The Bottleneck Hypothesis Updated

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Abstract

The Bottleneck Hypothesis identifies parts of the grammar that are easier or more difficult to acquire in a second language. It argues that the functional morphology is the bottleneck in L2 acquisition because it bundles a variety of semantic, syntactic & phonological features that affect the meaning & acceptability of the whole sentence. In this chapter, the BH is updated after a decade since its proposal. Current views of Universal Grammar & parametric variation are outlined. Implications of those current views for adult L2A are spelled out. New evidence for the BH is reviewed from the L2A of semantics, morphophonology & syntax. Additional factors that complicate acquisition of the functional morphology are discussed and a pyramid of L2A difficulty is proposed.

Keywords: second language acquisition, Bottleneck Hypothesis, functional morphology, syntax, semantics, syntax-discourse interface, features, parameters, lexicon, hierarchy of acquisition difficulty

1. Introduction

It is often the case that adolescent and adult additional language learners are exposed to vastly smaller amounts of target language input, compared to children acquiring their mother tongue. And yet, there is a striking gap between the scarce, impoverished input and the linguistic knowledge that adult learners acquire. Just like in native first language acquisition (L1A), linguistic experience vastly under-determines linguistic representation. At the same time, linguistic experience does not generate linguistic representation in a direct manner. There are some properties that are amply modeled in the input but learners experience them as a challenge and error rates may be higher than accuracy rates. There are other, seemingly much more obscure and complex properties, whose acquisition is a snap. Why would that be?

In order to address this fundamental issue, a central question among researchers in the last decade has been: What is easy and what is hard in second language acquisition (L2A) (DeKeyser, 2005)? A related question of equal interest is: Why are some properties of language acquired relatively late, while others are acquired early? In this chapter I will ponder these questions from the perspective of generative approaches to second language acquisition. This will entail that the well-known distinction between competence and performance will be maintained. Learning a certain linguistic property means creating a mental representation of the property in the mind/brain. Whether learning has been accomplished or not can be deduced from observing learner behavior, as competence cannot be tested directly.

This chapter will compare findings from the acquisition of syntax, semantics, and functional morphology. In trying to ascertain successful acquisition, the relevant and indicative learner behavior cannot involve just the suppliance of correct morphemes in obligatory contexts. An important terminological distinction has to be set out from the very beginning. What constitutes knowledge of the "functional morphology" envisaged by the Bottleneck Hypothesis

(BH)? It goes much beyond recognition & production of the actual, overt inflection or free functional morpheme to include the syntactic and semantic reflexes of the morphemes. Learner behavior we observe in order to ascertain knowledge of a functional category (FC) has to include all morphophonological, syntactic and semantic facets of this knowledge.[1] For example, in order to examine knowledge of the English past tense marking in interlanguage, one type of information to be learned includes an array of facts on the phonologically-conditioned allomorphs of the marker (/–ɪd/, /–t/, /–d/) and the irregular past tense verb forms. A second type of information includes the temporal meaning of the marker and all its interactions with various aspectual meanings. Thirdly, a number of syntactic properties fall out of the functional category Tense that are arguably captured by formal features expressed by the past morpheme, such as case on the subject and subject–verb agreement. Only attaining this multi-faceted knowledge can be considered successful acquisition of the functional category Tense.

Why is it important to know which properties are easy and which are difficult to acquire? Among the many cognitive science reasons for this discussion, there is a practical benefit related to language teaching. Language instructors can pay more attention to the difficult properties in the language classrooms, and not waste time teaching the easy material that will come to the learners for free. It is possible that different teaching needs will emerge based on the target and the native languages, on input and exposure to the various properties and so on. However, it is always beneficial to keep in mind the learning challenges that stem from principled linguistic distinctions and from the architecture of the language faculty. These challenges will remain the same no matter the language pairs involved.

The BH (Slabakova, 2006, 2008, 2009) set out to identify parts of the grammar that are easier or more difficult to acquire in a second language. It argues that the functional morphology is the bottleneck in L2 acquisition because it bundles a variety of semantic, syntactic and morphophonological features that have an effect on the acceptability and the meaning of the whole sentence. This formulation is based on the Borer–Chomsky Conjecture (BCC), see discussion in the next section. The BH also capitalizes on the possible separation of these three types of knowledge, especially in production (White, 2003; Lardiere, 2005). Adhering to a syntax-before-morphology view (White, 2003), the BH does not suggest that learning the actual functional morpheme drives learning the syntax. To reiterate, what is included in my use of the term "functional morphology" is the set of morphosyntactic features that drive the syntax and semantics, as captured in the functional categories whose *exponence* is the functional morpheme. In other words, "functional morphology" is a bundle of morphosyntactic and semantic features, which may or may not be overtly expressed by a functional morpheme. Dissociated knowledge can be acquired at different rates. Thus, it is perfectly possible, and indeed amply demonstrated by research, that for the purposes of mental representations, whether or not the learner produces the exponent morphemes is beside the point (White, 2003; Lardiere, 2005). Knowing a feature and obeying its syntactic and/or semantic reflexes seem to be largely coterminous. We will see later in the chapter that complications of this learning situation can arise.

In this chapter, I will update the BH after about a decade since its proposal. I will start by outlining the current views of Universal Grammar (UG) and parametric variation among languages of the world, with a view of outlining how the model is informed by new theoretical developments. will discuss implications of those current views for language acquisition, and specifically, for adult L2A. I will review new evidence for the BH from the L2A of semantics, morphophonology and syntax. I will list and discuss additional factors that complicate acquisition of the functional morphology. Finally, I will propose a pyramid of L2A difficulty.

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[1] I am grateful to Donna Lardiere for bringing up this terminological issue with important theoretical consequences.

