International Morphological Processing Conference (MoProc)

Monday, November 4 — Thursday, November 7, 2019

University of Tübingen
Alte Aula (old auditorium)
Münzgasse 30, Tübingen

Book of Abstracts

Timetable

NOVEMBER 4, 2019

8.30 - 9.00	**REGISTRATION**	
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SESSION 1: COMPOUND PROCESSING		
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9.30 - 9.50	**Bilal Kırkıcı, Ozan Can Çağlar, and Esra Ataman**	The effect of morphological factors on the written production of Turkish compounds.
9.50 - 10.10	**Antje Lorenz, Pienie Zwitserlood, and Rasha Abdel Rahman**	Production of noun-noun compounds in young and older healthy speakers: An ERP-study.
10.10 - 10.30	**Melanie J. Bell and Martin Schäfer**	Interpreting novel compounds in and out of context.
10:30 - 11:00	**BREAK**	
SESSION 2: LEARNING AND INFORMATION THEORETICAL APPROACHES		
11.00 - 11.20	**Dušica Filipović Đurđević and Petar Milin**	Working with words: Merging information and learning theories to model paradigmatic and syntagmatic effects in word processing.
11.20 - 11.40	**Maša Vujović, Michael Ramscar, and Elizabeth Wonnacott**	The role of prediction error in linguistic generalization and item-learning.
11.40 - 12.00	**Jessie Nixon, Michael Ramscar, and Fabian Tomaschek**	The emergence of morphological structure from a continuous signal on the basis of error-driven learning
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15.15 - 16.15	**Benjamin V. Tucker (University of Alberta)**	Investigating morphological processing using the MALD database, a megastudy of auditory lexical decision.
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SESSION 4: SPOKEN MORPHOLOGY		
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9.20 - 9.40	**Marina Oganyan and Richard Wright**	Recognizing words before the uniqueness point: role of frequency, neighborhood density and the root morpheme in auditory word recognition in Hebrew.
9.40 - 10.00	**Sabine Arndt-Lappe, Robin Schrecklinger, and Fabian Tomaschek**	Modelling English stress assignment from orthography with Naive Discriminative Learning: Morphological and structural effects.
10.00 - 10.20	**Motoki Saito, Fabian Tomaschek, Ching-Chu Sun, and Harald Baayen**	Using ultrasound imaging to trace the effect of frequency on the articulation of the stems of inflected words.
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SESSION 5: MORPHOLOGICAL PROCESSING IN IMPAIRMENT		
10.40 - 11.00	**Elise Lefevre, Jeremy Law, and Eddy Cavalli**	Morphological awareness and morphological processing in high-school students with dyslexia are associated with successful reading comprehension.
11.00 - 11.20	**Raymond Bertram, Elina Mainela-Arnold, and Anna Kautto**	Morphological skills of 8-to-10-year old Finnish children with DLD.
11.20 - 11.40	**Alexandre Nikolaev, Eve Higby, Sameer Ashaie, Merja Hallikainen, Tuomo Hänninen, Jungmoon Hyun, Minna Lehtonen, and Hilkka Soininen**	Novel word production in a complex inflectional language: older adults with or without dementia.

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11.40 - 12.00	**Laura Anna Ciaccio, Frank Burchert, and Carlo Semenza**	Reading aloud prefixed words in acquired morphological disorders.
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13.20 - 13.40	**Nikolaos Ntagkas and Despoina Papadopoulou**	Evidence for early morpho-orthographic decomposition in Modern Greek derivational morphology.
13.40 - 14.00	**Harald Baayen and Eva Smolka**	Modeling morphological priming in German with naive discriminative learning.
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15.00 - 15.20	**Daria Chernova, Elizaveta Vilenchik, and Natalia Slioussar**	Homophony in case forms processing a self-paced reading study with reference to Russian.
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16.00 - 16.20	**Denisa Bordag and Andreas Opitz**	Processing of conversion as a 'non-finite' category and the role of capitalization as a noun cue in L1 & L2 German.
16.20 - 16.40	**Simona Amenta, Francesca Foppolo, Massimo Burattin, and Linda Badan**	The role of morphemes in processing novel derivations: It's a matter of experience.
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SESSION 9: MORPHOLOGY, PHONOLOGY AND PHONETICS		
9.00 - 9.20	**Fabian Tomaschek and Benjamin V. Tucker**	Fine phonetic cues of morphological categories in verbal stems — a perception study.
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9.40 - 10.00	**Mara De Rosa and Davide Crepaldi**	The role of affixes in the visual identification of words and nonwords.
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SESSION 10: PRODUCTION		
10.20 - 10.40	**Anna-Lisa Ndao, Rasha Abdel Rahman, Pienie Zwitserlood, and Antje Lorenz**	The representation and processing of noun-noun compounds in speech production: evidence from cumulative semantic interference.
10.40 - 11.00	**Laurie Feldman, Gary Libben, Rick Dale, and Jacolien van Rij**	Gradient effects in morphological processing as revealed by keystroke timing in a type-to-copy task.
11.00 - 11.20	**U. Marie Engemann, Ingo Plag, and Julia Zimmermann**	Paradigmatic effects in speech production: do bare stems influence the pronunciation of suffixed forms?
11.20 - 11.40	**BREAK**	
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11.40 - 12.40	**Peter Uhrig (University of Erlangen)**	The Distributed Red Hen Lab: morphology meets multimedia.
12.40 - 13.40	**LUNCH BREAK**	

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SESSION 11: Meet the parents: (re-)visiting morphological theory		
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13.45 - 14.05	**David Fertig**	Implicative relations in analogical change and morphological theory.
14.05 - 14.25	**Dunstan Brown**	Key dimensions of morphology.
14.25 - 14.45	**Paul O'Neill**	The role of diachrony and the importance of patterns for morphological theory.
14.45 - 15.05	**Dagmar Divjak and Petar Milin**	Cases in context: evidence for declension classes from reading.
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SESSION 12: MATHEMATICS, MACHINE LEARNING, AND INFORMATION THEORY		
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16.10 - 16.30	**Ching-Chu Sun and Peter Hendrix**	Compound words in Mandarin Chinese and English: the role of information theory.
16.30 - 16.50	**Marco Marelli, Marco Petilli, and Fritz Günther**	Semantic transparency in technicolor: image-based distributional models and the impact of perceptual information in compound processing.
16.50 - 17.00	**CLOSING REMARKS**	

NOVEMBER 7, 2019

Post-Conference Tutorial Workshops		
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11.00 - 13.00	**Matt Kelley (University of Alberta)**	**Deep learning** and wide learning of the comprehension of morphologically complex words: from audio signal to semantics.
13.00 - 14.00	**LUNCH BREAK**	
14.00 - 15.30	**Elnaz Shafaei-Bajestan (Universität Tübingen)**	Deep learning and **wide learning** of the comprehension of morphologically complex words: from audio signal to semantics.
15.30 - 16.00	**BREAK**	
16.00 - 18.00	**Peter Hendrix (Universität Tübingen)**	Introduction to statistical analysis with PAMM (piece-wise exponential mixed generalized additive models, a combination of survival analysis and generalized additive modeling) and QGAM (quantile regression with generalized additive models).

Contents

Compound processing in a compositional perspective

4th Nov
9:10 - 9:30

Fritz Günther[1] and Marco Marelli[2]

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In research on the processing of compound words such as airport or ladybird, the role played by the constituent parts (air and port, or lady and bird, respectively) is a central topic. In this context, a typical assumption has been that transparent compounds which are semantically related to their constituents (airport) should have a processing advantage over opaque compounds (ladybird), since the meaning of the former but not the latter can be accessed via the constituent meanings. However, empirical results investigating this hypothesis have been inconsistent at best. In the studies presented here, we re-frame the role of the constituents in compound processing by adopting a compositional perspective (see Günther & Marelli, 2016): Rather than conceptualizing the constituent and compound meanings as separate units in semantic memory (an implicit assumption when investigating influences of their semantic relatedness), we argue that compound processing should be seen as a process of conceptual combination, aimed at deriving a (compositional) meaning for the compound from its constituent meanings. Importantly, we assume that such a compositional process always takes place, regardless of whether the compound word is transparent or opaque, and regardless of whether it is a familiar or novel form. This maximizes the opportunity to understand the compound meaning (Libben, 2014) in the majority of cases, which outweighs the cost of sometimes obtaining an „incorrect“ meaning (in the case of opaque compounds). Consequently, we hypothesize that the speed of compound processing depends on how easily the constituents are integrated into the combined concept, and thus on their contribution to the compositional process.

In the studies presented here, we operationalize meanings as distributional vectors, extracted from large corpora of natural language. Vectors representing constituent and whole-word compound meanings are obtained directly from a corpus, while vectors representing compositional compound meanings are derived from the constituent vectors by applying a recent compositional model (CAOSS; Marelli, Gagné, & Spalding, 2017). Semantic relatedness is defined as the cosine similarities between the constituent vectors and the whole-word compound vector (see Schmidtke, Van Dyke, & Kuperman, 2018), while constituent compositionality is defined as the cosine similarity between the constituent vectors and the compositional compound vector. In a series of large-scale experiments across different tasks (lexical decision, timed sensibility judgments) and languages (English, German), we found that compositional measures consistently outperformed semantic relatedness measures in predicting compound processing times for existing compounds (airport, ladybird). Furthermore, across tasks and languages, we found that participants had more difficulties in rejecting novel compounds (bridgemill, radioham) with higher values of constituent compositionality. Given these results, we propose that the constituents should be seen as the building blocks of a compositional process that readers automatically engage in when encountering compounds, aimed at deriving

a (compositional) meaning from these constituent parts.

References

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Schmidtke, D., Van Dyke, J. A., & Kuperman, V. (2018). Individual variability in the semantic processing of English compound words. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 44, 421–439.

The effect of morphological factors on the written production of Turkish compounds

4th Nov
9:30 - 9:50

Bilal Kırkıcı[1], Ozan Can Çağlar,[2] and Esra Ataman[3]

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One of the main purposes of written production studies has been to scrutinize the relationship between central linguistic processing (e.g., lexical and semantic access) and peripheral motor processes (e.g., writing action). Linguistic processing is referred to as 'staged' if it is fully completed before motor execution is initiated[1,2] whereas it is suggested to be 'cascaded' if updates in linguistic processing are still possible during writing.[3,4] To be able to explore how linguistic processing unfolds in written production, a substantial number of the studies conducted to date have focused on compounds and the effect of morphological factors such as compound surface frequency, constituent frequency and syllable/morpheme boundary[4,5,6,7,8,9]. How compounds are stored in and retrieved from the lexicon was also addressed within the scope of these studies[7,10]. The present study sought to investigate whether linguistic processing was staged or cascaded for written compound production in Turkish by taking frequency and syllable/morpheme boundary into account. In addition, whether compounds were processed as unanalyzed units or decomposed into their constituents was also of central interest.

30 Turkish (L1) speakers (Mean Age: 21.7) performed an online self-paced picture naming task in which they were instructed to typewrite the name of the object they saw on the computer screen. Two additional groups of participants took an offline representativeness rating task containing 90 items taken from different picture databases[10,11] or an offline self-rating task to determine the pictures and compounds to be included in the online task. The remaining target pictures were 64

noun-noun compounds whose surface frequency (e.g., High: emniyet kemeri.' seat-belt', Low: deniz yıldızı, 'starfish') and second constituent frequency (e.g., High: tost makinesi, 'toaster', Low: bebek bezi, 'diaper') were manipulated. Writing onset time and inter-key interval at the syllable and morpheme boundary were the dependent measures. Writing onset time (WOT) was used to examine the processes occurring before the initiation of the writing action and inter-key intervals (IKIs) were used to see what was happening in the course of writing. The online key log software, InputLog, was used for data recording[12].

The WOT results revealed that both compound surface frequency [$F(1,29)=13.782$, $p=.001$)] and second constituent frequency [$F(1,29)=11.251$, $p=.002$)] affected writing onset time (Figure 1). A significant interaction was also obtained between surface frequency and constituent frequency [$F(1,29)=10.261$, $p=.003$]. For low surface frequency compounds, there was a significant difference between high and low second constituent compounds ($p<.05$) whereas there was no significant difference between these for high surface frequency compounds ($p>.05$), supporting a dual route account for compound retrieval before the onset of motor execution. The inter-key interval results (Figure 2) yielded a significant main effect of the position of IKI [$F(1,29)=223.148$, $p<.0001$] and compound surface frequency [$F(1,29)=10.777$, $p=.003$]. There was also a significant interaction between the IKI position and surface frequency [$F(1,29)=25.704$, $p<.0001$]. Pairwise comparisons showed that IKIs were significantly longer at syllable and morpheme boundary than at non-boundary positions ($p<.05$). Additionally, IKIs were longer at morpheme boundary than IKIs at syllable boundary ($p<.05$). These results indicated that linguistic processing was not fully completed before the onset of the writing action, but cascaded into motor execution in Turkish.

References

[1] Damian & Stadthagen-Gonzalez (2009).
[2] Baus, Strijkers, & Costa (2013).
[3] Roux et al. (2013).
[4] Álvarez et al. (2009).
[5] Kandel, Álvarez, & Vallée (2006).
[6] Weingarten, Nottbusch, & Will (2004).
[7] Bertram et al. (2015).
[8] Gagné & Spalding, (2014c).
[9] Gagné & Spalding, (2016).
[10] Janssen, Pajtas, & Caramazza (2014).
[11] Duñabeitia et al. (2017).
[12] Leijten & Van Waes (2013).

