explanation of the range of empirical observations surrounding opaque morphological priming within a graded view of morphology, while more generally demonstrating the

mechanisms of complex word recognition. Future work will investigate simulated priming effects with similar neural network structures after training on real-language vocabularies.

Figures
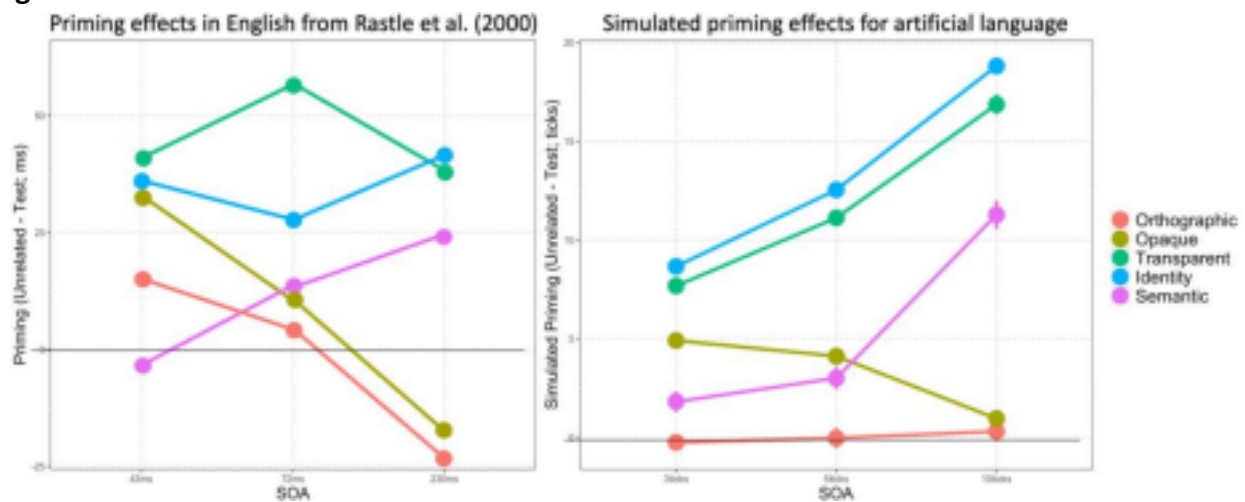
References

Baayen, R. H., Milin, P., Rević, D. F., Hendrix, P., & Marelli, M. (2011). An Amorphous Model for Morphological Processing in Visual Comprehension Based on Naive Discriminative Learning. *Psychological Review*, *118*(3), 438–481.

Frost, R., Deutsch, A., Gilboa, O., Tannenbaum, M., & Marslen-Wilson, W. D. (2000). Morphological priming: Dissociation of phonological, semantic, and morphological factors. *Memory and Cognition*, *28*(8), 1277–1288.

Marelli, M., Traficante, D., & Burani, C. (2020). Reading morphologically complex words: Experimental evidence and learning models. In V. Pirrelli, I. Plag, & W. U. Dressler (Eds.), *Word knowledge and word usage: A cross-disciplinary guide to the mental lexicon* (pp. 553-592). de Gruyter Mouton.

Plaut, D. C., & Gonnerman, L. M. (2000). Are non-semantic morphological effects incompatible with a distributed connectionist approach to lexical processing? *Language and Cognitive Processes*, *15*(4-5), 445–485.

Rastle, K., Davis, M. H., & New, B. (2004). The broth in my brother's brothel: Morpho orthographic segmentation in visual word recognition. *Psychonomic Bulletin and Review*, *11*(6), 1090–1098.

Rastle, K., Davis, M. H., Marslen-Wilson, W. D., & Tyler, L. K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes*, *15*(4-5), 507–537.

Smolka, E., Komlósi, S., & Rösler, F. (2009). When semantics means less than morphology: The processing of German prefixed verbs. *Language and Cognitive Processes*, *24*(3), 337–375.

Song, H. F., Yang, G. R., & Wang, X. J. (2016). Training excitatory-inhibitory recurrent neural networks for cognitive tasks: a simple and flexible framework. *PLoS computational biology*, *12*(2), e1004792.

Jonathan Geary

Orthographic neighborhood density effects in a Maltese visual lexical decision megastudy

Introduction: The processing of real and non-word targets, as measured in visual lexical decision, is differently affected by changes in the target's orthographic neighborhood density (i.e. the number of words that differ from the target by the substitution, insertion, or deletion of a letter; e.g. *dot*, *dogs*, and *do* are neighbors of *dog*): Response times (RTs) decrease for real-word targets as neighborhood density increases, but increase for non-word targets owing to the activation of potential real-word candidates (Andrews 1989, Hendrix and Sun 2021). We analyze neighborhood density effects on the processing of real and non-words in Maltese, a Semitic language, using data from the MaltLex database of Maltese visual lexical decision responses (Geary 2020).

Maltese is unique among Semitic languages in that it is written using the Latin alphabet, while it is also unique among the languages studied previously in that it uses nonconcatenative morphology typical of Semitic languages (cf. Frost et al. 2005 likewise found a facilitatory effect of orthographic neighborhood density on responses to real-word targets in a Hebrew masked priming visual lexical decision study). Additionally, little research has explored the processing of Maltese non-words (cf. Twist 2006). Thus, our study explores orthographic neighborhood density effects in a language with a unique combination of orthographic and morphological properties, while also illuminating the processing of Maltese-like non-words by Maltese speakers.

MaltLex stimuli: 104 native Maltese speakers provided 237,000 lexical decisions to 11,040 real-word and 10,954 non-word targets in a series of Maltese visual lexical decision tasks (Geary 2020). Real-word targets were randomly selected from the Korpus Malti v3.0 corpus (Gatt and Čéplö 2013), and then checked against the online lexical database Ġabra (Camilleri 2013) and vetted by a native speaker. Non-word targets were constructed by replacing the consonant letters of a real-word target to make a phonotactically-legal non-word. Real- and non-word targets were matched in length ($M = 7.1$ letters) and frequency-weighted neighborhood density ($M_{Real} = 157.4$, $M_{Nonce} = 123.9$ occurrences per million), and a native speaker vetted all non-word targets.

Analysis: We analyzed 210,960 datapoints from visual lexical decision trials on which the participant provided the intended response to real-word and non-word targets ($N_{Real} = 104,644$, $N_{Nonce} = 106,316$ datapoints). We analyzed log RTs using the lme4 package (Bates et al. 2015) in R (R Core Team 2021) to fit an LMER model, with target lexicality (Real vs. Nonce; reference: Real), target log frequency-weighted neighborhood density, and the interaction of target lexicality and target log frequency-weighted neighborhood density as fixed effects. The model also included control variables like target length and participant's age as fixed effects, as well as subjects and targets as random effects. We used the lmerTest package (Kuznetsova et al. 2016) to simulate Satterthwaite approximations for degrees of freedom to assess the significance of fixed effects.

Results and Discussion: Consistent with previous research, the effect of target lexicality was significant ($\beta = 0.014$; $t(21,140) = 2.76$, $p < 0.01$), with participants responding slower to non word targets ($M = 990$ ms) than real-word targets ($M = 850$ ms). The effect of neighborhood density was significant ($\beta = -0.016$; $t(21,220) = -25.78$, $p < 0.001$), with participants responding faster to real-word targets as neighborhood density increases, but the interaction of target lexicality and neighborhood density was also significant ($\beta = 0.020$; $t(20,800) = 28.482$, $p <$

0.001), with the facilitatory effect of neighborhood density diminishing for non-word targets. To investigate this interaction further, we split the dataset by target lexicality and re-fitted a model to each dataset: Consistent with previous research, the neighborhood density effect was facilitatory for real-word targets ($\beta = -0.021$; $t(10{,}430) = -30.914$, $p < 0.001$) but inhibitory for non-word targets ($\beta = 0.010$;
$t(10{,}170) = 21.187$, $p < 0.001$), indicating that Maltese's unique orthographic and morphological characteristics do not alter the effects of orthographic neighborhood density on lexical processing.

References

Andrews, S. (1989). Frequency and neighborhood effects on lexical access: Activation or search? *Journal of Experimental Psychology: Learning, Memory, and Cognition* 15: 802−814. https://doi.apa.org/doi/10.1037/0278-7393.15.5.802.

Bates, D., Maechler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67: 1−48. http://dx.doi.org/10.18637/jss.v067.i01.

Camilleri, J. J. (2013). *A computational grammar and lexicon for Maltese* (MSc Thesis). Chalmers University of Technology, Sweden. https://mlrs.research.um.edu.mt/resources/gabra/.

Frost, R., Kugler, T., Deutsch, A., and Forster, K. I. (2005). Orthographic structure versus morphological structure: Principles of lexical organization in a given language. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 31: 1293−1326. https://doi.apa.org/doi/10.1037/0278-7393.31.6.1293.

Gatt, A., and Čéplö, S. (2013). Digital corpora and other electronic resources for Maltese. In *Proceedings of the international conference on corpus linguistics*. University of Lancaster. Geary, J. (2020). MaltLex: A database of visual lexical decision responses to 11,000 Maltese words. Poster presented at *the 33rd Annual CUNY Conference on Human Sentence Processing* (CUNY 2020), Amherst, MA, March 20, 2020. https://osf.io/8rp3a/.

Hendrix, P., and Sun, C. C. (2021). A word or two about nonwords: Frequency, semantic neighborhood density, and orthography-to-semantics consistency effects for nonwords in the lexical decision task. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 47: 157−183. http://dx.doi.org/10.1037/xlm0000819.

Kuznetsova, A., Brockhoff, P. B., and Christensen, R. H. B. (2016). lmerTest: Tests in linear mixed effects models. [R package v. 2.0-32]. https://CRAN.R-project.org/package=lmerTest. R Core Team. (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Twist, A. E. (2006). *A psycholinguistic investigation of the verbal morphology of Maltese* (PhD Thesis). University of Arizona, Tucson, AZ. http://hdl.handle.net/10150/194996.

Shaina Benjamin and Daniel Schmidtke

Conceptual combination during novel and existing compound word reading: a self-paced reading study

Evidence from research on compound word processing indicates that humans generate new meanings from existing concepts by means of conceptual combination (Gagné & Spalding, 2014). According to the relational-interpretation-competitive-evaluation account (RICE; Spalding et al., 2010), compound word recognition involves the processing of underlying conceptual relations, i.e., semantic relations that are not explicitly contained in the surface form of a compound. For example, the compound *wristband* may be paraphrased as 'a band that is located on the wrist' via the application of the 'located on' conceptual relation. The central claim of the RICE theory is that *multiple* possible relational interpretations are generated and compete for selection as the most appropriate relational meaning during the processing of a compound word. While there is substantial evidence in support of the idea that competition between conceptual relations is a feature of existing compound word processing (e.g., Schmidtke et al., 2018), there are two outstanding questions that this study addresses. First, it is unclear whether the mechanism of competition generalizes to the recognition of novel compound words, e.g., *sungown*. Second, it remains unknown whether competition between conceptual relations occurs when compound words are encountered by readers in context.

Data were collected from two separate possible relations tasks wherein compound words were presented in isolation; one task included existing compounds, e.g., *airforce*, as critical stimuli and the other task included novel compounds, e.g., *butterlamp*, as critical stimuli. In addition, data was collected from two self-paced reading studies, one with existing compounds and the other using novel compounds. Both reading studies presented each compound in one of two discourse contexts. In the non-supportive context condition, compounds were embedded in sentences that   did not provide any semantic information that could help guide the possible relational interpretation of the compound word, e.g*., There is no airforce anywhere around here*. In the supportive context condition, the compound word was embedded in a context that was designed to provide a narrower semantic interpretation of the compound word, e.g., *Pilots in the airforce need a lot of experience flying*. After the presentation of each sentence, participants were asked to   select a relational interpretation that was appropriate for the compound word. Entropy computed over the frequency distribution of conceptual relations per compound word was used as an index of the magnitude of competition between conceptual relations.

The results of the possible relations tasks (Figure 1) showed that compared to existing compounds, entropy scores were significantly higher for novel compounds when read in isolation or in non-supportive contexts. However, entropy was not significantly different for both novel and existing compounds when they were embedded in supportive contexts, indicating that meaning dominance among possible relations is comparable for both compound types when the context   guides meaning interpretation. The reading data showed that entropy significantly predicted reading times for both novel and existing compound words (Figure 2). This result supports the   RICE accounts, showing that conceptual combination is a competitive process during sentence reading. Furthermore, there was a main effect of context, which showed that

novel compounds in supportive contexts were recognized more slowly than in non-supportive contexts, while the   opposite was true for existing compounds. We discuss the theoretical implications for word learning and morphological processing.
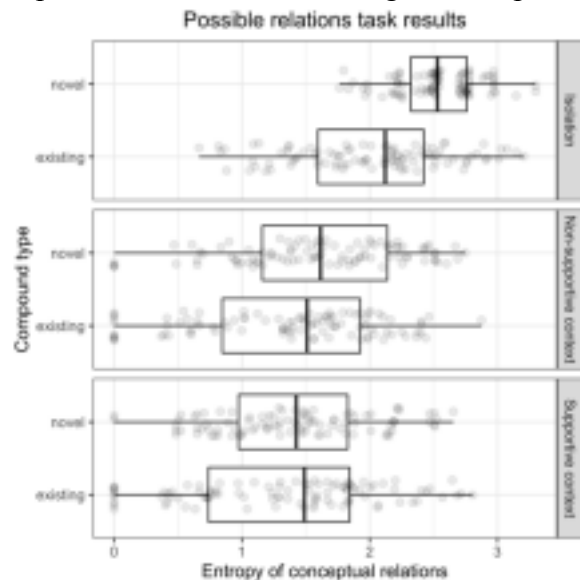
Figure 1. Box plots of entropy of conceptual relations broken down by compound type and presentation type. Each point represents a compound. Jitter added for readability.
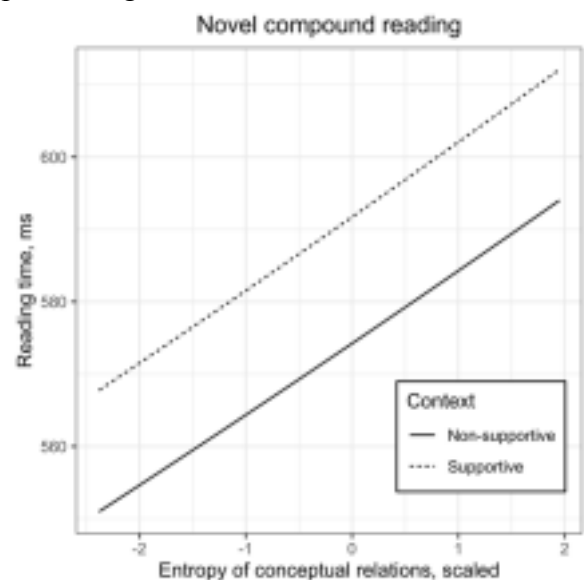
Figure 2. The partial main effects of entropy of conceptual relations (scaled) and context type on reading times of novel compounds during self-paced reading.

References

Gagné, C. L., & Spalding, T. L. (2014). Conceptual composition: the role of relational competition in the comprehension of modifier-noun phrases and noun-noun compounds. In B. H. Ross (Ed.), *The psychology of learning and motivation* (pp. 97–130). San Diego: Academic Press.

Schmidtke, D., Gagné, C. L., Kuperman, V., Spalding, T. L., & Tucker, B. V. (2018). Conceptual relations compete during auditory and visual compound word recognition. *Language, cognition and neuroscience*, *33*(7), 923-942.

Spalding, T. L., Gagné, C. L., Mullaly, A. C., & Ji, H. (2010). Relation-based interpretation of noun-noun phrases: A new theoretical approach. *Linguistische Berichte Sonderheft*, *17*, 283–315.