2. Current views of UG and parametric variation

UG characterizes the genetically determined aspect of the human capacity for grammatical knowledge (for a recent collection of state-of-the-art overviews of facets of UG, see contributions in Roberts, 2017). Views of language acquisition are currently guided by Chomsky's (2005) three factors that determine the nature of human I-languages, as expressed in (1):

(1)   F1: Genetic endowment, or UG
        F2: Experience, or Primary Linguistic Data (PLD)
        F3: Principles not specific to the faculty of language

F1 is the species-specific UG, or grammatical knowledge by which all languages are constrained and that is brought to bear in language acquisition. However, the effort to reduce its size and complexity means that UG is now much less elaborate and more minimal than in previous incarnations of generative linguistic theory. F2 is exposure of the UG to the PLD, which triggers variation in I-languages. Experience is very much a relational notion. It is determined not only by the UG-delimited "possible human experiences," but also by the many factors of the human individual: social experience, history, etc. F3 reflects general biological, physical and computational principles of two kinds: Principles of data analysis that might be used in language acquisition but also in other domains of cognition; and architectural and computational constraints, including canalization, organic form and efficient computation (Chomsky, 2005).

If UG is the common ground among languages, how is language variation delimited? We will discuss minimalist parameters here, but for a historical overview of the notion of parameters and its development, see Huang and Roberts (2017) and Newmeyer (2017). One current view is that variation is restricted to possibilities that the inflectional component makes available. "The inventory of inflectional rules and of grammatical formatives in any given language is idiosyncratic and learned on the basis of input data." (Borer, 1984: 29) This view has come to be known as the Borer–Chomsky Conjecture. After the division between lexical and functional heads became well-articulated in the theory, parameters were associated with functional heads rather than with inflectional items. Fukui's (1988) Functional Parameterization Hypothesis reflects this elaboration and has been very influential in second language acquisition theory. On this view, parametric variation is restricted to functional elements in the lexicon (that is, instantiations of Complementizer, Agreement, Tense, etc.).

However, not every generative linguist agrees with this view. In line with Chomsky's original (1981) formulation of Principles and Parameters, Baker (2008: 354) argues that there are "parameters within the statements of the general principles that shape natural language syntax." The notion of parameter should be invoked since we need a device that cuts across language families to describe differences in syntactic rules. One example of such a parameter is the directionality of the head-complement relationship within the phrase. Another example is the Polysynthesis parameter, regulating non-configurational versus more configurational, isolating languages (Baker, 1996). Although there is no complete correlation, Borer-style parameters are sometimes referred to as "microparameters" and Baker-style parameters are considered to be "macroparameters," see Baker (2008) for an illuminating discussion of this distinction.

Another view is due to Berwick and Chomsky (2011), suggesting that the variation is confined to how features and parameters are expressed in the linguistic string:

Parameterization and diversity, then, would be mostly—possibly entirely—attributed to externalization. That is pretty much what we seem to find: a computational system

efficiently generating expressions interpretable at the semantic–pragmatic interface, with diversity resulting from complex and highly varied modes of externalization, which, furthermore, are readily susceptible to historical change. (Berwick and Chomsky 2011: 37–8)

Boeckx's (2011) Strong Uniformity Thesis also comes in this camp: "Principles of narrow syntax are not subject to parameterization; nor are they affected by parameters." Boeckx (2011: 210) According to his view, narrow Syntax is feature-free, and only the operation Merge is possible. All variation is then post-syntactic, relegated to the externalization component.
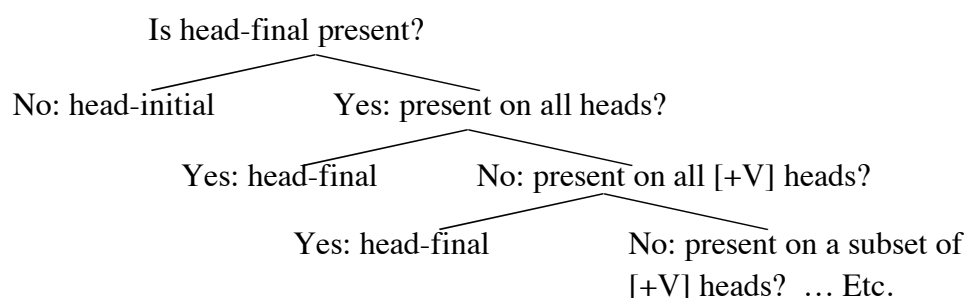
To be sustainable, the Chomsky–Berwick conjecture must rely on another conjecture, implicitly assumed by many and explicitly defended by Ramchand and Svenonius (2008): there cannot be any semantic parameters. Assuming transparency of the syntax–semantics mapping, since there are no syntactic parameters, it follows that semantics will be invariant as well. Externalization parameters determine the core component of each language since they are viewed as (semantically vacuous) linearization restrictions, e.g., the directionality of the head-complement relationship and the V2 parameter. For the time being, this particular view of parameters is not sufficiently articulated to be useful for language acquisition predictions.

All these new views of parameters are also closely related to the evolving understanding of the Lexicon. In a conception of the lexicon advocated in theoretical frameworks such as Distributed Morphology (Halle and Marantz, 1993) or other models like Nanosyntax (Starke, 2009), there is no lexicon in the sense familiar from traditional generative grammar. Instead, the tasks assigned to the component called the Lexicon in earlier theories are distributed through various other components. DM assumes that syntax itself generates and manipulates an unordered hierarchy of abstract syntactic features devoid of phonological content, the so-called "morphemes." Once generated, such abstract feature bundles receive morphophonological content in a step called Vocabulary Insertion.

In a logical extension of this view, Borer (2005, 2005, 2013) brings syntactic constituent structure into the lexicon and argues that words must be syntactically constructed. The content of lexical items is strictly encyclopedic and devoid of grammatical significance. Apart from encyclopedic meanings, variation among languages is reduced to "functors." Morphological realization never impacts semantics. Take for example the functor PAST: "A language which expresses PAST through the binding of an empty value by an adverb of tense or by discourse (e.g. Haitian Creole) is not semantically distinct from a language such as French, where PAST is realized as a marking on a verb or a V-equivalent root." (Borer 2013: 631)

Work on parametric theory has been vigorous in the last decade and there have been several new views of parameters articulated. For instance, Biberauer and Roberts (2015) (and previous publications with co-authors) propose to amalgamate cartographic hierarchies (Cinque, 1999 for TP, Rizzi, 1997 for CP), featural hierarchies such as Harley and Ritter (2002), and parameter hierarchies of the type first proposed by Baker (2001). Languages differ in the way in which they grammaticalize the semantic features which define "cartographic fields." These three hierarchies are unified in a single formal hierarchy, which is not predetermined by UG but which is an emergent property of the interaction of the three factors of language design (Chomsky 2005). An example of such a hierarchy is given in (2), illustrating the parametric options relating to word order, or linearization. "Head-final" here refers to "the presence of a diacritic ˆ which, when associated with the categorial feature of a head, triggers movement of the complement of that head to its specifier." (Biberauer & Roberts, 2015: 8)

(2) An example of a feature hierarchy from Biberauer and Roberts (2015)

Is head-final present?

