



Based on an innovative corpus-based approach, this book offers a comprehensive survey of the phonological and phonetic properties of L2 speech in English and German. The first part of the book critically examines current theoretical models and research methodologies in the field of second language acquisition of phonology and describes the advances that have been made in corpus linguistics over the past few years – in particular, the development of phonological learner corpora. It furthermore presents the first learner corpus of L2 English and L2 German that is fully aligned and has extensive phonological annotations: the LeaP corpus. The second part of the book describes the results of the quantitative and qualitative corpus analyses in the following areas of non-native speech: fluency, final consonant cluster realisation, vowel reduction and speech rhythm, intonation and general foreign accent. In addition, the influence of many non-linguistic factors, including instruction and a stay abroad, on the phonological properties of non-native speech is explored.

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## Non-native Speech

# english corpus linguistics

*Thomas Kohnen · Joybrato Mukherjee (eds.)*

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*Ulrike Gut*

# **Non-native Speech**

*A Corpus-based Analysis  
of Phonological and Phonetic Properties  
of L2 English and German*



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# 1 Introduction

In present-day societies it is rare to find someone who speaks only one language; most people around the globe know and use several languages in their daily lives. Of these, many will be considered a second language (L2), since their acquisition<sup>1</sup> began after one or more native languages (L1) had been acquired fully. Despite the abundance of second language learners, the scientific study of second language acquisition (SLA) is a relatively young discipline. First inquiries into the process and result of second language learning were made in the 1940s and 1950s, mainly as an adjunct to research in language teaching. First theoretical advances were made in the 1960s, with the major insight that language produced by language learners is systematic and can be described with the same rules and constraints as any other natural language. Corder (1967) proposed that properties of L2 speech that deviate from native speech should not be considered errors but instead be investigated as evidence for the language learner's cognitive processes. Selinker (1972) claimed that the language learner's productions are determined, at least in part, by an interlanguage (IL) system that is distinct from both the learner's L1 and the L2 grammar. Equally, Adjemian (1976) hypothesized that the language learner has a mental grammar that is constrained by universal principles of grammatical structure just like native speakers' grammars. This theoretical assumption that L2 data should be treated as part of a linguistic system in its own right necessarily leads to the idea that non-native speech can and must be described on its own ground (Bley-Vroman 1983).

By the mid-1980s, second language acquisition research had emerged as a basic discipline with a research agenda and methodology almost entirely distinct from its applied sister disciplines such as language teaching and research into multilingualism and bilingualism. Theories that have been proposed and tested in the area of second language acquisition include the role of universal language structures, Universal Grammar, Optimality Theory, psychological models of information processing, sociolinguistic theories and theories on language contact and language change (see overviews in Sharwood Smith 1994, Gass and Selinker 1994, Towell and Hawkins 1994, Mitchell and Myles 2004). Second language acquisition research now has a multidisciplinary focus including research on the structure and use of language, sociolinguistics, language variation and change as well as human cognition in general. The current dynamism of the field is reflected in the recent publications of handbooks (Ritchie and Bhatia 1996, Doughty and Long 2003), which cover the variety of

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<sup>1</sup> No distinction will be made between the terms *language acquisition* and *language learning* throughout this study.

approaches to second language acquisition, its theoretical foundations and research methodologies.

No general theoretical model of second language exists that covers the acquisition of all aspects of language structure and use. This is not only due to the fact that researchers have specialized interests and show different inclinations towards the approaches, methodology and focus of the various disciplines of linguistics, psychology and sociolinguistics, which contribute to theoretical development in SLA, but also due to the widespread notion of language modularity. The hypothesis of modularity claims that the various aspects of language such as morphosyntax, phonology, lexicon and pragmatics, are acquired and processed in different ways and predicts that it is theoretically possible for a language learner to have, for example, acquired native-like phonology in a second language but to still be at a beginner's level with regard to morphosyntax. This assumption of modularity, which still awaits empirical substantiation, probably constitutes one of the reasons why the acquisition of the phonology of a second language and the description of non-native speech form a distinct sub-discipline in SLA research.

As noted repeatedly in the past and even recently (e.g. Major 1998: 131), the scientific investigation of L2 phonology is underrepresented in SLA and trails behind research in other linguistic areas such as vocabulary and morphosyntax. Models of non-native phonology can be divided into two groups: those with a synchronic and those with a developmental focus. The former describe the characteristics of non-native speech at a given point in time, whereas the latter investigate changes in a language learner's L2 phonology over the course of time. So far, both types of approaches to non-native speech have been predominantly concerned with three major issues: the relationship between the speaker's L1 and L2, the role of language universals and the influence of non-linguistic factors on the acquisition process and outcome. The question of the influence of the learner's L1 on both the course and result of L2 acquisition has long been considered the most central issue in the study of second language acquisition and is still highly relevant until today (see e.g. Eckman 2004). Phonemic substitutions and errors on the prosodic level in non-native speech have been described and predicted by rule-driven approaches, underlying representations, derivations, Feature Geometry and prosodic hierarchies. Recently, L1 influence has been modelled as a reranking of constraints in a speaker's L2 phonology. The second major domain presumed to influence non-native speech is language universals, which form part of several theories of SLA. The discovery of general and implicative principles in the languages of the world culminated in the hypothesis that L2 learners will acquire universally less marked structures more readily than more marked structures. Apart from the relationship between a speaker's L1 and L2 and universal features in interlanguage phonology, non-linguistic factors affecting non-native speech



have been the focus of much recent research. These factors, which comprise such diverse concepts as motivation, age of first contact with the L2, length of residence, musical ability, type of instruction and continued L1 use, are investigated in order to explain the within-speaker variability in L2 phonology and to predict the ultimate outcome of second language learning.