Figures

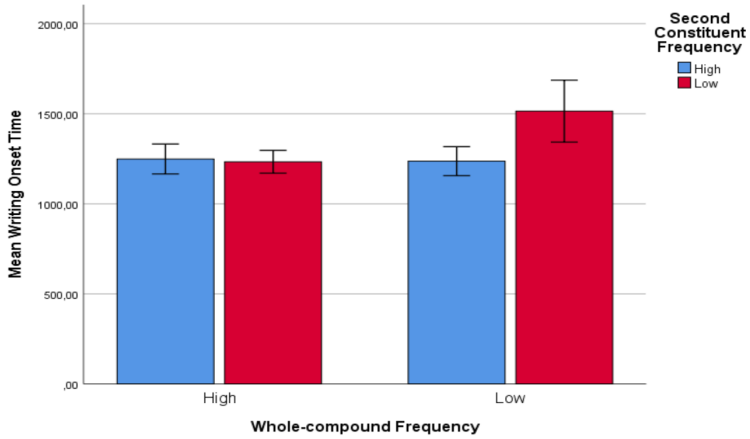

Figure 1: Mean Writing Onset Times(ms) across Conditions

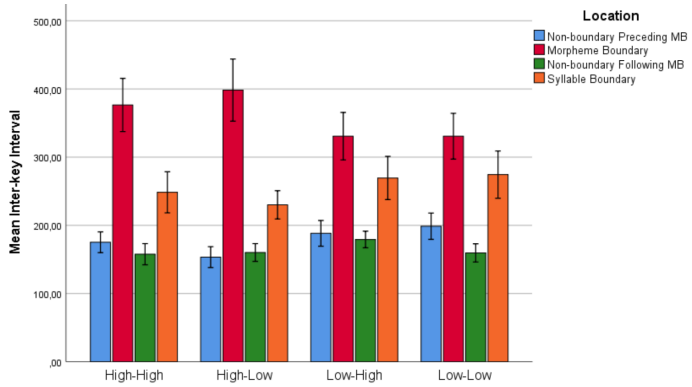

Figure 2: Mean Inter-Key Intervals(ms) by Location and Target Type

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4th Nov
9:50 - 10:10

Production of noun-noun compounds in young and older healthy speakers: an ERP-study

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In a picture-word interference paradigm, young (18-35 years) and older (65 + years) adult speakers named pictures of objects with compound names in the presence of morphological, semantic, and unrelated distractor words, to test models of speech production and lexical representation. Event-related brain potentials (ERPs) were extracted from the continuous electroencephalogram (EEG) and were analysed in

addition to picture-naming latencies (RT). Constituent distractors of compound targets (lip or stick for the target LIPSTICK) speeded compound naming, while naming was slowed by distractors that were categorically related to the compound as a whole (powder → LIPSTICK). No effects were obtained for distractors from the same category as the first constituent of compound targets (toe → LIPSTICK). These behavioural effects were present in both age groups, and the only age effect was that older speakers showed stronger morphological facilitation. The EEG data revealed age-related differences for semantic distractors related to the compound. Semantic whole-word distractors induced a significant N400 modulation for young speakers, but not for the older speakers, in spite of significant interference in reaction times. Significant ERP effects were observed in both morphological conditions and in both age groups. Interestingly, effects of first and second-constituent distractors were present in overlapping time windows, suggesting parallel processing of morphemes in both age groups. Our data corroborate single-lemma, but multiple-morpheme representations for compounds in production.

Interpreting novel compounds in and out of context

4th Nov
10:10 - 10:30

Melanie J. Bell, Martin Schäfer
Anglia Ruskin University

Recent eye-tracking studies show a relationship between comprehension of novel compounds in context and their ease of interpretation in isolation, which has been taken as evidence that compounds generate some sort of default interpretation, even when this is incompatible with the context (Cohen and Staub 2014, Smith et al. 2014). We show that when using attested novel compounds and rigorously controlling for possible confounds, no such relationship emerges. Our findings are consistent with the theory of Default Semantics (Jaszczolt 2016), according to which context plays a role from the earliest stages of processing.

We generated a set of attested novel compounds by selecting 45 noun-noun compounds that occur only once in ukWaC, a 2 billion word corpus of British English. Twenty demographically homogeneous native speakers of British English provided free paraphrases of each compound presented in isolation, and rated the difficulty of doing so on a 6-point Likert scale. The paraphrases were subsequently coded and grouped according to whether or not they represented the same reading. For every compound, we calculated the mean difficulty rating and three measures of diversity in interpretation: the number of different readings (spread), the percentage of participants who gave a non-unique reading (convergence) and the distribution of the probabilities of the readings (interpretational entropy). The compounds fall on a continuum across these four measures, which moderately correlate with each other: easily interpretable novel compounds tend to have fewer unique interpretations, fewer readings overall, and lower interpretational entropy. Compounds for which speakers easily converge on just a few readings can be regarded as having stronger context-free interpretations.

For each compound, we constructed four contexts intended to require a unique or unattested interpretation of the compound. After pretesting these contexts, we

selected twenty compounds for which two contexts reliably produced the intended unusual readings. To safeguard against unwanted effects linked to plausibility, we also obtained plausibility ratings for each reading, both in and out of context. We then conducted an eye-tracking study in which native speakers of British English from the same demographic group as those in the first study read the contexts mixed with filler items, and answered comprehension questions. We built mixed-effects regression models for all eye-tracking measures associated with semantic implausibility and semantic integration (Staub and Rayner 2007), with our four measures of context-free interpretability as fixed-effects and participant and context as random effects. If context-independent defaults arise in any context, and assuming that cancelling a reading is associated with an increased processing load, then compounds with stronger context-free readings will be processed more slowly in contexts that are incompatible with their context-free readings.

We found no effect of any of the context-free measures on processing in context, in line with the theory of Default Semantics (Jaszczolt 2016). According to this account, default interpretations, defined as unconscious and effortless interpretations, are the result of all knowledge bases, including lexical, contextual, and world knowledge, interacting from the beginning of processing onwards. Preferred interpretations of novel compounds in isolation are not so much the result of lexical properties of the words but rather due to the fact that these words are associated with the same or similar out-of-the-blue contexts across different speakers.

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Working with words: Merging Information and Learning Theories to Model Paradigmatic and Syntagmatic Effects in Word Processing

4th Nov
11.00 - 11.20

Dušica Filipović Đurđević[1] and Petar Milin [2]

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We investigated the processing of inflected Serbian adjective forms to bring together quantitative linguistic measures from two frameworks – information theory and discrimination learning. From each framework we derived several quantitative descriptions of an inflectional morphological system and fitted two separate regression models to the processing latencies that were elicited by inflected adjectival forms presented in a visual lexical decision task. The model, which was based on lexical distributional and information theory revealed a dynamic interplay of information. The information was sensitive to syntagmatic and paradigmatic dimensions of variation; the paradigmatic information (formalized as respective relative entropies) was also modulated by lemma frequency. The discrimination learning based model revealed an equally complex pattern, involving several learning-based variables. The two models revealed strikingly similar patterns of results, as confirmed by the very high proportion of shared variance in model predictions (85.83findings add to the body of research demonstrating that complex morphological phenomena can arise as a consequence of the basic principles of discrimination learning. Learning discriminatively about inflectional paradigms and classes, and about their contextual or syntagmatic embedding, sheds light on human language-processing efficiency and on the fascinating complexity of naturally emerged language systems.

The role of prediction error in linguistic generalization and item-learning

4th Nov
11.20 - 11.40

Maša Vujović[1], Michael Ramscar,[2] and Elizabeth Wonnacott[3]
[1,3]University College London
[2] University of Tübingen

Discriminative learning models frame language learning as a process by which prediction error is used to discriminate uninformative cues and to reinforce informative cues. This theoretical approach makes predictions about learnability since some learning contexts facilitate prediction error to a greater extent than others. Ramscar et al. (2010) demonstrated that learning of appropriately general word meanings is facilitated when learners (both adults and 2-year-olds) view referents before hearing their labels, compared to when they hear labels and then view referents. This is predicted under discriminative learning, since only in the former case is there opportunity for prediction error, which enables discrimination of the appropriate set of semantic features for a given label. Less work has addressed the predictions of this approach for linguistic learning at morphological/syntactic level; however, Ramscar (2013) proposes discriminative learning as an explanation of the cross-linguistic preference for suffixing (build-er, finish-ed) over prefixing (un-happy, dis-advantage) in marking linguistic generalizations (Greenberg, 1963). Specifically, as a consequence of linear order in discriminative-learning, suffixing benefits learning of abstract common dimensions from the preceding lexical items (which enables generalization to novel items), whilst prefixing benefits item-learning (Ramscar 2013).

Method: The current work explores this in a computational simulation and an experiment with humans in which we compared generalization and vocabulary learning in artificial languages. The languages described alien characters, with two noun

categories marked by phonological and semantic cues and each accompanied by one of the two affixes (category1_affix: ge, category2_affix: ma). Nouns could precede ("suffixing" language) or follow ("prefixing") the affix. Computational modelling using a discriminative implementation of the delta rule (Widrow & Hoff 1960) suggested that that participants exposed to a "prefixing" language would show better vocabulary learning, whereas those exposed to a "suffixing" language would be better at generalizing the correct affix to new category members. Four groups of participants (N=110 per condition) were trained on four versions of the artificial languages; we manipulated whether the language was prefixing or suffixing, vocabulary size and type (category) frequency.

Results: We found evidence of generalization in both prefixing and suffixing conditions, but, in line with the prediction, only participants in the suffix condition showed appropriate generalization over low type frequency items. While we did not see the predicted benefit of prefixing for vocabulary learning, there was overall better vocabulary learning for low type frequency items. Interestingly, these were the items for which we did not see strong generalization in the prefix condition. The results demonstrate the crucial role of prediction error in linguistic generalization, and the importance of linear order in human language learning. They also speak against any simplistic account in which item-based learning necessarily proceeds generalization.

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4th Nov
11.40 - 12.00

The emergence of morphological structure from a continuous signal on the basis of error-driven learning

Jessie Nixon, Michael Ramscar, and Fabian Tomaschek

University of Tübingen

When a fixed set of n items (e.g. A, B, C, D) is repeated m times and the total number of n*m stimuli is presented in randomized order, the a-prior probability of each item in the sequence is 1/m. However, combinations of items from two trials (e.g. AB,BC, CD) or three trials (e.g. ABC, BCD) are not uniformly distributed. Quite the contrary, certain sequences are more frequent than others, as can be seen in the rank-frequency plots in Figure 1.

Frequency effects are among the most robust effects in psycholinguistic research [see e.g. 3, for a review], suggesting that the structures in randomly generated sequences may potentially be used to predict upcoming items, as expectation increases

with two-trial and three-trial sequence frequency. We tested this hypothesis in two typing experiments with eleven participants.

In the first experiment, participants were presented with a sequence of four randomly presented letters and had to respond by pressing the respective key (with D representing the button press in a sequence of ABCD). We found that participants learned the structures emerging in random data, predicting upcoming letters (Figure 2, top panel). Response times (color coded, blue for low RT, yellow for high RT) decreased during the experiment (x-axis), with RT being faster in each trial as well as when the button press was preceded by more frequent CD sequence (y-axis). We found the same effect for by-trial activations for the button press, calculated on the basis of bigram cues (e.g. C, CD, D) in a Rescorla-Wagner learning model [6, 5]. However, counts of earlier trials, represented by counts of the BC sequence, did not predict faster response times, while activations on the basis of the BC sequences still did (Figure 2, bottom panel). Though participants used both, statistical learning (counts) and discriminative learning (activations) for learning of CD sequence, only discriminative learning enabled them to use even earlier trials as cues for upcoming letters.

In the second experiment, we tested whether participants learned larger chunks on the basis of the random sequences. For this, they had to type ten repetitions of each bigram combination from experiment one and we recorded their typing latency for the first stroke. Activations for the bigram, calculated on the basis of connection weights in the first experiment, were significantly predictive for typing latency: the stronger activated, the faster participants responded (Figure 3). By contrast, participants did not respond more quickly to more frequent bigram sequences.

These results indicate that humans learn sequences by means of error-driven learning. In upcoming experiments, we will test how non-random structures, resembling morphological structure such as stems and affixes, affect the performance of participants. Our prediction is that the behavior should mirror findings common findings in psycho-linguistic studies of morphologically complex words [e.g. 2, 1, 4].

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Figures

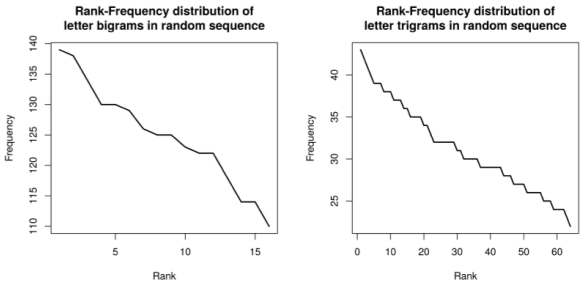

Figure 1: Rank-frequency distributions of two-trial and three-trial sequences in a random sequence.

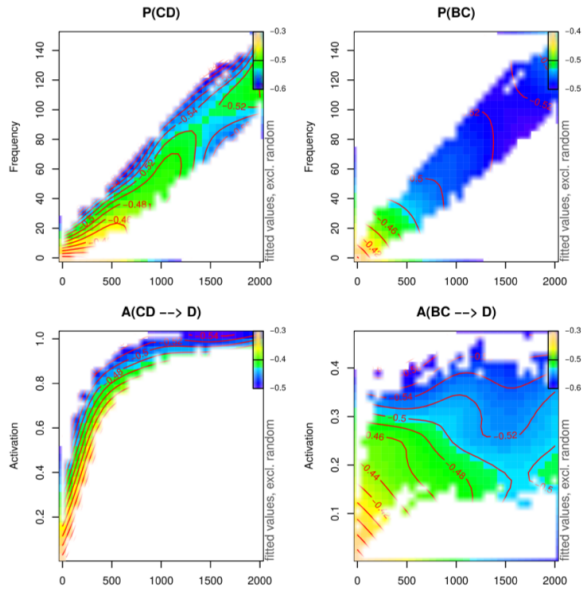

Figure 2: Response times to letter presentation depending on frequency and activation.

