On the Poverty of the Stimulus in Phonology

B. Elan Dresher
University of Toronto
elan.dresher@utoronto.ca

June 7, 2024

Abstract

Archibald's excellent keynote article argues for the importance of mental representations in modelling the acquisition of a second and third language. In this commentary, I elaborate on his observations concerning the 'poverty of the stimulus'. I argue that there is a fundamental incommensurability between the input data and the acquired mental representations. Through the lens of the projection problem I show why a rich theory of Universal Grammar (UG) is required to support the acquisition of segmental representations. I then consider the same problem with respect to metrical representations, extending Archibald's discussion to the Russian lexical accent system. I conclude that Archibald's program has done much to explore the projection problem in the domain of second and third language acquisition.

Keywords

poverty of the stimulus, projection problem, segmental representations, Contrastive Hierarchy Theory, Simplified Bracketed Grid, lexical accent, Russian

> [I]f you want to know what response a given stimulus is going to elicit, you must find out what internal representation the organism assigns to the stimulus.
>
> (Fodor 1975: 163)

1 Introduction

In his excellent keynote article, Archibald (2024) asks, "What role does the mental representation of sound play in the generation of second language (L2) linguistic strings?". In putting the focus on mental representations, Archibald's question brings to mind Jerry Fodor's dictum, cited at the top of this commentary. Archibald also alludes to the 'poverty of the stimulus' as being a problem that arises in phonology as well as in syntax. I believe that this is an important and correct observation, and in this commentary, I would like to elaborate on it.

Readers familiar with discussions of the poverty of the stimulus in linguistics might associate it specifically with syntax, in particular, with the phenomenon of learners acquiring certain patterns for which they did not have sufficient evidence in their linguistic input. I briefly review this type of case in section 2. Section 3 illustrates what has been called the 'projection problem', and in section 4 I show how it relates to a fundamental type of poverty of the stimulus that arises in phonology with respect to segmental representations. Section 5 considers the same problem with respect to metrical representations, extending Archibald's discussion to lexical accent systems, such as Russian. Section 6 is a brief conclusion suggesting how the projection problem as pictured in Section 3 can be extended to second language acquisition. Looking at phonological acquisition in these terms supports Archibald's emphasis on the importance of mental representations.

2 The 'parade case' of the poverty of the stimulus

In her introduction to a special issue of the *The Linguistic Review* on the poverty of the stimulus, Ritter (2002) characterizes it as the 'gap' between a child's exposure to language and the child's acquired knowledge of grammar. She frames the issue with respect to syntax, reflecting the historical emphasis of the discussion in the literature:

> the input that children are exposed to is poor (or inadequate) with respect to certain syntactic constructions found in the adult language; however, children are nonetheless capable of producing such syntactic constructions. This 'gap' between what constitutes diminished exposure to the child and the child's knowledge about the language being acquired is what has led many linguists to posit that another factor is responsible for the child's linguistic abilities, namely an innate disposition for language that is able to guide the child along the acquisition path despite the child's inadequate environmental encounter with language.

Framed in these terms, the argument has tended to focus on patterns—mostly drawn from syntax—that occur rarely or never in the data that learners are exposed to, but which they can be shown to have acquired. A famous example was proposed by Chomsky (1975: 30–35). Many simple English sentences show that one forms a *yes-no* question from a declarative with an auxiliary verb by moving the auxiliary verb to the front, as in (1).

(1) English *yes-no* question with one auxiliary verb: move the auxiliary verb to the front
   a. The man is tall.
   b. Is the man ___ tall?

When a sentence has more than one auxiliary verb, as in (2), it is the first one that is moved to the front. Chomsky argued that, based on the available input, learners of English might conclude that when forming a *yes-no* question from the declarative in (3a) one should move the first auxiliary verb to the front of the sentence, as in (3b). But this is clearly ungrammatical.

(2) English *yes-no* questions: move the first auxiliary verb to the front
   a. The man has been swimming.
   b. Has the man ___ been swimming?
   c. *Been the man has ___ swimming?