As yet, no comprehensive description of the phonological and phonetic features of non-native speech exists, nor has a model of L2 phonological acquisition been developed that comprises more than one phonological feature. Most of the work on L2 phonetics and phonology is limited to the segmental level and focuses solely on pronunciation errors in terms of phonemes or allophones (see Archibald and Young-Scholten 2003: 163). Similarly, formal models of L2 phonological acquisition are usually restricted to the explanation and prediction of one aspect of L2 phonology such as phonemic contrasts or the acquisition of stress. Further limitations of current research in second language phonology lie in the preferred research methods. The majority of studies favour experimental data and tend to be based on a relatively small empirical data base with a limited number of participants and the restriction to one particular speaking style. Investigations typically focus on one isolated aspect of non-native speech and the influence of the native language on L2 phonology, but do not often take into account the learning situation of the language learner and non-linguistic factors influencing the structure of non-native speech as well. Thus, it seems desirable that a corpus-linguistic approach should be introduced into research in language acquisition. In their outlook on future developments in SLA research, Mitchell and Myles (2004: 260) and Myles (2005: 381) argue that the greater use of computer-aided techniques and the development of second language corpora for the analysis of second language data constitute an important and productive development. Although they primarily envisage a facilitation of the study of lexico-grammatical and pragmatic-discoursal phenomena in L2 acquisition, they would probably agree that a corpus-linguistic investigation of second language phonology promises to be equally worthwhile. It is increasingly argued that a corpus-based methodology can complement the current research methods in second language acquisition and possibly compensate for some of their weaknesses (Biber et al. 1994, Botley, Glass, McEnery and Wilson 1996, Kettemann and Marko 2002, Granger et al 2002, Sinclair 2004, Granger 2004). For example, it is held that the representative sample of natural speech contained in a language learner corpus enables linguists to study patterns of actual non-native language use on a scope not achieved in small-scale experimental studies. Such an approach might lead to the discovery of typical errors and to previously unexpected linguistic phenomena.

Corpora of language produced by language learners, so-called learner corpora, have been collected since the 1980s (see Granger 1998, 2004, Granger

et al. 2002, Allan 2002, Pravec 2002, Santos Pereira 2004, Sinclair 2004, Myles 2005). Recently completed learner corpora include the ICLE corpus, the Longman's Learner Corpus, the HKCSE corpus of spoken English in Hong Kong, the HKUST learner corpus, the FLLOC and the Cambridge Learner Corpus. However, none of these learner corpora contain phonetic or prosodic transcriptions and can therefore only be used for the study of L2 vocabulary, morphosyntax and the like. This means that so far, due to the lack of suitable phonological learner corpora, the corpus-based analysis of learner phonology or prosody has not been possible. The recently completed LeaP corpus (Gut 2007, Milde and Gut 2002a) fills this gap by providing a phonetically annotated speech corpus of non-native English and non-native German. It contains phonetic and prosodic transcriptions of the pronunciation and various aspects of intonation, stress and speech rhythm produced by a wide range of L2 learners.

The present study is concerned with the description of phonetic properties of non-native speech and L2 phonology based on the LeaP corpus. It aims, amongst others, to support theoretical advances in second language phonological acquisition and to provide possible applications of the findings in areas such as language teaching and speech technology. The first goal of the study is to supply a comprehensive description of phonological and phonetic features of non-native speech, focussing especially on processes and structures above the segment. These suprasegmental areas include prosodic domains such as the syllable, the foot, the intonation phrase and textual paragraphs. It is increasingly recognized that the study of the characteristics of L2 speech and the development of L2 phonology contributes to the modification and improvement of phonological theories. While research in second language phonology has profited from a number of phonological theories such as Natural Phonology, lexical phonology, metrical phonology and autosegmental phonology, research in the acquisition of phonology has also begun to exert important influence on other disciplines, especially linguistic theory in dialect variation, historical change and language contact phenomena (Gass and Selinker 1994: 108, Major 1998: 132). In the area of phonology, it has been repeatedly proposed that research in non-native speech can contribute to the refinement of phonological theories by validating or falsifying phonological constructs (Ioup and Weinberger 1987: xi, Newmeyer 1996: 176, Leather and James 1996: 299, Major 1998: 131, Leather 1999: 34). With this corpus-based analysis of non-native speech, the validity of a wide range of theoretical concepts and models such as the concept of speech rhythm, intonational categories, the relationship between acquisition in phonology and other linguistic areas and the relative influence of native language, target language, universal and non-linguistic factors on the structure and use of L2 phonology can be tested.

The second aim of the present study is to provide a description of non-native speech that can be applied in areas such as language teaching and speech

technology. In the last 25 years, there has been a growing demand to develop speech corpora as training and testing material for a wide range of technological applications including speech recognition and speech synthesis systems as well as computer-based interactive teaching materials. Modern computer-aided language instruction tools accept speech input by language learners and provide feedback on the quality of the pronunciation, pointing out specific areas of problems or mistakes. Speech recognition technology is the key to allowing such feedback: speech recognition algorithms have to be trained to categorize and assess the speech produced by the language learner. These models of correct and erroneous categories in turn need to be based on a corpus of representative natural spontaneous non-native speech. In addition to computer-based language teaching, classroom language teaching can also profit from a detailed description of the phonetic and phonological features of non-native speech. A corpus-based analysis of the phonology of learner languages provides the opportunity to code and classify recurrent errors such as underuse and overuse of particular structures (e.g. Chen and Warren 2000), to determine the relative frequency of errors and the extent of variation. So far, learner corpora have only played a minor role in the development and improvement of printed teaching material (see Flowerdew 2001, Meunier 2002), but there are reports of an increasing variety of ways in which learner corpora can form the basis of pedagogic materials (Hunston and Francis 1998, Osborne 2000, Carter et al. 2000, Mindt 2002).