<u>**Saturday, November 27**</u>

Talks 5

Georgia Roumpea, Katarina Marjanovič, Tjaša Mlinarič, Zvezdan Pirtošek, Jure Bon and Christina Manouilidou

Repetitive Transcranial Magnetic Stimulation treatment improves language performance in different stages of Alzheimer's disease

In the current study we investigated the effect of rTMS on production of simple and derived words, and lexical decision in individuals with mild and moderate AD. Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive technique and due to its ability to regulate cortical plasticity and neuronal activity, it has been proposed as an effective tool to improve cognitive abilities in AD (Lin et al., 2019). Previous studies report action and object naming improvement in all stages of AD (Cotelli et al., 2006, 2008), while deverbal forms (agent "reader" and process "reading" nominalizations) have not been examined. Moreover, the potential improvement of lexical accuracy and RTs, as well as word production abilities by derivation, are addressed for the first time in the rTMS and AD literature. Intervention: high frequency 10-Hz rTMS over the DLPFC bilaterally (5/sessions × 3/weeks). Evaluation: baseline, post-treatment, 2-weeks post-treatment. Materials: Picture-naming: 20 × 3 (verbs, agent-nominalizations, process-nominalizations), 30 nouns; LDT: 234 words, 234 non-words; Derivation-task: 30 × 3 (verbs, agent-nominalizations, process-nominalizations). Tasks: picture-naming, production by derivation, online and offline LDT. Participants: 1 mild-AD, 2 moderate-AD, all females, and native Slovene-speakers. Preliminary results: In the moderate AD group no effect of treatment was observed on the picture-naming and off-line LDT (p> .05 always), while participants' performance on the derivation task was significantly improved immediately post-treatment (86%, p= .013) and 2-weeks post-treatment (84%, p= .044) compared to baseline (77%) (Fig. 1). Regarding individual's with mild-AD language performance, it was found to be improved in specific tasks (Fig. 2). More specifically, an increased naming accuracy immediately post-treatment (92%, p= .021) and 2-weeks post treatment (97,5%, p= <.01) compared to baseline (80%) was observed. Agent (75% vs. 95%vs. 95%) and process (60% vs. 90% vs. 100%) nominalizations were the most improved categories, while slight differences were observed in verbs (95% vs. 90% vs. 95%) and nouns (90% vs. 93% vs. 100%). On derivation-task (96% vs. 92% vs. 97%) and offline-LDT (93%vs. 97% vs. 93%) accuracy did not differ after intervention (p> .05 always). Accuracy on the online-LDT was significantly improved post-treatment (95%) (p< .01) compared to baseline (73%). 2-weeks post-treatment the accuracy slightly decreased (90%), yet it remained significantly (p< .01) higher compared to baseline. The RTs were significantly improved (2281ms vs. 1445ms vs. 1624ms) after intervention (p< .01 always). Discussion: rTMS treatment seems to be effective in improving language performance in AD, with its effect being task specific, as well as related to the stage of the disease. In mild-AD, besides verbs and objects, rTMS appears to benefit naming accuracy for other impaired categories, like deverbal forms. Also, it improves accuracy in online-LDT and positively influences LDT latency by speeding RT. In moderate-AD the improvement was limited to participants' production by derivation ability, a finding that was not observed on the mild-AD participant. The positive effects of the treatment might persist up to 2-weeks post-treatment.

References:

Cotelli, M., Manenti, R., Cappa, S. F., Geroldi, C., Zanetti, O., Rossini, P. M., & Miniussi, C. (2006). Effect of transcranial magnetic stimulation on action naming in patients with Alzheimer disease. Archives of neurology, 63(11), 1602-1604.

Cotelli, M., Manenti, R., Cappa, S. F., Zanetti, O., & Miniussi, C. (2008). Transcranial magnetic stimulation improves naming in Alzheimer disease patients at different stages of cognitive decline. *European Journal of Neurology*, *15*(12), 1286-1292.

Lin, Y., Jiang, W. J., Shan, P. Y., Lu, M., Wang, T., Li, R. H., ... & Ma, L. (2019). The role of repetitive transcranial magnetic stimulation (rTMS) in the treatment of cognitive impairment in patients with Alzheimer's disease: a systematic review and meta-analysis. *Journal of the neurological sciences*, *398*, 184-191.

Fig. 1: Percentages of participants' overall language performance in the different linguistic tasks in moderate-AD

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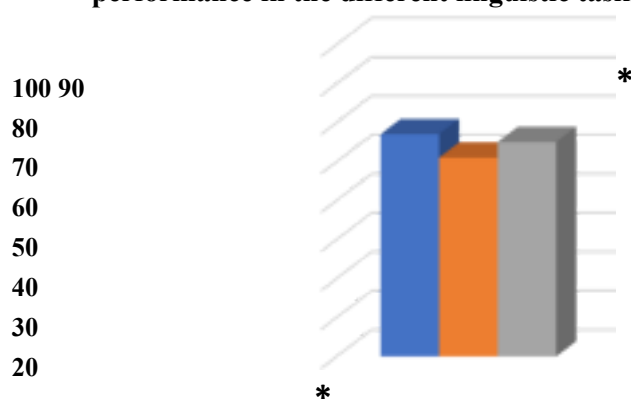
picture-naming derivation-task offline-LDT baseline

post-treatment 2-weeks post-treatment

Fig. 2: Percentage of individual's with mild-AD correct responses on the different linguistic tasks

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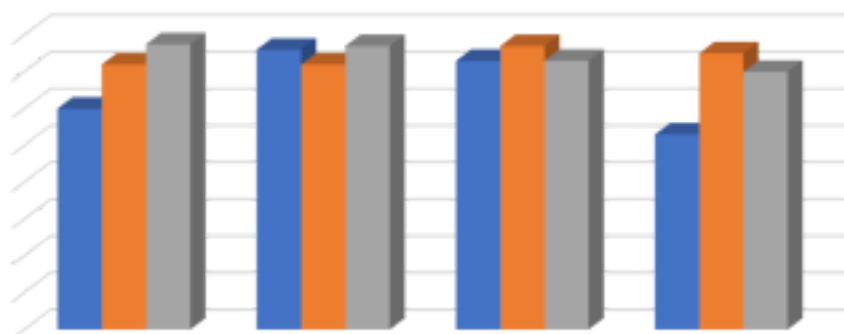
picture-naming derivation-task offline-LDT online-LDT baseline

post-treatment 2-weeks post-treatment

María Fernández-López, Manuel Perea and Marta Vergara-Martínez

Are letter detectors resilient to rotations during word recognition? A masked priming ERP investigation

A strong prediction of the Local Combination Detectors [LCD] model of word recognition (Dehaene et al., 2005) is that letter rotations above 40° should disrupt the mapping of the visual input onto orthographic representations. However, two recent behavioural masked priming papers showed robust masked identity and transposed-letter effects with 90° (or greater) wholly rotated words (Perea et al., 2018). To further check this assumption of the LCD model, we conducted a masked repetition priming lexical decision ERP experiment where we rotated the individual letters of the identity/unrelated primes (0°, 45°, and 90°). Targets were always presented in the standard horizontal format. Behavioural results revealed that the identity priming effect decreased as a function of letter rotation (i.e., strong at 0°, weaker at 45° and negligible at 90°). In the Event-Related Potentials (ERP) analyses, the N/P150 showed enhanced amplitudes for the 0° compared to the rotated primes. The N250 showed an effect of identity priming only for 0° primes. This effect was also significant with 45° primes in the N400. Altogether, the processing cost of words preceded by rotated stimuli originates in the "visual feature encoding" stage. Furthermore, although we found a masked identity priming effect for 45° primes, it completely vanished for 90° primes, which add evidence to the prediction of the LCD model. (Dehaene et al., 2005).

Dehaene, S., Cohen, L., Sigman, M., & Vinckier, F. (2005). The neural code for written words: A proposal. *Trends in Cognitive Sciences*, *9*(7), 335–341. doi:10.1016/j.tics.2005.05.004

Perea, M., Marcet, A., & Fernández-López, M. (2018). Does letter rotation slow down orthographic processing in word recognition? *Psychonomic Bulletin and Review, 25*, 2295–2300. doi:10.3758/s13423-017-1428-z

Juliana Novo Gomes, Marije Soto, Aniela Improta França, Julia Cataldo and Aline Gesualdi Manhães

Comparing ERP and the Divided Visual Field paradigm to explore Hemispheric Specialization as a Predictive and Descriptive Tool for grapheme and word processing

This study zooms in on the specialization of visual processing that underlies grapheme and word form processing, and presents a comparison between an electrophysiological experiment and the divided visual field paradigm performed with 8th graders in a public state elementary school in Brazil.

In a previous Event Related Brain Potential (EEG/ERP) study, we found a qualitative correlation between performance and the degree of lateralization of the neuronal signature for grapheme and word processing, the N170 component, testing a group of 8th graders in a public elementary school in Rio de Janeiro, Brazil. The results indicated that higher performance in grapheme recognition was not associated to a reduced difference between ERP wave amplitudes in response to word and false font stimuli, but instead, to a left lateralization of print sensitive N170 responses in a stimulus repetition detection task. The levels of intensity and lateralization of the neurophysiological response indicate that a large portion of the participants remain in the process of obtaining reading fluency long after having started to learn how to read.

Our earlier study proved the neurophysiological signature of visual processing, the N170, to be a reliable indicator for the lateralization of print-sensitive responses that reflect higher reading proficiency. Now, using a divided visual field paradigm with similar stimuli and task, we expected response times (RTs) and accuracy rates to show an advantage for right visual field presentation due to the well described effect of lateralization of grapheme and word processing in the left hemisphere.

Four different types of stimuli (words, pseudowords, symbols and figures) were presented alternately in the left or right visual field (RVF, LVF) in a repetition detection task.

So far, we have tested 19 Brazilian college students as participants. With accuracy and RTs as dependent variables and stimulus type as fixed-effect, our initial mixed-effect models results yielded significant values: $X^2=8.7115$, p=0.013 and X2 =23.51, p<0,000. Accuracy is greatest for figures and words, and lowest for pseudowords. Interaction between hemisphere and stimulus type is not (yet) significant. However, there seems to be an advantage for words presented in the RVF reflected in accuracy increase and faster RTs. Overall, RTs were slowest for pseudowords. Therefore, the divided visual field paradigm of our current study, with a much simpler behavioral technique, seems to replicate the lateralization effects found earlier.

Keywords
ERP, Divided-visual field paradigma, Word recognition, Grapheme recognition, Hemisphere Lateralization

References:
Bentin S, Mouchetant-Rostaing Y, Giard MH, Echallier JE, Pernier J: ERP manifestations of processing printed words at different psycholinguistic levels: time course and scalp distribution. J Cogn Neurosci 1999, 11:235–260.
Bentin S, Allison T, Puce A, Perez E, McCarthy G: Electrophysiological studies of face perception in humans. J Cogn Neurosci 1996, 8:551–565.

Brem S, Bucher K, Halder P, Summers P, Dietrich T, Martin E, Brandeis D: Evidence for developmental changes in the visual word processing network beyond adolescence. Neuroimage 2006, 29:822–837.

Brem S, Lang-Dullenkopf A, Maurer U, Halder P, Bucher K, Brandeis D: Neurophysiological signs of rapidly emerging visual expertise for symbol strings. Neuroreport 2005, 16:45–48.

Cohen L, Dehaene S, Naccache L, Lehéricy S, Dehaene-Lambertz G, Hénaff M, Michel F: The visual word form area. Spatial and temporal characterization of an initial stage of reading in normal subjects and posterior split-brain patients. Brain 2000, 123:291–307. Dehaene S, Le Clec'H G, Poline J, Le Bihan D, Cohen L: The visual word form area: a prelexical representation of visual words in the fusiform gyrus. Neuroreport 2002, 13:321–326. França, A.I (2006). Introspecção e a Neurociência da Linguagem: duas práticas bem afinadas. Revista Neurociências, 2006, v.3 n.3 p. 135-138

Gomes, J.N., França, A.I. A direcionalidade no relacionamento semântico: um estudo de potenciais bioelétricos relacionados a eventos lingüísticos (ERP). Veredas, Revista do Programa de Pós-Graduação em Lingüística da Universidade Federal Juiz de Fora, Rio de Janeiro, v. 12, n. 2, p. 132-136, julho-dezembro 2008.

Kreitewolf J, Friederici AD, von Kriegstein K. Hemispheric lateralization of linguistic prosody recognition in comparison to speech and speaker recognition. Neuroimage. 2014 Nov 15;102 Pt 2:332-44. doi: 10.1016/j.neuroimage.2014.07.038. Epub 2014 Aug 1. PMID: 25087482. Kim, A., & Osterhout, L. (2005). The independence of combinatory semantic processing: Evidence from event-related potentials. Journal of Memory and Language, 52(2), 205–225. Kotz, S. A.; Friederich, A. D. Electrophysiology of normal and pathological language processing. Journal of Neurolinguistics, v. 16, p. 45-58, 2003.

Kutas, M., & Hillyard, S.A. (1980). Reading senseless sentences: Brain potentials reflect semantic incongruity. Science, 207,203-205.

Kutas, M., & Hillyard, S.A. (1984). Brain potentials during reading reflect word expectancy and semantic association. Nature, 307, 161-163.

Maurer U, Brem S, Bucher K, Brandeis D: Emerging neurophysiological specialization for letter strings. J Cogn Neurosci 2005, 17:1532–1552

McCandliss BD, Posner MI, Givón T: Brain plasticity in learning visual words. Cogn Psychol 1997, 33:88–110.

Maurer U, Brandeis D, McCandliss BD: Fast, visual specialization for reading in English revealed by the topography of the N170 ERP response. Behav Brain Funct 2005. Prasada, S.; Salajegheh, A.; Bowles, A.; Poeppel, D. Characterizing kinds and instances of kinds: ERP reflections. Language and Cognitive Processes, v. 23, p. 1-15, 2008. Soto, M.; Gomes, J. N.; França, A. I.; Manhães, A. G. Neurophysiology of grapheme decoding: The N170 as A Predictive and Descriptive Tool. Revista da ABRALIN, v. 17, n. 1, p. 402-433, 30 mar. 2019.

Tanaka JW, Curran T: A neural basis for expert object recognition. Psychol Sci 2001, 12:43–47.

Training Workshop

gather.town tutorial (Zoom)

Shanley Allen

Scientific Writing (Part 1): Developing a storyline

Hanne Surkyn, Reinhild Vandekerckhove and Dominiek Sandra

The impact of analogical effects and social factors on the spelling of partially homophonous verb forms

The present study examines unintentional spelling errors on past participles produced by Flemish teenagers in private online writing. Previous psycholinguistic research on verb spelling errors in Dutch mainly focused on *identical* homophones, which yielded an effect of homophone dominance, i.e., most errors occurred on the lower-frequency form, both in experiments and in social media writing (Bosman 2005; Sandra, Frisson, & Daems, 1999; Schmitz, Chamalaun, & Ernestus, 2018; Surkyn, Vandekerckhove, & Sandra, 2020).

The present study, however, deals with past participles like *genoemd* ('named')*,* which are only partially homophonous with other forms in the inflectional paradigm (e.g., *noemt,* 'names'). The past participles are spelled with a <d> ending, although a final [t] sound is heard. The spelling of these verb forms cannot be influenced by an identical homophone (*genoemt*, 'namet' does not exist), but it can be affected by other forms in the verb's inflectional paradigm. For example, the present tense (*noemt*, 'names') may trigger a <t> spelling, whereas the past tense (*noemde*, 'named') may be a trigger for a <d> ending.

We tested (a) the effect of the support for the <d> form, which we operationalized as the ratio between the (logarithm of the) summed frequencies of the <d> forms over the summed frequencies of the <t> forms in the verb's paradigm, (b) the effect of the frequency of the past participle itself, (c) its 'compound' family, and (d) the effect of <d> support in word-final bigrams ending in <d> and <t>, e.g., the ratio of the frequency of <md> over the frequency of <mt> for verbs with a stem-final <m>.

Although the frequency of the verb form itself (and its compound family) played no role, we found a significant effect of the intraparadigmatic support for the <d> spelling in the verb's inflectional paradigm and in the final bigrams of all Dutch verb forms (an interparadigmatic effect). Stronger <d> support caused fewer errors. The bigram effect we found has not been reported before.

The unique database made it possible to analyze the impact of three social factors as well (gender, educational track and age). Our results revealed that all social variables had an effect on the error rates. These social factors did not interact with intraparadigmatic and bigram <d> support.

Our results suggest that the spelling of verb forms is not only affected by the existence of an identical homophone, but also by (partially homophonous) morphological variants of the same verb.

References

Bosman, A.M.T. (2005). Development of rule-based verb spelling in Dutch students. *Written Language & Literacy*, *8*(1), 1–18.

Sandra, D., Frisson, S., & Daems, F. (1999). Why simple verb forms can be so difficult to spell: the influence of homophone frequency and distance in Dutch. *Brain and Language*, *68*, 277–283.

Schmitz, T., Chamalaun, R., & Ernestus, M. (2018). The Dutch verb-spelling paradox in social media. A corpus study. *Linguistics in the Netherlands*, 111-124.

Surkyn, H., Vandekerckhove, R., & Sandra, D. (2020). From experiment to real-life data: social factors determine the rate of spelling errors on rule-governed verb homophones but not the size of the homophone dominance effect. *The Mental Lexicon*, *15*(3), 422–463.