(3) English yes-no question with a subordinate clause
   a. The man who is tall is in the room.
   b. *Is the man who ___ tall is in the room?
   c. Is the man who is tall ___ in the room
   d. The man [who is tall] is in the room.

The problem with (3b) is that the first auxiliary verb is in a subordinate clause; to form a proper question (3c), one must move the auxiliary verb that is in the main clause, whether or not it is the first one in the sentence. In other words, the correct movement rule is *structure dependent*, whereas the incorrect rule in (3b) ignores structure and looks only at linear order. Chomsky (1975) proposed that children do not make mistakes like (3b) because child learners are inherently predisposed to consider only grammars with structure-dependent rules.

This example became the 'parade case' of poverty of the stimulus, according to Crain (1991: 602); see Thomas (2002) for discussion. Those who have been critical of this argument have countered that the gap between what learners are exposed to and what they acquire has been greatly exaggerated or is non-existent. In this case, Sampson (1989) and Pullum & Scholz (2002) argue that child learners are exposed to many sentences that could provide evidence for (3c). That is, there is no gap between the input data and the acquired grammar, hence no need to assume an innate predisposition to posit structure-dependent rules.[1]

When the issue of the poverty of the stimulus is debated in these terms, it is understandable that phonology has not been prominent in these discussions. Compared to syntax, phonology appears to offer fewer examples of gaps between input and grammar. Therefore, one might suppose that if it is controversial that the poverty of the stimulus exists in syntax, then *a fortiori* it is not an issue for phonology.[2] As I will show, however, the poverty of the stimulus can be thought of in much more basic terms.

[1]Pullum & Scholz (2002) caution that they do not intend their article to be read as a defense of the claim that "purely empiricist language learning, via domain-unspecialized algorithms for knowledge acquisition, can suffice for learning natural languages, given children's experience". They are merely arguing that certain types of arguments for nativism have not been shown to be correct.

[2]Just to be clear, I do not actually believe this to be the case. As Archibald shows, phonology, too, is structure dependent and offers many instances of productive patterns that require speakers to go beyond the precise combinations that they may have been exposed to.

3 The projection problem in phonology

In generative grammar, an essential aspect of language acquisition has been schematically depicted as in (4):

(4) The projection problem

Data of L The Learner Grammar of L

The diagram illustrates a learner born into a community that speaks a language, L, who is exposed to a sampling of data, D_L, from L, and somehow acquires a grammar of L, G_L. How a learner does this is known as the 'projection problem' (Peters 1972; Baker 1979), because the learner is required to *project* a grammar G_L from D_L. This projection is made possible by the learner's innate cognitive endowment. In generative grammar the innate endowment has been referred to as UG, for Universal Grammar. UG suggests an innate cognitive endowment that is specific to language, although it has sometimes been used to refer to the collection of cognitive principles that allow learners to acquire a language, whether these are specific to language or not. It is the latter sense I intend here; thus, UG refers to the innate endowment that makes language learning possible, leaving open how much of it is unique to language. What is important is that, by definition, UG itself is not learned, but is rather what the learner brings to the task of acquiring a grammar. In Bayesian terms, UG is the hypothesis space and the set of priors in the learning scenario.

The diagram in (4) obviously abstracts away from many issues surrounding the acquisition and use of language, and is particularly unsuited as a model of second or third language acquisition. However, it does not aim to be a realistic model of the stages of language acquisition; rather, it is a representation of what Hornstein & Lightfoot (1981) have called 'the logical problem of language acquisition'. As such, it is useful in focusing our attention on two central questions, shown in (5):

(5) Goals of generative grammar
   a. *Descriptive adequacy*: What is the nature of G_L, the grammar of L?
   b. *Explanatory adequacy*: What is the nature of UG, which enables a learner to project G_L from D_L?