In sum, the first aim of this study is to stimulate the development of theories in the area of second language phonology with the help of a corpus-linguistic approach. As yet, there is no comprehensive theory that can explain and predict phonetic and phonological features of non-native speech, especially in the area of prosody. Research on non-native speech is usually restricted to small case studies and has only recently started to investigate prosodic aspects of L2 productions. This study presents the first large-scale corpus-linguistic investigation of non-native speech, including both phonological processes and prosodic features. It is based on the LeaP corpus, a fully text-to-tone aligned and extensively annotated learner corpus of L2 speech in English and German, which combines cross-sectional and longitudinal data. It presents findings on non-native fluency, on consonant clusters and syllabification, on speech rhythm and vowel reduction, on intonation and the correlation of non-linguistic factors and global foreign accent. In addition, the co-variation of these phonological aspects with each other as well as with measurements of syntactic and lexical complexity and diversity is investigated. By analysing both non-native English and non-native German, universal learner processes can be separated from target language-specific processes. Based on these results a multifactorial model of non-native speech will be developed. Secondly, it is hoped that the descriptions of non-native speech will contribute to the development of teaching materials

and computer-based language teaching as well as to other areas of speech technology.

This book is structured in the following way: Chapter 2 describes and compares current theories and models of the acquisition of second language phonology. In particular, models that explain properties of non-native speech on the basis of native language influence, approaches that stress the role of universal processes in L2 phonological acquisition such as markedness theory, the theories of Universal Grammar and Natural Phonology, and a model of L2 phonological acquisition within the framework of Optimality Theory will be discussed in terms of their theoretical foundation, scope and limitations.

Chapter 3 presents and evaluates current research methodologies in L2 phonology research. It surveys 171 empirical studies on non-native speech published between 1969 and 2008 in the major journals of SLA research. These studies are compared in terms of subject matter, target language, number of participants, study design, data collection, data analysis and underlying theoretical framework as well as correlations of these. It is shown that empirical research on L2 phonology is rarely based on large-scale analyses and how it might profit from a corpus-linguistic approach. The terms corpus, phonological corpus and learner corpus are introduced and the few available phonological learner corpora are described according to their size and content, type of annotation, data format and availability.

Chapter 4 presents the LeaP corpus, which was collected at the University of Bielefeld between 2001 and 2003. It is the currently largest available fully text-to-tone aligned learner corpus of non-native English and non-native German with extensive phonetic annotations. Chapter 4 describes the theoretical background of the corpus creation, the corpus design in terms of type of recordings, number and characteristics of speakers, the metadata that was collected, the type of annotations carried out and the XML-based corpus format.

In chapter 5, the term fluency is introduced with the definitions used by language teachers, language testers, linguists and psycholinguists. The temporal measurements of fluency such as speech rate, pausing and disfluency markers that have been proposed so far are discussed. After an overview of previous empirical findings on non-native fluency, the purpose and method of the analysis of the LeaP corpus are presented, followed by the results and a discussion.

Chapter 6 is concerned with syllabification and coda consonant cluster reduction in non-native speech. It presents a description of the syllable structure, syllabification and the realization of coda consonant clusters in both English and German and discusses studies on syllabification and coda cluster reduction in non-native speech. Results of the LeaP corpus analysis for these features are presented and discussed.

In chapter 7, vowel reduction and speech rhythm are investigated. Various concepts and measurements of speech rhythm are presented and discussed. Cross-linguistic differences in speech rhythm and the properties of speech rhythm in English and German are described. This is followed by an overview of the findings on non-native speech rhythm and vowel reduction, including a number of studies on non-native varieties of English. The analysis of the LeaP corpus includes quantitative and qualitative analyses of vowel reduction and speech rhythm in non-native speech.

Chapter 8 presents current models of intonation and describes the tone inventory of English and German. It summarizes the function of intonation in these two languages in terms of marking of given and new information and using pitch range for the structuring of speech (paratone). The few available studies on non-native intonation, including intonation in L2 varieties of English, are reviewed and the purpose, method and results of the LeaP corpus analysis are described.

Chapter 9 discusses studies on non-linguistic factors influencing the foreign accent of non-native speakers. These factors include motivation, type of instruction, musical and acting ability, age of learning, length of residence and continued L1 use. The intercorrelation of these factors and their predictive value for the quality of the foreign accent of the speakers in the LeaP corpus is explored.

The aim of chapter 10 is to relate the findings on the phonological processes of syllabification and cluster reduction, on fluency, vowel reduction and speech rhythm and on intonation in non-native speech to each other and to explore their co-variation and interdependencies. In addition, it will be investigated whether the syntactic and morphological complexity and the lexical diversity of non-native speech co-vary with these phonological features. Another question is whether competence in second language phonology can be considered independently of competence in other structural domains such as morphosyntax and the lexicon.

In chapter 11 the results of this study are summarized and discussed. A theoretical model of non-native speech is proposed, which aims at explaining and predicting features of non-native speech. The contribution of the corpus-based findings to the further development of models of second language phonology acquisition and to the improvement of second language teaching and testing is evaluated and an outlook for further research is given.



## **2 Theories of L2 phonological acquisition**

The objective of research on non-native speech is to describe and explain the pronunciation patterns of second language learners. The common direction of all approaches from the first models developed in the 1950s to current theories has been to show that non-native speech and the acquisition of an L2 phonology are constrained by linguistic and other principles. Models and theories of second language phonology differ in their basic tenets concerning the linguistic and cognitive ability of humans and the relative importance they attribute to factors influencing the process of L2 phonological acquisition. This chapter presents the major theoretical models that have been proposed to explain and predict second language acquisition of phonology in the past 50 years. These include early models that explain properties of non-native speech on the basis of native language influence (section 2.1) and approaches that stress the role of universal processes in L2 phonological acquisition, such as markedness theory (section 2.2), the theory of Universal Grammar (section 2.3) and Natural Phonology (section 2.4). A model of L2 phonological acquisition within the framework of Optimality Theory is presented in section 2.5, before the scope, predictive value and explanatory power of all approaches are compared and discussed in section 2.6.