Dilsah Kalay

WORD KNOWLEDGE GAINS VIA CONCEPTUAL APPROACH

The major concern of this study is to describe the attempt to explicitly teach words in the light of conceptual approach as well as to investigate the relationship between such an explicit vocabulary instruction and implicit word knowledge gains. Target vocabulary in this study is "Phrasal Verbs", as they have complex structures and unpredictable meanings (Lee, 2012; White, 2012), resulting in being acknowledged as problematic constructions to be acquired by foreign language learners (Laufer & Eliasson, 1993; Liao & Fukuya, 2004). This is a within group pretest/posttest design experimental research carried out with 60 Turkish EFL learners enrolled in the School of Foreign Languages in a state university. The analysis was conducted in terms of three dimensions, which are achievement and retention of receptive and productive PV knowledge, subconscious lexical recognition and processing, and semantic lexical processing. For the analysis of the first dimension, a multiple-choice test to evaluate receptive PV knowledge as well as a c-test to measure controlled productive PV knowledge were administered as the pretest, immediate posttest, and delayed posttest. To investigate the subconscious lexical recognition and processing, a masked repetition priming lexical decision task and to examine semantic lexical processing a self-paced task were applied to the participants. The results of the study found out that explicitly presented PV knowledge in the light of conceptual metaphors significantly influences not only the achievement and retention of receptive and productive PV knowledge but also the subconscious lexical recognition and processing as well as semantic priming of PV knowledge, validating a strong interface position in terms of the lexical aspect of language learning.

Keywords: Phrasal verbs, Conceptual approach, Explicit instruction, Implicit PV knowledge

Alexandra Schmitterer and Garvin Brod

Connected **Neighborhoods are more Competitive:**

The Influence of Connectivity on Lexical Competitiveness in Children's Decisions About Thematic Relations

Last year, we presented a study on 8-year-olds decisions about thematic relations. Thematic knowledge represents the knowledge based on the co-occurrence of concepts (Mirman, Landrigan, & Britt, 2017) and has been shown to be particularly relevant for the development of knowledge organization in childhood (Unger, Savic, & Sloutsky, 2020). We were able to present some evidence that suggests a lexical retrieval based on a small-world network organization of thematic knowledge (Hills et al., 2010). In these networks frequently encountered concepts are organized in few but strongly linked lexical entries (i.e., hubs). We could show that comparisons between two thematic relations was easier, if the difference between co-occurrence weights (t_{diff}) was large, because in this case *competition* would be low and inhibition effects would be weaker. However, we also assumed that competition effects would be stronger near the center of the *hub*. This remained difficult to quantify and interpret. This year, we will present an additional analysis of this data for which we used a connectivity measure (i.e., how many words are connected to the target word in a meaningful way). We expected trials with *strongly interconnected* target words to increase competitiveness in highly competitive comparisons.

In our triads task, 108 children listened to a an SVO sentence that included a target word (i.e., *Jo sees the <u>cloud</u>.*) and two test words (i.e., *rain/lip*). They decided which word fit better to the sentence. The test words varied in frequency of co-occurrence to the target word (i.e., strong–distant: *rain/lip, t_{diff}* =4.15; strong–weak: *rain/mountain, t_{diff}* = 2.5; weak–distant: *mountain/lip, t_{diff}* =1.65). Conditions were controlled for frequency and number of syllables. We measured the proportional frequency (%) and speed (ms) of children's responses for the stronger relation and analyzed them using (general) linear mixed effects models with crossed random effects.

Results showed competition effects: Children were more likely to pick the strongly related word (i.e., *rain*), in the strong–distant than in the strong–weak (i.e., *rain*) or weak-distant (i.e., *mountain*) condition. Therefore, children picked the strongly related word more often, if the difference between co-occurrence weights (t_{diff}) was high and, thus, *competition* was low. In addition, specifically in the strong-weak condition (i.e., highly competitive and close to the hub), children were less likely to pick the strongly related word, if the connectivity of the target word (i.e., cloud) was low and gradually became more likely to pick the stronger related word the lower the connectivity was (see Figure 1). The results indicate that not only the strength of relation between words but also the connectivity of the words in the mental lexicon influence how children make decisions about thematic relations. These findings point to a new and exciting measure that could be of relevance for experimental studies on semantics in psycholinguistics.

Hills, T. T., Maouene, J., Riordan, B., & Smith, L. B. (2010). The associative structure of language: Contextual diversity in early word learning. *Journal of Memory and Language*, *63*(3), 259-273. https://doi.org/10.1016/j.jml.2010.06.002

Mirman, D., Landrigan, J.-F., & Britt, A. E. (2017). Taxonomic and thematic semantic systems.

Psychological Bulletin, 143(5), 499–520. https://psycnet.apa.org/doi/10.1037/bul0000092

Unger, L., Vales, C., & Fisher, A. V. (2020b). The Role of Co‑Occurrence Statistics in Developing Semantic Knowledge. *Cognitive Science*, *44*(9), https://doi.org/10.1111/cogs.12894
Figure 1

Effect of Connectivity of the Reference Word between Conditions in Children's Decisions

Angelika Golegos and Theo Marinis
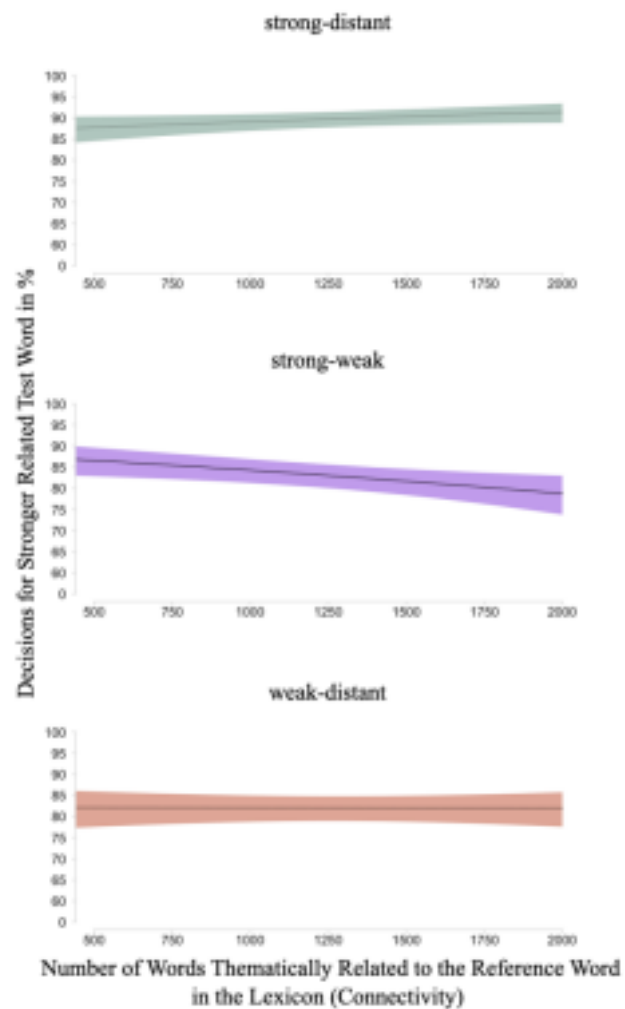
Pronoun resolution in monolingual German adults

Across languages pronoun resolution has been extensively studied for over three decades. Relatively less studies focused on German pronouns and the role of prosody has not been systematically investigated yet, i.e., whether stressing a pronoun changes the resolution preferences. Research on German pronouns has shown mixed results when it comes to the interpretation of the personal pronoun *er* and the demonstrative pronoun (henceforth d pronoun) *der*. Both are third person singular masculine pronouns that are used especially in ambiguous contexts with two competitive antecedents (see example 1).

1) Der **Tiger**$_j$ will den **Igel**$_k$ vorsichtig auf die Hand küssen. Aber **er**$_{(j)}$/**der**$_{(k)}$ kann nicht stillstehen.

   The tiger wants to the hedgehog carefully on the hand kiss. But he cannot hold still.
   'The tiger wants to kiss the hedgehog carefully on the hand. But he cannot hold still.'

Based on the Complementary Hypothesis, the personal pronoun prototypically refers to the subject and discourse topic while the d-pronoun refers to the object and discourse non-topic (Bosch et al., 2007). While most studies confirm this hypothesis for the d-pronoun, the results are not straight forward when it comes to the resolution of the personal pronoun. Some studies have shown a strong preference towards the subject (e.g., Bouma and Hopp, 2007), whereas others have revealed the same preference but to a less clear extent (e.g., Schumacher et al., 2017). Our study aims to expand the evidence base by using a picture selection task, a method that has not been used yet for investigating pronoun resolution in German and is suitable for studies with adults as well as children. Moreover, we included an additional condition with the personal pronoun *er* in a stressed condition that has not been tested before. The theoretical account of Fery (2017) suggests that stressing a pronoun creates a reversed anaphoric relationship between the pronoun and the antecedents. Given that the unstressed *er* shows a preference for the subject (discourse topic), this predicts that participants will resolve a stressed *er* towards the object (discourse non-topic).

The present study included 65 monolingual German adults (mean age: 25.6, SD: 7.4, age range: 19-56). In an online experiment, participants were auditorily presented with ambiguous sentences that contained one of the three pronouns (*er, der*, stressed *er*), similarly to (1). While listening to the sentences they saw three images on the screen, representing the competing subject and object as well as a distractor, all included in the audio stimuli. After listening to the sentence, they were asked a content-based question that forced them to interpret the pronoun towards one of the two antecedents. Responses were given by clicking on the image of the respective antecedent. The task contained 24 ambiguous experimental items and 8 non-ambiguous filler items.

The results are in line with studies showing that the d-pronoun *der* is strongly resolved towards the discourse non-topic, while the personal pronoun *er* overall tends to favor discourse topics (see Figure 1). They also confirm previous studies showing that *er* is more flexible in comparison to *der,* and therefore, it is sometimes also resolved towards the non-topic. On the contrary, when it comes to the stressed *er* condition, the data show chance level resolution (see Figure 2), and therefore, they do not support the reversed anaphoric relationship theory. To date very few studies have investigated German pronoun resolution in children (e.g., Bittner

and Kuehnast, 2012; Bittner, 2007) and only one used an experimental design with the same testing material with adults and children (Blything et al., 2021). In a follow up study we plan to use the same material with primary school children to investigate if children show the same preferences as the adults of the present study in the three conditions (*er, der*, stressed *er*) and if not, at what age they reach adult-like pronoun resolution preferences.

Figure 1: Preference for object (discourse non-topic) per condition
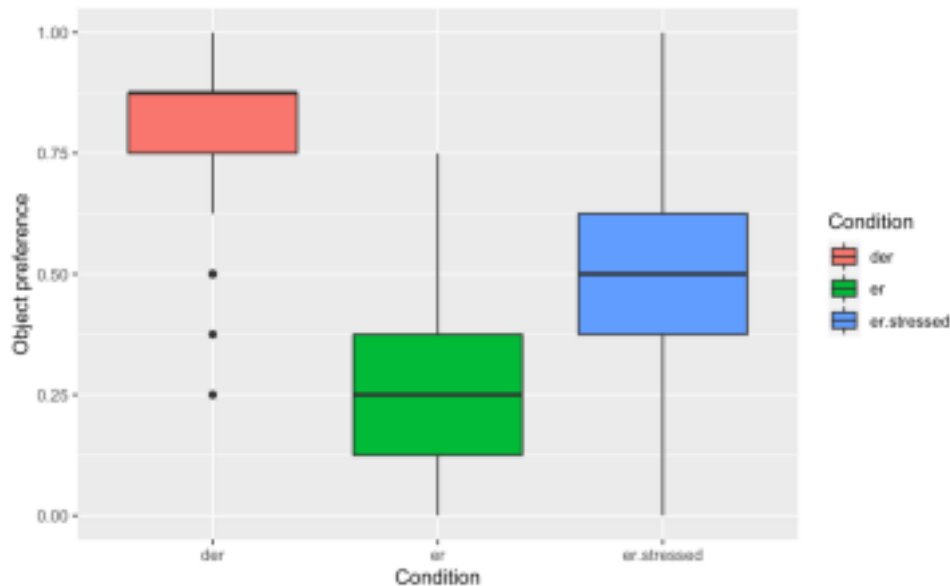
Figure 2: Resolution of the stressed personal pronoun *er*
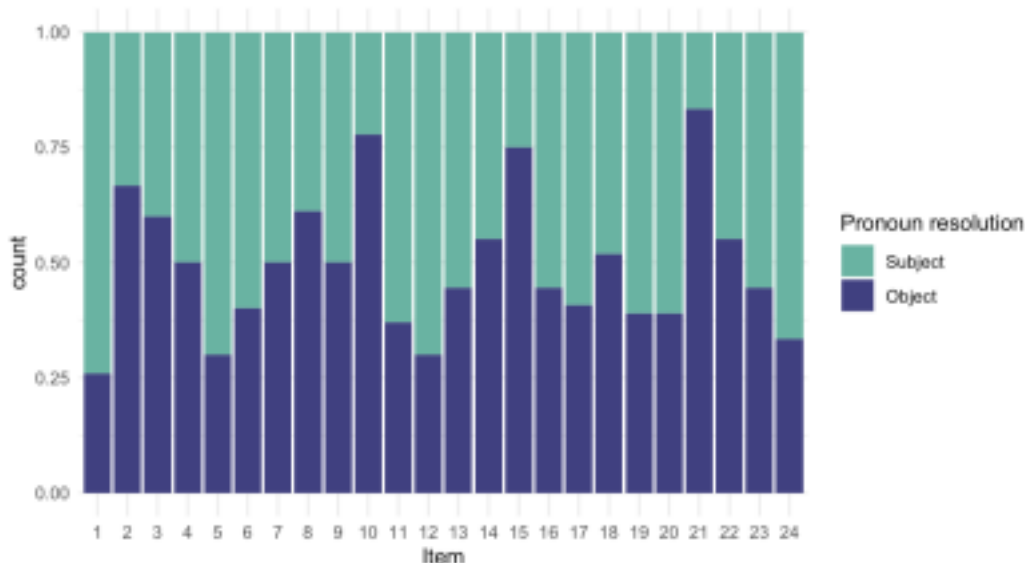
References:

Bittner, D. (2007). Influence of animacy and grammatical role on production and compre- hension of intersentential pronouns in German L1-acquisition, *ZAS Papers in Linguis- tics*, 48, 103-138. Bittner, D., & Kuehnast, M. (2012). Comprehension of intersentential pronouns in child Ger- man and child Bulgarian, *First Language*, 32, 176-204.

Blything, L. P., Iraola Azpiroz, M., Allen, S., Hert, R., & Järvikivi, J. (2021). The influence of prominence cues in 7- to 10-year-olds' pronoun resolution: Disentangling order of mention, grammatical role, and semantic role. *Journal of child language*, 1–29.

Bosch, P., Katz, G., Umbach, C., (2007). The non-subject bias of german demonstrative pronouns. In Schwarz Friesel, M., Consten, M., & Knees, M. (Eds.), *Anaphors in Text: Cognitive, Formal and Applied Approaches to Anaphoric Reference.* Benjamins.

Bouma, G., & Hopp, H. (2007). Coreference preferences for personal pronouns in German. *ZAS Papers in Linguistics*, 48, 53-74.

Fery, C. (2017). *Intonation and Prosodic Structure. Key Topics in Phonology*. Cambridge University Press.

Schumacher, P., Roberts, L., & Järvikivi, J. (2017). Agentivity drives real-time pronoun reso- lution: Evidence from German er and der, *Lingua*, 185, 25-41.

Phonetic variation in NNN compounds: acoustic duration and plosive reduction

This paper investigates variation in the phonetic signal of English left-branching and right-branching NNN compounds.

English compounding is argued to have an internal binary, recursive structure. Thus, an NNN is formed by adding an N (the free constituent) to an NN (the embedded com pound). If the N is added to the right, the NNN is left-branching, otherwise it is right branching. Previous research on affix ordering in English shows that inner boundaries in embedded forms are weaker than outer boundaries (Hay and Plag 2004, Zirkel 2010), and acoustic studies investigating different morphological boundaries show that the degree of boundary strength affects the phonetic signal (Lee-Kim et al. 2013, Blazej and Cohen Goldberg 2015, Kunter and Plag 2016). Building on these findings, we predict that there is more phonetic reduction in embedded compounds than in free constituents.

This prediction is tested with constituent durations and plosive reduction in exper iment 1. 42 participants produced 100 NNN in four conditions (see ex. (1)): An NN like *account service* occurs as embedded compound in one left-branching (LB1) and one right-branching (RB2) NNN as well as embedded constituent + free constituent in one left-branching (LB2) and one right-branching (RB1) NNN. Constituent-final /t,d/, thus, occurs at inner (LB1, RB2) and outer (LB2, RB1) boundaries in the NNN. In statistical analyses that control for the number of phonological segments, accentuation and speech rate we find no significant effect of embeddedness on either constituent durations or plo sive reduction. However, branching direction significantly affects the phonetic signal in NNN irrespective of the morphological boundary: In left-branching NNN, N2 constituents are shorter, and in right-branching NNN, plosives are more reduced.

Another factor that is assumed to affect the phonetic signal is lexical frequency. In NNN, lexical bigram frequency determines branching direction in such a way that high frequent bigrams form an NN and generally take the position of the embedded compound. Previous research on the effect of lexical frequency on the phonetic signal shows that highly frequent n-grams are more often phonetically reduced than less frequent n-grams (Pluymaekers et al. 2005, Aylett and Turk 2006, Arnon and Cohen Priva 2013). We therefore predict that there is more phonetic reduction in high-frequent NN that form an embedded compound than in low-frequent NN that do not form an embedded compound, irrespective of its position in the NNN.