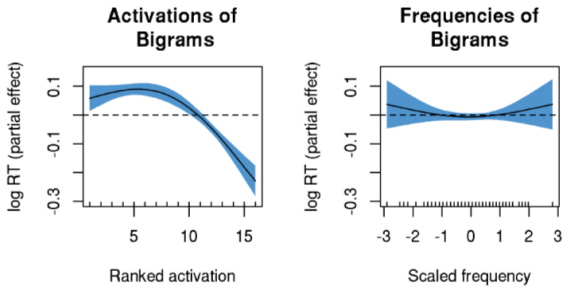

Figure 3: Response times to bigram presentation depending on frequency and activation.

Surface and base frequency effects in the processing of Russian noun forms

4th Nov
13:30 - 13:50

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Overview: The role of frequency is a long-standing issue in probing the mechanisms of lexical access to morphologically complex words. We explore the effects of frequency in lexical decision to evaluate the claims of Gimenes, Brysbaert, and New (2016) (henceforth GBN2016) regarding the base and surface word frequency and determine which approach to morphological processing (fulllisting, full parsing or dual route) is favoured by noun forms data in Russian, a morphologically rich language.

Russian nominal system has six cases (nominative, genitive, dative, accusative, instrumental, and locative) and two numbers (singular and plural). Information about case and number of a noun is included in a single inflection. Nominative singular is considered to be a primary form. Method. We tested 28 individuals on a lexical decision task in Russian. Targets were real nouns in nominative plural (e.g. kartiny, primary form kartina 'picture'), instrumental singular (e.g. kartinoj), or nonce nouns (fillers). Stimuli were selected so that the surface frequency of nominal plural form as well as instrumental singular form of a word was either lower or higher than 2 ipm (GBN2016), a threshold value below which a full decomposition would potentially take place. So, we have four groups of words with 28 items in each: nom.pl and inst.sg > 2; nom.pl and inst.sg ≤ 2; nom.pl > 2 and inst.sg ≤ 2; nom.pl ≤ 2 and inst.sg ≥ 2.

Analysis. Following GBN2016 we conducted separate regression analyses for nom.pl forms and inst.sg forms in each frequency range (4 analyses in total). Mixed effects linear regression models of reaction time were fitted with a random effect for subjects and targets and fixed effects of surface word frequency, base (also called cluster) frequency, trial number, word length, orthographic neighbourhood size, and amount of homonyms (kartiny could be nom.pl or gen.sg). The best models were selected using the stepwise algorithm in the lmerTest package in R.

Results and discussion. When the word form in nom.pl or inst.sg had a frequency below 2 ipm, we found a base frequency effect only, suggesting full decomposition for these words. Above 2 ipm, instrumental singulars showed a surface frequency effect only suggesting full listing, whereas for nominative plurals there were neither significant effects of base nor surface frequency. The latter result goes in line with parallel dual-route (PDR) model (Schreuder and Baayen, 1995). According to the PDR model, every word should be recognised either through decomposition or through whole-word access (this is determined by several properties of a word). A possible explanation could be that in this range there are two different types of words: one type mainly processed by decomposition, and another stored in the lexicon. Overall, we suggest that PDR model is the best to explain our results.

The study was supported by the RFBR grant #18-312-00101.

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4th Nov
13.50 - 14.10

Morphological variability in linguistic generalization: the Turkish aorist

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A controversial issue in psycholinguistic literature concerns the question of which mechanisms are employed in morphological generalization to nonce words. Different mechanisms have been suggested for morphological generalization, in particular associative extensions of existing patterns, and/or generalization based on morphological rules or rule-like operations; see Veríssimo and Clahsen (2014) for a review. The present study employs the Gradient Symbolic Computation (GSC) framework (Smolensky et al., 2014; Goldrick et al., 2016) to investigate morphological generalization in the Turkish aorist. GSC is a constraint-based approach that brings together symbolic grammatical constraints and graded representations. It defines grammar via a set of violable constraints that assigns a numerical well-formedness value (Harmony) to each of the possible outputs by generating a probability distribution.

By using a nonce-word production experiment, 50 Turkish native speakers were tested in the Turkish aorist. The aorist form encodes habitual aspect or general present tense and unlike most inflectional exponents in Turkish, it is not completely regular but involves a restricted set of irregular forms, specifically for monosyllabic

stems. 78 nonce-words were created using rhyme similarity, in four conditions: (i) nonce words similar to existing irregular verbs, (ii) similar to existing regular verbs, (iii) rhymes that exist both with existing regular and irregular verbs, and (iv) nonce words that are phonotactically legal but do not rhyme with existing verbs of Turkish. Participants had to complete sentences by forming an irregular or regular aorist form of a nonce-word presented in its infinitive form. The results showed that Turkish native speakers most commonly relied on the regular aorist in all conditions. The highest proportion of irregular aorist forms was found for irregular rhymes (49%), followed by the mixed condition (iii) (39%), with very low proportions for the non-rhyme condition (7.9%) and for regular rhymes (4.8%).

Two constraints were determined for GSC modeling of the Turkish aorist: strength of the rhyme (how prototypical is a given rhyme for a regular vs. an irregular aorist form) and applying the rule (forming the nonce-word in regular aorist form). The model was fed with the corpus frequencies of a large data base with 4.950.407 word types and 491.360.398 tokens of written and spoken existing Turkish verbs (Sezer, 2017) to yield the estimated probabilities for the four types of nonce words we tested with the human participants. Comparison of the model's output to the participants' nonce-word productions revealed that while the model correctly estimated the proportions of regular rhymes in condition (ii), it overestimated the proportions of irregular aorist forms in the other three conditions.

These results indicate that a model that was trained on the frequency distribution of the similarity clusters amongst existing verb forms only provides a partial account of morphological generalization. We conclude that morphological generalization in the Turkish aorist is largely driven by the regular pattern and less so by similarity to existing forms.

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Natural Processing across Word Classes: Beyond Dual-Route and Single Mechanism

4th Nov
14.10 - 14.30

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Most word processing models argue that irregular, morphologically complex words cannot be decomposed. We report new data from English nouns which challenge this claim.

Experiment 1: Processing Regular and Irregular Plural Nouns

In a speeded judgment task with repetition priming, native English speakers were presented aurally with pairs of regular (systems-systems) and irregular (children-children) plural nouns (real words and non-words) and had to decide whether the words were the same or different (Schwarz, Post, & Božić, in prep.). All regular forms contained the Inflectional Rhyme Pattern, i.e. the voicing agreement between a regular inflection and its preceding element (IRP, Marslen-Wilson, 2007), which was previously found to trigger decomposition in verbs (Post et al., 2008). We expected that all words and non-words featuring the IRP would be processed differently from words without the Rhyme Pattern independent of the different allomorphic variations of the plural inflection (Table 1).

The analysis confirmed our prediction and showed that all regularly inflected nouns (real words and non-words) were processed differently from irregular nouns. This suggests that the morpho-phonological structure of English plural nouns affects word processing independent of purely phonological and semantic factors. However, in contrast to previous findings for past tense verbs (e.g. Tyler, Randall & Marslen-Wilson, 2002), our results indicate that irregular complex nouns are processed more slowly than regularly inflected (non-)words when word duration is taken into account.

To explain these findings, we suggest that both stem-overlap between plural and singular forms of a lexeme, as well as the IRP may activate a rule-based parsing mechanism. We argue that the results can be interpreted within a parallel dual-route model, in which a conflict situation arises for irregular noun plurals due to parallel activation of parsing route (stem recognition) and direct word access. In addition, we discuss the implications of word duration differences between regular and irregular forms and of class size differences between nouns and verbs.

Experiment 2: Processing across Word Classes – Comparing Nouns and Verbs

In a follow-up experiment with the same repetition-priming task, we compare nouns to verbs to further explore the surprisingly longer reaction times observed for irregular plural nouns as well as the potential effects of stem overlap and IRP. If our results for nouns are independent of the task and analysis used, the reverse pattern is expected for verbs, i.e. shorter reaction times to irregularly inflected past tense verbs – as has been found in previous studies.

Table

Conditions	Examples	Coda cluster	Word final voicing	Inflectional Rhyme Pattern
Irregular	*mice-bice*	-	+/-	-
Regular + z	*friends-priends*	+	+	+
Regular + s	*books-sooks*	+	-	+
Regular + V + z	*guys-fuys*	-	+	+

Table 1: Summary of Conditions in Experiment 1.

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What is the difference between *boys* and *boys'* ? The phonetics of plural vs. genitive-plural in English

5th Nov
9.00 - 9.20

Ingo Plag[1], Sonia Ben Hedia, Arne Lohmann, and Julia Zimmermann

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Recent research on the acoustic properties of morphologically complex words has shown un-expected effects of morphology on phonetic realization. For instance, it has been demonstrated that the phonetic properties of final /s/ and /z/ (henceforth: 'S') in English may differ systemat-ically by morphological status (e.g. Zimmermann 2016, Plag et al. 2017, Seyfarth et al. 2017, Tomaschek et al. 2019). And even a particular kind of final S, i.e. third person singular, has been shown to vary phonetically according to morphological properties, such as paradigmatic probability (Cohen 2014). Such findings are unexpected since standard feed-forward theories of morpho-phonology (e.g. Lexical Phonology) and of speech production (e.g. Levelt et al. 1999) do not have a mechanism that would allow morphology to influence articulation, or that would model such behavior.

In this paper we test several hypotheses concerning the potential durational contrast be-tween plurals and genitive-plurals (as in boys vs. boys'), which is a contrast about which exist-ing studies are silent or inconclusive. Standardly, it

is assumed that the two forms do not show systematic phonological or phonetic differences (cf., for example, Zwicky 1975, Bauer et al. 2013: 145, Palmer et al. 2002: 1595).

We report the results of an experiment in which 82 participants read aloud sentences which contained twelve different word pairs (plural vs. genitive-plural forms, such as boys vs. boys') in very similar contexts. 462 plural tokens and 417 genitive-plural tokens were phoneti-cally annotated, and the duration of S as well as the duration of the whole word were analyzed using mixed effects regression models with pertinent co-variates (e.g. speech rate, voicing, lemma frequency). The results show that plural S is significantly shorter than genitive-plural S, with a mean difference of 7 to 8 ms (as predicted by different regression models). The duration effect is, however, not restricted to the final S, but extends over the whole word, with (mono-syllabic) plural nouns being 14 ms shorter than genitive-singular nouns.

The statistical analysis reveals that word-form frequency is predictive of word duration and S duration, with word-forms of higher frequency showing shorter durations (see Figure 1 for word duration). Since genitive-plural forms are generally of lower frequency than their cor-responding plural forms (see Figure 2), and since the two forms systematically covary in word-duration (see Figure 3), the general durational difference between plural and genitive-plural can be interpreted as a word-form frequency effect. This is in line with recent studies that have found that the frequency of inflected word-forms is predictive of word durations (Caselli et al. 2016, Lõo et al. 2018).

The word-form frequency effect on both word duration and S duration can be naturally accounted for in word-and-paradigm models of morphology (e.g. Blevins 2016), in which in-dividual word-forms may have representations in a network of morphologically related forms (see Tomaschek et al. 2019, Baayen et al. 2019 for a modern interpretation of such paradigmatic effects in a dynamic system).

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Figures

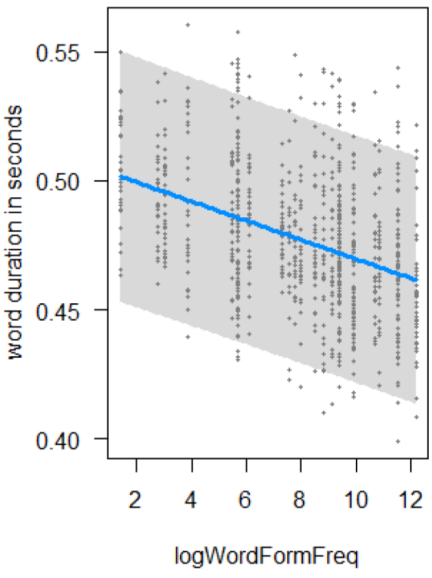

Figure 1: Word duration by word-form frequency (logged)

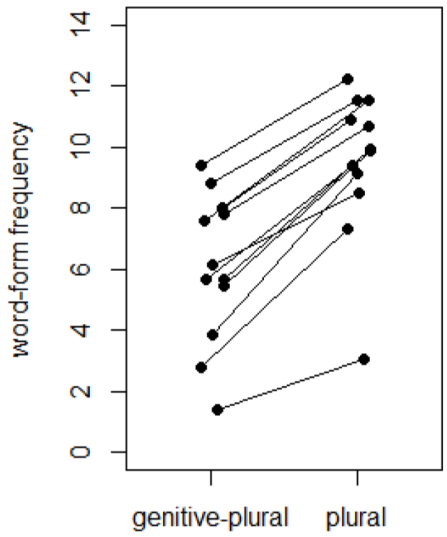

Figure 2: Word-form frequency (logged) by morphological category. Pairs of dots represent the plural and genitive-plural forms of one lexeme

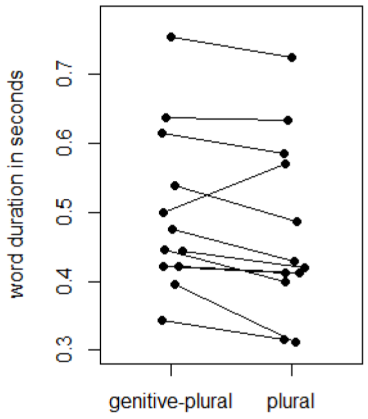

Figure 3: Mean word duration by morphological category. Pairs of dots represent the plural and genitive-plural forms of one lexeme

Recognizing Words Before the Uniqueness Point: Role of Frequency, Neighborhood Density and the Root Morpheme in Auditory Word Recognition in Hebrew

5th Nov
9.20 - 9.40

Marina Oganyan and Richard Wright
University of Washington

In contrast to visual word recognition where word information is available simultaneously, in auditory word recognition, words are typically recognized by their uniqueness point – UP – (point at which a word differs auditorily from all other words). Using the gating paradigm developed by Grosjean (1980, 1996), factors such as frequency and neighborhood have been shown to play a role in whether and how quickly words are recognized before this point (Grosjean, 1980; Metsala, 1997). Recognition of morphologically complex words in concatenative languages has also been investigated, showing evidence of dual route processing with properties of both full forms and morphemes affecting recognition point (Schriefers, Zwitserlood & Roelofs 1991; Wurm, 1999). This study investigates the role of frequency and neighborhood density (experiment 1) and morphology (experiment 2) in online auditory word recognition in Hebrew, a language with a templatic morphology. Identifying morphemes, particularly the root, has been shown to play an important role in templatic word recognition (Velan & Frost 2009; Perea et al 2010) in visual experiments. Using the gating paradigm, this study explores how this affects online word identification in the auditory domain.