### **2.1 L1 as an explanation for the structure and acquisition of non-native speech**

The question of the influence of the L2 learner's L1 on both the course and result of second language acquisition has long been considered the most central issue in the study of second language acquisition and remains highly relevant today. Some of the earliest research on the role of the learner's L1 in accounting for pronunciation errors was carried out in the context of the Contrastive Analysis Hypothesis (CAH) (e.g. Lado 1957). It arose from the combination of behaviourist psychological theories and structural linguistics and assumed that language acquisition can be described as the formation of a set of habits. Further, it was claimed that habits formed in the native language are initially transferred to the L2. This was based on the observation that many features of the learner's behaviour in the L2 resembled those of his or her L1 (leading to a perceived 'foreign accent'). It was proposed that a comparison of the linguistic systems of the learner's L1 and L2 allows accurate predictions of L1 influence in L2 behaviour. Those habits taken from the L1 that happened to be appropriate in the L2 were called positive transfer. The transfer of inappropriate habits was

called negative transfer. Phonological analysis at that time mainly consisted of an account of the phonemes and allophones of the languages in question, and L2 pronunciation errors were explained in terms of a comparison of the phoneme inventories and their distribution within the language learner's L1 and L2. According to Lado (1957), maximum learning difficulty for a language learner lies in the assignment of sounds that constitute two allophones in the learner's L1 to two different phonemes in the L2.

Lado's (1957) claims cannot be considered a model of L2 phonological acquisition since no predictions are made concerning the developmental process or expected end state of acquisition. Reflecting the limitations of phonological and phonetic knowledge at that time, the CAH' scope is restricted to the segmental features of non-native speech and describes this in terms of phonemes and allophones. Furthermore, Lado's claims were based mainly on anecdotal evidence and no systematic studies were carried out personally by him. Later empirical research within the CAH paradigm has shown that the influence of the L1 phonology can only explain a portion of the learner's phonological errors. Not all errors are predictable by a comparison of the L1 and L2 phoneme inventories and many difficulties do not arise from L1-L2 differences.

A number of current models of L2 phonological acquisition have been proposed which focus on the constraints that L1 structures place on L2 phonology (Best 1995, Brown 1998, 2000, Flege 1995). In these models, L1 influence is predominantly seen in connection with the language learner's perceptual abilities, which are considered to restrict his or her production abilities. Best (1995) and Brown (1998, 2000), for example, proposed that second language learners perceive the L2 sounds through categories of the phonological structure of their L1. These categories constrain which non-native sounds can be perceived correctly and, in turn, learned to be produced correctly. Flege's (1995) Speech Learning Model (SLM) is currently one of the most influential models of L2 pronunciation. Its aim is "to account for age-related limits on the ability to produce L2 vowels and consonants in a native-like fashion" (p. 237), and it consists of a collection of four postulates (P1 to P4) and seven hypotheses:

- P1 The mechanisms and processes used in learning the L1 sound system, including category formation, remain intact over the life span and can be applied to L2 learning.
- P2 Language-specific aspects of speech sounds are specified in long-term memory representations called "phonetic categories".
- P3 Phonetic categories established in childhood for L1 sounds evolve over the life span to reflect the properties of all L1 and L2 phones identified as a realization of each category.



- P4 Bilinguals strive to maintain contrast between L1 and L2 phonetic categories, which exist in a common phonological space.

P1 specifies that a second language learner does not make use of fundamentally different cognitive resources than a first language learner. P2 postulates that speakers have mental representations of the contrastive sounds of their native language/s. These categories can be modified in the case of the acquisition of further languages (P3) or new categories can be created (P1), although speakers are assumed to actively strive not to mix L1 and L2 categories (P4). These categories are proposed to act as filters in the perception of L2 speech sounds. The acquisition of L2 sounds that do not exist in the speaker's L1 is described as the establishment of new categories. In the seven Hypotheses, the SLM predicts the preconditions and stages of phoneme acquisition. The L2 learner is thought to compare the sounds of the L2 to sounds of the L1 on a "position-sensitive allophonic level" rather than an abstract phonemic level. A precondition for the establishment of a new phonetic category is the language learner's ability to perceive at least some of the phonetic differences between two L1 and the L2 sounds. The greater the perceived phonetic dissimilarity between an L2 sound and L1 categories, the greater is the chance that a new category will be established. This new category for an L2 sound may nevertheless be different from the category of a native speaker by, for example, being based on different feature weights. It is further predicted that when no phonetic differences between two sounds are perceived by the learner – a process that is labelled "equivalence classification" – category formation for an L2 sound will be blocked and the learner will end up with the representation of a single phonetic category for both sounds.

Predictions for the production of speech sounds are vague: Flege (1995) claims that the production of a sound for which a new phonetic category was established will eventually correspond to the properties represented in this category. When no new category was established but two sounds in the L1 and L2 were linked by equivalence classification, the production of these sounds will resemble each other. The SLM differentiates between 'new', 'similar' and 'same' sounds. Sounds perceived as the same in both languages do not necessitate any learning. The phonetic category established for the L1 'evolves' to incorporate this sound as a realization of the category. New sounds are perceived as not belonging to the L1 sound inventory. For these, new categories will have to be established. Similar sounds have certain phonetic characteristics of L1 sounds and might therefore not be perceived as different enough to warrant the creation of a new category by the second language learner. One non-linguistic factor, which is claimed to constrain L2 phonological acquisition, is incorporated into the model: the age of first contact with the second language. Flege (1995) proposes that the likelihood that a language learner will be able to perceive

phonetic differences between L1 and L2 sounds decreases with increasing age of first contact with the L2.

The SLM is based on extensive research carried out by Flege and his colleagues (e.g. Flege 1987a, b, Flege and Eefting 1987, Flege, Yeni-Komshian and Liu 1999), which led to the reformulation of some of its hypotheses. Compared to the CAH, it predicts learners' difficulties with L1-L2 differences more precisely by differentiating between same, new and similar sounds in the two languages. Criticism of the model can be made concerning its limited scope. Only the level of phonemes and allophones is considered, but recent advances in phonological theory such as underspecification theory and Feature Geometry are not incorporated. In the former, it is claimed that speech sounds are represented by the learner only to the extent necessary to contrast them to all other speech sounds of the language. The latter constitutes a system of the representation of speech sounds as hierarchically structured features, partly dependent on each other. In both models, phonological acquisition would be predicted as a process in which individual phonetic features – instead of phonemes – and their representation constrain a non-native speaker's perception and production. Neither does the SLM make any predictions about the acquisition of prosodic categories (e.g. tones or stress) or the acquisition of phonological processes (e.g. final plosive devoicing or flapping). Furthermore, the model does not describe by which process a new phonetic category will be established; neither does it state whether and how this process can be improved or disrupted. Linguistic or non-linguistic factors other than age that might influence acquisition are not mentioned. Similarly, no clear description is given of the consequences that the establishment of a new phonetic category has for L2 phonological production.