No: head-initial   Yes: present on all heads?

          Yes: head-final   No: present on all [+V] heads?

                    Yes: head-final   No: present on a subset of
                                            [+V] heads? … Etc.

Another idea, whose seeds were sowed in Kayne (2005:10) and Baker (2008:354n2), is that macroparameters are not primitive aspects of UG but are aggregates of microparameters with correlating values. In this sense, macroparameters are epiphenomenal (Roberts, 2017) and each microparameter that falls under a macroparameter obeys the Borer–Chomsky Conjecture. Microparameters act in concert for reasons of markedness related to the general conservativity of the learner. Parametric variation thus is an emergent property of the interaction of an underspecified UG, the PLD and third-factor computational conservativity on the part of the acquirer. The markedness constraints, or the principles of conservativity, are defined like this:

(3)   Feature Economy: Postulate as few formal features as possible to account for the input.
        Input Generalization: If a functional head F sets parameter P_j to value v_i then there is a
    preference for all functional heads to set P_j to value v_i.

Still another proposal is the one articulated by Longobardi and his associates, e.g., Gianollo, Guardiano and Longobardi (2008). In their view, there is a distinction between parameters themselves construed along the lines of the Borer–Chomsky Conjecture (hence microparameters), and parameter schemata, which also take a hierarchical shape. UG makes available a small number of schemata, which work with the PLD to determine the non-universal aspects of the grammatical system. Gianollo, Guardiano and Longobardi (2008) offer an illustration of the system through the workings of the feature [definiteness] within the DP of 24 languages. Over 40 parameters work together implicationally to determine, e.g., whether a language has a null article, whether it has an enclitic article, whether demonstratives combine with articles, etc. The implicational nature of parametric variation means that only one parameter value (out of + or –) implies the relevance of other parameters and other values, etc. Thus, both parametric hierarchies and implicational parameter schemata reduce the space of possible grammars by making certain parameter values interdependent, which is a desirable outcome.

Putting all of these new ideas together, Biberauer (2011, 2015) and Roberts (2012) propose that there exist finer-grained distinctions among parameters, resulting in four classes of parameters (see also Baker 2001, 2008) as articulated in (4):

(4)   For a given value v_i of a parametrically variant feature *F*:
        a. Macroparameters: all heads of the relevant type (all probes, all phase heads, etc.) share v_i, e.g., harmonic head-final order;
        b. Mesoparameters: all heads of a given natural class (e.g. [+V] or a core functional category) share v_i, e.g., the null subject in Romance;
        c. Microparameters: a small, lexically definable subclass of functional heads (e.g., modal auxiliaries, subject clitics) shows v_i, such as parameters defined by the Borer–Chomsky Conjecture, Kayne (2005);
        d. Nanoparameters: one or more individual lexical items is/are specified for v_i.

The parameter hierarchy view will gain validity if it can be supported with data from language acquisition. This is already happening. Tsimpli (2014: 285), for example, has proposed a relative order of acquisition. Baker-style macroparameters are fixed early in first language acquisition because they represent "an overarching property of a language, the backbone defining the type of language the learner is exposed to." Mesoparameters are also proposed to be fixed early, since there is abundant evidence for them. Micro- and nanoparameters are where the thorny acquisition issues lie; they may take longer and there may be a lot more individual variation in developmental paths, as individual experience will vary much more widely. In the next section, I will summarize the assumptions I make about adult L2 acquisition and build on Tsimpli's (2014) arguments to articulate predictions for L2 behavior.

3. Adult L2A: Assumptions and predictions

In elaborating on the BH, I will make one crucial assumption that may seem far-fetched to some and perfectly natural to others: Adult L2 acquisition is natural language acquisition and it does not follow a qualitatively different developmental path compared to L1 acquisition, even if the outcomes may be different due to a host of other factors. One formulation of this view appears in Hopp (2007) as the Fundamental Similarity Hypothesis. I do not have the space to argue explicitly for this view here, but see Slabakova (2016, chapter 4) and Schwartz and Sprouse (2013), among many others. I will also be assuming that macroparameters exist, as they were described above and as developed in the work of Baker, Biberauer, Holmberg, Longobardi, Roberts and their associates. The Minimalist Program, a radical change in theoretical perspective, does not preclude principles and parameters theory, although it modifies them considerably. Parameters are seen as points of underspecification in UG, whose values emerge in the interaction between UG, the PLD and third factors of computational efficiency. However, both macroparameters and microparameters are needed in linguistic theory. As proposed by Baker and others, macroparameters may be conceived as aggregates of microparameters working in consort to achieve a conservative learning strategy, itself a third-factor principle.

Based on this new architecture of the grammar, where can we expect the challenges in L2 acquisition? Assuming that the parameters are organized in hierarchies and they interact with third-factor principles, the Borer–Chomsky Conjecture is still valid. Third-factor considerations are the same for all learners of a language: children, bilinguals or multilinguals. Since languages differ in the ways in which they grammaticalize the semantic features, this is where we should expect most difficulties to arise. These latter features, defining cartographic fields, are universally relevant to the syntax-semantics interface, but there appears to be considerable cross-linguistic variation as to their realization.

We can also predict that we will see the same differential difficulty as delineated by the parametric hierarchy and demonstrated in L1A by Tsimpli (2014). More specifically, the prediction is that macroparameters will be acquired easier and faster than mesoparameters; in turn mesoparameters will be acquired easier and faster than microparameters, etc. This is because there is less and less evidence in the input for each type of parameter going down the hierarchy. Purely semantic reflexes of universal syntactic operations will come for free. Narrow syntax operations (Merge, Agree) do not need to be acquired. The bulk of acquisition difficulty lies in learning the *expression* of semantic features and the conditioning environments for each FC exponent.