The most basic goal of generative phonology (5a) is to correctly characterize G_L, the grammar acquired by learners of L, for any given language L. If we can do that, then we have attained a theory that is *descriptively adequate*, according to the levels of adequacy introduced by Chomsky (1965). A more ambitious goal (5b) is to correctly characterize UG. It is UG that accounts for how a learner is able to project a grammar from data. A theory that has a correct model of UG is said to have achieved *explanatory adequacy*.[3]

In abstracting away from the entire developmental sequence of language acquisition, the model in (4) incorporates what has been called 'the idealization of instantaneous acquisition' (Chomsky

[3] In the 21st century, a third question has been asked (Chomsky 2004): Why does UG have the properties that it has? Answering this question requires us to go *beyond explanatory adequacy* to look at biological and evolutionary factors that could have shaped the language faculty. I will not be concerned with this goal here.

1975: Chap. 3; Chomsky & Halle 1968: Chap. 8) According to this idealization, the learner acquires the final adult grammar in one leap, *as if* instantaneously, without any intermediate grammars along the way. Note that this is an idealization, not a hypothesis! Idealizations are measured in terms of how useful they are in the analysis of certain problems; for my purposes here, the idealization in (4) will suffice. See Dresher (1999) for further discussion of this idealization and how it might be modified to take into account the effects of the developmental stages of language acquisition, and see Section 6 for how the diagram in (4) can be augmented to include second language acquisition.

4 UG and segmental representations

What are phonological grammars, the G_Ls in (4), like? Consider, to begin, representations of the segmental aspects of phonology. Some representational issues that have been debated by phonologists are listed in (6).

(6) Questions about the representation of phonemes
   a. Are phonemes (or segments) represented as indivisible atoms, or do they consist of smaller units?
   b. If the latter (according to the overwhelming majority of phonologists), do the phonological 'primes' consist of binary or multi-valued features, or unary elements, or particles, or gestures?
   c. If they consist of features, do grammars draw on a set of universal fully-specified features or on language-particular contrastive features?
   d. Are words or phonemes represented by unique representations or by exemplar clouds?
   e. How much phonetic detail is included in lexical representations?

Similar questions have been debated concerning phonological computations; a few basic ones are listed in (7).

(7) Questions about phonological computations
   a. Do phonological grammars consist of context-sensitive rewrite rules, or constraints, or both?
   b. Are the rules and/or constraints ordered, or do they apply in parallel?
   c. Does the grammar have levels, and if so, how are they defined?

These are all questions that *phonologists* argue about; but presumably these are not issues for *learners*. As Archibald writes, "children do not have to test hypotheses wondering if the environmental input to which they are being exposed has features or vowels or consonants, or syllables, or feet". We assume that the basic form of each G_L is determined by UG. But there is a 'gap' between the signal D_L and the grammar G_L that learners acquire: simply attending to the input does not instruct learners how to represent that input in their internal grammars, no matter how much data they are presented with. I maintain that this type of gap is a fundamental form of poverty of stimulus. This type of poverty of stimulus does not depend on showing that learners have acquired patterns or generalizations for which they did not have sufficient input; rather, we are dealing with

a basic *incommensurability* between an acoustic signal and whatever representation learners assign it.

It is UG that has to bridge the gap between input and grammar. And however desirable it may be for the innate cognitive principles to be as general as possible and applicable across cognitive domains, it would appear that some of them have to be fairly specific to language, or even to phonology. Consider, for example, the argument by Archangeli & Pulleyblank (2015) that infants do *not* learn grammar "due to an innate capability specific for language, the Universal Grammar hypothesis". They propose instead that language learners make use of basic cognitive principles not special to language, what they call the Emergent Grammar hypothesis. The basic principles of Emergent Grammar are listed in (8):

(8) Principles of Emergent Grammar (Archangeli & Pulleyblank 2015)
   a. Ability to create categories
   b. Ability to attend to frequency
   c. Ability to generalize and create a symbolic system

That's it! Recall that these principles have to determine what grammars are like; in phonology, they have to guide the learner in resolving questions such as those in (6) and (7). But the principles in (8) are consistent with any conceivable grammar; therefore, they cannot guide the learner to any particular G_L, whatever it is. Whatever the exact nature of the phonological grammar, solving the poverty of the stimulus requires a more contentful theory of the innate endowment. In addition to the principles in (8), we would need at least principles such as those in (9). The principles in (9) may not all be correct; but if they are not, they need to be replaced by other principles that have the same degree of specificity.