## **2.2 Universal principles and non-native speech: typological markedness**

The second type of model of L2 phonological acquisition focuses on the role that language universals play in the phonological structure of L2 speech and its acquisition. Universals are linguistic generalisations that have been postulated on the basis of primary languages (L1s). One approach to studying language universals is to examine a representatively large sample of genetically unrelated and geographically non-adjacent languages to determine their shared properties. Universals are generalizations about the occurrence, absence or co-occurrence of linguistic structures in any given language and can be divided into absolute and implicational universals. Absolute universals are inherent in all languages of the world, whereas implicational universals involve two language properties in a conditional relationship "if X then Y". In implicational universals, the presence of one structure implies the presence of another structure but not vice versa. In such cases, the implicated structure is regarded as less marked. Typological

markedness is thus an asymmetric relation that is inferred to hold between language structures. This inference is based on the distribution of these structures in the languages of the world.

Typological markedness has been invoked to explain and predict a number of aspects of phonological acquisition in an L2, including order of acquisition, learning difficulty and transferability. Two hypotheses have been based on the construct of typological markedness: the Markedness Differential Hypothesis (MDH; Eckman 1977) and the Structural Conformity Hypothesis (SCH; Eckman 1984, 1991) (see Eckman 1996 for a comparison). The MDH bases predictions about a language learner's difficulties on a combination of L1-L2 differences and markedness relations between linguistic structures. The specific claims are that

- those areas of the L2 that differ from the L1 and are more marked than the L1 will be difficult;
- the relative degree of difficulty of those areas of difference of the L2 that are more marked than the L1 will correspond to the relative degree of markedness;
- those areas of the L2 that are different from the L1 but are not more marked than the L1 will not be difficult.

The MDH thus predicts that not all areas of L1 and L2 difference will cause the same amount of difficulty. For example, a learner of English – which is a language that allows both marked stop+stop and unmarked fricative+stop consonant clusters in the coda position – whose L1 does not allow any consonant clusters is predicted to experience a) difficulties with the consonant clusters and b) more difficulties with stop+stop clusters than with fricative+stop clusters. Since the MDH fails to make predictions about learner difficulties in areas where L1 and L2 structures do not differ, it was developed further into the Structural Conformity Hypothesis (Eckman 1984, 1991), which postulates that all universals that are true for primary languages are also true for interlanguages. This, in effect, states that no phonological structures or processes will be found in non-native speech that have not been attested in native speech. Both MDH and SCH claim that the acquisition of unmarked structures will pose fewer difficulties for language learners and will proceed faster than the acquisition of marked structures.

Both the MDH and SCH were tested empirically in the areas of morphosyntax and phonology alike, in the latter predominantly with a focus on syllable structure (e.g. Eckman 1991, Carlisle 1997, 1999). Although these hypotheses constitute an improvement of the CAH by incorporating the factor markedness, which allows more precise predictions about the learner difficulties associated with L1-L2 differences, the two hypotheses can be criticised in terms

of both their scope and explanatory power. Both MDH and SCH aim exclusively at predicting the type and degree of learner difficulties with certain linguistic structures. In contrast, predictions of the acquisition process, its initial state or end state are not made. By relying entirely on the concept of linguistic universals, the hypotheses restrict their scope to those linguistic areas for which linguistic universals have been proposed, as for example syllable structure or the frequency of individual speech sounds. The acquisition of prosodic phenomena or phonological processes or any other phonological feature that has not yet been classified in terms of typological markedness cannot so far be predicted with the hypotheses. Furthermore, the claim that non-native speech does not contain phonological structures that do not occur in native speech is too broad to predict and explain the many areas in which non-native speech does differ from native speech. Finally, the two hypotheses on the relationship between language universals and second language acquisition are restricted to linguistic constraints of L2 phonological acquisition and do not incorporate possible other (non-linguistic) factors influencing the acquisition process. Nor is the role of perception in L2 phonological acquisition incorporated into the hypotheses.

A model incorporating the notion of markedness that predicts longitudinal aspects of phonological acquisition of an L2 is Major's (2001) Ontogeny Phylogeny Model (OPM). He claims that it can be applied to both second language acquisition by individuals and groups of speakers over generations in situations of languages or dialects in contact. The model views the structural aspects of non-native speech as a composite system consisting of three parts: L1 structures, L2 structures and universals (U). These universals are claimed to include "several properties of the human language capacity and the resulting universal characteristics of languages. In addition to abstract linguistic constraints, U includes anatomical, functional and processing properties of the human mind" (Major 2001: 83). In the OPM, Major (2001) describes the interrelation and relative influence of L1 structures, L2 structures and universal language constraints over the course of phonological acquisition. While in initial stages L1 transfer is greatest and decreases gradually, L2 structures are initially non-existent and increase in later stages. The influence of universals is claimed to increase in early stages of phonological acquisition and to decrease afterwards. This is reflected in the appearance and then disappearance of overgeneralizations and hypercorrection.

Major (2001) also proposes that the relative influence of these factors on the interlanguage is further determined by similarity and markedness. The acquisition of language structures that are similar in both the language learner's L1 and L2 show an initially small influence of both L2 and U, but a more persistent influence of L1 transfer. The acquisition of marked structures is conceptualised as follows: L2 increases slowly, L1 transfer decreases slowly, and the influence of universals is most prominent by increasing rapidly and then

decreasing slowly. The OPM further includes explanations of variation in L2 phonology. Major (2001) lists various individual, social and demographic factors that affect L2 phonology, one of which is style. It is predicted that with increasing formality L2 increases, L1 decreases and U first increases and then decreases.