An equal number of words from each condition (frequency and neighborhood density-experiment 1 and morphological factors-experiment 2) were taken to create five online gating surveys. 22 native Hebrew speakers participated in between one and five online experiments each and each word was heard by between 10 and 15 participants. Words were presented in incrementally increasing gates, such that the first presentation was the first 50ms of the word, the second 100ms and so on until the whole word was presented. At each gate, participants were asked to identify the word they heard. For each word the difference in milliseconds from the gate of the Isolation Point – IP - (gate at which participants recognized the word on average) to the gate of the UP was measured and calculated. Analyses were performed with ANOVA for linear mixed effects models with difference between IP and UP as the dependent variable.

In the first experiment, words were either high or low frequency crossed with either high or low ND. Across neighborhood density, there was no significant overall effect for frequency, but for high neighborhood density words, low frequency words were identified on average 43ms later with respect to the UP than high frequency words ($F= 8.1489$, $p< 0.005$). There was no significant effect for frequency among low ND words. Across frequencies, words with low neighborhood density were identified on average 27ms earlier with respect to the UP than words with high ND ($F= 6.6169$, $p<.01$). In low frequency words, low ND words were identified 56ms faster with respect to UP than high ND words ($F= 12.947$, $p> 0.0004$). There was no significant effect for ND among high frequency words.

In the second experiment, words either had the root completed (all root phones heard) before the UP or the root completed after the UP. Words were controlled for

frequency and ND. When root completion preceded the UP, words were identified on average 157ms faster in relation to UP than when root completion came after (F=79.852, p<.0001).

The results suggest that as for concatenative languages, both frequency and neighborhood density play a role in the time course of auditory word recognition of a templatic language. In addition, recognition of the root is particularly important for templatic language such that early access to root information speeds up auditory word recognition significantly. Future studies will further investigate the role of morphology by manipulating root neighborhood density as well as template information.

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Modelling English stress assignment from orthography with Naıve Discriminative Learning: morphological and structural effects

5th Nov
9.40 - 10.00

Sabine Arndt-Lappe[1], Robin Schrecklinger [1] and Fabian Tomaschek[2]

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The relation between English orthography and English phonetics is not a simple one. One and the same phone can be encoded by many combinations, such as /əs/ by <ous> as in nervous or by <ice> as in service. However, it seems as though the relation is not as arbitrary as it might seem. Numerous studies have found that English orthography does not only provide cues about morphological relations (Berg & Aronoff 2017, but also about the stress position (Kelly et al. 1998, Ševa et al. 2009). In the present study, we investigated this relation with Naive Discriminative

Learning (NDL, Baayen et al. 2011), a two-layer network that is based on traditional conditioning (Rescorla & Wagner 1972) and Discriminative Learning (Ramscar et al. 2010, 2013), according to which speakers learn to discriminate the world by means of (visual or acoustic) cues. Specifically, we studied how and on the basis of what information NDL would be able to emulate two fundamental characteristics that have been ascribed to stress assignment in English in the mainstream phonological literature. One is that stress assignment is usually claimed to require access to abstract phonological properties of words, especially to syllable counts and syllable structure. The other is that stress assignment is usually claimed to be sensitive to morphological structure, in the sense that it needs to differentiate so-called 'stress-preserving' affixation from 'stress-shifting' affixation. The challenge for the NDL model was that neither of these two types of information was explicitely encoded in the cue structure in our simulations.

We trained three NDL networks to discriminate stress positions on the basis of bigram and trigram letter cues for all words from the CELEX lexicon for English (Baayen & Piepenbrock 1995). The three networks differ in how stress position was operationalised as outcomes in the classification task: 1) stress counted from the right, which is in line with traditional phonological perspectives according to which English stress assignment is located in a stress window at the right edge of the word (e.g. Hayes 1982 et seq., Pater 2000); 2) stress counted from the left, which counts the position of the stress from the left edge of the word; 3) stressed vowel, which allocates stress to a specific vowel in the word.

Accuracy in our simulations ranges between 59.4% and 84.5% depending on the cue and outcome structure used. The results thus provide general evidence that English orthography also encodes stress position. Furthermore, accuracy is higher when trigram cues are used than when bigram cues are used (ranging between 74.7% and 84.5% depending on the outcome formalisation used). Accuracy is lowest for stress counted from the right and highest for stressed vowel. The best model (84.5% accuracy) uses trigrams as cues and vowel letters as outcomes. Contrary to pertinent claims in phonological theory, hence, stress assignment does not seem to require access to syllable count and syllable structure directly.

To study the emulation of morphological effects in our simulations, we compared the cue-outcome weight structure of words with stress-shifting suffixes and of those with stresspreserving suffixes in our trigram-based model. We find that the two morphological categories differ significantly in how weights are distributed among trigrams that make up pertinent derived words. Trigrams representing stress-preserving suffixes have significantly lower weights than trigrams representing stress-shifting suffixes. Thus, contrary to pertinent claims in the traditional literature, the distinction between stress-preserving and stress-shifting suffixes is an emergent property of the system rather than an a priori specification in the input.

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Using ultrasound imaging to trace the effect of frequency on the articulation of the stems of inflected words.

5th Nov
10.00 - 10.20

Motoki Saito[1], Fabian Tomaschek [2], Ching-Chu Sun [3] and Harald Baayen[4]

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According to the speech production model of Levelt, Roelofs, and Meyer (1999); Roelofs (1997), speech production is highly modular: it begins with concepts activating lemmata, lemmata activating morphemes, morphemes activating in phonemes, phonemes activating syllables, which in turn activates motor programs. This model predicts morphological functions are mainly encoded in their respective morphemes, such as the suffix -st for the second person singular for German verbs. The base words of complex forms are assumed to be invariant with respect to inflectional functions. Furthermore, effects of the frequency of occurrence of complex words are assumed not to play a role in speech production, as complex words are always assembled on-line from their parts.

However, a number of studies have documented systematic differences in acoustic and articulatory realizations of inflected verbs' base as a function of the inflectional functions they encode (Kemps, Ernestus, Schreuder, & Baayen, 2005; Kemps, Wurm, Ernestus, Schreuder, & Baayen, 2005; Tomaschek, Plag, Ernestus, & Baayen,

2019; Tomaschek, Tucker, Fasiolo, & Baayen, 2018). Tomaschek et al. (2018) observed anticipatory coarticulation for German inflected verbs using electromagnetic articulography (EMA). Importantly, the effect and strength of coarticulation was modulated by the frequency of the inflected verb forms. These results suggest, first, that morphological functions are already, at least partially, visible in the base of an inflected word, and, second, that the amount of practice a speaker has accumulated for articulating a specific word form is a factor that needs to be incorporated in theories of speech production. As for other motor skills, practise makes perfect also for articulation.

The present study follows up on Tomaschek et al. (2018), using ultrasound imaging instead of EMA. Ultrasound imaging enables to record large parts of the tongue, including the tongue root, the movements of which cannot be recorded with EMA. And whereas EMA recordings depend on sensors placed on the tongue and lips, which may interfere with natural articulation, ultrasound only requires the placement of a scanning device below the jaw, which slightly limits jaw movements in articulation but does not interfere with tongue movements inside the oral cavity.

Using a generalized additive mixed-effects model, we observed that the articulation of the vowels in the stems of German inflected verbs show coarticulation with both preceeding pronouns and following inflectional exponents. Importantly, coarticulation patterns are co-determined by frequency of use, thereby providing further evidence for the role of practise in the motor skill of articulation.

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Figures

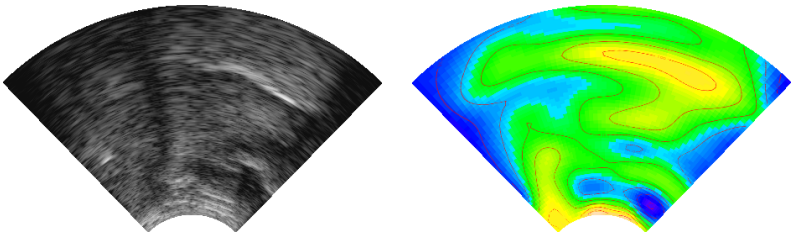

Figure 1: Ultrasound scan and corresponding fitted regression surface for a realization of German *wir sagen*.

Morphological awareness and morphological processing in high-school students with dyslexia are associated with successful reading comprehension.

5th Nov
10.40 - 11.00

Elise Lefevre[1], Jeremy Law,[2] and Eddy Cavalli[1]

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Dyslexia is a persistent reading impairment affecting word decoding, reading fluency and orthographic performances. Although not considered a primary deficit, reading comprehension difficulties are often observed in individuals with dyslexia. While considered a lifelong condition, some individuals with dyslexia may achieve some level of compensation for their underlying phonological difficulties during reading through a reliance on larger consistent linguistic units such as morphemes while decoding. Studies have begun to lend support to this theorised morphologically avenue to compensation, specifically during visual word recognition and reading comprehension. In an effort to further understand the role of morphological knowledge in the reading outcomes of individuals with dyslexia, the present study assessed morphological awareness, morphological processing and reading comprehension among 44 French high-school students with and without dyslexia. Morphological awareness was assessed with a suffixation decision task and morphological processing was assessed using a primed lexical decision task in which we contrasted orthographic, morphological and semantic processing. In addition to measure these priming effects, morpho-semantic (M+S+) and the morpho-orthographic (M+O+) effects were calculated. Results showed no differences between groups on measures of morphological awareness. However, adolescents with dyslexia were found to benefit more from the morphological structure than the control during the task used to assess morphological processing. Adolescents with dyslexia appear to rely on both morpho-orthographic and morpho-semantic properties of morphemes while controls readers seem to predominantly rely on morpho-semantic properties. Correlational analyses between morphological awareness, morphological processing and reading comprehension revealed greater group differences. In the group of typical readers negative

correlations was observed between both reading comprehension scores and morphological awareness with morphological priming effects. While, positive correlations within the adolescents with dyslexia group were found between both morphological priming effects and morphological awareness score with reading comprehension scores. This study demonstrates that morphological awareness and visual processing of derivational morphology in high-school students with dyslexia may act as compensatory processing that will be involved in successful reading comprehension.

Morphological skills of 8-to-10-year old Finnish children with DLD

5th Nov
11.00 - 11.20

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The current study focuses on morphological skills of children with developmental language disorder (DLD). Finnish language users have to rely on these skills frequently, as Finnish is a morphologically very productive language. In English, children with DLD have shown to have difficulties in producing complex word forms in both verbal and nominal inflectional morphology. Their deficits show in areas such as past tense formation (Leonard et al., 1992a; Norbury et al., 2001; Oetting & Horohov, 1997; Ullman & Gopnik, 1994, 1999; van der Lely & Ullman, 2001), agreement (Bortolini et al., 2002; Gopnik & Crago, 1991; Rice & Oetting, 1993; Rothweiler & Clahsen, 1993), pluralization (Clahsen, 1995; Goad & Rebellati, 1994; Gopnik & Crago, 1991), and morphological cases (Wexler et al., 1998b). In contrast, Niemi (1999) did not find clear differences in Finnish between 10-to-11-year-old TD children and children with DLD in the production of transparent and nontransparent plurals. This suggests that morphological processing problems may depend on the language under investigation. The current study investigates by means of an auditory lexical decision task how quickly and accurately Finnish 8-to-10-year-old children with and without DLD process inflected nouns (kesältä 'from the summer', autossa 'in the car') from the low-to-high frequency range in comparison to monomorphemic words (pakkanen 'frost', ystävä 'friend') from the same frequency distribution. The results shows no differences between response latencies of inflected and monomorphemic words at the high-frequency end, but a clear processing cost for inflections at the low-frequency end. However, this pattern of results is similar for TD children and DLD children. The results suggest that the morphological richness of Finnish may alleviate the problems DLD children experience with inflectional morphology

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5th Nov
11.20 - 11.40

Novel word production in a complex inflectional language: Older adults with or without dementia

Alexandre Nikolaev[1], Eve Higby [2,3] , Sameer Ashaie [4], Merja Hallikainen [5], Tuomo Hänninen [5], Jungmoon Hyun [6], Minna Lehtonen [7] and Hilkka Soininen[5]

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Inflecting novel words in a language that has complex inflectional paradigms provides a good opportunity to observe how language processes change in normal and abnormal aging. Studies of novel word acquisition in children suggest that phonological similarity of the novel word to existing words influences the inflectional paradigm chosen for the novel word (Granlund et al., 2019). It is unclear whether speakers continue to use this strategy throughout the lifespan. The current study addresses the question of how older adults inflect novel words and what factors contribute to this process. Single-route models suggest that we use a single associative process, namely phonological analogy, to bind novel words with existing word forms. Dual-route models instead assume that novel words are inflected either by applying symbolic rules or by analogical generalization. We examined the inflection of novel Finnish nouns by healthy older adults, individuals with Mild Cognitive Impairment, and individuals with Alzheimer's disease. Participants performed a simple speech elicitation task (Berko, 1958) involving real Finnish words. and Finnish-conforming pseudo-words. Phonological resemblance of novel words to both a regular and an irregular inflectional type as well as bigram frequency of novel words played a significant role in participants' decision to inflect novel words regularly or irregularly in the elderly control group and in people with Alzheimer's disease. Results support theories advocating for phonological analogy (single-route models) and contradict theories advocating for formal symbolic rules (dual-route models).