(9) Some basic UG principles for phonology
   a. Learners analyze segments into primes which consist of {features or elements or particles, whichever is correct}.
   b. Interactions between segments involve the primes in (a).
   c. Learners have access to the morphological make-up and paradigmatic membership of lexical items.
   d. Learners attempt to arrive at a single underlying form for each lexical item.
   e. Where possible, rules and representations formulated in phonological terms are preferred to those that mention non-phonological terms (e.g., diacritics or morphosyntactic terms).

Archangeli & Pulleyblank (2015) call their approach 'Emergent Grammar', alluding to proposals that features are not innate and universal, as in the theory of Chomsky & Halle (1968), but rather are learned and emerge in the course of language acquisition. There are several reasons for taking this view. As argued by Mielke (2008), Samuels (2011), and others, no specific set of innate features have been found that work for all languages. Moreover, an innate set of features based on phonetic properties exclude sign languages. However, replacing innate features with emergent ones does not lessen the need for UG principles that are specific to phonology. On the contrary, as argued by Dresher (2014), if learners have to construct their own phonological features, they need to have UG principles that will guide them in this task. What sort of features should they

construct? How many features do they need to find for a given inventory? How specific or general should they be? Contrastive Hierarchy Theory, which Archibald discusses in his article, proposes some answers to these questions, summarized in (10).

(10) Some principles of Contrastive Hierarchy Theory
   a. *The Successive Division Algorithm* (Dresher 2009: Assign contrastive features by successively dividing the inventory until every phoneme has been distinguished.
   b. *Variability of feature ordering*: Contrastive feature hierarchies are language particular.
   c. *The Contrastivist Hypothesis* (Hall (2007)): The phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another.
   d. Features are binary, and every feature has a marked and an unmarked value, determined on a language-particular basis (Rice 2003, 2007).

According to the Successive Division Algorithm (10a), features are assigned hierarchically until every phoneme has been assigned a unique representation. According to (10b), the order in which features are assigned is language-particular, and thus needs to be determined by the learner. According to the Contrastivist Hypothesis (10c), the phonology operates only on the contrastive features so assigned. I assume also that features are binary and have a marked and an unmarked pole (10d). The effect of the principles in (10) is to limit the number and form of the features that learners need to find. For example, an inventory consisting of three phonemes can have exactly two features, and five phonemes can have between two and four features. In general, the minimum number of features required by an inventory of n phonemes is equal to the smallest integer that is greater or equal to $\log_2 n$, and the maximum number of features is equal to $n - 1$.

In sum, the fact that phonological distinctive features are emergent does not relieve us of the need for a UG theory of features. Rather, a theory of specific innate features must be replaced by a more abstract theory that allows for the construction of phonological features with specific properties. Moreover, principles like those in (10) do not refer to phonetics, and so are arguably applicable also to sign language phonology; see van der Hulst (2022) for a recent survey of sign language phonology and parallels between spoken and signed phonology.

5 UG and metrical representations

I would like to expand a bit on Archibald's remark that it is not sufficient for learners merely to 'notice' elements in the input. Indeed, it is sometimes assumed that surface phonological representations can be observed in the phonetic signal; but, as Archibald points out, this is to ignore Plato's Problem, i.e. the poverty of the stimulus, in this case the incommensurability of the phonetic signal and the mental representations of acquired grammars. I presented several aspects of this problem in Dresher (2004); here, I would like to add to Archibald's examples of word and phrase stress in various languages.