The Ontogeny Phylogeny Model is based on a variety of studies by Major and collaborators (e.g. Major 1994, 1996, Major and Faudree 1996), which gathered supporting evidence in the areas of phoneme and syllable structure acquisition. The claim that L1 transfer decreases with increasing degree of formality of the speaking situation, however, has not been proven yet. The model's scope is very wide: Major proposes that it is transferable to other phonological structures and even to non-phonological phenomena. One of the model's drawbacks lies in the absence of clear definitions of the term 'universals' and the interrelation of the three proposed components of interlanguage grammar, which remains mainly open to speculation. Additional factors, both linguistic and non-linguistic, which constrain the language acquisition process and might contribute to variation, are mentioned as important but are not included in the OPM in any specific way.

### **2.3 Universal principles and non-native speech: Universal Grammar**

A different approach to language universals is the theory of Universal Grammar (UG). It postulates that all humans are innately endowed with a language faculty or module that contains both invariant language universal principles shared by all languages of the world and parameters that can be set according to language-specific requirements. Both universal principles and parameters place limitations on grammars, constraining their form and their operating mechanism. It is argued that only inborn knowledge in the form of language-universal principles and parameters can account for the relative uniformity and speed of first language acquisition, which proceeds even with little positive evidence of some language structures in the ambient language ('poverty of the stimulus'). The theory of UG has been employed to predict and explain second language acquisition in general, while the investigation of principles and parameters in the area of phonology has been fairly neglected in research within this framework (see White 1996: 114). The theory of UG in general is primarily a theory of the representation of subconscious language knowledge and does not make any clear predictions about the development of phonological phenomena during language acquisition. Nevertheless, various scenarios have been proposed for second language acquisition and the principles and parameters of UG. In the 'no access hypothesis', it is claimed that none of the innate principles and parameters of UG are accessible to the second language learner so that L2 acquisition has to

proceed using other cognitive mechanisms outside the hypothesised language module. There are two approaches that assume that the parameters set in L1 acquisition play a special role in L2 acquisition. Some proponents of this 'partial access hypothesis' claim that language learners can use only those parameter settings not touched upon in L1 acquisition, which can then still be set for the L2. The other side propose that it is precisely only those parameters that have been set during L1 acquisition which can be reset during L2 acquisition, and that those parameters which were not set in the L1 acquisition process are unavailable for the L2 learner. In this scenario and the scenario of no access to UG at all, learners will have to revert to L1 structures and 'transfer' them into their L2. Proponents of the 'full access theory', conversely, assume that a fully functional UG is available to L2 learners (e.g. Schwartz and Sprouse 1996). Both the partial access and full access hypothesis imply that interlanguages are governed by UG, whereas the no access model claims that non-native language is not constrained by the universal principles and parameters of UG.

In the area of phonology, a number of studies have utilized parameter settings in UG as an explanation of properties of non-native speech. This includes the production of onset clusters (Broselow and Finer 1991) and word stress patterns (Archibald 1993, 1997b). Archibald (1994) developed a model of L2 stress learning based on the theory of UG. He envisages the language learning process as an interaction between UG and the input of the linguistic environment with the goal of establishing a language-specific grammar. Learning is conceptualised as the (re-)setting of language parameters. This is influenced by three phenomena: indirect negative evidence in the ambient language, ability to choose appropriate cues and lexical dependency. Archibald (1994: 224) argues that second language learners have access to negative evidence in the input and that the non-occurrence of a certain linguistic structure is interpreted as positive evidence of ungrammaticality when a certain time threshold is crossed. Thus in an initial state, learner speech will be highly variable or show a preference for the L1 parameter setting, since the parameter for the L2 has not yet been set. After the threshold has been crossed, however, the parameter is set in the L2 and variation should stop. In order to be able to reset parameters the learner is presumed to possess the ability to choose appropriate cues from the input language. The claim of lexical dependency finally frees the language learner from setting the parameter for every lexical item. Once certain entries have been set, this information is transferred to other lexical items via feature-copying mechanisms. Acquisition is thus pictured as a development from initially highly variable productions with clear L1 properties to an invariant and complete attainment of L2 features.

Empirical support for the model comes from various studies carried out by Archibald (e.g. 1993, 1994) on the parameter resetting of word stress. A critical assessment of Archibald's model of stress acquisition gives rise to the following

points: It is the first attempt to combine the theory of UG as a theory of language representation with a learning mechanism that predicts the development of phonology during L2 acquisition. However, despite proposing factors that enhance the learning process, the model fails to give a detailed description of developmental stages or a presumed end state. Neither can it account for learner differences and variability. Equally, no factors that influence the acquisition process other than sufficient exposure to the L2 are incorporated into the model. No account is given in which way UG may constrain the perception of phonological categories in the L2. Furthermore, the model's scope is restricted to word stress, and no indication is given whether it can be employed to describe and predict acquisition in other phonological areas.

## **2.4 Universal principles and non-native speech: Natural Phonology**

The theory of Natural Phonology, founded by Stampe (1979), is concerned with the explanation of phonological changes. It postulates universal natural phonological process types or preferences that are inborn and form part of human cognition. These include processes that improve the articulation or perception of language and are conceptualized to have a phonetic basis. The process of first language acquisition is understood as a selection of those processes that conform to the language-specific requirements. This is achieved by suppression, limitation and ordering of the natural processes or preferences, which eventually allow the correct production and perception of the target language's phonological categories. Natural Phonology includes a number of context-sensitive processes: pragmatic and phonostylistic processes. The former can be divided into hearer-oriented 'foregrounding' and speaker-oriented 'backgrounding' processes, which lead to optimal perception and achieving less articulatory effort, respectively. The latter refer to phonological processes that are style-dependent.