We tested these predictions with constituent durations and plosive reduction in ex periment 2. 43 participants produced 40 NNN in four conditions which combine bigram frequency and position (see ex. (2)): A high-frequent NN like *mind frame* (HF1) and a low-frequent NN like *band forum* (LF1) occur in leftmost position in an NNN, and the same high-frequent NN (HF2) and low-frequent NN (LF2) occur in rightmost position in an NNN. Constituent-final /t,d/ is set either at the boundary between N1 and N2, or between N2 and N3. Preliminary results from the statistical analysis indicate that there is a significant shortening effect of lexical bigram frequency on constituent durations, however, NN in leftmost position are also significantly shorter than in rightmost position. Plosive reduction is not significantly affected by lexical bigram frequency.

On the basis of the (preliminary) results, we reject our predictions: Morphological embeddedness does not affect the phonetic signal in NNN, and it is not lexical bigram frequency alone that affects phonetic variation in NNN compounds.

(1) left-branching (LB1) [[*account service*] *assistant*]

          (LB2) [[*guest account*] *service*]

    right-branching (RB1) [*account* [*service assistant*]]
                      (RB2) [*guest* [*account service*]]

(2) low-frequent (LF1) *band forum talk*
    high-frequent (HF1) *mind frame support*

    low-frequent (LF2) *rebel band forum*
    high-frequent (HF2) *machine mind frame*

References

Arnon, I. and Cohen Priva, U. (2013). More than words: The effect of multi-word frequency and constituency on phonetic duration. *Language and speech*, 56(Pt 3):349– 371.

Aylett, M. and Turk, A. (2006). Language redundancy predicts syllabic duration and the spectral characteristics of vocalic syllable nuclei. *Journal of the Acoustical Society of America*, 119(5):3048–3058.

Blazej, L. J. and Cohen-Goldberg, A. M. (2015). Can we hear morphological complexity before words are complex? *Journal of experimental psychology. Human perception and performance*, 41(1):50–68.

Hay, J. and Plag, I. (2004). What constrains possible suffix combinations? on the inter action of grammatical and processing restrictions in derivational morphology. *Natural Language & Linguistic Theory*, 22(3):565–596.

Kunter, G. and Plag, I. (2016). Morphological embedding and phonetic reduction: The case of triconstituent compounds. *Morphology*, 26(2):201–227.

Lee-Kim, S.-I., Davidson, L., and Hwang, S. (2013). Morphological effects on the darkness of english intervocalic /l. *Laboratory Phonology*, 4(2).

Pluymaekers, M., Ernestus, M., and Baayen, R. H. (2005). Lexical frequency and acous tic reduction in spoken dutch. *The Journal of the Acoustical Society of America*, 118(4):2561–2569.

Zirkel, L. (2010). Prefix combinations in english: structural and processing factors. *Mor phology*, 20(1):239–266.

Ellen Taylor, Kate Nation and Yaling Hsiao

Context availability and sentence availability ratings for 3,000 English words and their association with lexical processing

Abstract

Words that can be easily placed in contexts are more easily processed, yet norms for context availability are limited. Here, participants rated 3,000 words for context availability and sentence availability, a new metric predicted to capture information relating to textual variation. Both variables were investigated alongside other word-level characteristics to explore lexical-semantic space. Analyses demonstrated that context availability and sentence availability are distinct. Context availability covaries with concreteness and imageability, while sentence availability captures information relating to contextual variation, frequency and ambiguity. Analyses of megastudy data showed that both context availability and sentence availability uniquely facilitated lexical decision performance.

Solbin Lee, Eun Ha Lee, Jinwon Kang, Jeahong Kim, Sangyub Kim, Changwhan Lee and Kichun Nam

Comparison type and token syllable effect in Korean morphologically complex words

Previous studies reported that first syllable token frequency inhibited visual word recognition (Carreiras, Alavrez & Devega, 1993; Conrad, Carreiras & Jacob,2008; Kwon, 2012). The phenomenon is called syllable frequency effect. However, there are morphologically complex words (MCWs) in Korean which are formed by adding affixes to roots. MCWs are widely used for visual word recognition research since their visual features drastically when compared to simple words. As a result, the current study aimed to test how token and type syllable frequencies had effect on the recognition of MCW. Total 600 stimuli were selected from media which had 2~4 syllables. 32 participants performed a lexical decision task on Korean morphologically complex nouns and verbs. Correlation and regression analyses were carried out in order to investigate whether which syllables in MCWs have most powerful influence for recognition. Task difficulty was manipulated by setting illegal MCWs in two ways. One way is that the first syllable of target MCWs was replaced by illegal syllable for easy lexical decision.

Another way is that the last syllable of target MCWs was kept and rest of syllables were replaced pseudo-syllables for difficult lexical decision. Token and type frequency of each syllable consisting of MCW were calculated based on the Korean Sejong corpus (Kim & Kang, 2009) and used as predictors. On the other hand, reaction time was used as dependent variable for both correlation and regression analyses. The correlation analysis result showed that token and type frequency of the first syllable was negatively related to reaction time. Also, type and token frequencies were positively correlated in each syllable. Regression analysis result showed that token frequency of first syllable reported negative relation with reaction time, regardless of task difficulty. On the other hand, type frequency of first syllable reported   negative relation with reaction time but this result was dependent on length of syllable and task difficulty. The current results demonstrate that token and type frequency of syllables consisting of MCW are highly related to each other but they modulate the processing of MCW in different ways. Furthermore, the syllable effect for Korean MCW is quite different with that of previous visual word recognition studies on simple word form, hence suggesting the necessity for a new perspective on syllable effect of MCWs.

Joohee Ahn, Jaehee Ryu, Jinwon Kang, Seonghak Jo, Junghye Choi and Sun-Young Lee

An fMRI study on morphological processing of Sino-Korean derivational prefix

This study investigates the processing of Sino-Korean words with derivational prefixes using the fMRI method. Many studies on morphological processing of compound and complex words have been conducted in English and German. For example, the processing of English regular and irregular past tense verb processing is a well-known issue regarding the processing of polymorphemic words. A full-list or a decomposition model has been proposed and tested using various research methods including neuropsychological methods. However, the neuropsychological morpheme study with Korean is still very rare. Our study examined brain activity using fMRI method with masked priming task to investigate how Sino-Korean derivational prefixes were processed. The stimuli were three-syllable derivational words in Korean composed with Sino-Korean prefixes and stems. Three conditions were compared: C1. Morphological condition (sharing a same/different morpheme), [*GO-seongneung*(high performance)-*GO-pumgyeog*(high quality); C2. Orthographical condition (sharing a same/different orthographical syllable), [*GANG-ulyang*(the amount of rainfall)-*GANG-simjang*(a strong heart)], and C3. Semantic condition (sharing a same/different semantical syllable), [*maegugno*(betrayer)-*banminjog*(antinational)]. The results from 32 participants data revealed a significant difference in brain activity only in C1 Morphological condition. The activated regions were the right fusiform gyrus and the right dorsolateral prefrontal cortex(dlPFC). Meanwhile, conditions 2 and 3 showed no significant difference in brain activity to report. In addition, the behavioral results also revealed a significant priming effect only in Morphological condition. These findings indicate the role of morphological property in the early visual processing in recognition of Korean derivation word. In particular, while previous studies documented brain activation in the left hemisphere in the semantic processing with 100ms (or longer) SOAs (Beretta et al., 2003; Morris et al., 2008), our study found action of *right* hemisphere with very short SOAs (52ms). The results conforms to the finding of Laine et al. (1999), proposing the role of right hemisphere in the very early stage of morphological processing.

JuGyeong Sun, Kichun Nam

Which flicker frequency is more useful than others?

Korea University

  Visual motion captures attention and attention is one of the important factors in learning. However, little is known about the effect of visual motion on learning. We modulated flicker frequencies, as one form of motion to test efficiency in phrase learning. The goal of this experiment is to investigate which flicker frequency is more effective than others in language learning. Eighty-four university students participated in the experiment. Participants performed a pretest, followed by 6 sessions, where each session was carried out twice a week, making a 3-week program. The program consisted of learning phase, recognition-test phase, and grammar-test phase. In the recognition test, the participants were asked to decide whether the stimulus was presented in the learning phase. In the grammar-test phase, they were asked if a sentence was grammatically correct. Participants were divided into three groups, according to presentation frequency. During the learning phase, English sentences were displayed at a frequency of 1Hz, 2Hz, and 4Hz (i.e., one, two, or four sentences per second). The stimuli were selected from high frequency words in British National Corpus. For both testing phase, all groups showed a significant improvement in the final session relative to the pretest session. In the final session, reaction times and error rates were lowest in the 2Hz group. The primary goal of this study was to investigate which group showed more superior performance than other groups. These results suggest an idea to develop efficient learning stimuli.\

Evonne Syed

How do we learn the meanings of words? Investigating semantically related vs. unrelated novel word learning

Purpose

Learning words in semantically unrelated sets has been shown to yield better results than learning vocabulary in semantically related sets in children [1]. However, current linguistic literature surrounding adult word learning and meaning relationships is limited. This experimental study examines how adult native speakers of English learn meanings of new words, and how semantically related vocabulary and linguistic context affect acquisition and retention of new lexical knowledge.

Method

We employed an incidental word learning paradigm to investigate how novel words (plurk; wurge) with related (e.g., fast and slow) and unrelated (e.g., hot and slow) intended meanings are learned when embedded in various linguistic contexts. In Experiment 1, 73 participants read passages containing novel words that either formed antonym pairs or were semantically unrelated. In Experiment 2, 72 participants read passages where semantic associations between novel words were not present. After reading, participants were tested on semantic learning of the novel words.

Results

Vocabulary post-tests tapping into memory recall and recognition showed no effect of semantic associations on semantic knowledge of novel words. However, reading times showed that sentences in Experiment 2 that did not contain semantically related novel words were read significantly faster than sentences with antonym pairs.

Conclusions

The results indicate that the presence of semantic relations between novel words that are learned does not affect semantic knowledge of novel words, which is contrary to previous findings [1]. Yet the presence of a semantic relation between novel words increases the cognitive effort reading, likely due to the need to form overlapping representations in the mental lexicon. These findings help inform the current linguistic literature regarding a less explored area of research. These findings also help inform language learning methods.

References
1. Erten, İ. H., & Tekin, M. (2008). Effects on vocabulary acquisition of presenting new words in semantic sets versus semantically unrelated sets. System, 36(3), 407-422.

Bahareh Yousefzadeh, Gary Libben and Sid Segalowitz

Persian compounds in the mental lexicon

Compound words have a structure somewhere between a single word and a phrase or sentence. Such a middle structure raises the question whether it is retrieved as a single unit or computed as would be a phrase or sentence. While good evidence suggests that compound words are decomposed, this is influenced by their transparency (Gagné & Spalding, 2016; Libben et al., 2014; Sandra, 1990). For example, in a semantic priming study, 'death' primed 'birthday' but 'moon' did not prime 'Sunday'. Either of the two constituents may be transparent (T) or opaque (O), as in birthday (TT), Sunday (OT), cardshark (TO) and dingbat (OO) in terms of it relating semantically to the full meaning of the compound. However, these studies involved European languages where the head constituent always comes second, with the modifier first, somewhat complicating the interpretation of results. To address this issue and to examine compound decomposition in another language, we presented Persian stimuli auditorily in a non-priming paradigm involving typing out the stimuli. We varied transparency but additionally took advantage of Persian compounds permitting modifier-head and head-modifier orderings. Thus, we could see whether transparency and headedness act separately on decomposition. In the typing task, we recorded the RT for each key press, permitting us to examine responses to the compound structure letter by letter instead of only having an RT to the entire stimulus. We currently have data analyzed from 10 native speakers of Persian with data from an additional 20 native speakers currently being added to the data set. Initial results indicate an interaction between head-position and transparency (p < .03) such that transparency increased decomposition for head-initial but not head-final compounds only when the modifier was opaque. Analyses of the complete data set will be presented at the conference. We also will examine some specific issues with respect to Persian grammar.

Gagné, C. L., & Spalding, T. L. (2016). Written production of English compounds: effects of morphology and semantic transparency. *Morphology*, *26*(2), 133-155.

Libben, G., & Weber, S. (2014). Semantic transparency, compounding, and the nature of independent variables. *Morphology and Meaning*, 205-221.

Sandra, D. (2020). Morphological Units: A Theoretical and Psycholinguistic Perspective. In *Oxford Research Encyclopedia of Linguistics*.

Julia Cataldo and Aniela França

Friend or foe: the morphological kinship between words

Lexical access allows the immediate understanding and production of words online. Despite being a basic linguistic computation, there is a lot of heated theoretical dispute in this area. For example, literature presents competing views regarding how semantically opaque words are accessed and stored.

This study will present an empirical research whose results shed light on: i) the way we access transparent and semantically opaque words, i.e., if we activate whole words (Hay, Baayen, 2005; Morris et al., 2017; Jared, Journalev, Joanisse, 2017) or if we assemble them by their morphemes (Taft, Forster, 1975; Stockall, Marantz, 2006; Kazanina et al., 2008; Lázaro, Garcia, Illera, 2021); and ii) the method of representing words in the mind, i.e., if words bearing a semantic relationship between them would be linked and words having a morphological relationship with each other would also be linked, but by a different process than the semantic one (Garcia, 2009; Dominguez, Vega, Barber, 2004; Jarvikivi, Pyykkonen, 2011).

The Distributed Morphology (MD - Halle, Marantz, 1993; Marantz, 1997) theory suggests there are different lexical approaches, originated from psychologically different processes. However, we are interested in the access of words that bear a morphological relationship between them and that once also shared a semantic relation, but that under the synchronous perspective have lost it. For instance, *liquidação* (Brazilian Portuguese for the word sale) derives diachronically from *líquido* (liquid), but nowadays Brazilian speakers seem to ignore this semantic relationship. This very specific type of morphologic and semantic relationship between words has never been tested before in this language.

In order to evaluate MD predictions, we ran a behavioral priming test with a lexical decision judgment (word/non-word). We compared pairs of synchronically semantically unrelated (but morphologically linked) words -like *líquido/liquidação* (liquid/sale)- with pairs that maintain a transparent compositional relationship -like *líquido/liquidificar* (liquid/to liquefy)- and with pairs that maintain only a semantic (and not morphological) relationship -like *líquido/derretido* (liquid/melted). For each of these three conditions, we selected stimuli with two different sizes/morphologic layers: for instance, *líquido-liquidação* (liquid-sale) pairs, presented above, stand for the long condition of the opaque relationship, whereas *líquido liquidar* (liquid-to liquidate) pairs stand for the short one.

The results of a first behavioral pilot test confirmed the MD hypothesis, evidencing i) a decompositional course during processing, regardless of semantic opacity; ii) new entries for words such as *liquidação* (sale) in the mental lexicon; and iii) different psychological processes for the morphologic and semantic routes: we propose linguistic composition for the former and joint memory for the latter.

Our next step will be to run an EEG test with the same design to test the neuropsychological correlates to this computation (Bozic et at., 2007; Lavric, Clapp, Rastle, 2007; Gwilliams, Marantz, 2018; Kastner, Pylkkänen, Marantz, 2018). We expect to find wider ERP amplitudes for the semantically opaque conditions and different latencies between

two
different-size stimuli (2 and 3 morphologic layers) for both the transparent and opaque morphological conditions, but not for the semantic-only one. These findings would confirm our previous conclusions for the pilot test.