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Reading aloud prefixed words in acquired morphological disorders

5th Nov
11.40 - 12.00

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A consistent number of neuropsychological studies have investigated how derived words are impaired in acquired morphological disorders. However, the literature lacks a thorough investigation of the impairment of prefixed words. Psycholinguistic research has shown differences in the processing of prefixed and suffixed derived words (e.g. Ferrari Bridgers & Kacinik, 2017), with prefixed words being more difficult to decompose. Hence, we may expect this to be reflected in how prefixed and suffixed derived words are impaired. Furthermore, while several studies have systematically investigated the nature of morphological errors in reading aloud suffixed words (Rastle, Tyler, & Marslen-Wilson, 2006), this has never been done with prefixed words. Because word endings tend to be generally more affected than word beginnings (irrespective of the morphological structure of the word; Shallice & Warrington, 1975), it may be easier to isolate truly morphological errors in prefixed than suffixed words.

In Study 1, we tested reading aloud of prefixed and suffixed words in three German individuals with agrammatic aphasia. Although the number of errors was similar for prefixed and suffixed words, we found that errors reflected the morphological structure of the derived word (i.e. they involved the stem or the affix while sparing the other constituent) more often with prefixed than suffixed words, which suggests that the morphological structure of prefixed words was more easily accessible (thus against previous psycholinguistic evidence on word recognition). When specifically focusing on affixes, we found more errors with prefixes than suffixes, especially omissions. Because suffixes, but not prefixes, are generally the head of the derived word, this may be a similar finding to the 'headedness effect' that has been reported in the literature on compounds (Semenza et al., 2011).

In Study 2, we investigated the nature of morphological errors in reading aloud prefixed words in a German individual with deep dyslexia. We found similar proportion of errors with truly prefixed words (e.g. unklar 'unclear') and simple words containing word-final embedded stems (e.g. Giraffe 'giraffe' contains Affe, 'monkey'), but qualitatively different errors for prefixes compared to non-morphological word beginnings (unin unklar as compared to e.g. gir- in Giraffe). This suggests that the mechanisms involved in reading aloud prefixed words differ from those involved in reading aloud simple words with embedded stems, thus providing evidence for truly morphological errors.

Overall, our two studies suggest different processing mechanisms for reading aloud prefixed and suffixed words. Furthermore, we also show truly morphological errors with prefixed words, replicating previous findings on suffixed words (Rastle et al., 2006).

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5th Nov
13:00 - 13:20

Evidence from masked priming shows processing differences between real and pseudo morphology

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The processing of morphologically complex words has remained a topic of ongoing discussion. On one hand, there is evidence showing that words with real (talk + er) and pseudo morphological structure (corn + er) are read the same way (e.g., Rastle, Davis, & New, 2004). On the other hand, recent studies indicate that differences in the processing of pseudo and real morphology, as well as early semantic effects of the whole words exist (e.g., Järvikivi & Pyykkönen, 2011; Milin, Feldman, Ramscar, Hendrix, & Baayen, 2017), which challenges the automatic decomposition view. To shed further light on these opposing views, we conducted two masked priming experiments with native speakers of English. The results of Experiment 1 (n =77) indicated that words only in the transparent morphological condition (e.g., corns) are primed by the stem (corn), whereas in the pseudo-complex (corner) and in the stem-embedded condition (corne t) the priming effect remained indifferent from the baseline condition (eyes). Second, the prime-target frequency ratio inhibited processing when the primes were higher frequency than the targets, but only for corner and cornet words and to the same degree, whereas frequent transparent primes (corns) facilitated processing.

Experiment 2 (n =57) replicated the findings with three additional conditions (inflected, derived and identity condition). Our preliminary results show that identity priming (i.e., priming with the stem itself) results in the largest priming, followed by inflectional and derivational priming. As before, there was no priming effect for pseudo-complex and stem-embedded condition. Furthermore, the quantile regression analysis indicates that identity, inflected, and derived conditions facilitate

processing across quantiles, i.e., both short and long responses. Pseudo-complex and stem-embedded conditions facilitated shorter responses, but inhibited longer responses. Our results suggest that processing of complex words is more complicated than suggested by a simple automatic decomposition view. Taking advantage of recent methodological and statistical advancements, as well as accounting for the interaction of distributional properties and word types, can provide a more accurate picture of the exact nature of morphological processing.

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Evidence for early morpho-orthographic decomposition in Modern Greek derivational morphology

5th Nov
13:20 - 13:40

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A matter of debate in morphological processing research refers to the role of semantic transparency in early visual word recognition. Decompositional ("form-then-meaning") approaches postulate an early morpho-orthographic segmentation process for all apparently morphologically complex words, irrespective of meaning (Rastle & Davis, 2008; Taft, 2015). On the other hand, "form-with-meaning" accounts suggest that early morpho-orthographic and morpho-semantic processes occur concurrently and interdependently (Feldman et al., 2015). Furthermore, within the latter framework, parallel distributed processing (PDP) theories predict not only early but also graded effects of semantic transparency (Jared et al., 2017).

The present study examines the parameter of semantic transparency in Modern Greek (MG) derivational morphology. Specifically, we deal with denominal suffixed verbs and adjectives, aiming to investigate whether semantic transparency affects early morphological processing and –if this is the case– whether semantic transparency effects are "all-or-none" or graded. To test these hypotheses, we conducted a visual lexical decision experiment, employing the forward masked priming paradigm with 50 ms prime-target SOA, which is considered to reflect early subliminal processing (Forster et al., 2003).

Forty eight university students (half men half women, from several faculties) participated in the experiment. Ninety morphologically related prime-target pairs, each

comprising a (pseudo)derived prime and a (putative) noun-base target, were equally distributed in three semantic transparency conditions (transparent, e.g. *χτενιζω* /xtenízo/ 'to comb' - *χτενα* /xténa/ 'comb'; semitransparent, e.g. *ψειριζω* /psirízo/ 'to split hairs' - *ψειρα* /psíra/ 'louse'; opaque, e.g. *σκλιζω*/skalízo/ 'to hoe' - *σκαλι* /skalí/ 'step, stair'), according to mean rating scores from three semantic relatedness pretests. Critical primes and targets were matched across conditions for length, lemma and word frequency, syllable and bigram frequency, prime-target formal similarity, orthographic transparency, orthographic neighborhood size, uniqueness point, morphological family size, grammatical category, inflectional and derivational suffixes. Critical stimuli along with 90 control primes (matched to critical primes but morphologically, orthographically and semantically unrelated to targets) were divided into two counterbalancing lists in a Latin square design, so that each participant was exposed to all priming conditions but saw each target only once. Moreover, each list included 180 word-nonword pairs and 90 filler word-word pairs, such that total prime-target relatedness proportion was reduced to 25% and lexical status of targets could not be predicted from prime-target formal similarity, derivational suffixes of primes, or total word-nonword proportion.

Statistical analyses revealed significant priming for semantically transparent, semitransparent and opaque conditions (figure 1) but no significant differences in the amount of priming among the three conditions (figure 2). Results point to an early morpho-orthographic processing stage, where morphologically (pseudo)derived words are decomposed on the basis of their surface morphological structure rather than their meaning (Rastle & Davis, 2008; Taft, 2015; Orfanidou et al., 2011, for MG).

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Figures

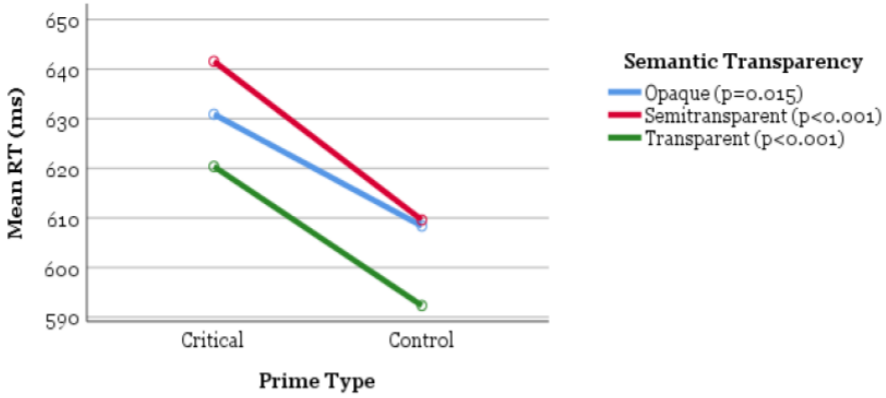

Figure 1: Significant differences in mean RTs between control and critical conditions

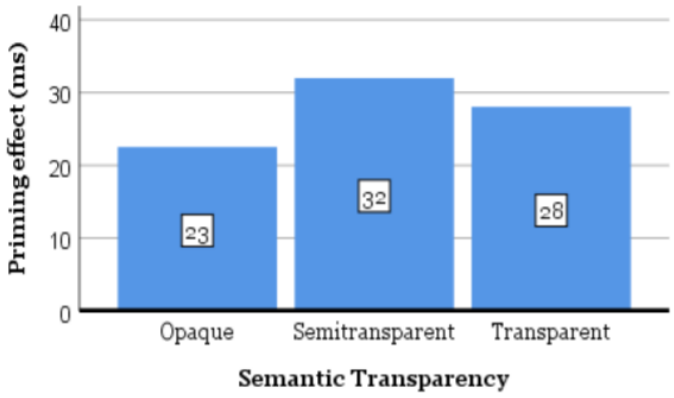

Figure 2: Non significant differences in priming among semantic transparency conditions

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Modeling morphological priming in German with naive discriminative learning

5th Nov
13:40 - 14:00

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Both localist and connectionist models, based on experimental results obtained for English and French, assume that the degree of semantic compositionality of a morphologically complex word is reflected in how it is processed. Since priming experiments using English and French morphologically related prime-target pairs reveal

stronger priming when complex words are semantically transparent (e.g., refill–fill) compared to semantically more opaque pairs (e.g., restrain–strain), localist models set up connections between complex words and their stems only for semantically transparent pairs. Connectionist models have argued that the effect of transparency should arise as an epiphenomenon in PDP networks. However, for German, a series of studies has revealed equivalent priming for both transparent and opaque prime-target pairs, which suggests mediation of lexical access by the stem, independent of degrees of semantic compositionality.

This study reports a priming experiment that replicates equivalent priming for transparent and opaque pairs. We show that these behavioral results can be straightforwardly modeled by a computational implementation of Word and Paradigm Morphology (WPM), Naive Discriminative Learning (NDL). Just as WPM, NDL eschews the theoretical construct of the morpheme. NDL succeeds in modeling the German priming data by inspecting the extent to which a discrimination network pre-activates the target lexome from the orthographic properties of the prime. Measures derived from an ndl network, complemented with a semantic similarity measure derived from distributional semantics, predict lexical decision latencies with somewhat improved precision compared to classical measures such as word frequency, prime type, and human association ratings. We discuss both the methodological implications of our results, as well as their implications for models of the mental lexicon.

5th Nov
14.20 - 14.40

Factors affecting the decay of stem-final consonant mutations: Ukrainian vs. Russian

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In this paper, we present the results from our study of the decay of stem-final consonant mutations in Ukrainian. Ukrainian has two types of mutations resulting from so called Slavic Palatalization, formerly phonologically conditioned, see (1).

1st Palatalization: k → č, g → ž, x → š
(ruka 'handNOM' – ručka 'little hand')
2nd Palatalization: k → c, g → z, x → s
(ruka 'handNOM' – v ruce 'in hand_LOC')

Consonant mutations of the first type can be found in some verbs, adjectives and nouns (in particular, in expressive nouns, i.e. diminutives and augmentatives) while second type mutations are obligatorily present in the paradigm (in locative singular) of any noun with a stem ending in a velar. Hence, mutations of the first type are more widespread, while mutations of the second type are more regular. Our goal was to analyze the productivity of these mutations: how often they are applied to recently loaned and nonce words.

We conducted an online survey with 25 Ukrainian native speakers (21-48 years old). Participants were asked to put nouns in parentheses in an adequate form according to the context. For example, cytuvati u [blog] 'to cite in [blog_NOM.SG]' → u bloze 'in blog_LOC.SG' (a stimulus, we provide a normative form in the abstract, but forms without mutations were also expected and indeed observed). The experiment had three sections: with locative forms, expressive derivates and locative/expressive forms of pseudowords. Stimuli were 12 real nouns (recent borrowings from English) and 5 nonce nouns. As a result of the experiment, we had 1025 answers in total.

First, we found that for the locative case, speakers have an avoidance strategy. Some Ukrainian nouns have two locative forms: ending in -u (used for purely locative meanings) and in -e (used for all other meanings). This is the case for relatively few nouns, and no noun has only the -u form. Still, participants used the suffix -u with our stimuli because it does not require mutations — see Table 1. Secondly, we found that expressive nouns lack mutations significantly less often than locative forms even if examples with the avoidance strategy are not counted.1

The decay of stem-final consonant mutations has been studied primarily in Russian (e.g. Kapatsinski 2010; Magomedova, Slioussar 2016; Slioussar, Kholodilova 2013) where only the reflexes of the First Palatalization are preserved. We demonstrated that similar processes are also taking place in Ukrainian, and the mutations caused by the Second Slavic Palatalization look to be more vulnerable. This could be caused by two major factors. First, the First Slavic Palatalization may be more resilient to the decay in general. Second, it may be more resilient to the decay because of the Russian influence. We think that this is very unlikely: the geographic factor (from which part of Ukraine the speaker is) was not significant. Third, the expressiveness itself may help mutations to resist the decay. Alderete & Kochetov (2017) have shown that diminutive and affectionate tones can be expressed with palatalization in many languages in a "sound symbolism" kind of way. In general, this variation is an interesting piece of evidence against the modeless based purely on analogy — the language contains numerous words with mutations, but having these examples does not prevent the decay.