In addition to languages in which word stress is more or less predictable based on syllable structure, there are languages which have *lexical accent*. In such languages, some morphemes are associated with a lexical, i.e. underlying, accent which under certain circumstances surfaces as a stress. For example, Russian has three types of noun stems as shown in (11) and two types of suffixes (12).

(11) Three types of Russian noun stems (Idsardi 1992; Osadcha 2019)

a. Unaccented stem: *golov-* 'head'
b. Accented stem: *korov-* 'cow'
c. Post-accenting stem: *gospož-* 'lady'

(12) Two types of Russian suffixes

a. Unaccented suffix: *-u* 'ACC.SG'
b. Accented suffix: *-a* 'NOM.SG'

Stems and suffixes interact as shown in (13). Unaccented stems have stress or not depending on the suffix (13a): with an unaccented suffix, stress appears on the initial syllable of the stem; with an accented suffix, stress appears on the suffix. Placement of stress is more consistent in the other two stem types: accented stems (13b) are stressed with all suffixes, and post-accenting stems (13c) always cause stress to appear on the suffix.[4]

(13) Interactions between stems and suffixes

a. unaccented stem + unaccented suffix: *gólov-u*
unaccented stem + accented suffix: *golov-á*
b. accented stem + unaccented suffix: *koróv-u*
accented stem + accented suffix: *koróv-a*
c. post-accenting stem + unaccented suffix: *gospož-ú*
post-accenting stem + unaccented suffix: *gospož-á*

Because of the way that accented and unaccented morphemes interact, deciding what sort of lexical accent any given stem or suffix has is not a trivial matter. For example, a stress on an unaccented stem which is assigned in the absence of an accented suffix, such as in *gólov-u*, does not sound different from a stress that is due to an underlying lexical accent, as in *koróv-u* or *jágod-u* 'berry.ACC.SG'. And it can be hard to determine if a suffix has lexical accent or not, because sometimes an accented suffix surfaces without stress, as in *koróv-a*, and sometimes an unaccented suffix is stressed, as in *gospož-ú*. It is not, then, a matter of simply 'noticing' which morphemes are accented and which are not.

It is therefore a challenge to understand how learners determine which morphemes have lexical accent, and at the same time, how accented and unaccented morphemes combine to generate the position of surface stress; see Dresher (2016) for discussion. But even more basic is the question: How do learners represent stress in their grammar? Many models of stress have been proposed in the history of phonological theory, and it is hard to imagine that learners have to work out for themselves which one is correct. Rather, as in the case of other aspects of phonological theory, we understand the various iterations of stress theory to be hypotheses about UG in the domain of stress.

Archibald briefly shows how stress is represented in the Simplified Bracketed Grid model of Idsardi (1992) and Halle & Idsardi (1995). In this model, Russian accented stems and suffixes are represented with a left parenthesis to the left of the line 0 grid mark of the accented syllable,

[4]The interactions shown in (13) only scratch the surface, so to speak. Further complications are introduced by phonological processes and derivational morphemes; see further Halle & Vergnaud (1987) and Idsardi (1992).

post-accenting stems have a left parenthesis to the right of their last grid mark, and unaccented stems have no lexical parentheses. Given only these markings, the underlying metrical forms of the words in (13) are as in (14).

(14) Underlying metrical forms of the words in (13)

	Unaccented stem		*Accented stem*		*Post-accenting stem*	
Line 0	x x x	x x (x	x(x x	x(x (x	x x(x	x x((x
	golov+u	golov+a	korov+u	korov+a	gospož+u	gospož+a

In order to account for how morphemes combine to yield surface stress, Idsardi (1992) proposes the *edge marking* and headedness parameters in (15) (see also Osadcha 2019).