A Natural Model of acquisition of second language phonology was proposed by Dziubalska-Kołaczyk (1990a, 1990b). In contrast to first language acquisition, which is considered to proceed largely subconsciously, second language acquisition of phonology is assumed to be based on learning in a controlled and conscious manner. In the course of SLA, access to universal processes is considered to be more difficult than during first language acquisition as the phonological system of L1 is already established and thus limited to selected processes, underlying representations as well as rules. The essential prerequisite for the L2 learning process is that the language learner can access the universal processes. This allows the learner to modify the suppression, limiting and ordering of the universal process types of the L1 (see Figure 2.1). Acquiring the L2 phonology may involve the unsuppression of

processes that were suppressed in L1 acquisition and the reordering of process types that were ordered differently in L1 phonology. It is assumed that access is facilitated by favourable psycholinguistic conditions such as the amount of formal language instruction, the learner's attitude towards the L2 and his or her general linguistic aptitude.

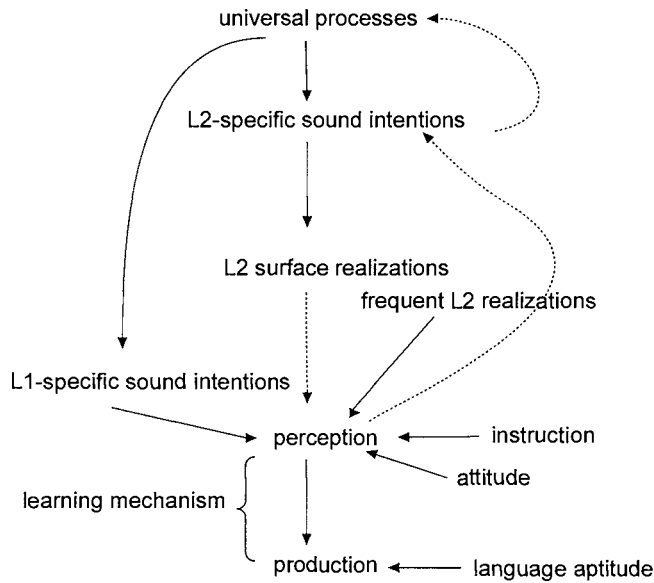


Figure 2.1: *The Natural Model of Phonology Acquisition (modified with permission from Dziubalska-Kotaczyk 1990b)*

The Natural Model of Phonology Acquisition distinguishes between phonemes and surface phonetic segments. It postulates that a speaker perceives the sound intention (phoneme) rather than the actual surface realization. A language learner's task is therefore to acquire L2 sound intentions by perceiving L2 surface realizations. Figure 2.1 shows that in an initial state, a language learner relates L2 surface realizations to L1 phonemes. As a first step, L2 surface realizations need to be perceived without reference to L1 categories, which is supported by a high frequency of L2 realizations, formal language instruction and a favourable attitude towards the L2 and the language learning process by the language learner. In a second step, this perception leads to a representation of L2-specific phonemes (sound intentions), which then triggers the reordering



and un-/suppression of natural processes. The task of a Polish speaker acquiring aspiration of voiceless plosives in English, for example, can be described as the 'unsuppression' of a natural process. For the L1 acquisition of Polish, where aspiration appears only optionally in emphatic styles, it is hypothesised that the natural process of aspiration was suppressed. This suppression now needs to be reversed in order to allow for the syllable-initial aspiration of voiceless plosives in English.

Dziubalska-Kořaczyk's model (1990a, 1990b) furthermore employs the concept of markedness. A language is least marked with reference to a particular natural process that is fully applied in that language. A language structure is relatively marked, conversely, if it is eliminated by a universal process, which thus has to be suppressed in order for the structure to appear in the language. For the acquisition of an L2 phonology this means that relatively unmarked structures in the L2 as compared to the speaker's L1 are more easily acquired than relatively marked structures. Structures that are less marked in the L1 than in the L2 are predicted to be more difficult to acquire.

The Natural Model of the acquisition of phonology is the first model discussed here that incorporates both linguistic and non-linguistic factors influencing and constraining L2 phonological acquisition. Being based on an encompassing theory of phonology, its scope is wider than those of other models – in principle, the acquisition of all phonological processes underlying phoneme realization, prosodic phenomena and phonological processes can be predicted and explained. The model furthermore includes both perception and production and draws attention to phonetic and phonological categories in non-native speech. Moreover, it accounts for the acquisition of stylistic phonological processes by second language learners. Yet, like the SLM, it is not made clear how the step between correct perception and representation of L2 structures and the production of these by the language learner should be conceived of. The major drawback of the model, however, is the lack of systematic empirical testing that has been exposed to so far.

## **2.5 L2 phonological acquisition in Optimality Theory**

Optimality Theory (OT) shares many basic conceptions with Natural Phonology. OT grammars are conceptualised to consist of a universal set of innate constraints, some of which are violable. The universal constraints are divided into two categories: faithfulness constraints, which require identity between the input and the output, and markedness constraints, which impose well-formedness conditions. In speech production, speakers act according to their knowledge of the relative importance of these constraints to achieve an optimal output. The grammaticality of an utterance is therefore assumed to be

determined by an optimisation process: well-formed utterances are those that conform to the highest ranked constraints in the grammar. An illustration of a constraint-ranking grammar is the English word "input", which has a perceptual specification of /input/, but will often be produced as [ɪmpʊt] with an assimilation of /n/ to [m], which saves the speaker one tongue tip gesture. In OT, production processes are represented in a tableau:

Table 2.1: *Tableau for nasal assimilation in English*

	[ɪnpʊt]	*GESTURE(tip)	*REPLACE(cor onal)
	[ɪnpʊt] /input/	*!	
	[ɪmpʊt] /ɪmpʊt/		*

