

Introduction

BASILIO CALDERONE¹
WOLFGANG U. DRESSLER²

Language sounds are realized in several different ways. Every language exploits no more than a subset of the sounds that the vocal tract can produce, as well as a reduced number of their possible combinations. The restrictions and the phonemic combinations allowed in the language define a branch of phonology called phonotactics.

Phonotactics refers to the sequential arrangement of phonemic segments in morphemes, syllables, and words (Harris 1955) and underlies a wide range of phonological issues, from acceptability judgments (pseudowords like legal <blick> vs. illegal <bnik> in English or legal <Pfraus> vs. illegal <Xraus> in German) to syllable processes (the syllabic structure in a given language is based on phonotactic permissions in that language) and the nature and length of possible consonant clusters (which may be seen as intrinsically marked structures with respect to the preferred CV template). This volume deals only with consonant clusters.

The study of phonotactics entails a set of problematic aspects due to its nature. In fact, if, on the one hand, phonotactics is part of the phonological grammar of the language and appears as a rules-based system, on the other, it is controlled by a number of non-categorical, probabilistic and gradient constraints. Often the researcher is faced with a series of apparent contradictions and empirical problems that require critical comparisons of alternative explanatory models and, most often, an investigation of the ‘interfaces’ and ‘intersections’ between phonotactics and other levels of linguistic organization, particularly phonetics or, instead, only phonology and morphology.

However, this volume focuses on experimental, acquisitional and corpus linguistic aspects of *morphonotactics*, which represents an intersection area between phonotactics and the morphemic structure of the language.

In particular, morphonotactics deals with the interplay between the ordering restrictions of morphemes (the so-called *morphotactics*) and the

¹ CNRS, CLLE-ERSS, University of Toulouse (UT2), Toulouse, France.

² Austrian Centre for Digital Humanities and Cultural Heritage (ACDH-CH) of the Austrian Academy of Sciences, Vienna & University of Vienna.

phonemic sequences of consonant clusters (*phonotactics*). More specifically, a consonant cluster is *phonotactic* in the strict sense when it occurs within a morpheme (such as /kt/ in German *nackt* ‘naked’ or *Akt* ‘act’, or in English <act> or <detect>, or as /nd/ in German *Kind* ‘child’ or *Rand* ‘edge’, or in English <kind> or <sound>). A consonant cluster counts as morphonotactic when it results from a morphological operation such as concatenation (such as /kt/ in German *zuck-te* ‘jerked’, *tank-te* ‘re-fuelled’, and in English <kick-ed>, <thank-ed>). It is important to note that apart from clusters that are purely phonotactic (such as final /mp/ in English <limp>, or final /mpf/ as in German *Dampf* ‘steam’) or purely morphonotactic (such as final /md/ in English <seem-ed>; or final /ŋkst/ in German *lenk-st* (steer-2SG) ‘you steer’), many clusters can occur both phonotactically and morphonotactically (e.g. the cluster /kt/ in German as in *Akt* ‘act’ vs. *zuck-te* ‘jerked’, or /nd/ in English as in <kind> vs. <sign-ed>). A much less frequent interaction between phonotactics and morphotactics takes place when phonological deletion produces a consonant cluster in inflection or word formation (as in German *Risiko* ‘risk’, *Risk-en* (risk-PL) ‘risks’, *risk-ant* (risk-ADJ) ‘risky’).

A main focus of several of the articles collected in this volume is the Strong Morphonotactic Hypothesis (SMH), as proposed by Dressler and Dziubalska-Kołaczyk (2006). The SMH claims that morphonotactic consonant clusters are favoured in processing and acquisition compared to phonotactic clusters. This implies a synergy of morphology and phonology, with the acquisitionist effect that morphonotactic consonant clusters are acquired earlier than corresponding phonotactic clusters. This was first interpreted as an earlier emergence of morphonotactic clusters (i.e. when a consonant cluster is first produced correctly), but Kelić and Dressler (2019) have shown for Croatian that it rather holds for mastery of consonant clusters (i.e. when a cluster continues to be produced correctly). As to processing, the SMH claims that morphonotactic clusters are processed more accurately and rapidly than corresponding phonotactic clusters. These claims have been restricted to languages or morphological components with a rich morphology, such as inflection in Slavic languages, whereas they may not hold for languages and morphological components with less morphological wealth, such as inflection in Germanic languages. See, for more on this, the chapter by Sommer-Lolei et al. in this volume.