(15) Russian edge marking and headedness parameters (Idsardi 1992: 110, Osadcha 2019: 14)

a. Line 0 Edge: RRR. On line 0, mark the edge of a word by placing a Right parenthesis to the Right of the Right-most element.

b. Line 1 Head: L. Project the Left-most element in a line 0 constituent to Line 1.

c. Line 1 Edge: LLL. On line 1, place a Left parenthesis to the Left of the Left-most element.

d. Line 2 Head: L. Project the Left-most element in a line 1 constituent to Line 2.

e. Conflation. Only the line 2 mark (main stress) is phonetically realized as a stress.

These parameters are specific to Russian. The Simplified Bracketed Grid model posits that the parameters in (15) are settings drawn from a limited hypothesis space; for example, instances of 'Right' in (15) could be changed to 'Left' and vice-versa. When applied to the forms in (14), the edge marking and headedness parameters in (15) yield the results in (16).

(16) Full metrical forms of the words in (13)

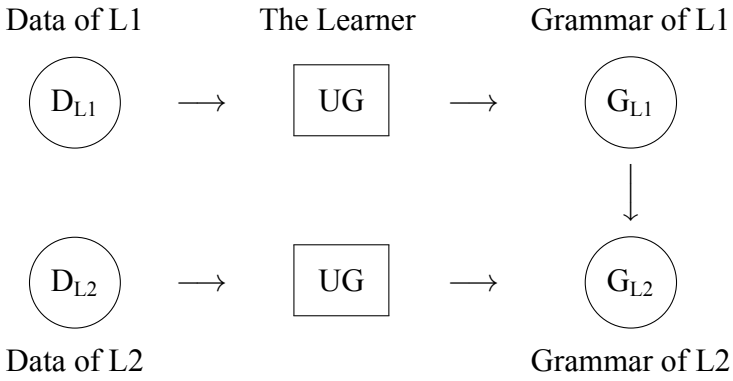
	Unaccented stem		*Accented stem*		*Post-accenting stem*	
Line 2	x	x	x	x	x	x
Line 1	(x	(x	(x	(x x	(x	(x
Line 0	x x x)	x x (x)	x(x x)	x(x (x)	x x(x)	x x((x)
	golov+u	golov+a	korov+u	korov+a	gospož+u	gospož+a

The grids in (16) yield the correct placement of main stress in the words in (13). That does not mean that this particular theory of Russian stress is correct; but whichever theory is correct will have to be at least as complex, and will have to be supported by a UG that is rich enough to guide learners to the correct grammar.

6 Conclusion: The projection problem for L2

To conclude, I would like to return to the diagram in (4) and briefly consider how it could be augmented to include the acquisition of a second language (L2). As an initial simplified model, we could expand it as in (17).

(17) The projection problem extended to L2



Unlike L1 acquisition, the grammar of L2 is influenced not only by UG, but also by the grammar of L1. Similarly, acquisition of a third language is potentially influenced by both G_{L1} and G_{L2}. The diagram in (17) remains an idealization, abstracting away from stages of acquisition. More importantly, it does not specify the relative contributions that UG and the grammar of L1 make to L2. This is what John Archibald's program addresses, and his work has done much to explore the projection problem in the domain of second and third language acquisition.

References

Archangeli, Diana and Douglas Pulleyblank. 2015. Phonology without universal grammar. *Frontiers in Psychology* 6, article 1229. doi:10.3389/fpsyg.2015.01229.

Archibald, John. 2024. Waiting in the wings: The place of phonology in the study of multilingual grammars. *Second Language Research* 4(4).

Baker, C. L. 1979. Syntactic theory and the projection problem. *Linguistic Inquiry* 10(4): 533—581.

Chomsky, Noam. 1965. *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.

Chomsky, Noam. 1975. *Reflections on language*. New York, NY: Pantheon.

Chomsky, Noam. 2004. Beyond explanatory adequacy. In Adriana Belletti (ed.), *Structures and beyond: The cartography of syntactic structures*, 104–131. Oxford: Oxford University Press.

Chomsky, Noam and Morris Halle. 1968. *The sound pattern of English*. New York: Harper and Row.

Crain, Stephen. 1991. Language acquisition in the absence of experience. *Behavioral and Brain Sciences* 14: 597–650.