Response times X Conditions:
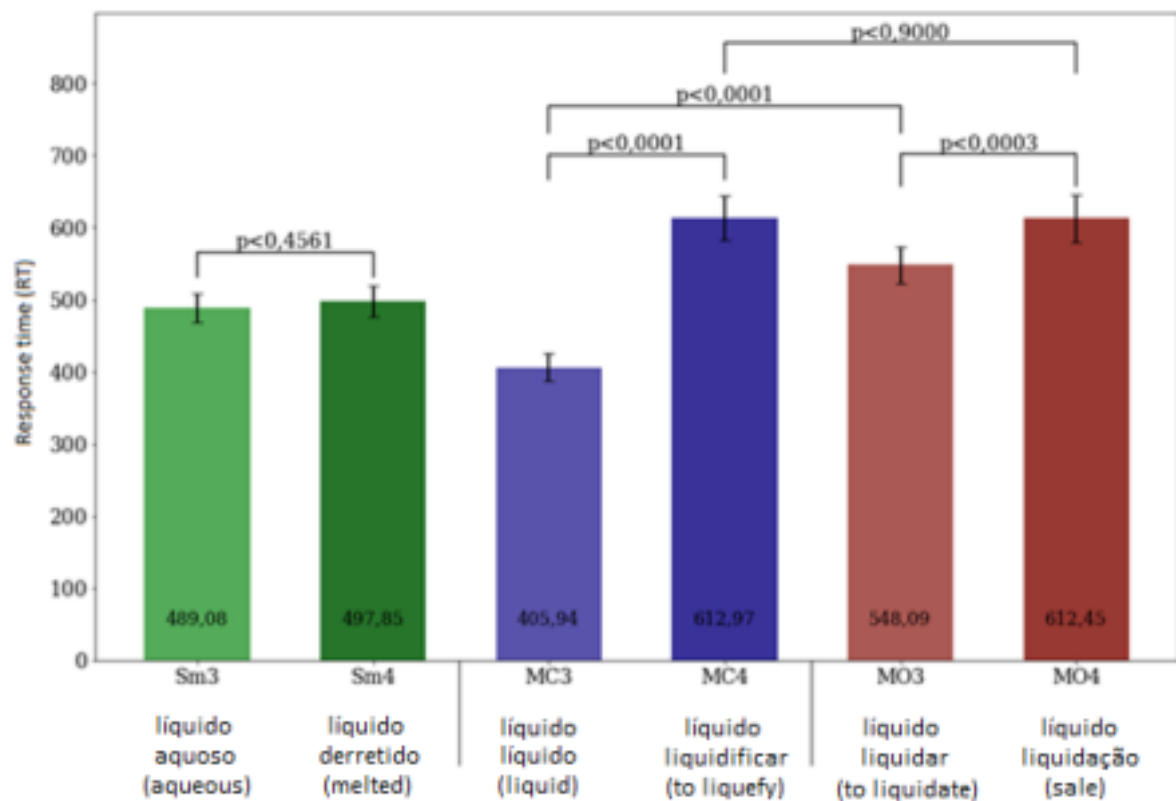
References:

GWILLIAMS, L.; MARANTZ, A. (2018) Morphological Representations Are Extrapolated from Morpho-Syntactic Rules. Neuropsychologia, n. 114, 77-87. HALLE, M.; MARANTZ, A. (1993) Distributed Morphology and the pieces of inflection. In: HALE, K. L.; KEYSER, S. J. (Eds.) The view from building 20. Cambridge: MIT Press, 111–176.

HAY, J. B.; BAAYEN, R. H. (2005) Shifting paradigms: gradient structure in morphology. Trends in Cognitive Sciences, v. 9(7), 342-348.

JARED, D.; JOURAVLEV, O.; JOANISSE, M. F. (2017) The effect of semantic transparency on the processing of morphologically derived words: Evidence from decision latencies and event-related potencials. Journal of Experimental Psychology: Learning Memory and Cognition, v. 43(3), 422-450.

JÄRVIKIVI, J.; PYYKÖNEN, P. (2011) Sub- and supralexical information in early phases of lexical access. Frontiers in psychology, v. 2(282).

KAZANINA, N.; DUKOVA-ZHELEVA, G.; GEBER, D.; KHARLAMOV, V.; TONCIULESCU, K (2008) Decomposition into multiple morphemes during lexical access: A masked priming study of Russian nouns. Language and cognitive processes, v. 23(6), 800–823.

LAZARO, L.; GARCÍA, L.; ILLERA, V. (2021) Morpho-orthographic segmentation of opaque and transparent derived words: New evidence for Spanish. Quarterly Journal of Experimental Psychology, 74(5):944-954.

STOCKALL, L.; MARANTZ, A. (2006) A single route, full decomposition model of morphological complexity: MEG evidence. The Mental Lexicon, v. 1, 85-123. TAFT, M.; FORSTER, K. I. (1975) Lexical storage and retrieval of prefixed words. Journal of Verbal Learning & Verbal Behavior, v. 14(6), 638-647.

Stephen Politzer-Ahles, Julie Siying Chen and Ka Keung Lee

A failure to replicate the Ganong effect for tone continua

Introduction. People hearing an ambiguous sound tend to categorize it in a way that yields a real word—for instance, given a sound that is ambiguous between /t/ and /d/, listeners are more likely to judge the sound as /t/ in the context _est (where *test* is a real word and **dest* is not) than in the context _esk (**tesk* is not a word but *desk* is). This is the Ganong effect (Ganong, 1980). In the present study we aimed to use the Ganong effect to probe the lexical status of surface forms that are derived as a result of phonological alternation (tone sandhi) but are not themselves citation forms in the lexicon; in the process, however, we unexpectedly found that the Ganong effect failed to occur under certain conditions.

The present study uses Mandarin stimuli varying on continua between Tone 1 (high tone) and Tone 2 (rising tone). The Ganong effect has been observed in such continua (Fox & Unkefer, 1985; Yang et al., 2019; Wiener & Liu, 2021).

Experiment 1 (N=100). We selected segmental syllables that yielded Tone-1-biased continua (continua in which the syllable in Tone 1 is a real word and in Tone 2 is a pseudoword, e.g. $diu^1 - *diu^2$), syllables that yielded Tone-2-biased continua (e.g. $*qiong^1 - qiong^2$), and syllables that yielded "neutral" continua in which each endpoint was a real word or each endpoint was a pseudoword (e.g. $die^1 - die^2$, $*te^1 - *te^2$). Each continuum type included 3-4 different syllables. There were also two additional conditions involving tone sandhi, but which we do not report here in the interest of space. We recorded natural tokens of each item (spoken by a female northern Mandarin speaker) in both Tone 1 and Tone 2, and for each item we created a seven-step continuum where the steps differed only in F0 contour and duration, by interpolating the F0 contour and duration in five equal steps between the natural endpoints and superimposing these contours onto one token (see Figure 1).

The results from 100 native Mandarin-speaking participants are shown in Figure 2. The Tone-1-biased continua yielded more Tone 1 judgments than the Tone-2-biased continua did, consistent with a Ganong effect. On the other hand, the results for the neutral continua were, unexpectedly, not in between these two.

Experiment 2 (N=100). We suspected that the unexpected pattern of our results may have been due to the way we created our continua, which allowed each item to have different endpoints – meaning that the apparent Ganong effect may have been due to low-level acoustic factors instead (for example, the natural Tone-2 endpoint for $*diu^2$ might have happened to be less Tone-1-like than the natural Tone-2 endpoint for $qiong^2$). Thus, we re-ran the study using only stimuli with no obstruents and superimposed identical pitch contours for each step across all items (such that, e.g., the step 1 token for *yue* had the exact same duration and F0 contour as the step 1 stimulus token for *lan*, etc.; see Figure 3).

The results are shown in Figure 4. This experiment failed to elicit a Ganong effect; the Tone-1-biased continua elicited *fewer* Tone 1 responses, rather than more. **Discussion.** We are unable to explain why no Ganong effect was elicited in Experiment 2, nor why the neutral continua in Experiment 1 did not yield "neutral" (i.e., intermediate between the two biased continua) categorization patterns. The lack of Ganong effect for Tone-1-biased vs. Tone-2-biased continua in Experiment 2 cannot be readily explained by other lexical-level confounds in the stimuli (such as neighbourhood density or tone-segment combination probability), because the same items from Experiment 1 were also used in Experiment 1 and did yield an apparent Ganong effect (even when analyzed separately from the other items). The stimulus manipulation method also does not explain our results. Yang et al., 2019, had a

similar pattern as ours: Ganong effect when they used the method we used in Experiment 1, but no Ganong effect when they used the method we used in Experiment 2. But Fox & Unkefer (1985) and Wiener & Liu (2021) used a method similar to what we used in Experiment 2 and did find Ganong effects. These results raise questions about the robustness of the Ganong effect, particularly for tonal continua.

References

Fox, R., & Unkefer, J. (1985) The effect of lexical status on the perception of tone. *Journal of Chinese Linguistics, 13*, 69-90.

Ganong, W. (1980). Phonetic categorization in auditory word perception. *Journal of Experimental Psychology: Human Perception and Performance, 6*, 110-125. Yang, T., Jin, S., & Lu, Y. (2019). The effect of Mandarin accidental gaps on perceptual categorization. *Proceedings of the 19th International Congress of Phonetic Sciences.* Wiener, S., & Liu, J. (2021). Effects of perceptual abilities and lexical knowledge on the phonetic categorization of second language speech. *JASA Express Letters 1*, 045202.

Figures
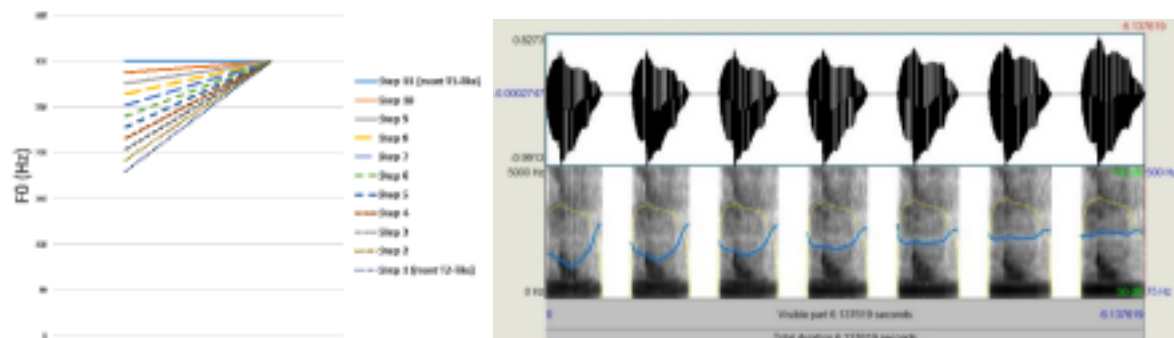
Figure 1. Seven-step continuum from *Tone-1 and Tone-2 F0 contours.*
nong²to nong¹. *Note that the F0 contounrs* ***Figure 3. F0 contours for Experiment 2.***
were intermediate steps between natural
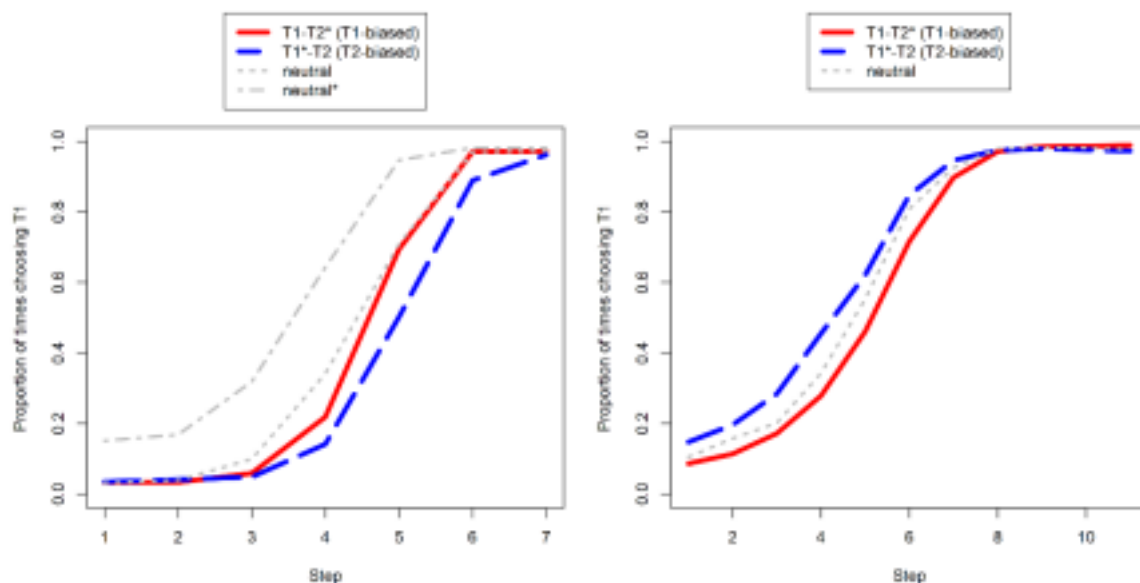
Figure 2. Results from Experiment 1. *The Ganong conditions, highlighted in red and blue lines, were seen in a manner that elicited the Ganong effect, but the neutral conditions in light gray did not match either the patterns of T1 word or nonword conditions.*

Figure 4. Results from Experiment 2. *The blue dotted line, in which T1 is a pseudoword, showed a higher proportion of Tone 1 responses, compared to the red line, stimuli in which T1 is a word. This shows a failure to elicit the Ganong effect.*

Talks 6

Jessica Nieder, Fabian Tomaschek and Ruben van de Vijver

The process behind production: Inflection of Maltese pseudo words is based on discriminative learning

A dominant question in linguistics is what knowledge native speakers use to inflect novel word forms. To answer this question, many studies rely on socalled *wug tests* (BerkoGleason, 1958; van de Vijver & BaerHenney, 2014). However, even after the successful completion of the task, it remains unclear what kind of learning strategy the participants used for their inflections: Is their knowledge based on linear rules that capture inflectional changes (Albright & Hayes, 2003)? Is it based on detecting similarities in the data and comparing these to stored word forms (Daelemans & van den Bosch, 2005)? Or is the knowledge based on adjusting weights between cues and outcomes as a result of predictions and prediction errors? The latter view is computationally implemented in the Naive Discriminative Learner (NDL) (Baayen et al., 2011).

In this study, we use NDL (Arppe et al., 2018; Baayen et al., 2011), a simple two layer network that is based on the ideas of discriminative learning, to model the inflections of Maltese pseudo singulars taken from a production experiment reported in Nieder et al. (2021). The Semitic language Maltese shows a bewildering amount of different *sound* plurals, such as *prezz prezzijiet* 'prices', and *broken* plurals, such as *qattus qtates* 'cats'. Some word forms, e.g. *kaxxa* 'box' even show both plurals without a change in meaning: *kaxxi* vs. *kaxex*. Despite being faced with such a complex plural system as a result of the morphological variation, native speakers are able to apply their knowledge to new word forms. To do so they rely on the most frequent sound plural suffixes and broken plural templates given in their language (Nieder et al., 2021). While this conclusion describes the end result well (= the plural inflections collected in the study) the process behind selecting a specific plural suffix or template is not clear at all. It might be the case that speakers learned to discriminate the plural class on the basis of the phonological cues of the singular form. Another possibility would be that during the wug test, speakers select the plural class by testing the phonological cues of the pseudo word against both, singular and plural cues of existing word forms.

These hypotheses can be tested with NDL (Arppe et al., 2018). The strength of a prediction in NDL is based on the informativity of cues that takes into account both the cooccurrence and the nonoccurrence of cues and outcomes, and the resulting cue competition (Ramscar et al., 2013; Rescorla & Wagner, 1972). Using the experimental data provided by Nieder et al. (2021) and a corpus of 3174 Maltese singularplural pairs, we compare the distribution of the predicted plural classes in the data of the human participants with the distribution of the different plural classes for the same pseudo words from different NDL models with various cuetooutcome structures by means of a Spearman's correlation.

The results are visualized in figures 1 and 2. We find statistically significant and strong correlations between the NDL data and the corpus data (ρ = .8204851, p < 0.01 for a model with singular cues, ρ = .8602941, p < 0.01 for a model with singular plural cues), indicating that NDL is able to mirror the distribution of plural classes found in the Maltese lexicon. In addition, we find strong and statistically significant correlations between the answers of the participants in the production experiment and the NDL predictions, with marginally better results for a model using singular plural cues (ρ = .7289183 and statistically significant p = 0.02588 for the singular cue model, ρ = .7593637, p = p < 0.01 for the singular plural cue model).

The modeling results indicate that the production of Maltese plurals can be explained on

the basis of discriminative learning. As NDL implements a cognitively plausible learning model, these results indicate that Maltese speakers learned to use phonological information of existing singulars and plurals to successfully predict a plural class for pseudo singulars.
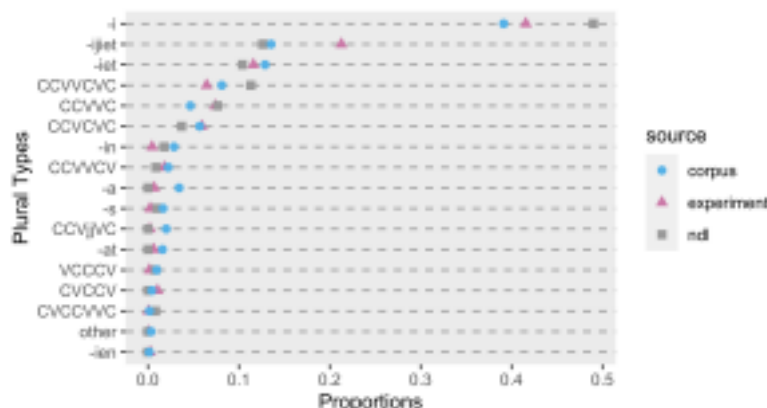

Figure 1: Proportion of plural classes used in the production experiment vs. plural classes used by the NDL model vs. plural classes in the corpus using **singulars** as cues
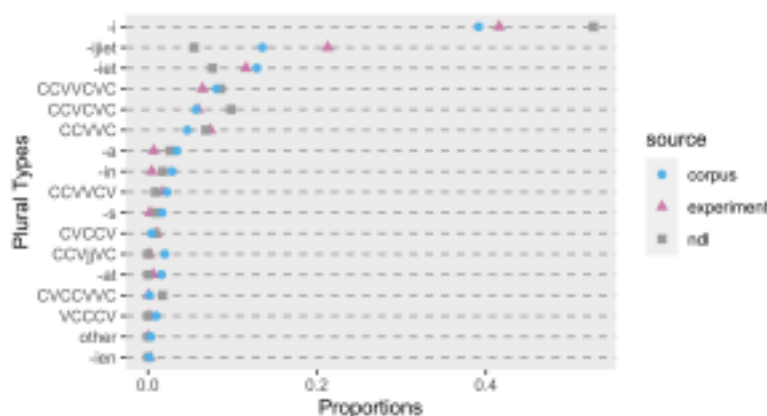

Figure 2: Proportion of plural classes used in the production experiment vs. plural classes used by the NDL model vs. plural classes in the corpus using **singulars and plurals** as cues

References

Albright, A., & Hayes, B. (2003). Rules vs. analogy in English past tenses: A computational/experimental study. *Cognition*, *90*(2), 119–161.