Table

	Mutations: real/nonce		**No mutations: real /nonce**		**Avoidance: real /nonce**	
Locative	32%	58%	37%	14%	31%	28%
Expressive	82%	57%	18%	43%	-	-

Table 1: The distribution of answers in the experiment.

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5th Nov
14.40 - 15.00

The age of acquisition effect in the processing of Russian inflectional morphology

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Many neuroimaging studies address the problem of morphological regularity. While most experiments were conducted on languages where only one inflectional class is frequent and productive, a series of fMRI experiments on Russian (Kireev et al. 2015, 2018) allowed comparing several verb classes that differ in frequency, productivity and defaultness. Regularity effects (in the form of stronger connectivity in left fronto-temporal network) were found to be associated not with relative frequency or productivity, but with defaultness, i.e. they characterize only one verb class, so-called AJ-class, as opposed to all others.

In the present ERP study, we hypothesize that stronger connectivity found by (Kireev et al. 2015, 2018) means more effective processing and this results from the AJ class being acquired first. The age of acquisition (AoA) is an important psycholinguistic variable. In ERP studies, the AoA effect appears in the Selection Negativity (SN) component (Adorni et al. 2013) that can be observed on lateral occipito-temporal electrodes in the left and right hemispheres (Shedden & Nordgaard 2001; Keil & Muller 2010; McGinnis & Keil 2011). However, all previous behavioral and neurophysiological studies focused on lexemes with different AoA, no experiment explored this effect for grammatical phenomena such as inflectional classes.

Participants were 38 adult native Russian speakers. In every trial, participants saw a fixation cross, then the infinitive of a real or nonce verb and a personal pronoun below it (e.g. chitat' 'to read' + ja 'I'), the fixation cross again, and finally a screen with two forms of the previously shown verb in the present tense (e.g. chitaet 'read3SG' – chitaju 'read1SG'). Participants were asked to choose the form matching the previously shown pronoun by pressing the left or the right button. There were 210 trials. This task was developed by (Kireev et al. 2018) because their first fMRI experiment (Kireev et al. 2015) focused on production, and they

wanted to replicate the regularity effect in comprehension, but concluded that in the tasks like lexical decision, form processing would be too shallow for any grammatical effects to be observed. This design proved to be effective, so we used it in our ERP study as well.

The stimuli included verbs from 3 inflectional classes: the default, most frequent and productive AJ class, the second in frequency productive I class and the least frequent non-productive class (henceforth irregular). All verbs were balanced across classes for length and frequency. We also created nonce verbs resembling verbs from these three classes.

We hypothesized that if increased connectivity found for the AJ class is indeed associated with earlier AoA, then I class and irregular verbs will cause a larger SNamplitude than default verbs. For the statistical analysis we used ANOVA (by participant and by verb inflectional class). The interval of interest was 100-300 ms after the second stimulus presentation. We also verified the results with SPM to be independent from separate electrodes. We found a significant defaultness effect (AJ class vs. other two classes) in the left posterior temporal and occipital sites. This is the area associated with Selection Negativity. This proves our hypothesis and shows that AoA effects can be observed not only for lexemes, but also for grammatical phenomena, which has not been done before.

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Figures

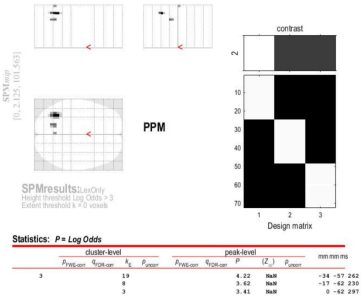

Figure 1: Selection Negativity showing the defaultness effect.

5th Nov
15.00 - 15.20

Homophony in case forms processing: a self-paced reading study with reference to Russian

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One of the crucial theoretical issues in psycholinguistics research is the way the wordforms are stored in mental lexicon. The dual-route theory argues for two independent ways of printed words processing: one relies on phonological representation and the other on the visual image of the word. The single-route theory claims that phonological processing is a default procedure of cognitive system and meaning only can be accessed via phonological representation. Access to inflectional wordforms in morphologically rich languages is particularly widely discussed in psycholinguistics studies (Hyönä et al.1995, Clahsen et al.2001, Gor et al. 2017). In Russian case forms processing was investigated for isolated forms lexical decision study by (Vasilieva 2017) however, case forms processing in sentential context has not been studied yet. Our study focuses on processing Russian case forms in context. We compare sentences containing homophonous and non- homophonous case errors to grammatically correct sentences. We hypothesize that if a homophonous error is slows down the processing in the same way as a non-homophonous one, it gives evidence for the visual route to meaning. If homophony facilitates processing or provokes grammaticality illusion, it gives evidence for the phonological route. Russian is rich in inflectional morphology, especially case morphology, and in some declension types certain case forms are homophonous but have different spelling. 24 native speakers of Russian aged 18-32 performed word-by-word non-cumulative self-paced-reading task and answered comprehension questions after 30% of sentences. In the first group of stimuli a target wordform (Feminine Singular Genitive) in the control condition was substituted by a non-homophonous case form, its orthographic

neighbour (Feminine Singular Dative): Otrytka dlya sestry/ sestre poterjalos' na pochte 'The letter for the sister$_{Gen/Dat}$ was lost at the post office'. In the second group the target wordform in control condition was substituted by a homophonous case form: Gazetnyj kiosk okolo ostanovki/ostanovke zakryt ves den 'The newsstand near the bus stop$_{Gen/Dat}$ is closed all day long'. We had 12 homophonous pairs, 12 non-homophonous pairs, 72 filler sentences, 2 experimental lists and Latin-square design. T-test shows that reaction time for the non-homonymous error wordform is significantly longer in comparison to the control condition (t=2.3, p=0.01), whereas the reaction time for the homophonous error does not differ from the control condition (t=0, p=0.5). Thus, homophonous error does not slow down processing due to the fact that its phonological representation coincides with the correct case form. However, for the word which followed the target one we see a significant slowdown in case of an error, both homophonous (t=2.04, p=0.02) and non-homophonous (t=3.5, p=0.0003) compared to the control condition. Our data gives evidence for the phonological route at the early stages of processing as homophonous error does not slow down the recognition of the target word. At the same time, we see a strong spill-over effect on the post-target region both for homophonous and non-homophonous errors which gives evidence for matching orthographical and phonological representations on later stages of processing. Acknowledgements. The study is supported by the grant of Russian Fund of Fundamental Research, #18-012-00837.

Word knowledge as a new metric tool for visual word processing

5th Nov
15:40 - 16:00

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Morphological theories set a clear distinction between simplex words and different kinds of complex words, like derivatives and compounds. Forty years ago, leading-edge work such as Aronoff (1976) has inspired many other ground-breaking studies, which have led many linguists to undertake the analysis of languages other than English (cf. Scalise (1984) for Italian, Villalva (1994), for European Portuguese).

All these theoretical constructs are solidly presented and they are based on straightforward reasoning, but 'external evidence', such as the result of word processing experiments, tends to defy the strength of some theoretical claims.

In a previous work (cf. Villalva & Pinto 2018), we presented the results of an offline test that was designed to assess the relationship between explicit word knowledge and word frequency obtained in a reference corpus (CRPC). These results have show that word knowledge and word frequency are unrelated metrics. In fact, we have found out that the informants (circa 50 young adults) may have a good knowledge of frequent and infrequent words, and the same applies to poor knowledge. These results were coherently obtained for words of different length (2 to 6 syllables), which allowed us to conclude that word knowledge is also unrelated to word length.

In this poster, we will present the results of an online lexical decision test that was designed with the same set of words (96 Portuguese deverbal action nouns and their base verbs) and an equivalent sample of informants of the above-mentioned offline test. These results consider:

- adequate and inadequate replies regarding the knowledge of each word
- mean reaction time for all the words (irrespective of the yes/no choice on the lexical decision test)

These results will be cross-checked, which will allow us to evaluate word knowledge as a relevant metric tool for visual word processing. Finally, we will consider these results for the discussion of visual word recognition models for morphologically simplex and complex words.

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5th Nov
16.00 - 16.20

Processing of conversion as a 'non-finite' category and the role of capitalization as a noun Cue in L1 & L2 German

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In a visual priming study we investigated the relation of form-identical word forms with different grammatical functions in adult native (L1) speakers of German and advanced second-language learners (L2) with L1 Czech. Four different grammatical types (inflected verbs, infinitives, deverbal conversion nouns and countable nouns) were used as primes and their influence on the processing of form-identical inflected verbs as targets was compared. In German, each verb can be converted into a zero-derived noun with predictable semantics and morphology (neutral gender, singulare tantum)

Prime and target were phrases that were each presented in two steps (see Table). The first step of the target phrase (S1) was always the personal pronoun wir ('we') and in the second step (S2), there was always the corresponding conjugated verb form, written either in capitals (e.g. SPIELEN ('play') [Experiment 1] or according

to German capitalisation rules (spielen – a verbal form vs Spielen – a noun form) [Experiment 2]. Primes were presented accordingly in the conditions listed in the Table:

	Condition	**Prime**		**Target**	
		S1	**S2 Exp1/Exp2**	**S1**	**S2 Exp1/Exp2**
1	identical	wir	SPIELEN/spielen	wir	SPIELEN/spielen
2	inflected	sie	SPIELEN/spielen	wir	SPIELEN/spielen
3	infinitive	wir wollen	SPIELEN/spielen	wir	SPIELEN/spielen
4	conversion	das	SPIELEN/Spielen	wir	SPIELEN/spielen
5	countable noun	mit den	SPIELEN/Spielen	wir	SPIELEN/spielen
6	unrelated	wir	TRINKEN/trinken	wir	SPIELEN/spielen

In both Experiments 1&2, results revealed full priming of inflected verb forms, partial priming for infinitives and no priming for semantically related, formally identical countable nouns indicating that they have a separate representation. Conversion forms as primes led to the same partial priming as infinitives when presented in CAPITALS (Exp1) and to no priming when presented with the noun orthographic cue (Exp2). Results were the same in L1 and L2 German. The findings bring the first psycholinguistic evidence for typological claims that deverbal conversion nouns and infinitives fall into the category of non-finites (see Ylikoski, 2003, for an overview). We will demonstrate that the pattern of results suggests representation with a grammatically underspecified basic lexical entry (that corresponds to non-finite representations) and word-category specific subentries for morphologically and/or orthographically specified forms (verbs or nouns). The inflected targets always activate the verbal subnode accessed via the base node which is also coactivated. Prime forms that activate only the base node (non-finites without word class specifications) pre-activate only partial representation of what is accessed at the target presentation, and therefore lead to partial priming only. Orthographic forms with a noun specific cue (capital initials) activate the noun specific subnode which then needs to be inhibited so that the verbal subnode can be selected at the presentation of the target verb form (reanalysis of the ambiguous form). This inhibition cancels out the potential facilitation effect that would have appeared due to e.g. semantic overlap (cf. polysemy). Similar reanalysis involving an inhibition of a competing noun representation that had been presented as a prime is assumed also when countable nouns with dative plural specification were presented as primes.

The role of morphemes in processing novel derivations: It's a matter of experience

5th Nov
16:20 - 16:40

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What constitutes a word in a given language is a matter of agreement and use between speakers of that language. Language productivity allows speakers to create new words and understand the meaning of words they have never heard or read before. Morphology plays a fundamental role in the game of productivity; however, speakers of a given language need to be proficient enough to exploit morphological information in a productive way.

In this study, we explore the ability of learners of Italian as a second language to use morphological information when reading novel derived words.

Participants were divided into 3 groups (beginner, intermediate, advanced) based on their level on the European Common Framework (CEFRL). Furthermore, we recruited native speakers of Italian as a control group. All four groups participated in a simple lexical decision task where they had to decide if the string appearing on a computer screen was an Italian word or not. In this experiment, word items could be simple or complex, but, for the scope of our research, they were considered control items. Non-word items were of three types: strings formed by an existing Italian stem plus a non-morphemic ending (e.g., *calzeccia*; *calz-* meaning *sock*) [realstem]; strings formed by a non-existing "stem" plus an existing suffix (e.g., *tencapabile*; *-abile* meaning *–able*) [realsuffix]; strings formed by a novel legal combination of an existing stem plus an existing suffix (e.g., *stelloso*; interpretable as *with stars*) [novel derivation].

All participants were overall accurate on word items, showing a good lexical proficiency in Italian. An analysis of accuracy on non-words showed that, while all groups were quite accurate on the realstem and the realsuffix categories, they were less accurate on novel derivations. Moreover, the accuracy on novel derivations decreased with language proficiency, as advanced learners and native speakers found it more difficult to reject novel derivations as non-existing words. Finally, the analysis of response latencies revealed that all groups were faster in rejecting real-root items (*calzeccia*) in comparison to both realsuffix items (*tencapabile*) and novel derviations (*stelloso*). Interestingly, only advanced learners and native speakers were further slowed down when rejecting novel derivations.

Our results show that the presence of an existing suffix slows down the process of rejecting a non-word. This may depend on the fact that morphemic endings are much more frequent than non-morphemic endings, hence, they represent a relevant cue for speakers. In contrast, only advanced learners and native speakers were hindered in rejecting novel derivations, suggesting that it is necessary to have richer linguistic experience in order to be able to exploit morphology productively.

Fine phonetic cues of morphological categories in verbal stems — a perception study

6th Nov
9:00 - 09:20

Fabian Tomaschek[1] and Benjamin V. Tucker[3]

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According to one of the most influential models on speech production - the theory of lexical access by Levelt et al. (1999) - speech production is a modular, sequential process, in which a word's conceptual, syntactic, and morphological information is encapsulated from the articulatory process. Consequently, the theory predicts that morphological structures should not have any effects on the dynamics of articulatory processes. However, an increasing number of studies show that morphological properties are reflected in fine phonetic details of speech and consequently, such a separation cannot be upheld (Drager, 2011; Lee-Kim et al., 2012; Plag et al., 2017; Tomaschek et al., 2019). Investigating the stem vowel in German and American English verbs using electromagnetic articulography, Tomaschek et al. (2018b, submitted) have found that speakers show stronger anticipatory coarticulation of upcoming suffixes, the more lexical proficiency they have with these words. The current study builds on these findings, investigating whether fine phonetic detail in the verbal stem is just a kinematic effect of practice (Sosnik et al., 2004; Tomaschek et al., 2018a) or whether it is part of listeners' knowledge which they use to process morphological contrasts before the appearance of the suffix.

