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### Habilitation Thesis review

**Eva Maria Luef (2021): *Phonological networks and their growth in second language learners***

The Habilitation Thesis by Dr. Eva Maria Luef examines lexical knowledge and its development in a large corpus of English as a second language from the perspective of network theory. Since the application of network science to the study of the mental lexicon is still rather new, the author decided to focus on phonological networks; this is a logical decision, given that phonological similarity and neighbourhood are notions whose conceptualization is relatively transparent.

The book is divided into five main chapters. In a brief introduction, the author contrasts the traditional approach of studying word processing using bottom-up approaches with the modern top-down approach which views the mental lexicon as a complex system amenable to examinations within the framework of network science. Chapter 2 presents these approaches in more detail, with the traditional approach relying on the concept of phonological neighbourhood and on co-activation of phonologically similar lexical items, as well as on the diverging effects of phonological neighbours on word perception and word production. The largest part of the second chapter is dedicated to network theory – that is, to various (macro-, meso- and micro-) levels of network analysis and to the ways in which information spreads through networks. The notions are typically applied to phonological networks and exemplified by means of figures which were designed to illustrate specific properties of networks, or constructed using the learner networks analyzed in subsequent chapters. As someone not active in this specific field, I would have welcomed more detailed information on what the latter type of figures actually shows; the same applies to the figures featured in Appendix A, to which the reader is referred throughout the text. It is not readily apparent what each figure illustrates and how it supports the author's argumentation. To

provide but one example, what exactly are the relevant differences between the B1- and B2-level charts on page 207? What specifically should the reader infer about their eigenvector centrality (the title of the Appendix section)?

Chapter 3 begins with introducing the language corpora used for subsequent network analysis. Relying on the British National Corpus for the first language (L1) data and on the English Vocabulary Profile word lists from the Cambridge Learner Corpus for the second language (L2) data, Dr. Luef describes the processing of the words necessary for the determination of phonological neighbours and similarity scores between word pairs; the source data is provided in the form of an online appendix. Separate sections of the chapter are dedicated to the construction of L1 and L2 (from A1 to C2 levels as per the CEFR) networks in the Gephi tool, and to their analysis conducted mostly using a variety of R packages. The macro-structure of learner networks at different proficiency stages is examined by comparing the role of giant components, lexical islands and singleton items in the entire network, and the effect of several linguistic variables on the macro-structure is plotted. Meso-level analysis consists in investigating the structure of communities within the giant component of each proficiency level network.

In Chapter 4, the author examines lexical learning and treats it as the growth of phonological networks. First, the mechanisms behind the addition of new members (words, nodes) into an existing network are introduced, specifically to which existing nodes of a network a new one is most likely to become attached; several principles such as “first-mover-advantage”, “rich-gets-richer”, “poor-gets-richer”, or “fit-gets-richer” are described here. Apart from network growth, the chapter also briefly addresses declining phonological networks, a process which may result from aging or a neurodegenerative disease. Chapter 5 then sets out to examine the growth of phonological networks in the learner data. First, lexical growth is measured between adjacent proficiency levels in the individual parts of the lexical network (giant component, islands and singletons), with phonological neighbours shown to be growing mostly in the giant component. As in the third chapter, the author also analyzes effects on lexical growth at each proficiency level of linguistic variables like word length, lexical frequency, or phonotactic probability. A separate section of the fifth chapter is dedicated to algorithms of lexical growth probability in learner networks; preferential attachment is shown to correlate best with the observed growth in all proficiency groups, documenting the dominance of the “rich-gets-richer” principle at the macro-, meso-, and micro-level of analysis. In further investigations of the learner data, the author shows that the potential for growth of a word’s neighbourhood is greatest soon after it has been acquired, and that this is again modulated by the word’s length, frequency and phonotactic probability. In the sixth chapter, Dr. Luef examines lexical growth in L2 learners from the perspective of the yet-to-be-learned words and reveals parallels between the dynamic of growth in her L2 data and that reported for L1 data.

In her Habilitation Thesis, Dr. Luef examines lexical networks in English as a second language and charts the growth of these networks from one proficiency level to the next. This makes the submitted book innovative, as this is the first comprehensive study to examine L2 lexica and the dynamics of lexical L2 learning using network analysis. The author demonstrates impressive knowledge of most current literature, including works which have not yet been published, which points to her close contacts with others active in the field of lexical network science. In her own analyses, Dr. Luef makes use of a vast array of modern statistical and graphical tools, mostly in the R environment. The results are accompanied by critical evaluations and discussed with respect to comparable studies which focused on adult L1 phonological networks, as well as on lexical development in children. I therefore have no doubt that the book constitutes a significant contribution to the study of lexical development in L2 learners.

The formal quality of the book is very high, written in excellent English, with only exceptional shortcomings concerning the figures; decimal commas are used instead of points in several (or to be exact, in some types of) figures (Fig. 25, 52–57 etc.), and figures on pages 79 and 80 are incorrectly referenced. Naturally, these minor weak points do not detract from the overall high quality of the book.

I only have one question, which is, however, of great importance to me. I have been struggling somewhat with the ecological validity of using network theory and the concept of phonological relatedness to explain lexical access and lexical activation. How would the author reconcile this approach with research that empirically proves that real-life speech perception does not (and computationally could not due to the prohibitive processing cost) proceed in a phoneme-by-phoneme, feedforward manner (as demonstrated, for instance, by the so-called “phoneme restoration effect”), but rather relies on powerful predictive mechanisms of word-like units?

Based on the review presented above, I conclude that Dr. Eva Maria Luef’s book *Phonological networks and their growth in second language learners* meets the criteria for a Habilitation Thesis at the Faculty of Arts, Charles University, and I therefore recommend that it be accepted for the subsequent steps in the habilitation process.

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