L2 acquisition is more complicated in comparison to child language acquisition. L1 Transfer and the diminished amount of exposure to PLD are just the beginning. Thus, we can expect additional factors to confound the architecture-based predictions above and beyond transfer. These factors include: L1–L2 syntax–semantics (syn-sem) mismatches (to be defined

below); complexity of the property to be acquired, including processing complexity; L2 feature re-assembly needed (Lardiere, 2009); redundancy of the L2 functional morphology marker; opaqueness of form–meaning mapping; frequency of usage; and so on. These are predictions that we can articulate based on parameter theory and language architecture, using careful linguistic analysis to describe L1–L2 differences at every turn.

4. Evidence from the acquisition of syntax

In the introduction, I talked about the three type of features that are bundled together in knowing a FC. Is there evidence for the successful acquisition of syntax to the exclusion of functional morphology? Early generative L2A work on VP word order can be relevant here. In addition to being a purely syntactic parameter, word order is regulated by a macroparameter in the sense of the hierarchy in (4) above. The prediction is that its acquisition will be early and relatively straightforward.

Quite a lot of the studies discussing the Initial State of L2A looked at the acquisition of basic word order, or the verb-complement (VO–OV) order: Meisel, Clahsen, and Pienemann (1981), Schwartz and Sprouse (1994, 1996), Vainikka and Young Scholten (1994, 1996), Gavruseva and Lardiere (1996), Epstein, Flynn and Martohardjono (1996), etc. A solid body of findings attested to L1 transfer of VP word order, e.g., Meisel, Clahsen, and Pienemann (1981), Schwartz and Sprouse (1994, 1996), Vainikka and Young Scholten (1994, 1996). The correct word order in the VP emerged very early and learners were pretty accurate. For example, the finite V placement of Schwartz and Sprouse's subject Cevdet (L2 German, L1 Turkish) was already correct from the first files.[2] The example sentence in (5) is from Lina, an Italian speaker learning German (Vainikka and Young Scholten 1996:161). While the tense morphological marking is not correct, she produces the correct OV structure from her sixth file.

(5)   *Ja sechszwanzig Tage arbeite*
        yes twenty-six   days work-1sg
        'Yes, (I) work(ed) twenty-six days.'

This is a well-known body of work, robustly supporting the prediction of macroparameters being easy to acquire.

How about V2, a well-known and pervasive property in grammars that instantiate it (e.g., German, Norwegian). Continuing with the discussion of Cevdet's grammar, he does not reach a true V2 grammar, allowing $XSV_{[+Finite]}$ until the end of data collection, over two years. Schwartz and Sprouse postulate that this structure will fossilize because of an earlier analysis (adjunction to CP) that the learner had posited. But there is more evidence. Wahlstrom McKay (2001) tested oral production of beginning to intermediate instructed learners of German (3rd and 4th semester of German classes). She found that students violated V2 in 49.3% of obligatory contexts. However, Conradie (2006), Prévost (1999), and Tran (2005a,b) present evidence for successful acquisition of the V2 rule. So, the evidence is decidedly mixed so far.

With respect to V2, we have somewhat conflicting predictions in the literature. On the one hand, it is purportedly, if not a macro-, at least a mesoparameter, semantically vacuous and determining the core component of the language, early acquired according to Tsimpli (2014). On the other hand, Yang (2002, 2004) gives the V2 parameter in German as an example of a late

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[2] However, as Schwartz and Sprouse (1994) acknowledge, Cevdet's language may have undergone an earlier stage not captured by the transcripts available to them, in which his production data may have looked like the early Turkish–German learners of Vainikka and Young-Scholten' (1994) study, with transfer of the L1 word order of the VP. Nevertheless, resetting the word order of the VP appears to be accomplished early.

acquired parameter. It is unambiguously evidenced only by sentences where the object or some other constituent is in the sentence-initial position and the verb precedes the subject (XVS). Taking into account all the child-directed relevant sentences, such evidence comes in only 1.2% of them, which results in a relatively late acquisition at the 36th–38th month (Clahsen, 1986).

I will summarize here the findings of a recent direct syntax–morphology comparison, Jensen, Slabakova and Westergaard (2017). The researchers tested two constructions exhibiting a contrast between English and Norwegian: V2 (attested in Norwegian) and S–V agreement (not attested in Norwegian). The test instrument was an Acceptability Judgment Task including past tense non-subject-initial declaratives with auxiliary verbs and lexical verbs as in (6) and present tense subject-initial declaratives with plural and singular subjects as in (7). Local as well as long-distance agreement was tested as well, as in (8):

(6)   *Yesterday the teacher went to the shop.*
(7)   *The brown dog plays with the yellow football.*
(8)   *The boys in the black car look very scary.*

Learner judgments were not compared to native speakers but examined on whether they distinguished between grammatical and ungrammatical sentences. While all the learners were quite accurate in accepting grammatical structures, Figure 1 focuses on the rejection accuracy and compares the syntactic property (V2) with the morphological property (S–V agreement).

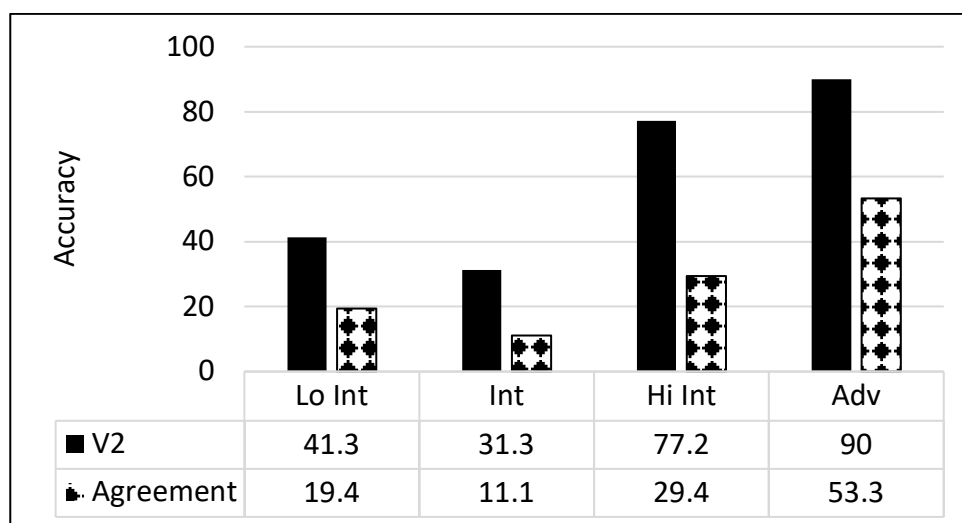|	Lo Int	Int	Hi Int	Adv
■ V2	41.3	31.3	77.2	90
▲ Agreement	19.4	11.1	29.4	53.3