Dresher, B. Elan. 1999. Child phonology, learnability, and phonological theory. In William C. Ritchie and Tej K. Bhatia (eds.), *Handbook of child language acquisition*, 299–346. New York, NY: Academic Press.

Dresher, B. Elan. 2004. On the acquisition of phonological representations. In William Gregory Sakas (ed.), *Proceedings of the Workshop on Psycho-Computational Models of Human Language Acquisition*, 43–50. Geneva, Switzerland: COLING. URL `https://aclanthology.org/W04-1306`.

Dresher, B. Elan. 2009. *The contrastive hierarchy in phonology*. Cambridge: Cambridge University Press.

Dresher, B. Elan. 2014. The arch not the stones: Universal feature theory without universal features. *Nordlyd* 41(2): 165–181. Special issue on Features ed. by Martin Krämer, Sandra Ronai and Peter Svenonius. University of Tromsø — The Arctic University of Norway.

Dresher, B. Elan. 2016. Covert representations, contrast, and the acquisition of lexical accent. In Jeffrey Heinz, Rob Goedemans, and Harry van der Hulst (eds.), *Dimensions of phonological stress*, 231–262. Cambridge: Cambridge University Press.

Fodor, Jerry A. 1975. *The language of thought*. Cambridge, MA: Harvard University Press.

Hall, Daniel Currie. 2007. *The role and representation of contrast in phonological theory*. Ph.D. thesis, University of Toronto.

Halle, Morris and William J. Idsardi. 1995. General properties of stress and metrical structure. In John A. Goldsmith (ed.), *The handbook of phonological theory*, 403–443. Oxford: Blackwell.

Halle, Morris and Jean-Roger Vergnaud. 1987. *An essay on stress*. Cambridge, MA: MIT Press.

Hornstein, Norbert and David Lightfoot. 1981. Introduction. In Norbert Hornstein and David Lightfoot (eds.), *Explanation in linguistics: The logical problem of language acquisition*, 9–31. London: Longman.

van der Hulst, Harry. 2022. The (early) history of sign language phonology. In B. Elan Dresher and Harry van der Hulst (eds.), *The Oxford history of phonology*, 284–305. Oxford: Oxford University Press.

Idsardi, William J. 1992. *The computation of prosody*. Ph.D. thesis, MIT, Cambridge, MA.

Mielke, Jeff. 2008. *The emergence of distinctive features*. Oxford: Oxford University Press.

Osadcha, Iryna. 2019. *Lexical stress in East Slavic: Variation in space and time*. Ph.D. thesis, University of Toronto.

Peters, Stanley. 1972. The projection problem: How is a grammar to be selected? In Stanley Peters (ed.), *Goals of linguistic theory*, 171–188. Englewood Cliffs, NJ: Prentice-Hall.

Pullum, Geoffrey K. and Barbara C. Scholz. 2002. Empirical assessment of stimulus poverty arguments. *The Linguistic Review* 19(1–2): 9–50.

Rice, Keren. 2003. Featural markedness in phonology: Variation. In Lisa Cheng and Rint Sybesma (eds.), *The second Glot International state-of-the-article book: The latest in linguistics*, 387–427. Berlin: Mou-

ton de Gruyter.
Rice, Keren D. 2007. Markedness in phonology. In Paul de Lacy (ed.), *The Cambridge handbook of phonology*, 79–98. Cambridge: Cambridge University Press.
Ritter, Nancy A. 2002. Introduction. *The Linguistic Review* 19(1–2): 1–7.
Sampson, Geoffrey. 1989. Language acquisition: Growth or learning? *Philosophical Papers* 18: 203–240.
Samuels, Bridget D. 2011. *Phonological architecture : A biolinguistic perspective.* Oxford: Oxford University Press.
Thomas, Margaret. 2002. Development of the concept of 'the poverty of the stimulus'. *The Linguistic Review* 19(1–2): 51–71.