Arppe, A., Hendrix, P., Milin, P., Baayen, R. H., Sering, T., & Shaoul, C. (2018). Ndl: Naive Discriminative Learning. Retrieved November 20, 2020, from https://CRAN.Rproject.org/package=ndl Baayen, R. H., Milin, P., Đurđević, D. F., Hendrix, P., & Marelli, M. (2011). An amorphous model for morphologhical processing in visual comprehension based on naive discriminative learning. *Psychological Review*, *118*(3), 438–481. https://doi.org/10.1037/a0023851

BerkoGleason, J. (1958). The child's learning of English morphology. *Word*, *14*, 150–177. Daelemans, W., & van den Bosch, A. (2005). *Memorybased language processing*. Cambridge University Press. Nieder, J., van de Vijver, R., & Mitterer, H. (2021). Knowledge of Maltese singularplural mappings. *Morphology*, *31*, 147–170. https://doi.org/10.1007/s11525020093537

Ramscar, M., Dye, M., & McCauley, S. M. (2013). Error and expectation in language learning: The curious absence of "mouses" in adult speech. *Language*, 760–793.

Rescorla, R., & Wagner, A. (1972). A theory of pavlovian conditioning: Variations in the effectiveness of rein forcement and nonreinforcement. In A. H. Black & W. Prokasy (Eds.), *Classical conditioning II:*

Current research and theory (pp. 64–69). Appleton Century Crofts, New York.

van de Vijver, R., & BaerHenney, D. (2014). Developing biases. *Frontiers in Language Sciences*, *5*(634). https: //doi.org/10.3389/fpsyg.2014.00634

Daria Gvozdeva, John Cristian Borges Gamboa, Juhani Järvikivi and Shanley E. M. Allen

How does context affect the perceived difficulty of long nominal compounds?

One typical characteristic of scientific texts is the frequent use of nominal compounds. A nominal compound (NC) is a sequence of nouns denoting a single concept (e.g., *waste water treatment facility*). These sequences are arguably hard to process, as they pack into a few words information that would otherwise be spread through longer structures that use of relative clauses or prepositional phrases (cf. *facility for the treatment of water from waste*; see Levi, 1978).

While in a typical scientific article the reader is confronted with several NCs, some NCs seem to be harder than others (compare, for example, *stress response gene* vs. *start arm barrier*). The Uniform Information Density account (Jaeger, 2010) proposes that speakers transmit information at a close-to-constant rate, near the capacity of the channel (between transmitters and receivers). This may explain partly why some NCs seem to become easier as the context is taken into account. For example, in this study, when presented with the context, *start arm barrier* averaged 1.9 on a 1-10 difficulty scale (see below, also Figure 1). If NCs are dense, but the information is transmitted at a constant rate, then they must be set up by the context, so that readers are able to expect an NC when they get to it.

In this study, we estimated the "strength" of this set up by counting the number of words preceding the NC that were semantically similar to the NC words (as determined computational using BERT words vectors; Devlin et al., 2018). We used this count to divide them into three categories (see Table 1). Our data included 120 NCs (60 3-word NCs and 60 4-word NCs) extracted from a corpus of scientific texts from the fields of Biology, Linguistics and Economics. Native English speakers (N=54) read 20 NCs presented in their original context, answering on a 1-10 scale the question *How hard is it to understand the highlighted noun phrase after you have read the text passage?* (1: very easy; 10: very hard). Participants also read 20 other NCs in isolation, and answered the question *How hard is it to understand the given noun phrase?* We predicted participant ratings to be higher for longer compounds (4-word NCs > 3-word NCs). We also predicted higher ratings for NC text passages with the least semantically similar words (A > B > C), but expected that no such effect would be found for the NCs presented in isolation. Ratings were analysed with two maximally specified linear mixed-effects models: one for NCs in context and one for NCs in isolation.

Ratings were quite spread throughout the 1-10 range, as can be seen in Figure 1, which shows the results for both the case when the NCs were presented along with their respective text passage, and when they were presented in isolation. Longer NCs were rated as harder both when presented with context (t=3.012, p<0.005) and in isolation (t=3.103, p<0.005). However, no effect of Category was found in either model, regardless of whether the NC was presented along with context or in isolation. That is, we found no evidence that the number of semantically similar words preceding the NC affected its processing. This may be for a number of reasons. For example, maybe only counting preceding similar words (and disregarding the sentences' structure) is not a sensitive enough measure of set up "strength". Alternatively, we may have not controlled for important variables in our design. Indeed, a posthoc examination of the results suggested that some NCs were rated quite easy in isolation. These often were "familiar" NCs such as *heart rate variability* or *head noun phrase*. To our surprise, in these cases, the presence

of context sometimes led to *higher* average difficulty ratings. Conversely, as exemplified in Figure 1, some hard NCs did become easier when presented along with their context. Therefore, in a future study, we plan to explore NC familiarity in a better controlled manner.

Each session consisted of six trials and all animals completed one session a day. Each session consisted of three correct left and three correct right trials, presented in a pseudorandom order. Each trial comprised two stages, a 'sample run' followed by a 'test run'. At the start of each trial, two sucrose pellets were placed in each food well and a metal barrier was placed at the choice point of the T-maze, thereby closing one cross arm (Fig. 8). On a sample run, the animal was placed in the start area and the aluminium barrier removed, allowing the rat to run down the start arm. Because of the metal barrier blocking the entrance to one of the cross arms, the rat could only enter the one open arm. Once the rat had collected the sucrose pellets from the well at the end of the open arm, the rat was returned to the start area, where it remained for 10s while the barrier at the choice point was removed and the same arm as previously visited was rebaited. The test run started as the start arm barrier was raised, allowing the animal a free choice between the two cross arms of the T-maze.

Figure 1. An example text passage as it was presented in the questionnaire to the participants.

Answers to the question of the trials with CNC in context

A B C A B C
Groups of the amount of similar words in a sample
Answers to the question of the trials with CNC in

isolation₃ ₄

1

A B C A B C Groups of the amount of similar words in a
sample

(a) (b)

Figure 2. Participant ratings when the NCs were presented along with their original context (a), and in isolation (b).

Table 1. *NCs were divided into three classes according to the number of words in its preceding context that were semantically similar to the NC words.*

NC Category A B C
# of similar words in the context 10-19 20-29 30-39

References
Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2018). Bert: Pre-training of deep bidirectional transformers for language understanding. *arXiv preprint arXiv:1810.04805*. Levi, J. (1978). *The syntax and semantics of complex nominals.* New York: Academic Press. Jaeger, T. F. (2010). Redundancy and reduction: Speakers manage syntactic information density. *Cognitive psychology*, *61*(1), 23-62.

Fernanda Marabelly de Oliveira Veras and Gustavo Lopez Estivalet

Deriving word Portuguese semantic variables from English metrics

Abstract: Psycholinguistic studies aimed to comprehend and explore the influence of emotional and semantic aspects in the processing of isolated words have been successfully developed during the last years. These word lexicons containing semantic variables have been used for selecting and controlling stimuli in experiments. The semantic variables are defined as intrinsic word properties that can modulate aspects of linguistic processing. These variables are valence (pleasantness of a stimulus), arousal (intensity of alert), dominance (degree of control), concreteness, and imageability (semantic representation) (Warriner et al., 2013). For example, the world "hug" owns the following metrics: V = 6.62, A = 3.89, D = 5.35, C = 5.19, and I = 5.9; while the word "kill" has: V = 1.66, A = 4.87, D = 3.28, C = 5.13, and I= 3.65. Thus, while the word "hug" clearly presents higher values of valence, dominance, and imageability, the word "kill" has a higher value of arousal, suggesting differences in the semantic processing during word recognition. Despite these metrics being available in English lexicons, there is a lack of this information for Brazilian Portuguese language. Hence, this work is justified by the importance and significance of these variables in psycholinguistic research in Brazilian Portuguese language. Therefore, the main objective of this work was to create a Brazilian Portuguese lexicon of words with the semantic variables listed above. The secondary objectives were: i. describe the method employed for this lexicon construction and ii. validate this lexicon through a meta-analysis of lexical decision data. The following questions guided our work: Can the English values from these variables be directly transferred to Brazilian Portuguese words? Are these metrics correlated to reaction times of word recognition in Brazilian Portuguese? One hypothesis is that the English metrics do not work for other languages because they are intrinsic to each language; our hypothesis is that these metrics can be considered as general semantic properties independently of language. To construct the Brazilian Portuguese Semantic Lexicon, we first created a single list of the English metrics of valence, arousal, and dominance of the 14K lexicon words from Warriner et al. (2013), the concreteness of 40K lexicon words from Brysbaert et al. (2014), and the imageability of 6K lexicon words from Cortese & Fugett (2004) and Schock et al. (2012). Then, we translated all these English words to Portuguese through the Google Spreadsheet function "GoogleTranslate" and associated the metrics to the Brazilian Portuguese Lexicon (Estivalet et al., 2019). Finally, we expanded the lexeme metrics of its lemma, and then, to all the lexemes from the same lemma. Afterwards, in order to validate these metrics as Brazilian Portuguese semantic variables, we performed a meta analysis of reaction time on a sample of 400 words. As a first result, from our knowledge, this is the first Brazilian Portuguese lexicon presenting these psycholinguistic semantic variables. The Brazilian Portuguese Semantic Lexicon presents the five semantic variables discussed above for 33K words, as well as frequency, word length, and neighborhood. In the meta analysis, we found significant correlations between reaction times and valence, arousal, and imageability. Thus, our results suggest that it is perfectly possible to derive semantic metrics from one language to other one, as well as expand these metrics based on lemma-lexeme paradigms. Also, our results showed that arousal and valence are the semantic variables which better correlate to reaction times, suggesting that these variables are generally represented, independently of language. We hope the Brazilian Portuguese Semantic Lexicon can be explored and useful in psycholinguistic research on semantic processing of Brazilian Portuguese words, as well as general stimuli control. Our next step is to perform a straightforward experiment for categorizing and recognizing a sample of this data to cross

validate the method and lexicon developed here.

Keywords: Lexicon; Valence; Arousal; Dominance; Imageability; Concreteness.
References

Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40 thousand generally known English word lemmas. *Behav. Res. Methods*, *46*(3), 904–911.

Cortese, M. J., & Fugett, A. (2004). Imageability ratings for 3,000 monosyllabic words. *Behavior Research Methods, Instruments, & Computers*, *36*(3), 384–387

Estivalet, G. L., et al. (2019). LexPorBR Infantil: Uma base lexical tripartida e com interface Web de textos ouvidos, produzidos e lidos por crianças. In C. A. Prolo & L. H. M. de Oliveira (Eds.), *Proceedings of the XII STIL2019,* 190–199.

Schock, J., Cortese, M. J., & Khanna, M. M. (2012). Imageability estimates for 3,000 disyllabic words. *Behavior Research Methods*, *44*(2), 374–379.

Warriner, A. B., Kuperman, V., & Brysbaert, M. (2013). Norms of valence, arousal, and dominance for 13,915 English lemmas. *Behavior Research Methods*, *45*(4), 1191–1207.

Laura Schwalm and Ralph Radach

Desirable difficulty in reading- the curious case of Sans Forgetica.

The issue of *desirable difficulty* has recently become a hot top topic in cognitive science. It is assumed that making a task more difficult leads to deeper processing and better memory. An alternative view suggests that any improvement may be due to the longer duration of processing. One form of *desirable difficulty* is the use of typographically degraded (non continuous) fonts during reading. A team at the RMIT university in Melbourne developed a degraded named Sans Forgetica, claming that it boosts memorization (Earp, 2018).

Attempts to test potential advantages of Sans Forgetica have focused on recall from text passages (Taylor et al. 2020), so far with negative results. Our own work aims to deepen this discussion in two ways: First, we use eye movement methodology to document the fine grain changes induced by a degraded fort during reading. Second, we pursue a more advanced understanding of comprehension in terms of distinguishing between the levels of propositional text base and situation model (Kintsch, 1998).

Participants (N=42) were asked to read six texts (1000 words each) on popular science issues. The materials were adapted from Maier and Richter (2013) and displayed alternately in Sans Forgetica and Arial. After each text, participants responded to 24 comprehension questions targeting the levels of text base and situation model according to the Kintsch (1998) theory of text processing. Here is an example sentence in Sans Forgetica and Arial:

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The aim is to improve the purity of the products and achieve higher
response rates.
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The aim is to improve the purity of the products and achieve higher response rates.

Results indicate a substantial inflation of word viewing times due to the degraded font, especially for longer words, during the reading of the initial text. The effect materializes primarily in the number and not the duration of individual fixations. The differences between fonts decreased as reading progressed, up to a relatively small effect in the final phase of the experiment. We cannot exclude the possibility that a residual difference remains when reading over a longer period, but it is apparent that readers quickly adapt to the somewhat degraded script. Looking at comprehension, results indicate that the Sans Forgetica does not provide any advantage both on the level of text base and situation model, even for the initial phase, where reading times still differ substantially.

We conclude that there is no evidence that the idea of *desirable difficulty* applies to normal reading for comprehension. Theoretical implications will be discussed.

Normal reading, Desirable difficulty, text comprehension, eye movements

References

Earp, J. (2018). Q&A: Designing a font to help students remember key information

Geller, J., Davis, S. D., & Peterson, D. J. (2020). Sans forgetica is not desirable for learning. *Memory*, *28*(8), 957-967.

Kintsch, W. (1998). *Comprehension: A Paradigm for Cognition*, Cambridge University Press, 1998 Maier, J., & Richter, T. (2013). Text belief consistency effects in the comprehension of multiple texts with

conflicting information. *Cognition and Instruction, 31(2),* 151-175.

Taylor, A., Sanson, M., Burnell, R., Wade, K. A., & Garry, M. (2020). Disfluent difficulties are not desirable difficulties: the (lack of) effect of Sans Forgetica on memory. *Memory, 28(7),* 850-857.

Elizaveta Kovalenko and Daria Chernova

The Robustness of Graphic Representation of a Word in the Mental Lexicon: an Experimental Study with Reference to French

Introduction
Spelling errors in most cases are considered as a consequence of a word's weak orthographic representation in mental lexicon (see the Lexical Quality Hypothesis (Perfetti&Hart2007)). Rahmanian and Kuperman (2019) suggested that frequent alternative spellings can affect visual recognition of correctly spelled words as they increase entropy in the mental lexicon and blur orthographic representations. High entropy is expected to result in slower word recognition, even if spelled correctly which has been shown for English, Chinese, Greek, Finnish, and Hebrew (Kuperman et al. 2021).
Rationale of the study
In this study, we turn to the French, which is characterized by opaque orthography. The most common spelling errors are wrong diacritics, errors in bigrams or trigrams, inserting an extra letter, replacing one letter with another, incorrect letter order, or missing endings. Our experiment will show how mistakes a native speaker is exposed to when reading unedited texts alter the lexical quality of the word.
Material
We selected 30 words that are frequently misspelled according to Sketch Engine frTenTen: Corpus of the French Internet (www.sketchengine.eu/frtenten-french-corpus). We used a spelling decision task, presenting in the first report half of the words with correct spelling, half with errors and vice versa in the second experimental list. For each word, we defined the frequency of the correct spelling, the frequency of the incorrect spelling, and the uncertainty between spelling variants using an information-theoretic measure of entropy (see Rahmanian and Kuperman 2019).
Participants and Procedure
36 native speakers of French (aged 18-49, 19 female) took part in the study. The experiment was conducted online using Ibexfarm (spellout.net/ibexfarm/). The participants were presented isolated words and had to decide whether the spelling is correct or not. Accuracy and reaction times were registered.
Results and discussion. For correctly spelled words, answer accuracy is affected both by entropy (Z=-4.21, p=0.001) and word frequency (Z = 3.63, p<0.001). The reaction time was affected by entropy (b= -14.2764,SE=6.25, t= -2.29, p= 0.02). It gives evidence that frequent misspelling blurs the mental representation of the word in the mental lexicon, making it difficult to make a spelling decision about the correctly spelled word. For both types of stimuli, frequency affects both reaction time (b = -17.7; SE = 7.99; t = -2.21; p = 0.03) and answer accuracy (Z = 2.9, p-value = 0.004). It gives evidence that frequent words are more robust to changes of orthographic representation than infrequent ones.