We recorded the verbs used in Tomaschek et al. (submitted) uttered by a native American English speaker and conducted two experiments. In the first experiment, we investigated the effect of fine phonetic detail in the stem on morphological processing. We hypothesized that when listeners are presented with fine phonetic detail inconsistent with the upcoming suffix, their morphological processing (i.e. answering which morphological contrast they perceive) would be slower than when they are presented with consistent fine phonetic detail. A linear mixed-effects regression analysis of log-transformed response times, in which we controlled for effects of stimulus duration and frequency of occurrence, revealed that response times were on average 120 ms slower for verbs with inconsistent phonetic detail (β = 0.12930, sd = 0.01893, t = 6.831), supporting our hypothesis.

In the second experiment, we trimmed the verbs of their suffixes. Thirty-three participants guessed to which morphological category the perceived stems belong. We found that participants were able to guess above chance (25%), which of the trimmed stimuli were the bare stems (37.6%, intercept β = -0.51, sd = 0.20, z = -2.5, p = 0.01) and which were the past tense verbs (47.0%, β = 0.39, sd = 0.14, z = -3.57, p = 0.0004). They failed at recognizing the progressive participles (25.6%, β = -0.56, sd = 0.16, z = 2.77, p = 0.006) and the second person singulars (21.6%, β = -0.78, sd = 0.13, z = -5.9, p < 0.001).

Taken both experiments together, these results suggest that there seems to be sufficient fine phonetic detail in verbal stems reflecting a morphological contrast before the appearance of the suffix. Listeners seem to use that fine phonetic detail in perception and benefit from it in the identification of morphological contrasts.

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6th Nov
9:20 - 9:40

Lexical storage and morphological segmentability effects on the production of English derivatives

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In how far is phonetic detail affected by lexical frequency? This question has received much attention in morpho-phonetic and psycholinguistic discourse, as it has important implications for speech production and lexical storage. If acoustic detail varies with word frequency only, it seems likely that all words, morphologically simplex and complex ones, are stored morphologically unanalyzed in the mental lexicon ('whole-word storage'). If acoustic detail also varies with base frequency, however, morphemes must be stored separately ('compositional models'). Finally, if acoustic detail varies with relative frequency (e.g. Hay 2001, 2007), both types of storage may exist, and which one is processed faster will depend on the degree of morphological segmentability, i.e. ease of decomposition.

There has been some evidence in the past for phonetic detail to vary with both word frequency and base frequency, as well as with segmentability (see, e.g., Caselli

et al. 2015, Hay 2003, 2007, Plag and Ben Hedia 2018). However, some of these studies also yielded null results for some of the investigated affixes. It is not clear to this day why the three frequency measures do not consistently show phonetic effects. One possibility is that frequency effects might surface differently for affixes that more or less strongly integrate into the prosodic word of their host (Raffelsiefen 1999, 2007).

This study investigates frequency effects with the English derivational affixes -ness, -less, pre-, -wise, -ize, and -ation. Using corpus data from the AudioBNC (Coleman et al. 2012) and multiple linear regression, we explore whether word frequency, base frequency, or relative frequency (segmentability) affect acoustic duration. Two main findings emerge from the analysis. First, affixes differ regarding their sensitivity to the different frequency measures. Second, this variation does not does not pattern according to the predictions of prosodic word integration (Raffelsiefen 1999, 2007).

Our finding that duration is influenced by segmentability for at least some affixes implies that the morphology-phonology-phonetics interface is not adequately captured in models which traditionally do not allow for what they call a 'post-lexical' access of morphological information (e.g. Kiparsky 1982, Levelt et al. 1999, Bermúdez-Otero 2018). However, only some affixes are sensitive to segmentability effects, independent of prosodic structure. This suggests that neither segmentability nor prosody are satisfactory explanations for the influence of morphology on phonetic realization.

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The role of affixes in the visual identification of words and nonwords

6th Nov
9:40 - 10:00

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The exact mechanisms that govern the visual identification of complex words (e.g., build-er) are not entirely clear. In particular, it is not obvious why the system would identify (pseudo-)morphemes in words that only have an appearance of morphological complexity (e.g., corn-er, iron-y). One hypothesis is that this phenomenon is driven by letter co–occurrence regularity — morphemes are also recurrent clusters of letters. To test this hypothesis, we assessed masked priming as induced by morphologically structured (e.g., bulb-er) and non-morphologically structured nonwords whose endings were either as frequent (e.g., bulb-le) or less frequent (e.g., bulb-og) than suffixes. We observed equivalent facilitation by the three prime types, suggesting that neither the frequency nor the morphological status of word endings affects masked morphological priming with nonwords. Since this challenges the pattern of results typically observed with word primes, we ran a second experiment where morphological (bulb-er) or non-morphological (bulb-og) nonword primes were compared with transparent derivations (deal-er), pseudo-derived words (corn-er) and orthographic controls (dial-og). The data show a graded pattern of results, with maximal facilitation for transparent primes and no priming for orthographic controls; nonword primes elicited comparable facilitation again, regardless of their morphological status.

The representation and processing of noun-noun compounds in speech production: evidence from cumulative semantic interference

6th Nov
10.20 - 10.40

Anna-Lisa Ndao [1], Rasha Abdel Rahman [1], Pienie Zwitserlood,[2] and Antje Lorenz[1]
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The two-stage model of speech production (Levelt et al., 1999) assumes a single, holistic representation of noun-noun-compounds at the lemma level, and decomposed storage at the form level. Other models propose multiple lemma representations for compounds, one lemma for the compound as a whole in addition to lemmas for its constituents (Marelli et al., 2012). Results of previous experimental research on the topic are inconsistent (e.g., Lorenz et al., 2014, Lorenz et al., 2018, Marelli et al., 2012).

The present study exploits the cumulative semantic interference effect (CSIE) to further investigate the lexical representation of compounds. We conducted two continuous picture naming experiments, in which participants were presented a series of objects for spoken naming. Previous studies have shown that when naming a sequence of pictures of the same semantic category (e.g., for the category clothes: blouse, trousers, shirt, coat, socks), naming latencies increase with each additional category member. This CSIE is assumed to reflect semantic interference during lexical access (e.g., Howard et al., 2006).

The aim of Experiment 1 was to investigate whether the CSIE is influenced by morphological structure, that is, whether it differs for morphologically simple and complex nouns. The experimental items were derived from different semantic categories, selecting the pictures such that they could either be named with a noun-noun-compound or a simple noun, namely the compound's head (Seidenbluse (silk blouse) vs. Bluse (blouse)). The results show that the magnitude of the CSIE is identical in both word type conditions, thus indicating that the CSIE is not affected by morphological structure or additional semantic information introduced by the modifier, but is purely driven by the semantic relationship of the heads. This could indicate that the representation of compounds and simple nouns is identical, i.e., that both are represented as one lemma. However, it is also possible that compounds are stored as multiple lemmas but that this did not contribute to the CSIE, as the core meaning of our compound targets was conveyed through their heads.

To test the single-lemma account in a more direct way, we currently conduct a second continuous picture naming experiment. Here, category membership is established through the compounds‘ modifiers (e.g., for the category animals: Hundeleine (dog lead), Fuchsbau (fox's burrow), Pferdekutsche (horse-drawn carriage), Zebrastreifen (zebra crossing), Eselsohr (dog-ear (in a book), lit. donkey's ear)), while the heads (and thus the compounds) are not semantically related. Additionally, pictures depicting the compounds' modifiers (e.g., dog, fox, horse, zebra, donkey) were presented. In blocks, participants either named pictures of the compound condition or the simple-noun "modifier" condition.

While we expect a CSIE in the modifier condition, the outcome for the compound condition is still unclear. The multiple-lemma account predicts that the categorical

relationship of the compounds' modifiers should result in cumulative semantic interference. However, the two-stage model, assuming single, holistic compound lemmas, predicts no CSIE for compounds with related modifiers.

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6th Nov
10.40 - 11.00

Gradient Effects in Morphological Processing as Revealed by Keystroke Timing in a Type-To-Copy Task

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In previous work (Feldman, Dale, van Rij, 2019) we have used keystroke measures associated with a type to copy variant of a production task to examine how we produce and understand morphologically complex words. Systematic patterns excluding the initial keystroke challenge models based on all-or-none lexical retrieval and the claim that motor productions in typing are insulated from lexical effects once a word has been retrieved from the lexicon. With respect to morphological processing, variation in keystroke latencies by position within the stem show that the production of the stem morpheme of a morphologically complex word is subject to lexical (e.g., RENORMALIZE vs. RENORMALIST) and frequency (e.g., NORMALLY vs. NORMALCY) influences that arise as we manipulate the affix that accompanies the stem. Most novel are anticipatory effects such that upcoming affixes can influence production of an identical stem. Results suggest that the

execution phase of the typing task is linguistically informed and that people do not prepare a letter sequence and then initiate motor movements as some have claimed (cf. Crump and Logan, 2010a; Logan and Crump, 2011).

In ongoing work, we use keystroke measures associated with a type to copy to examine the production of the morphemes in semantically transparent compound words. We introduce the transition probability between constituents as well as their frequency and ask about the influence of an upcoming morpheme on production of the first constituent and the influence of an earlier morpheme on production of the second. Results will be interpreted in terms of claims about the execution phase of the typing task, ways in which it is linguistically informed and influences of upcoming constituents.

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Paradigmatic effects in speech production: do bare stems influence the pronunciation of suffixed forms?

6th Nov
11.00 - 11.20

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Recent studies have found that morphological information may influence phonetic duration. For example, in an experimental study on North American English, Seyfarth et al.(2017) have found that stems of words ending in [s, z] are longer in in ected words when compared to non-morphemic words. Seyfarth et al. (2017) argue that the differences in stem duration are due to a paradigm uniformity effect, in which the stem of a morphologically complex word like days is influenced by its morphologically simple paradigm member day.

In the present study, we replicate the results found by Seyfarth et al. (2017), using a different methodological approach, i.e. natural speech as recorded in the Quakebox Corpus of New Zealand English (Walsh et al., 2013). Based on Seyfarth et al. (2017), one would expect that stems of plural words (e.g. days) ending in [z] are longer than stems of monomorphemic words (e.g. daze) ending in [z]. In addition, we also replicate Seyfarth et al. (2017)'s investigation of frequency as a factor influencing the lengthening effect. We predict that the more frequent the bare stem of a word occurs, the stronger the lengthening effect on the inflected form.

We use linear mixed-effects regression modeling in R (Bates et al., 2017; R Core Team, 2015) to analyze two datasets. We created a model in which we predict the stem duration using the type of morpheme using a dataset of 435 tokens and 63 types (plural and monomorphemic words). In our study on the role of frequency, we create a model in which we predict the stem duration using a frequency ratio (the plural frequency divided by the stem frequency) using a dataset consisting of 317 tokens and 37 types (plural only).

We find that stems of plural words are about 20 milliseconds longer than stems of monomorphemic words ending in [z], as illustrated in Figure 1, thus replicating the experimental findings by Seyfarth et al. (2017) for corpus data, as well as for another variety of English (New Zealand English), and thereby delivering robust evidence for what appears to be a cross-dialectal effect of the phonetics-phonology-morphology interface. However, we are unable to provide conclusive evidence that these durational differences are affected by frequency, as our model investigating the role of frequency shows no significant effect.

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Figures

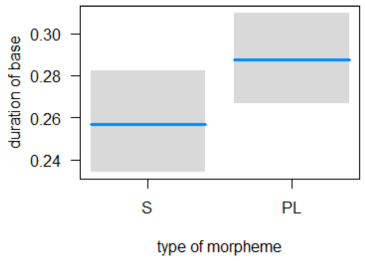

Figure 1: durational differences between the stems of monomorphemic word-final [z] and plural [z]

Implicative relations in analogical change and morphological theory

6th Nov
13:45 - 14:05

David Fertig
University at Buffalo (SUNY)

After many decades of attaching no theoretical significance to the proportional equations used to represent analogical changes, some historical linguists have begun rediscovering the exemplarbased, implicative word-and-paradigm theory of morphology in which these equations were originally embedded (Paul 1886). The relevance of this theory to analogical innovation and change is summed up by what I call Paul's proportional principle: "one word can be subject to analogical influence from another in its inflection only if it [already] corresponds to the other word in the formation of one or more forms" (1886:95). In this talk, I present several examples that illustrate how much the study of analogical change has to gain by taking word-based implicative/proportional ideas about inflectional morphology more seriously.

One example involves the spread of the 2sg -st ending in Germanic. Ringe & Taylor (2014) offer an explicitly morphemic account that treats an older -st in the 2sg of a small number of preterite-present verbs as the sole source of this ending. This is a relatively rare case where a morphemic account is clearly at odds with the proportional principle, and I show that a thorough examination of the available evidence points to a role for the preterite-present -st that has nothing to do with its supposedly morphemic status.

The regularization of English strong verbs provides a different kind of example. The view that this regularization has been going on throughout the history of English, or even Germanic, and that it reflects some kind of pervasive, universal tendency for irregular items to regularize, is widespread and persistent (Hare & Elman 1995; Gray et al. 2018). Linguists who have noticed that the only empirical evidence of any tendency toward regularization is restricted to the late medieval and early modern period generally find some way to explain away this observation. I show that proportional/implicative principles in fact predict that verb regularization, in the usual sense, would have been impossible in Old English and many dialects of Middle English and that it started happening precisely when a complex constellation of other changes, mostly reductive sound changes, made it newly possible, after which it relatively quickly ran its course.