The articles represent the result of a joint French-Austrian interdisciplinary project with the title ‘Human Behaviour and Machine Simulation in the Processing of (Mor)Phonotactics’ funded by the ANR (Agence

Nationale de la Recherche, ANR-13-ISH2-0002) and the FWF Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung, I-1394-G23). The main focus of investigation of the project was the study of the psycho-computational representation of (mor)phonotactics in French and German speakers from two angles simultaneously: *human behaviour* and *machine simulation*. Both of them cover a broad range of activities: from computational simulations (computational models appealing solely to distributional information for the linguistic data and processing the statistical regularities of representative corpora) to longitudinal studies of acquisition (in order to test whether there are systematic differences with regard to the phases at which phonotactic and morphonotactic clusters are acquired), psycholinguistic analyses (aiming at verifying the psychological plausibility of hypotheses on the phonotactics/morphonotactics distinction) and production analysis (focusing on the phonetic repair mechanisms and the systematic differences in the production of morphonotactic and phonotactic clusters in actual speech data). The present volume contains five papers focusing on the acquisition, speech production, processing and corpus linguistic analysis of morphonotactic vs. phonotactic clusters.

The papers combine distributional analysis and experimental investigations based on large corpora or on the analysis of the speakers' behaviour in producing phonotactically marked structures such as consonant clusters.

The first paper of the collection 'German phonotactic vs. morphonotactic obstruent clusters: a corpus linguistic analysis' by **Wolfgang U. Dressler** and **Alona Kononenko-Szozzkiewicz** presents a corpus-based study of the obstruent clusters in German. In particular, the paper investigates the distribution, in terms of type and token frequency, of triple consonant clusters (excluding glides) containing two obstruents. The study is framed within the NAD (Net Auditory Distance) model, a net reflection of the difference between adjacent segments in terms of the manner and place of articulation (Dziubalska-Kołaczyk 2002). One main result discussed by the authors is that, according to NAD predictions, (at least triple) morphonotactic clusters are preferred over phonotactic clusters for German word-final position, which supports the Strong Morphonotactic Hypothesis (SMH, as described above). This must be compared with psycholinguistic evidence, as reported in the chapter by Sommer-Lolei et al. (below). The typological characterization of the German language with regard to the word-final and word-initial obstruent clusters, in contrast to Slavic and other Indo-European languages, is also discussed at the end of the paper.

The paper ‘Morphonotactics in speech production’ by **Hannah Leykum** and **Sylvia Moosmüller**[†] investigates the influence of morphology on the phonetic realization of utterances. The authors perform acoustic analyses of word-medial and word-final consonant clusters, which could occur both within a morpheme as well as across morpheme boundaries. The hypothesis underlying the study is that consonant clusters across word-internal morpheme boundaries (morphonotactic clusters) are expected to be more robust and more highlighted in speech production than consonant clusters within a morpheme (phonotactic clusters). The analyses are conducted in three different language types: a word language (Standard German German, SGG), a mixed-type language (Standard Austrian German, SAG) and a quantifying language (Standard French, FR). These three types were chosen to investigate whether language-type-specific timing characteristics have an influence on the highlighting/reduction of consonant clusters. Concerning the language type, the authors hypothesize that differences between phonotactic and morphonotactic clusters are more pronounced in SGG as compared to SAG, and the differences are expected to be greater than those in FR for both varieties of German. The results of the analyses fail to confirm the main hypothesis and reveal that there is no difference in respect of durational and intensity characteristics between clusters with and those without a morpheme boundary. However, as the authors state, the absence of any effects does not necessarily imply that no direct influence of morpheme boundaries on the realization of consonant clusters exists, thus overriding an impact on phonology. Besides language-specific timing characteristics, other language-specific differences could exist. The three investigated languages share a low morphological richness, raising the question of whether the morphological richness of a language determines whether phonotactic and morphonotactic clusters behave the same or not. It is possible that in morphologically richer languages, the information about the morpheme boundary is more important to ensure intelligibility.

The paper ‘The acquisition and processing of (mor)phonotactic consonant clusters in German’ by **Sabine Sommer-Lolei**, **Katharina Korecky-Kröll**, **Markus Christiner** and **Wolfgang U. Dressler** presents a set of psycholinguistic experiments testing the Strong Morphonotactic Hypothesis (SMH) which claims that morphonotactic consonant clusters foster processing and acquisition. The two psycholinguistic processing methods used are progressive demasking and lexical decision. The results partially confirm the SMH, showing a significant positive effect only for rich compounding, a partial trend for less rich derivational

morphology and no effect for inflection, which is relatively poor in German and thus cannot facilitate lexical processing. A psycholinguistically important finding is that familiarity often has a greater facilitating effect than frequency. The acquisition part of the chapter presents longitudinal data up to 3 years (3;0) of age and quasi-longitudinal transversal data up to a mean age of 4;8. Since the data does not suffice for making separate statistical analyses for inflection, derivation and compounding, no facilitating effects have been found in previously reported analyses. This contrasts with the facilitation effects found in morphology-rich Lithuanian, Polish and Croatian inflectional and derivational morphology.