References
Perfetti, C. A., Hart, L. The lexical quality hypothesis. Precutsors of functional literacy, 2002, Vol. 11. Pp. 67–86.
Rahmanian, S., Kuperman, V. Spelling errors impede recognition of correctly spelled word forms. In: Scientific Studies of Reading, 2019, Vol. 23(1). Pp. 24–36.
Kuperman, V., Bar-On, A., Bertram, R. et al. Prevalence of spelling errors affects reading behavior across languages. Journal of Experimental Psychology: General, 2021. Advance online publication. https://doi.org/10.1037/xge0001038

Talks 7

Ana Baciero, Pablo Gomez, Jon Andoni Duñabeitia and Manuel Perea

Letter similarity effects in braille word recognition

Models of word recognition typically posit that the initial mapping of the sensory information onto abstract letter representations is noisy (e.g., see Norris & Kinoshita, 2013). Indeed, masked priming experiments in the visual modality have repeatedly shown that recognizing a word like *NEUTRAL* is faster when preceded by the masked prime *nevtral* than when preceded by the prime *neztral*—note that *v* is more similar to *u* than *z*. However, letter similarity effects are elusive in unprimed experiments: *viotin* and *viocin* (base word: *violin*) produce similar response times and error rates in the lexical decision task (e.g., Perea & Panadero, 2014). Here, we examined whether letter similarity effects can be found when reading braille. The rationale is that braille is a writing system in which the sensory information from the word's letters depends on fast serial scanning of characters that differ very little among themselves. Hence, the process of mapping sensory information onto letter identities in braille may be a noisier process than visual reading and, as a result, tactually similar pseudowords (e.g., ausor [ausor], baseword: autor [autor]) could be more wordlike than tactually dissimilar pseudowords

(aucor [aucor]). To test this hypothesis, we conducted a lexical decision experiment with congenitally blind adult participants. Pseudowords were created by replacing one letter of a word with a tactually similar or dissimilar letter in braille. Bayesian linear mixed effects models on accuracy showed responses were less accurate to the "tactually similar" pseudowords than to the "tactually dissimilar" pseudowords. A parallel trend occurred for response time data. These findings favor the idea that, when reading, mapping the input information onto abstract

letter representations involves some degree of confusability.

References

Norris, D., & Kinoshita, S. (2012). Reading through a noisy channel: Why there's

nothing special about the perception of orthography. *Psychological Review, 119*(3),

517– 545. https://doi.org/10.1037/a0028450

Perea, M., & Panadero, V. (2014). Does Viotin Activate Violin More Than Viocin?

Experimental Psychology, 61(1), 23–29. https://doi.org/10.1027/1618-3169/a000223

Annika Tjuka, Robert Forkel and Johann-Mattis List

Comparing word properties across languages:

A case study on ratings for arousal and valence

Psycholinguists have collected ratings on different properties for a wide range of words in languages with many speakers. Some of this work is stored in databases that focus on a single language (e.g., for German: Heister et al., 2011), or that give bibliographic references to avail able studies (Buchanan, Valentine, & Maxwell, 2019; Winter, Wedel, & List, 2017). However, as the need and interest for multilingual studies in the field of psychology grows (Jackson, Watts, List, Drabble, & Lindquist, in press), a resource that combines data across several languages is required. Linguistics has a long history and expertise in how to compare languages. A well established resource for comparing concepts in different languages, including underrepresented languages, is the Concepticon (List, Cysouw, & Forkel, 2016). The Concepticon was used as a reference catalog to create the Database of Cross-Linguistic Norms, Ratings, and Relations for Words and Concepts (NoRaRe, see Tjuka, Forkel, & List, 2021). The NoRaRe database al lows word properties to be compared across multiple languages. New data can be conveniently added using predefined workflows for small and large word lists as well as online databases. In addition, the web interface enables users to search for specific words and find data with various properties related to them.

The present case study tested the applicability of the NoRaRe database. Word properties available for three languages were obtained using the web interface. Interestingly, although many studies collected data on the same properties, such as concreteness or imageability, most of them used different scales (e.g., 5-, 7-, or 9-point scales) and were not directly comparable. The case study, therefore, examined ratings for arousal and valence of words on a 9-point scale across English, Dutch, and Spanish. Data were taken from studies by Scott, Keitel, Becirspahic, Yao, and Sereno (2019) for English, Moors et al. (2013) for Dutch, and Stadthagen-González, Imbault, Pérez-Sánchez, and Brysbaert (2017) for Spanish. The data were linked to the Con cepticon concept sets which provided the advantage that the words in each list were not subject to translation into a metalanguage, but could be analyzed on the basis of comparable concepts curated by linguists, the editors of the Concepticon.

The results showed that the Pearson coefficient for valence was above 0.8 in all language pairs. In the case of arousal, however, the correlation was less strong, with the highest Pearson coefficient found for the Dutch-Spanish pair (R=0.6) and the lowest for the English-Spanish pair (R=0.3). Thus, the results were only partially consistent with previous studies that found closely related languages to have more similar emotion semantics (Jackson et al., 2019). It would be desirable to obtain additional standardized rating studies for the same word property in a variety of languages in the future to investigate where these differences originate.

The case study illustrates that the comparison of word properties between different languages is still in its infancy. Most psycholinguists have focused on studying single languages, and many studies are still conducted with English-speaking participants or languages spoken by WEIRD participants (Henrich, Heine, & Norenzayan, 2010). The NoRaRe database is a step in the right direction,

providing the opportunity to identify gaps and improve cross-linguistic comparison of word properties. The implications of this case study are far-reaching in that we were able to compare ratings from three separate studies that offered values for arousal and valence across different languages with little effort. The approach of combining word ratings conducted separately may also help to improve the reproducibility of results.

References

Buchanan, E. M., Valentine, K. D., & Maxwell, N. P. (2019). LAB: Linguistic Annotated Bibliography – A searchable portal for normed database information. *Behav Res*, *51*(4), 1878–1888.

Heister, J., Würzner, K.-M., Bubenzer, J., Pohl, E., Hanneforth, T., Geyken, A., & Kliegl, R. (2011). dlexDB – Eine lexikalische Datenbank für die psychologische und linguistische Forschung. *Psychologische Rundschau*, *62*(1), 10–20.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behav Brain Sci*, *33*(2-3), 61–83.

Jackson, J. C., Watts, J., Henry, T. R., List, J.-M., Forkel, R., Mucha, P. J., … Lindquist, K. A. (2019). Emotion semantics show both cultural variation and universal structure. *Sci Rep*, *366*, 1517–1522.

Jackson, J. C., Watts, J., List, J.-M., Drabble, R., & Lindquist, K. (in press). From text to thought: How analyzing language can advance psychological science. *Perspect Psychol Sci*, 1–46.

List, J.-M., Cysouw, M., & Forkel, R. (2016). Concepticon: A resource for the linking of concept lists. In N. Calzolari et al. (Eds.), *Proceedings of the Tenth International Conference on Language Resources and Evaluation* (pp. 2393–2400). Portorož, Slovenia: European Language Resources Association.

Moors, A., De Houwer, J., Hermans, D., Wanmaker, S., Van Schie, K., Van Harmelen, A.-L., … Brysbaert, M. (2013). Norms of valence, arousal, dominance, and age of acquisition for 4,300 Dutch words. *Behav Res*, *45*(1), 169–177.

Scott, G. G., Keitel, A., Becirspahic, M., Yao, B., & Sereno, S. C. (2019). The Glasgow Norms: Ratings of 5,500 words on nine scales. *Behav Res*, *51*(3), 1258–1270.

Stadthagen-González, H., Imbault, C., Pérez-Sánchez, M. A., & Brysbaert, M. (2017). Norms of valence and arousal for 14,031 Spanish words. *Behav Res*, *49*(1), 111–123.

Tjuka, A., Forkel, R., & List, J.-M. (2021). Linking norms, ratings, and relations of words and concepts across multiple language varieties. *Behav Res*. Retrieved from https://digling.org/norare/ Winter, B., Wedel, A., & List, J.-M. (2017). *The Language Goldmine*. Jena, Germany: Max Planck Institute for the Science of Human History.

Roya Khalili, Eva Kehayia and Marc Roig

Can exercise improve language functions in older adults? Evidence from a Scoping Review

Healthy as well as pathological aging can be accompanied by cognitive challenges. Brain structural changes and functional modifications resulting from healthy aging[1], acquired neurological conditions[2], or neurodegenerative diseases[3] can influence information processing, attention, inhibition control, and ultimately language performance. Research to date has shown that neuroplasticity can contribute to alterations of the affected language networks in post stroke aphasia[2,4]. One feasible intervention to induce changes in neuroplasticity is cardiovascular exercise[5] which has yielded promising results in different aspects of cognitive functions[6,7]. While literature in support of the benefits of exercise on information processing, memory, and attention has already been reviewed[6,7], the effect that exercise may have on language performance is yet to be summarized. To address this gap, we conducted a scoping review to identify the existing evidence regarding exercise-induced changes in language performance in aging adults with and without neurodegenerative or acquired neurological conditions. We also sought to identify the language assessments used and the aspects of language performance measured.

Working within the framework proposed by Arksey and O'Malley (2005)[8], we selected eighteen key terms, and performed the search with two independent reviewers on four databases, i.e., PubMed, Ovid, CINAHL, and Cochrane Library. We included studies on older adults, with all designs, published in English since 1990, and having reported language performance as an outcome. The titles and abstracts of 337 articles were imported into the Rayyan platform, and the two reviewers worked separately to include/exclude the studies. A third reviewer, familiar with the field, was invited to resolve the conflicts. In the end, 27 studies were included among which 10 were on healthy aging[9-18] and 17 were on older adults with acquired neurological or neurodegenerative conditions[19-35]. The three reviewers independently extracted the data from the included studies using data extraction charts. The International Classification of Functioning, Disability, and Health (ICF)[36] was used to categorize the outcomes of the included studies following a uniform framework.

The 10 included studies on healthy older adults (N= 616,522 females) indicated improved language performance including semantic and phonological Verbal Fluency (VF) following exercise interventions[9-18]. Among these studies, seven (70%) reported significant improvement in language performance[9-15]. Among the 17 included studies with older adults with neurological conditions (N= 1368, 791 females), 11 studies (64.7%) reported improved language performance including picture naming/description, semantic VF, and phonological VF induced by exercise[19-29]. Four of these 11 studies (26.36%) found significant improvement in language functions[19-22].

Exercise interventions showed improved picture naming and picture description in stroke[23] and Parkinson's Disease[22,24] respectively. Improvement in both semantic and phonological VF was also reported by three single studies on older adults with depression[30], cognitive deterioration[31], and older adults at risk of Alzheimer's Disease (AD)[32]. However, the improvement was not significant. It should be mentioned that two studies on older adults with AD and Dementia reported no change in semantic VF [33,34] and only one study showed deteriorated semantic VF in older adults with AD[35].

In total, we found that in 85% of the included studies, exercise enhanced VF, naming, and picture description. Importantly, language tasks. which dominantly measure linguistic functions such as VF tasks showed optimal language improvement following exercise. Improvement was mostly reported for semantic VF compared to the phonological VF or other language aspects. Our findings

are consistent with previous reviews assessing the effect of exercise on different aspects of cognitive performance[6,7] with selective benefits mostly for executive-control processes[37]. This

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Can exercise improve language functions in older adults? Evidence from a Scoping Review

scoping review provides new evidence on enhanced language performance following exercise interventions in aging adults with and without language impairment.

Reference

1- Salthouse, T.A. (2004) Localizing age-related individual differences in a hierarchical structure. Intelligence, 32, 541–561

2- Hamilton, R. H. (2016). Neuroplasticity in the language system: reorganization in post-stroke aphasia and in neuromodulation interventions. *Restorative Neurology and Neuroscience, 34*(4), 467–471. https://doi.org/10.3233/RNN-169002

3- Weiler, M., Fukuda, A., Massabki, L. H., Lopes, T. M., Franco, A. R., Damasceno, B. P., Cendes, F., & Balthazar, M. L. (2014). Default mode, executive function, and language functional connectivity networks are compromised in mild Alzheimer's disease. *Current Alzheimer research, 11*(3), 274–282. https://doi.org/10.2174/1567205011666140131114716

4- Kiran, S., & Thompson, C. K. (2019). Neuroplasticity of language networks in aphasia: advances, updates, and future challenges. *Frontiers in Neurology, 10*. https://doi.org/10.3389/fneur.2019.00295 5- Hendrikse, J., Kandola, A., Coxon, J., Rogasch, N., & Yücel, M. (2017). Combining aerobic exercise and repetitive transcranial magnetic stimulation to improve brain function in health and disease. *Neuroscience and Biobehavioral Reviews, 83*, 11–20. https://doi.org/10.1016/j.neubiorev.2017.09.023

6- Roig, M., Nordbrandt, S., Geertsen, S. S., & Nielsen, J. B. (2013). The effects of cardiovascular exercise on human memory: a review with meta-analysis. *Neuroscience and Biobehavioral Reviews, 37*(8), 1645–1666. https://doi.org/10.1016/j.neubiorev.2013.06.012

7- Chang, Y. K., Labban, J. D., Gapin, J. I., & Etnier, J. L. (2012). The effects of acute exercise on cognitive performance: a meta-analysis. *Brain Research, 1453*, 87–101. https://doi.org/10.1016/j.brainres.2012.02.068 8- Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology, 8,* 1, 19-32.

9- Nocera, J. R., Mammino, K., Kommula, Y., Wharton, W., Crosson, B., & McGregor, K. M. (2020). Effects of combined aerobic exercise and cognitive training on verbal fluency in older adults. Gerontology and Geriatric Medicine, 6, 233372141989688–233372141989688. https://doi.org/10.1177/2333721419896884

10- Helmes, E., & Harris, S. (2017). Exercise and executive functioning in older women. J Women Aging, 29(5), 376-384. doi:10.1080/08952841.2016.1256736

11- Nocera, J., Crosson, B., Mammino, K., & McGregor, K. (2017). Changes in cortical activation patterns in language areas following an aerobic exercise intervention in older adults. Neural Plasticity, 2017, 6340302-6340302. doi:10.1155/2017/6340302

12- Ansai, J. H., & Rebelatto, J. R. (2015). Effect of two physical exercise protocols on cognition and depressive symptoms in oldest-old people: A randomized controlled trial. Geriatr Gerontol Int, 15(9), 1127-1134. doi:10.1111/ggi.12411

13- Nocera, J., McGregor, K., Hass, C., & Crosson, B. (2015). Spin exercise improves semantic fluency in previously sedentary older adults. Journal of Aging and Physical Activity, 23(1), 90-4. doi:10.1123/japa.2013-0107 14- Rahe, J., Petrelli, A., Kaesberg, S., Fink, G. R., Kessler, J., & Kalbe, E. (2015). Effects of cognitive training with additional physical activity compared to pure cognitive training in healthy older adults. Clin Interv Aging, 10, 297-310. doi:10.2147/CIA.S74071

15- Córdova, C., Silva, V. C., Moraes, C. F., Simões, H. G., & Nóbrega, O. D. T. (2009). Acute exercise performed close to the anaerobic threshold improves cognitive performance in elderly females. Brazilian Journal of Medical and Biological Research, 42(5), 458-464.