Table 2.1 contains, in the left-hand top cell, the perceptual specification of [ɪnpʊt]. Beneath are two articulatory outputs, namely [ɪnpʊt] and [ɪmpʊt] and their corresponding perceptual outputs /input/ and /ɪmpʊt/. Two constraints are assumed: the articulatory constraint \*GESTURE(tip), which reads as "do not make a tongue tip opening and closing gesture", and the faithfulness constraint \*REPLACE(place:coronal, labial / nasal / \_C), which reads as "do not implement a perceptual coronal place specification as something that will be heard as labial place, for a nasal, before a consonant" (abbreviated to \*REPLACE(coronal) in Table 2.1). Both constraints protest against one of the articulatory output candidates (illustrated by the \*), but since the constraint \*REPLACE(coronal) is ranked higher than the constraint \*GESTURE(tip), the violation of the constraint \*GESTURE(tip) is crucial (marked by the ! in Table 2.1) and the second candidate is the winner (shown by the pointing hand). Ranking the relative importance of the constraints is assumed to be acquired in L1 acquisition and needs to be reordered for the L2. In the OT framework, thus, phonological acquisition is pictured as the reranking of universal constraints (see Hancin-Bhatt 2008 for an overview of OT in second language phonological acquisition).

A model of L2 phonological acquisition in the general framework of OT was proposed by Boersma (1998). In contrast to OT, in his model of Functional Phonology no innate constraints are assumed. Instead, Boersma (1998) posits that all aspects of speech production and speech perception must be learned and are eventually learned. Functional Phonology distinguishes between articulatory and perceptual representations and features, as illustrated in Figure 2.2. In speech perception, a hearer is confronted with the acoustic input of speech. This acoustic input consists of physical properties such as frequency, loudness and noise and is put into square brackets in Figure 2.2 because it is language-

independent. The hearer's perception grammar, which consists of a perceptual categorization system, converts the raw acoustic input into a more perceptual, language-specific representation. This perceptual input is put between slashes in Figure 2.2. It is interpreted by the recognition system, which converts it into an underlying form (written between pipes). A speaker takes the perceptual specification of a word or syllable as it is stored in his or her lexicon and uses it as the input to the production grammar, which determines the surface form of the word or utterance. This results in an articulatory output in terms of articulatory gestures, which in turn constitutes an automatic result of the acoustic output. The speaker's perceptual output is his or her acoustic output as perceived by himself or herself. This can be compared to the perceptual input of an acoustic input by another speaker and thus forms the essential part of the learning system.

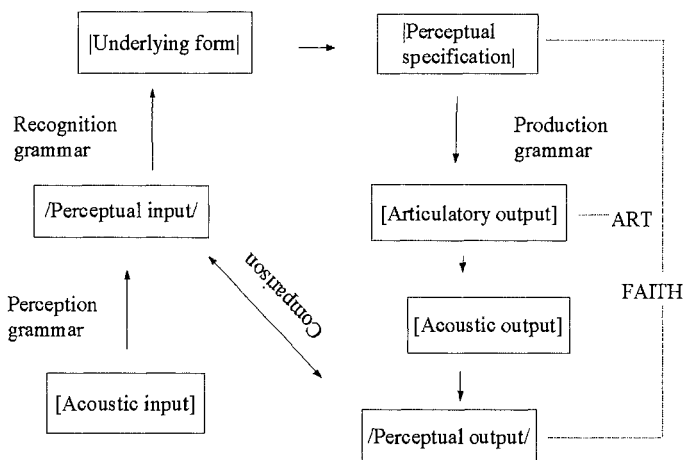


Figure 2.2: *Articulatory and perceptual representations in Functional Phonology (adapted from Boersma 1998)*

The grammars are pictured, like in Optimality Theory, to consist of ranked constraints, either articulatory or perceptual in nature. The articulatory constraints (ART in Figure 2.2) apply at the level of the acoustic output. Since constraints are assumed to be violable and can dominate each other, the articulatory output depends on the ranking of a set of competing constraints. Another type of constraint are faithfulness constraints (FAITH in Figure 2.2),

which evaluate the similarity between the perceptual specification and the perceptual output.

Functional Phonology describes language acquisition in terms of learning how to rank constraints. For this, a Graduate Learning Algorithm (GLA) is proposed. In its minimal form, the GLA will "if a learner's current grammar computes a 'winner' that is different from the correct [...] output form (as perceived by the learner), look for the offending crucial mark that the current hypothesis incurs on the correct output form, and move the responsible constraint down by a small step along the continuous ranking scale" (Boersma 1998: 273). In its maximal form, the GLA will not only move down the constraints violated in the correct output form, but also move up the constraints violated in the incorrect learner's output form by a small step along the continuous ranking scale. How much a constraint is moved up or down is assumed to depend on the plasticity of the brain, which in turn is assumed to vary with age. It is claimed that with increasing years, plasticity decreases and the reranking steps get smaller.

No difference between first and second language acquisition is proposed in Functional Phonology. In contrast to OT, Boersma does not assume a finite set of innate constraints, but claims that language learners construct a perception and a production grammar from scratch. The number of learnable constraints is infinite. The initial state of a first language learner is a true *tabula rasa*, an empty grammar. No articulatory gestures have been learned so that all articulatory constraints are undominated. No perceptual categories have been learned either, so that all faithfulness constraints are ranked at the bottom of the hierarchy. The language learner possesses a reservoir of latent articulatory gestures and latent faithfulness constraints. Boersma (1998) proposes that a language learner can be in this initial stage for some phonological features while being in further advanced stages for other features. For example, a second language learner might have a fully specified perception and production grammar and fully specified underlying forms and perceptual specifications for all phonological features of his or her native language/s, but he or she can still be in stage 1 with respect to the acquisition of ejectives, if his or her native language does not have them as phonemes.

In this initial stage, the language learner will hear the syllable [k'a] containing the ejective / k'/ as the acoustic input, but will perceive it as /ka/. The resulting underlying form will also be [ka], and the speaker will generate the articulatory candidate [ka] and perceives this as /ka/, which is faithful to the underlying form. The first learning step consists of the acquisition of perceptual categorization. In general, the language learner listens to the language input and notices that speakers tend to centre the perceptual feature values of their productions along continuous perceptual dimensions, which, together with the