I conclude with some thoughts on the question of the relevance of historical evidence to synchronic grammatical theory, a question closely tied to our conception of the nature of the mental grammar and its relation to acquisition and use. If the construction of grammars by learners can be largely separated from the representation and use of those grammars by speakers, then the important role that implicative/proportional principles play in analogical change could be attributed to the construction of grammars by new learners and would not necessarily correspond to anything ultimately represented in the grammar itself. If, on the other hand, one believes with Paul that a speaker's grammar is in constant flux and is, at any given moment, "a product of everything that has ever entered consciousness through listening to others, through one's own speech and through thinking in linguistic forms" (1886: 23), then grammar, acquisition, and use are essentially inseparable, and his-

torical analogical changes could be directly relevant to our understanding of the architecture of the grammar.

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6th Nov
14:05 - 14:25

Key dimensions of morphology

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From a typological perspective one thing that makes morphological systems particularly interesting is that they are more often than not a compromise between two different options: lexical listing and implicative relations (rules). But languages differ substantially in how this duality plays out. We argue that accepting this dual nature leads to a characterisation of one kind of morphological complexity, which we term 'central system complexity' (Baerman, Brown and Corbett, 2017). It can be illustrated by three idealized paradigm types: i) cross-classifying systems, ii) grid systems and iii) hierarchical systems. In its maximal form type (i) systems must rely entirely on lexical listing, because implicative relations (rules) between paradigm cells are non-existent, and they are therefore high in entropy. In type (ii) systems, for any paradigm cell each inflectional class has a form unique to it, and therefore the forms in one cell predict every other form of the lexeme. (This means that type (ii) systems are very low in entropy.) If one construes complexity in terms of entropy, cross-classifying systems and grid systems are completely opposed. But from the perspective of central system complexity they are very similar, because they can be characterized simply: either there is a reliance solely on lexical listing (cross-classifying systems), or there is a reliance solely on the morphological grammar (grid systems). For both (i) and (ii) central system complexity is low. This is because it is at its highest when the contribution of lexical listing and implicative relations (the morphological grammar) is in balance. Type (iii), hierarchical systems, are high in central system complexity, because they can only be characterized in terms of a compromise between lexical stipulation and rules based on implicative relations. This kind of complexity is at its highest when the dual nature of morphology is to the fore. Each type is illustrated and it is shown how measures provided by Stump and Finkel (2013) can be used to understand their effect. Stump and Finkel's (2013) average ratio of actual to possible optimal dynamic principal parts is argued to be a good proxy for central system complexity. A real-life example is considered, using data from Feist and Palancar (2015) to model the verbal system

of Tlatepuzco Chinantec. We show how hierarchical patterns can be recapitulated by intermediate structures termed 'inflectional series' (Palancar 2014). These patterns can only be observed if one is prepared to abandon the 'continuity hypothesis', the reductive assumption that the properties of the component parts are contained within the larger scale object (an hypothesis critiqued in Blevins, Ackerman, Malouf, & Ramscar 2016). Given current assumptions about low entropy (Ackerman and Malouf 2013) it is argued that high central system complexity may come close to the plausible boundary for what is actually possible in elaborated morphological systems. We consider how this perspective might be useful for morphology and morphological processing, and the extent to which questions that arise from it can be answered given the endangered and minority nature of relevant languages.

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The role of diachrony and the importance of patterns for morphological theory

6th Nov
14.25 - 14.45

Paul O'Neill

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Complex morphological systems typically display multiple inflectional forms for individual lexemes, many of which are syncretic or have partially overlapping forms. Available corpus studies suggest that speakers do not encounter every inflectional form of even relatively frequent items (Blevins, Milin, and Ramscar 2017) and therefore speakers do not simply memorize every inflectional form of the language but are capable on the basis of limited data to extrapolate and produce forms that they have never heard before. Morphological theory ultimately has as its goal to capture and formalise this creative capacity of speakers. In constructive Word and Paradigm models (Stump 2001; Bonami and Stump 2016) the general methodology to formalize these forms is for linguists to analyse the different distributions and syncretisms within an inflectional class and formulate deterministic rules which can succinctly

capture such distributions and syncretisms in terms which are maximally economical so as to avoid redundancy and repetition of rules, unless there is significant evidence for such redundancy. More abstractive models of morphology rely on statistics and mathematical notions such as entropy and related concepts in Information theory (Shannon 1948) to more reliably predict what paradigmatic cells are the most informative and/or related based on the distribution of form and also some frequency effects (Ackerman (Ackerman, Blevins, and Malouf 2009; Blevins 2016; Sims and Parker 2016).

In this paper I argue for the latter models but note that although probabilistic models can predict, on the basis of the inputted data, the most likely patterns of word formation, the language itself may opt for a totally different pattern, and that such patterns are often only revealed by historical morphological changes. I present data from the Romance languages to support this claim and I suggest that the importance of word-formation patterns, independent of meaning and of the actual form which expresses these patterns, has not been fully considered in many abstractive theories of morphology. These patterns, I argue, combined with a more sophisticated approach to matters of type and token frequency, are fundamental for understanding how morphological systems are structured, since a number of mid-frequency lexemes with the same patterns of alternation in their inflectional forms can act as a prototype and model for similar but less frequent tokens (see also Pirrelli, Herreros, and Calderone (2007: 285) for morphology and Strack and Mussweiler (1997) and Goldberg, Casenhiser, and Sethuraman (2004) for other linguistic domains) and override other patterns which could seem to prima facie be more relevant and statistically dominant.

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Cases in context: evidence for declension classes from reading

6th Nov
14.45 - 15.05

Dagmar Divjak and Petar Milin
University of Birmingham

A paradigm is typically defined as a set of forms having a common root or stem, of which one form must be selected in certain grammatical environments. Declension classes, then, are made up of the commonalities across many paradigms. These constructs play core role in linguistic morphology (see Blevins, 2016), and have been used in language pedagogy for centuries. Their mental correlates have been accepted to exist in psychological and computational approaches (see Milin & Blevins, to appear). In this talk we present evidence from reading showing that linguistically naïve language users have knowledge of the set of forms a noun is encountered in, and that they may abstract over this knowledge to form higher-level categories that could be defined as declension classes.

We present results from two reading experiments during which we recorded eye-movements of 81 highly educated L1 speakers of Serbian. The 212 target sentences they were presented with contained two nouns in experimentally manipulated Case/Number combinations; in Experiment 1 the two nouns belonged to the same declension class while in Experiment 2 they belonged to different inflectional classes. Across both experiments, the distance at which the nouns followed each other was controlled: they either followed each other directly, or they were separated by one or two intervening words. A Generalized Additive Mixed Model shows that sequences of words that belong to the same declension class are read with longer saccades into the target word than sequences of words that belong to a different class. To uncover the mechanism behind the difference in saccade length, finally, we ran a Generalized Additive Mixed Model predicting saccade length into the target word. We found the following predictors to be significant: (1) the Levenshtein distance between two nouns if they are non-adjacent; (2) the Relative Entropy of the target word if the nouns belong to the same class; (3) the Cosine Similarity between nouns if they belong to different classes. First, if the words are not presented consecutively, reading benefits from orthographic similarity, with visually less similar words marked by shorter saccades. Next, when the words belong to the same class, then saccades are shorter the more the target word differs from the prototypical member of the class. Finally, if the words belong to different classes the saccades are longest for noun pairs with similarity values around average where the readers benefit from many examples in experience. This pattern of effects presupposes parafoveal processing of the target word (cf., Rayner, 1998).

We conclude that users appear to be aware of the set of forms a noun can occur in because activating the same or a different declension class when reading nouns in context affects the length of the saccade. In particular, when two nouns belong to the same inflectional class, the saccades become significantly longer which leads

to fewer fixations and makes reading faster and more efficient. The present results imply that there may be some cognitive reality to declension classes, at least if classes are understood as collections of (implicitly) discovered commonalities across the paradigmatic sets of forms nouns can occur in.

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Morphological superstates and the written production of words

6th Nov
15.50 - 16.10

Gary Libben

Brock University

The study of on-line morphological processing research has demonstrated that patterns of lexical activation are linked to a complex interplay of stimulus and participant factors, as well as situational variables (Gagné, 2017). Such findings are at odds with a view of morphological structure that is rigid and static.

I present data from three experiments (English, French, and German) that investigate the production of multimorphemic words in typing tasks. I claim that, in each case, the data show that words do not have a fixed structure in the mind. Rather, what appears to be morphological structure is in fact the processing patterns that make all potential morphological configurations available.

I present a mechanism of fuzzy forward lexical activation that makes such potential morphological configurations possible and claim that the morphology of a word can only be captured through cognitive activity, rather than cognitive representation. I suggest that there is a 'fallacy of misplaced concreteness' (Whitehead, 1929) associated with the view that words have a fixed morphological structure. A more useful approach was outlined by James (1890) who claimed that putative cognitive representations are fundamentally fluid activities.

I propose that, as activities, words may vary quite considerably in their morphological structure both within and across individuals. In order to account for such variability, complex words can be described as lexical superstates (Libben, 2017). A lexical superstate defines the kinds of morphological configurations that a word can have, based on patterns of language use. It is not, however, any one of those morphological configurations in particular. I argue that this perspective provides the best account of the data that I present from native speakers of English, French, and German producing words in their mother tongue. It also has consequences for models of lexical knowledge among bilinguals and multilinguals

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Compound words in Mandarin Chinese and English: the role of information theory

6th Nov
16.10 - 16.30

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University of Tübingen

Compounding is a productive word formation process in both Mandarin Chinese and English. English is an alphabetical language with a relatively rich inventory of syllables. The frequency of occurrence of compound words in English is low. The type percentage of compound words in the English Lexicon Project (Balota et al., 2007), for instance, is no more than 4.50%. Mandarin Chinese is a logographic language with a limited set of phonological forms (i.e., syllables), even when the presence of lexical tones is taken into account. To allow language users to efficiently distinguish word forms in the auditory modality, the language heavily relies on compound words. The prevalence of compound words therefore is much higher in Mandarin Chinese than in English. The type percentage of di-syllabic two-character words in the Chinese Lexical Database (Sun, Hendrix, Ma, & Baayen, 2018), for instance, is over 70%. An overwhelming majority of these two-character words are compound words (cf. Myers, 2006).

Through two analyses, we establish the influence of information-theoretic properties of compound words on lexical processing, as well as on the organisation of lexical-distributional space in Mandarin Chinese and English. First, we conducted time-to-event analyses of word naming latencies for compound words in both languages using piece-wise additive mixed models (henceforth pamms; Bender & Scheipl, 2018; Bender, Groll, & Scheipl, 2018; Bender, Scheipl, Hartl, Day, & Küchenhoff, 2018). pamms provide information about the temporal profile of predictor effects, even when the response variable is unidimensional in nature. For both English and Mandarin Chinese, we observed early effects of the entropy of both constituents, as well as temporally widespread effects of point-wise mutual information (henceforth pmi). For both languages, the effects of entropy were facilitatory (cf. Bien, Levelt, & Baayen, 2005), whereas the effect of pmi was inhibitory. To our knowledge, the current study is the first to report an effect of pmi for compound words.

Second, we investigated the relations between lexical-distributional aspects of compound words through causal inference modeling. The picture that emerged from causal additive models (cams; Peters, Mooij, Janzing, & Schölkopf, 2014) of

lexical-distributional space in Mandarin Chinese and English is that the information-theoretic measures entropy and pmi describe properties of a carefully balanced system that resolves local bottlenecks through global optimisation for efficient processing. The information-theoretic measures have a central position in this system in both languages, and are causally influenced not only by frequency, but also by the effects of other lower-level lexical-distributional variables such as visual complexity and phonology-to-orthography consistency. Despite the differences between Mandarin Chinese and English, therefore, the principles that guide lexical processing of compound words and the embedding of novel compound words in lexical distributional space are remarkably similar in both languages.

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Semantic transparency in Technicolor: image-based distributional models and the impact of perceptual information in compound processing

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Semantic trasparency, namely the degree to which the meaning of a compound word can be inferred from its parts, has been a central topic in the investigation

of compound processing (Günther & Marelli, 2018). Recent results suggest that its impact may be better understood when framed in compositional terms (Libben, 1998), in line with the conceptual combination literature (Ji et al., 2011). However, conceptual combination is believed to be grounded on sensorimotor aspects, that is, compositional processes should not build on linguistic information only, but also rely on perceptual and bodily experiences (Lynott & Connell, 2010). The present study investigates this hypothesis by evaluating to what extent image-based transparency estimates can explain behavioral data in a series of compound-processing tasks.

In order to obtain a measure of "perceptual compound transparency", we exploited convolutional neural-network systems from computer vision (Vedaldi & Lenc, 2015), trained on image databases, to induce perceptual vector representations for 384 compounds and their corresponding constituents. These vector representations were then used to train a compositional distributional model (the CAOSS model; Marelli et al., 2017) that can produce representations for compounds on the basis of any pair of elements. Through this model we were hence able to compute estimates of perceptual compound transparency, capturing to what extent the visual representation of a compound can be obtained by the visual features of its constituents (e.g., to what extent a swordfish is, visually, a combination of a sword and a fish). Perceptual compound transparency for 736 compounds was evaluated against response latencies in three behavioral tasks (lexical decision, word naming, and timed sensibility judgment).

Perceptual compound transparency was found to have a small but consistent effect: in all tasks, response latencies were found to be shorter for compounds which are perceptually more transparent. This effect is independent from the impact of linguistic predictors, including semantic transparency as estimated through the CAOSS model trained on text-corpus data.

These results confirm that word comprehension entails perceptual re-activations of the lexically-denoted objects. This does not only apply to the word itself, but also to its morphemic units. Perceptual representations of compound constituents seem to undergo a compositional process that is similar to the one characterizing their language-grounded counterparts.

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