Figure 1: Accuracy % in rejecting ungrammatical test items, V2 and S–V agreement compared

While ungrammatical sentences of both constructions were difficult to reject for the low intermediate and the intermediate learners, accuracy with V2 was much higher than accuracy with agreement. In the high intermediate and advanced groups accuracy on V2 improved, reaching 90%, while accuracy with agreement barely rose above 50%. The important conclusion was that agreement appeared more difficult to acquire, and gave rise to more errors over time, than V2 word order. This is the first study that compares syntactic to morphological knowledge head-to-head, in the same learners.

5. Evidence from acquisition of semantics

In this section, I review support for the claim that *learning L2 semantics comes with little or no exposure,* in the absence of a syn-sem mismatch. The first piece of evidence comes from the

meaning of Topicalization and Clitic Left Dislocation (CLLD) In L2 Spanish. Slabakova, Rothman and Kempchinsky (2012) tested whether adult learners recognize the meaning and appropriate context of CLLD and Focus Fronting. The English equivalent to CLLD, Topicalization, does not double the dislocated object with a clitic, while Spanish and English Focus Fronting work in a similar way. The specific semantic constraint tested relates to the semantic freedom of the antecedent–dislocate relationship. The dislocated clitic-doubled constituent can be identical, a subset or even a part of the discourse antecedent, as exemplified in (9), and that is true for English and for Spanish:

(9)   Context: What shall we do with **the table**? It is too big!
          *Mira, **las patas**, las   doblas   así…*
          look the legs   Cl.ACC   fold.PRES.2sg   this-way
          'Look, you can fold the legs like this…'

A felicity judgment task ascertained that the learners were no different from the monolingual native speakers in their comprehension of this semantic freedom. Thus, even though the grammatical form of the construction differs in English and Spanish, the universal meaning restrictions on a moved constituent presents no difficulty whatsoever.

Another example comes from L2 acquisition of entailments. Slabakova (2003) tested the bare infinitive completion entailment, embedded under perception verbs:

(10)   a.   *I saw Mary **cross** the street*. (completion entailed)
        b.   *I saw Mary **crossing** the street*. (no completion entailed)

Bulgarian does not have this distinction, since it has no infinitive forms, bare or otherwise. Typical classroom learners with Bulgarian as their native language took a Truth Value Judgment Task in English. High-intermediate and advanced learners demonstrated knowledge of this property, although it is never taught explicitly.

A third example comes from a property that arguably presents a Poverty of the Stimulus (PoS) learning situation. Montrul and Slabakova (2003), Slabakova and Montrul (2002) looked at two very similar types of sentences with impersonal subjects as in (11) and (12). The only difference between the sentences was the use of preterit or imperfect aspectual tenses. However, that difference in tense leads to dramatically different subject interpretations. In (11), the sentence with the imperfect verb, the impersonal subject can be interpreted as specific (we, a contextually-determined group of people) as well as generic (people in general). In (12) with a preterit verb, only one of those subject interpretations is available:

(11)   *Se comía   bien en casa de abuela*
        Se eat-IMP well in house of grandma
        √ 'We would eat well at grandma's.' (specific subject)
        √ 'One would eat well at grandma's.' (generic subject)
(12)   *Se comió   bien en casa de abuela*
        Se eat-PRET well in house of grandma
        √ 'We would eat well at grandma's.' (specific subject)
        # 'One would eat well at grandma's.' (# generic subject)

This is a classic PoS learning situation, as straightforward analogy would lead learners to assume that the Spanish impersonal subject *se* has two interpretations, corresponding to *we* and *one* in English. Montrul and Slabakova's (2003) advanced learners were over 85% accurate in

judging these interpretations, crucially including the lack of one interpretation. The correct knowledge started to emerge even among intermediate learners.

How about interpretations that emerge at the syntax-discourse interface, arguably dependent on information from two linguistic modules? The Interface Hypothesis (Sorace & Filiaci, 2006; Sorace, 2011) proposed that even near-native learners experience optionality and divergence from native competence with properties at this interface, because it involves higher complexity calculations. While there is substantial evidence for the hypothesis coming predominantly from null and overt subject usage, a range of experiments on other constructions has not uncovered adult L2 learner deficiencies.

For example, Donaldson (2011) analyzed near-native speaker production of French left dislocations, a construction depending on discourse that is a major facet of native French. He discovered that his participants had mastered the use of left dislocations to promote different types of discourse referents to topic status and their performance converged with the native performance. Ivanov (2012) also established successful acquisition of clitic left dislocation in L2 Bulgarian. Leal, Rothman and Slabakova (2014) investigated a very rare construction, right-dislocated clitic-doubled objects, which is felicitous in highly restricted contexts. Spanish-dominant and heritage bilinguals were equally selective with the contexts in which they allowed clitic right dislocation. No group differences were in evidence. All these findings challenge the Interface Hypothesis, at least in off-line tasks where there are no time constraints.

In summary, the studies mentioned in this section bring to bear on the claim that meanings arising from regular semantic operations do not constitute a challenge to learners. In one sense, this knowledge comes for free because it is present when overall knowledge of the property is established. This acquisition is based on no explicit teaching, needs little input exposure, and in the case of PoS situations, on no positive evidence at all. Very frequently, this knowledge is attested at intermediate levels of proficiency. Even more complex computations, such as those including discourse and depending on aspectual meanings in the sentence, are attainable. Although we have not had the space to discuss the concrete linguistic analyses of these properties, they all involve semantic reflexes of grammatical features that learners had already acquired.