16- Santos, P., Cavalcante, B. R., Vieira, A., Guimaraes, M. D., Leandro Da Silva, A. M., Armstrong, A. D. C., . . . Souza, M. F. (2020). Improving cognitive and physical function through 12-weeks of resistance training in older adults: Randomized controlled trial. J Sports Sci, 38(17), 1936-1942. doi:10.1080/02640414.2020.1763740

17- Ji, Z., Feng, T., Mei, L., Li, A., & Zhang, C. (2019). Influence of acute combined physical and cognitive exercise on cognitive function: an NIRS study. PeerJ, 7, e7418. doi:10.7717/peerj.7418 18- Klusmann, V., Evers, A., Schwarzer, R., Schlattmann, P., Reischies, F. M., Heuser, I., & Dimeo, F. C. (2010). Complex mental and physical activity in older women and cognitive performance: a 6-month randomized controlled trial. J Gerontol A Biol Sci Med Sci, 65(6), 680-688. doi:10.1093/gerona/glq053

19- Alfini, A. J., Weiss, L. R., Nielson, K. A., Verber, M. D., & Smith, J. C. (2019). Resting Cerebral Blood Flow After Exercise Training in Mild Cognitive Impairment. Journal of Alzheimer's Disease, 67(2), 671-684. doi:10.3233/JAD-180728

20- de Oliveira Silva, F., Ferreira, J. V., Placido, J., Sant'Anna, P., Araujo, J., Marinho, V., . . . Camaz Deslandes, A. (2019). Three months of multimodal training contributes to mobility and executive function in elderly individuals with mild cognitive impairment, but not in those with Alzheimer's disease: A randomized controlled trial. Maturitas, 126, 28-33. doi:10.1016/j.maturitas.2019.04.217 21- Bossers, W. J., van der Woude, L. H., Boersma, F., Hortobagyi, T., Scherder, E. J., & van Heuvelen, M. J. (2015). A 9-Week Aerobic and Strength Training Program Improves Cognitive and Motor Function in Patients with Dementia: A Randomized, Controlled Trial. Am J Geriatr Psychiatry, 23(11), 1106-1116. doi:10.1016/j.jagp.2014.12.191

22- Nocera, J. R., Altmann, L. J., Sapienza, C., Okun, M. S., & Hass, C. J. (2010). Can exercise improve language and cognition in Parkinson's disease? A case report. Neurocase, 16(4), 301-306. doi:10.1080/13554790903559663 23- Harnish, S. M., Rodriguez, A. D., Blackett, D. S., Gregory, C., Seeds, L., Boatright, J. H., & Crosson, B. (2018). Aerobic Exercise as an Adjuvant to Aphasia Therapy: Theory, Preliminary Findings, and Future Directions. Clin Ther, 40(1), 35-48 e36. doi:10.1016/j.clinthera.2017.12.002

24- Altmann, L. J., Stegemoller, E., Hazamy, A. A., Wilson, J. P., Bowers, D., Okun, M. S., & Hass, C. J. (2016). Aerobic Exercise Improves Mood, Cognition, and Language Function in Parkinson's Disease: Results of a Controlled Study. J Int Neuropsychol Soc, 22(9), 878-889. doi:10.1017/S135561771600076X

25- Hoffmann, K., Sobol, N. A., Frederiksen, K. S., Beyer, N., Vogel, A., Vestergaard, K., . . . Hasselbalch, S. G. (2016). Moderate-to-High Intensity Physical Exercise in Patients with Alzheimer's Disease: A Randomized Controlled Trial. Journal of Alzheimer's Disease, 50(2), 443-453. doi:10.3233/jad-150817

26- Arcoverde, C., Deslandes, A., Moraes, H., Almeida, C., Araujo, N. B. D., Vasques, P. E., ... & Laks, J. (2014). Treadmill training as an augmentation treatment for Alzheimer? s disease: a pilot randomized controlled study. Arquivos de neuro-psiquiatria, 72(3), 190-196.

27- El-Tamawy, M. S., Abd-Allah, F., Ahmed, S. M., Darwish, M. H., & Khalifa, H. A. (2014). Aerobic exercises enhance cognitive functions and brain derived neurotrophic factor in ischemic stroke patients. NeuroRehabilitation, 34(1), 209-213. doi:10.3233/NRE-131020

28- Cruise, K. E., Bucks, R. S., Loftus, A. M., Newton, R. U., Pegoraro, R., & Thomas, M. G. (2011). Exercise and Parkinson's: benefits for cognition and quality of life. Acta Neurol Scand, 123(1), 13-19. doi:10.1111/j.1600-0404.2010.01338.x

29- Baker, L. D., Frank, L. L., Foster-Schubert, K., Green, P. S., Wilkinson, C. W., McTiernan, A., Plymate, S. R., Fishel, M. A., Watson, G. S., Cholerton, B. A., Duncan, G. E., Mehta, P. D., & Craft, S. (2010). Effects of aerobic exercise on mild cognitive impairment: a controlled trial. *Archives of neurology, 67*(1), 71–79. https://doi.org/10.1001/archneurol.2009.307

30- Hoffman, B. M., Blumenthal, J. A., Babyak, M. A., Smith, P. J., Rogers, S. D., Doraiswamy, P. M., & Sherwood, A. (2008). Exercise fails to improve neurocognition in depressed middle-aged and older adults. Medicine and science in sports and exercise, 40(7), 1344–1352. doi:10.1249/MSS.0b013e31816b877c

31- Boa Sorte Silva, N. C., Gill, D. P., Gregory, M. A., Bocti, J., & Petrella, R. J. (2018). Multiple-modality exercise and mind-motor training to improve mobility in older adults: A randomized controlled trial. Exp Gerontol, 103, 17-26. doi:10.1016/j.exger.2017.12.011

32- Lautenschlager, N., Cox, K., Flicker, L., Foster, J., Van Bockxmeer, F., Xiao, J., . . . Almeida, O. (2008). Effect of physical activity on cognitive function in older adults at risk for alzheimer disease: A randomized trial. Jama, 300(9), 1027-1027. doi:10.1001/jama.300.9.1027

33- Toots, A., Littbrand, H., Bostrom, G., Hornsten, C., Holmberg, H., Lundin-Olsson, L., . . . Rosendahl, E. (2017). Effects of Exercise on Cognitive Function in Older People with Dementia: A Randomized Controlled Trial. J Alzheimers Dis, 60(1), 323-332. doi:10.3233/jad-170014

34- Vital, T. M., S. S. S. Hernandez, R. V. Pedroso, C. V. L. Teixeira, M. Garuffi, A. M. Stein, J. L. R. Costa and F. Stella (2012). "Effects of weight training on cognitive functions in elderly with Alzheimer's disease." Dement Neuropsychol **6**(4): 253-259.

35- Öhman, H., Savikko, N., Strandberg, T., Kautiainen, H., n Raivio, M., Laakkonen, M., . . . Pitkälä, K. (2016). Effects of exercise on cognition: The finnish alzheimer disease exercise trial: A randomized, controlled trial. Journal of the American Geriatrics Society, 64(4), 731-738. doi:10.1111/jgs.14059

36- World Health Organization. (2001). *International classification of functioning, disability and health : icf.* World Health Organization.

37- Colcombe, S., & Kramer, A. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science, 14*(2), 125-130.

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Psycholinguistic perspectives on power and positivity in Canadian parliament

We report on a corpus analysis of speech in Canadian Parliament in which we sought to determine whether the emotional valence (positivity) of words used by Members of Parliament can be linked to characteristics of political parties, political changes over time, and significant events such as the COVID-19 pandemic. A key feature of this research is that it uses the psycholinguistic research reported by Warriner, Kuperman and Brysbaert (2013) in which valence ratings were obtained for 13,915 words in an online experiment.

We constructed a corpus of all words spoken by Members of Parliament from all represented parties (Bloc Québécois, the Conservative Party of Canada, the Green Party, the Liberal Party of Canada, and the New Democratic Party) in the House of Commons from 2006 to the present. This was done using the official records of the House debates, known as the Hansard (Caruso, Frohman, Kinsman & Sutherland, 2015). We parsed 1,675 Hansard documents into a corpus of 91 million individual tokens, tagged by date, language, speaking turn, member, and political party. We then linked those tokens to lexical ratings provided by the Warriner et al., (2013) database. This provided us with valence ratings for each token.

We chose an individual MP's speaking turn (n=389,841) as our fundamental unit of analysis and calculated the mean emotional valence rating for words in each speaking turn. The resulting data structure enabled us to investigate whether speaking turn valence was influenced by political and societal dynamics.

Our findings show a strong relationship between positive language and political power. Word positivity was related to which party was in power (supporting the results of Rheault et al., 2016). We also found effects associated with the majority or minority status of the government, as well as with more fine-grained measures, such as the relative number of seats held by a given party at a given time. This suggests that, at an individual (and perhaps unconscious) level, politicians' language choices are sensitive to the power dynamics among parties.

Focusing on the effects of the COVID-19 crisis revealed that, overall, politicians responded to the crisis and the associated social anxiety with increases in word positivity. Moreover, word positivity was significantly linked to COVID-19 case counts in a month-by-month analysis.

Together, these results support the view that the relationship between positivity and power can be captured through the analysis of individual word properties. We see this as consistent with the view that lexical processing is automatic and obligatory. We furthermore interpret these findings to reveal that lexical valence in the political domain is a variable that is closely attuned to social

dynamics. Thus, our findings show how complex political and societal phenomena may be reflected in the lexical choices made by politicians. They also show how recent psycholinguistic databases and corpus analysis tools can be combined to capture the linguistic correlates of political culture.

References

Caruso, D., Frohman, L., Kinsman, R., & Sutherland. R. (2015). Some editing required: Producing Canada's Hansards. *Canadian Parliamentary Review, 35(2)*, 7-14.

Rheault, L., Beelen, K., Cochrane, C., & Hirst, G. (2016). Measuring Emotion in Parliamentary Debates with Automated Textual Analysis. *PLoS ONE 11(12):* e0168843. doi:10.1371/journal. pone.0168843

Warriner, A. B., Kuperman, V., & Brysbaert, M. (2013). Norms of valence, arousal, and dominance for 13,915 English lemmas. *Behavior Research Methods*, 45(4), 1191- 1207.

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Labels speak volumes: the role of intergroup membership in accent perception

A speaker's accent signals to the listener social and linguistic cues such as possible country of origin and perceived group membership. It has been shown that non-standard accents may elicit negative stereotypes such as lower socioeconomic status, intelligence, and other traits (Fuertes et al. 2012). Speakers of non-standard varieties of English, such as immigrants, face real social consequences and discrimination as a result of these negative language attitudes (Lev-Ari & Keysar, 2010). Labelling immigrants can also lead to adverse effects: a study conducted by Rucker and colleagues (2019) found that negatively labelling immigrants increased the participant's support for stricter immigration policies. Little research has been conducted on the effect of labelling speakers on perceived accent strength. The present study investigated the malleability of accented speech perception: we hypothesized that ratings of a speaker's accent strength would be influenced by manipulating introductions of speaker membership. Speakers were introduced as either a Canadian, a New Canadian, an immigrant or with no introduction (control). Of particular interest was whether differences in accent ratings were systematically modulated by participants' individual differences in disgust sensitivity and political views.

A pretest was completed to select the auditory stimuli. 15 native English speakers rated 66 speech samples from *The Speech Accent Archive* (Weinberger, 2015) to form baseline ratings of accent strength, likeability, and intelligibility. Based on the pretest, speech samples of four speakers (two male, two female) were selected for each language background (Canadian English, Asian, Middle Eastern, and European). Accent strength ratings (weak, strong) were further counterbalanced for the non-native speech samples. The selected speech samples were separated into two passages so that the same speaker was presented to the participant twice (1st half vs. 2nd half) in different conditions (counterbalanced). A separate group of 82 English native speakers completed the main experiment, which always began with the control condition (no introduction). Participants were asked to rate 32 speech samples in total (4 intro x 2 gender x 2 accent strength x 2 passage) on a scale of 1-7 according to how native-like a speaker's accent is (1- Very Native-like, 7 Very Foreign), and then completed an exit questionnaire.

Fig 1 shows the mean accent ratings in the four Introduction conditions by speaker Language Background. Data were analyzed in two steps using ordinal General Additive Mixed-Models (GAMM, Divjak & Baayen, 2017) The first analysis, with Introduction as a fixed predictor and random intercepts for participants and items as well as by-trial random smooths for participants, found a significant effect of speaker introduction (Fig. 2). Participants were more likely to rate speakers from all language backgrounds as having a stronger accent when the speaker was introduced as an immigrant ($p < 0.001$), and as a New Canadian ($p = 0.008$) compared to the control condition. Further analyses of the rating data for non-native stimuli only (Fig. 3) showed an effect of Introduction and Accent Strength, and an interaction between Accent Strength and Background ($p = 0.004$), suggesting there was a larger difference in perceived accentedness between weak and strong conditions for Middle-Eastern speakers than the other speaker backgrounds. For our presentation, we will further inspect the relationship between individual listeners' accent ratings and their political ideology and disgust sensitivity. The results imply that how we choose to label group membership influences perceived accent strength,

which may enforce negative language attitudes (Dragojevic et al. 2017) and may in turn have very real implications for members of society with non-standard accents.
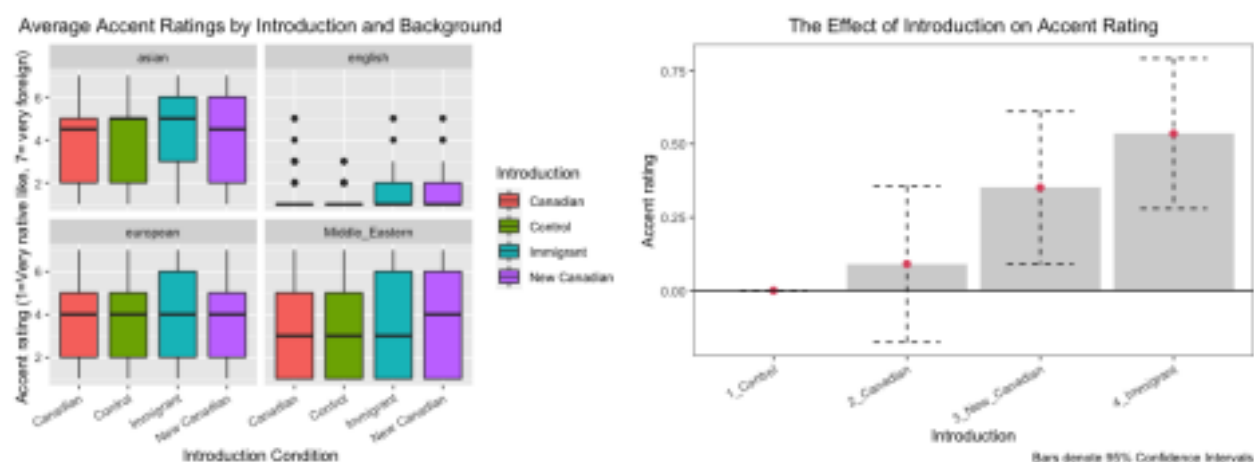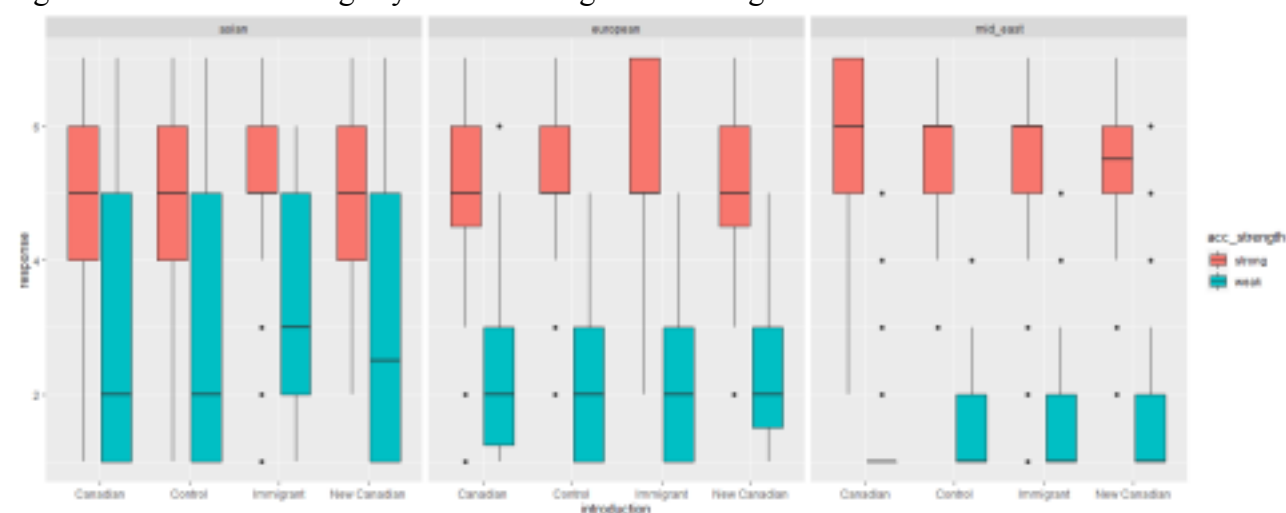Fig 1. Fig 2.

Fig. 3: Accentedness ratings by Accent Strength and Background in Introduction conditions

References

Divjak, D., & Baayen, H. (2017). Ordinal GAMMs: In *Each venture, a new beginning: Studies in Honor of Laura A. Janda* (pp. 39-56). Slavica Publishers.

Dragojevic, M., Giles, H., Beck, A.-C., & Tatum, N. T. (2017). *Communication Monographs*, 84(3), 385–405.

Fuertes, J. N., Gottdiener, W. H., Mastin, H., Gilbert, T. C., & Giles, H. (2012). *European Journal of Social Psychology*, *42*(1), 120–133. https://doi.org/10.1002/ejsp.862 Lev-Ari, S., Keysar, B., (2010). *Journal of Experimental Psychology*, 46(6), 1093-1096. https://doi.org/10.1016/j.jesp.2010.05.025

R Core Team (2020). R: Retrieved from https://www.R-project.org/

Rucker, J. M., Murphy, M. C., & Quintanilla, V. D. (2019). *Group Processes & Intergroup Relations*, *22*(8), 1139–1160. https://doi.org/10.1177/1368430218818744

Weinberger, Steven. (2015). *Speech Accent Archive*. http://accent.gmu.edu