The paper 'Exploring phonotactic and morphonotactic constraints in the acquisition of consonant clusters in L1 French' by **Barbara Köpke**, **Olivier Nocaudie** and **Hélène Giraudo** focuses on the possible effects of age, position and phonotactic vs. morphonotactic status in the successful pronunciation of the different French consonant clusters. The authors analyse distributionally longitudinal CHILDES data from four children (aged 1;6 to 3;0) collected in spontaneous speech interactions between a parent and the child. The analysis shows a high variation of error types (such as reduction, substitution, omission, repetition, epenthesis, shifted cluster or mixed sounds) in the characterization of consonant clusters. A more detailed exploration of the individual developmental trajectories, however, demonstrates the presence of an overall developmental pattern with the number of omissions decreasing while the number of reductions increases within the age groups. Concerning the consonant cluster's position in the word, overall French children have a tendency to a left-side preference in the development of the pronunciation of clusters. Finally, also, the morphonotactic status of the cluster seems to have a significant effect on the development of pronunciation, although only in a medial position. According to the authors, this positive effect of the morphonotactic status should be pondered in relation to several factors inherent to the corpus which may modulate and affect the results. In particular, morphonotactic clusters are relatively scarce in French and they never appear in the word-initial position, in contrast to a medial position and especially the word-final position, which seems a less favourable position in early acquisition. This and other considerations led the authors to the conclusion that an extension of the study to later developmental stages in older children, with a consistent vocabulary between the age groups, is needed, in order to weigh in detail the influence of frequency and position effects in the error patterns related to the (mor)phonotactic status of consonant clusters.

The last paper 'The natural perceptual salience of affixes is not incompatible with a central view of morphological processing', by **Hélène Giraud**, **Karla Orihuela**, **Basilio Calderone** and **Barbara Köpke** reports on a set of behavioural experiments testing the reactions of French adults in a letter search task. The authors discuss the issue of morphonotactic processing through the notion of morphological salience – the functional and perceptual relative prominence of the whole word and its morphological components – and its implications for theories and models of morphological processing. With regard to the SMH, the task was carried out using words that include the target letter after a morphonotactic boundary (e.g. *vivre* 'to live' which contains *viv-* as a morphological base (stem) and *-re* as a suffix, a marker of an infinitive) against those with a purely phonotactic one (e.g. *centre* 'centre' in which *-re* is not a suffix and *cent-* is not a stem). The main hypothesis is that morphonotactic segmentation should be facilitated due to a double salience conveyed in the boundaries, as it is not only phonological but also morphological. The effects of position, initial vs. final, are also explored. The final results show that prototypical morphonotactic sequences are processed faster than phonotactic sequences in a final position, suggesting that phonotactics helps to decompose words into morphemes by enhancing their morphological salience.

Taken together, the papers offer an interdisciplinary view of (mor)phonotactics, as they provide acoustic-phonetic, psycholinguistic and corpus-based evidence in support of the proposed theoretical claims about the nature of phonotactic and morphonotactic structures.

Another merit of the present volume is its crosslinguistic methodology, including two phonologically and morphologically relatively distant languages such as French and German.

Comparing phonotactically very different Germanic and Romance languages in the analysis provides a larger and more informative picture of (mor)phonotactics in these two languages.

Behavioural analyses are of particular relevance for the development of crosslinguistically valid generalizations on (mor)phonotactic processing. Psycholinguistic tests applied to the two languages may help to define a continuum of phonotactic and morphonotactic complexity, with respect to which the two languages will occupy partly different and partly overlapping positions. Similarly, the crosslinguistic differences which emerge from the analysis of speech production contribute to the definition of the continuum of (mor)phonotactic complexity.

We hope that this special issue will provide inspiring suggestions for further investigations, including interdisciplinary approaches, within the

domain of the acquisitional, cognitive and physical aspects of sound organization in languages, thus contributing to our knowledge of how human speech structures are acquired, mentally organized and physically produced.

The volume is dedicated to the memory of our colleague Sylvia Moosmüller (1954–2018) who died shortly after finishing her part of the joint contribution with Hannah Leykum.

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