6. Complicating factors

6.1 Morphosyntax–semantics mismatches

The linguistic properties whose acquisition we discussed in the previous section already include a fair smattering of morphosyntax-semantics mismatches (syn–sem mismatches for short). That is because L2A scholars rarely attempt to study knowledge of a universal semantic property in the L2. The interpretations of the impersonal subjects in L2 Spanish in (11) and (12) follow from universal semantic rules, but knowledge of the aspectual morphemes themselves constitute such a syn-sem mismatch, discussed at length in Slabakova and Montrul (2003). Let us look at a similar contrast now, that between generic and specific definite plural and bare plural subjects (Ionin & Montrul, 2010; Ionin, Montrul & Crivos, 2013):

(13)   a.   *Tigers eat meat*   (√generic meaning; #specific meaning)
         b.   *The tigers eat meat*   (#generic meaning; √specific meaning)
(14)   a.   **Tigres comen carne*
         b.   *Los tigres comen carne* (√generic meaning; √specific meaning)

The English-Spanish syn-sem contrast involves pairing of form and meaning in English (bare plurals are generic, definite plurals are specific), while Spanish offers only one grammatical form, the definite plural, but that form is ambiguous between the two interpretations. Ionin and Montrul (2010) and Ionin, Montrul and Crivos (2013) tested acquisition of this contrast in both learning directions. They established that acquisition is indeed challenging but can be ultimately successful. Knowledge of ungrammaticality as in (14a) came before knowledge of interpretation. (See also Cuza, Guijarro-Fuentes, Pires & Rothman, 2013 for similar findings.) Comparing their results to Serratrice et al. (2009), a study looking at the same property with a different methodology, Ionin et al. found similarities in the developmental path of definite plural and bare plural meanings among monolingual, bilingual children and adult L2ers.

The example above would fall under a syn-sem mismatch description involving a difference in feature expressions. Another case in point would be a feature or a meaning that is overtly expressed in one language but left morphologically unrealized in the other. Article meaning is acknowledged as one of the thorniest areas of L2 acquisition, possibly because there may be two closely-related semantic features involved (definiteness and specificity), and articles cross-linguistically can choose which feature to express through their articles. English chooses to express definiteness. The learning task is especially complicated for learners coming from languages where neither of these two features is expressed morphologically. In addition, languages have a variety of expressions of these same features, such as topic–focus marking, demonstratives, particles, word order, and so on. (Remember, there are no semantic parameters, by assumption). Articles can take considerable exposure and practice to get right in L2A, which is actually true of L1A of English as well. Ionin, Ko and Wexler (2004), by now a classic study of English article acquisition, looked at the interlanguage of speakers coming from languages lacking articles, such as Korean and Russian. They investigated The Fluctuation Hypothesis, namely, that learners would fluctuate between thinking that articles mark definiteness and thinking that articles mark specificity, until they get it right.

Table 1: Percentage use of articles by Russian L2 learners of English, based on Ionin, Ko and Wexler (2004)

	Definite DP (Target **the**)	Indefinite DP (Target **a**)
Specific DP	79% the, 8% a	*36% the, 54% a*
Non-specific DP	*57% the, 33% a*	7% the, 84% a

As Table 1 shows, the indefinite article *a* is indeed overused in non-specific contexts, while the definite article *the* is overused in specific contexts, suggesting that specificity is playing a role in the learners' interpretations. Research on acquisition of English articles continues apace. One intriguing question that remains, for example, is why Russian native speakers are finding articles to be so much more challenging, compared to Korean and Chinese native speakers. The answer may lie in properties of the native language that give learners a better clue as to how English definiteness marking works.

While article meaning presents a thorny problem for learners until advanced levels of proficiency, another property that also represents an L1–L2 contrast in feature expressions illustrates a different outcome. The property is tense marking. Mandarin Chinese does not have dedicated temporal expressions while English does. Slabakova (2015a) tested whether English-native advanced and intermediate learners of Chinese L2 have acquired the correct temporal interpretations. The effect of lexical aspect, grammatical aspect morphemes and adverbs on temporal meaning were tested. It was predicted that this would be a difficult property to acquire.

Instead of using their native-style overt morpheme, learners have to infer the temporal interpretation from adverbs, aspectual morphemes and other indirect aspectual signals. Results went against the predictions of L2 difficulty. Temporality may be differently expressed in the L1 and the L2, but advanced learners of Mandarin behaved in a nativelike pattern. Intermediate learners with two to four semesters of college Mandarin were already aware of all temporal interpretations.

How can we explain this difference between the difficult interpretation of articles and the easy interpretation of past tense? It is suggestive to compare the results of Ionin, Ko and Wexler (2004) and Slabakova (2015).[3] There could be many reasons for this developmental contrast in acquisition, and probably are. First of all, a contrast may be attributed to the experimental tasks, an article choice task in the Ionin *et al*. study versus an interpretation choice task in the Slabakova study. Choosing a form may be more demanding than choosing an interpretation. We can also think of the internal complexity of the two meanings. There are almost certainly two features involved in the calculation of definiteness, familiarity and uniqueness (Birner & Ward, 1994; Schwartz, 2009), but only one feature in tense. Undoubtedly there are lots of exceptions and chunks in definiteness expression, while past tense marking is more uniform. The definitive answer is still to come, but comparing developmental trajectories for semantic properties is the way to go about settling the issue.

6.2. Feature Reassembly

Among the many examples of L2 feature re-assembly (Lardiere, 2009) in the literature to date, we now turn to an extreme case. The particular example comes from Korean and English plural marking (Hwang & Lardiere, 2013). Korean has two types of plural, intrinsic and extrinsic, the latter being very rare. However, both are marked by the morpheme *–tul*. The extrinsic plural appears on predicates and even adverbs. The intrinsic plural appears on Ns but depends on other conditioning features: specificity, type of quantifier (numerical or not) and individuation (human referent or not). In addition, a new functional category, ClassifierP, has to be acquired (depending on analyses). Hwang and Lardiere (2013) document prolonged learning difficulties in mastering the two types of Korean plural. The more extensive difficulties were attested with the extrinsic, or distributive plural, which includes the basic plural meaning of "more than one", but also the added meaning that the predicate sense is distributed over all members of the plural set denoting the subject, as shown in (15).

(15)   *haksayng-tul-i yelsimhi(-tul) enehak-ul kongpuha-n-ta*
          student-pl-nom intently(*-epl*) linguistics-acc study-pres-decl
          'The students study linguistics intently.' = 'Every student studies linguistics intently.'

Korean L2 learners as well as L1 children acquire the meaning "more than one" but lack the distributive meaning for a long time.[4]   Furthermore, Su (2016), a study of the interplay of the plural and human features in Korean–Chinese interlanguage, argues that even when both L1 and L2 select the same features, differences in the way these features are assembled can cause difficulties in L2 acquisition. One obviously speculative observation at this point can be that a more highly specified meaning (distributivity) co-occurring with an unmarked one (more than one) appears to create a heightened challenge.

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[3] Admittedly, the learner groups in the two experiments may not be matched for proficiency. While Ionin *et al*'s Russian learners were residing in the USA at the time of testing with a mean stay of 1.9 years, Slabakova's learners did not reside in China. The intermediate learners had two semesters of exposure to Mandarin.
[4] I am indebted to Donna Lardiere for clarifying the Korean plural acquisition facts.

6.3 Functional Redundancy

Redundancy of the inflection morpheme may also play a role in attested lower suppliance in production. A case in point is the well-known evidence for the separation of syntactic knowledge and morphological accuracy from White (2003). This particular comparison comes from child and adult production of L2 English (Lardiere, 1998a,b; Li, 2012). Lardiere's subject, Patty is a Hokkien and Mandarin-bilingual adult learner of English. Li's participants are six Mandarin-native children aged 7 to 9 acquiring English in a naturalistic environment in the USA. Patty's performance is considered to be at end-state, in the sense that she will not develop it further. The children's performance is captured longitudinally for eight months, starting when they had been in the USA for four months, so they will clearly continue to develop.

Table 2: Percentage accurate suppliance of inflection in TP and the syntactic effects associated with it

	3sg agreement	Past tense on lexical verbs	Suppletive forms of *be*	Overt subjects	Nom. case	V in VP (no verb raising)
Lardiere (1998ab)	**4.5**	**34.5**	90	98	100	100
Li (2012)	**16**	**25.5**	93	100	100	–

What is especially striking in the data presented in Table 2 is the clear dissociation between the incidence of verbal inflection (ranging between 34.5% and 4.5%) and the various syntactic phenomena related to it, like providing overt subjects, marking nominative case on the subject, and the verb staying in VP (above 98% accuracy). It seems that Patty and the children do not produce the overt morphemes *-s* and *-ed*, but they know what the morphemes stand for and what other syntactic processes they regulate in the sentence. Knowledge of all the properties reflected in Table 2 is purportedly knowledge related to the same underlying functional category of Tense Phrase and its features. In view of such data, it is hard to maintain that omission of functional morphology is indicative of lack of L2 morphosyntactic features. In addition, present S–V agreement *-s* appears to be dropped more often than the past tense morpheme (although for the children the difference may not be significant). Since the English subject is overt, we never wonder who is performing the action in the sentence. On the other hand, even if *-ed* morphology is supported by pragmatic information coming from the context, it is the only signal of temporality in many sentences. The marker of S–V agreement is truly redundant in English from a functional perspective; therefore it may be dropped more often than more meaningful morphemes.

6.4 Opacity

Somewhat related to functional redundancy, another factor that can affect the acquisition of functional morphology is the transparency or opacity of that morphology (DeKeyser, 2005). Opacity here refers to an unclear mapping between the form and function of that morphology. Let's exemplify this factor with Differential Object Marking (DOM) in Spanish again. The object marker *a* can be used with a person but not with an inanimate object:

(16) *Juan vio **a**   María*
      Juan saw DOM María
      'Juan saw Maria.'
(17) ***Juan vio **a**   la mesa*
      Juan saw DOM the table
      'Juan saw the table.'

Both animacy and specificity have to be taken into account when computing the case marker *a*. VanPatten and Cadierno (1993), Bowles and Montrul (2009) among others, suggest that DOM is a difficult structure to acquire, even for instructed learners at advanced proficiency levels. Recently, Guijarro-Fuentes, Pires and Nediger (2017) showed that DOM was not acquired to criterion by monolingual and bilingual children until their teens. One explanation suggested by the researchers is that the morphological marker depends on semantic factors whose mapping to the case marker is opaque.

6.5 Construction frequency

The factor of construction frequency in the input, while not discussed very often in the generative second language acquisition theory, is certainly an important one. Puzzled by differential acquisition outcomes in her bi-directional English–Spanish study, Slabakova (2015b) compared accuracy on CLLD and Fronted Focus (FF) in L2 Spanish and on Topicalization and FF in L2 English. The constructions have very similar analyses; the crucial difference is the presence of a resumptive pronoun in Spanish but lack of such pronoun in English. In Focus Fronting, on the other hand, both languages do not employ resumption.

(18) Monica: Did you eat the salad?
      Alfred: *The lettuce I ate (*it). I didn't like the tomatoes.*
      Alfred: *La lechuga *(la) comí. No me gustaron los tomates.*
            The lettuce   it   ate-1sg. I didn't like the tomatoes.

It turned out that CLLD is about 1000 times more frequent in Spanish than Topicalization is in English (Brunetti et al., 2011; Gregory & Michaelis, 2001). FF in Spanish is 500 times more frequent than in English.

Table 3: Predictions and actual results of three theoretical accounts, Slabakova (2015b)

	Interface Hypothesis	L1 Transfer	Input Frequency	Advanced and near-native results
Topicalization in English	Hard	Hard	Hard	**Failure**
CLLD in Spanish	Hard	Hard	Easy	**Success**
FF in English	Hard	Easy	Hard	**Success**
FF in Spanish	Hard	Easy	Easy	**Success**

The results in short are as reported in the last column of Table 3. Only Topicalization in L2 English was not acquired to criterion (that is, distinguishing reliably between acceptable and unacceptable sentences). This was the case for very advanced learners, with a few individual exceptions. Is there any one prediction that is singly capable of explaining all the results? There really is not, as Table 3 illustrates. The predictions of the Interface Hypotheses were not directly supported. This hypothesis predicted difficulties in both learning directions, but difficulties in only one direction were found. Transfer from the native language played a critical role, in the sense that it allowed all the English L2 learners to be accurate on FF, but it does not account for the successful acquisition of Spanish CLLD. The predictions of differential difficulty based on construction frequency go a long way toward explaining the findings. However, taken in isolation, they also come short because FF was acquired successfully in L2 English, while it is as rare in the input as is Topicalization. The conclusion is that only native transfer together with experience can account for all these findings in their complexity.

In sum, the difficulty of the functional morphology, understood as a complex of overt morphemes, formal syntactic features, semantic features and their conditioning environments, is *compounded* by these complicating factors I have discussed here: difference in feature expression, feature re-assembly, opacity, redundancy and frequency. The overall picture that emerges is not completely clear yet, but with more and diverse properties being investigated, some generalizations are already beginning to emerge.

7. Discussion and conclusions

Taking stock of the studies whose findings we reviewed here, there are several conclusions that may be warranted. The BH maintains that the functional morphology is the bottleneck of L2 acquisition. If we conceptualize a functional morpheme as just an overt exponent of the bundle of features reflected in the respective FC, there are theoretical reasons to expect differential difficulty on the three types of knowledge involved: syntactic, semantic, and morphological. We do find such differential difficulty, mostly in the direction of superior knowledge of syntax, and superior knowledge of semantics, as compared to production or recognition of the morphemes. To recapitulate, the challenges in L2A parameter resetting were attested in learning situations where there was an L1–L2 syn–sem mismatch (genericity, aspectual tenses). Such challenges were also found when there was a difference in feature expression (articles, Tense); however, article semantics proved to be much more resistant to acquisition than tense. When extensive L2 feature re-assembly was needed, as in the Korean–English plural marking example, even semantic properties proved to be exceedingly tough to acquire. Two additional factors augmenting difficulty are the redundancy of the L2 functional morphology marker (English –*s* versus –*ed*) and the opaqueness of form–meaning mapping (the DOM). When one construction is used much more frequently than its equivalent (Spanish CLLD and English Topicalization), that proved to have a dramatic effect on acquisition as well.

Looking at the factors I have catalogued, one could perhaps think that there is a significant overlap between factors discussed here from the generative framework viewpoint, and factors determining ease and difficulty of L2A put forward by usage-based approaches, e.g., Ellis and Collins (2009). That perception is correct. As argued in Rothman and Slabakova (2017), there is a considerable proportion of language acquisition facts that can be explained equally well by both types of approaches. In my exposition, I have highlighted opacity and redundancy of the form as well as construction frequency, and these same factors, among others, have been proposed by Ellis and Collins as deterministic in L2A. However, there is also a considerable

proportion of acquisition facts that cannot be explained with Zipfian learning,[5] salience of the form and prototypicality of meaning. In fact, the majority of the syn-sem mismatches I discussed here would not find a ready explanation under usage-based procedures. One factor Ellis and Collins call "contingency of form-meaning mapping" or "distinctiveness and reliability of the form–meaning mapping" is perhaps relevant in explaining syn-sem mismatches and feature reassembly, but it does not come close to doing them justice. Finally, Poverty of the Stimulus learning situations remain the cornerstone of generative versus usage-based debates. Well-attested successful L2 acquisition of properties that do not appear in the input to learners tips the scale of explanatory adequacy to the generative side (see also Rothman & Slabakova, 2017; Schwartz & Sprouse, 2013).
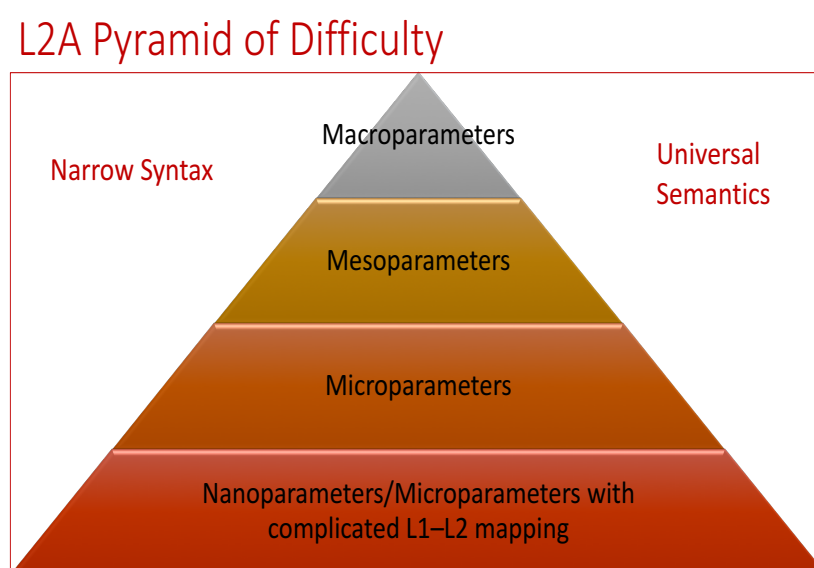
L2A Pyramid of Difficulty

Figure 2. Pyramid of difficulty in L2A

Some of the properties discussed in this chapter also address the predictions of the parametric hierarchy. Figure 2 combines those predictions with the intricacies arising from L1–L2 parameter mismatches: syn-sem mismatches, different realization of semantic features and feature reassembly. As we saw in section 4, macroparameters do appear to be acquired earlier than functional morphemes, as measured by sensitivity to ungrammaticality. Mesoparameters such as V2 have been attested to create difficulties by some studies, but ultimate attainment is possible, according to others. The majority of the parameters I discussed in section 6 were microparameters. Finally, when microparameters are complicated by mismatches in feature realization and feature reassembly, they present the highest difficulty to learners.

In conclusion, I have argued that adult L2 acquisition difficulties are essentially due to linguistic factors that stem from the language architecture and principled views of cross-linguistic variation. Frequency, redundancy and salience can explain some of the variation, but they are far from explaining all of it. The functional morphology is responsible for most of the acquisition challenges. Core syntax and semantics come for free!

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[5] In natural language, Zipf's law (Zipf, 1935) describes how the highest frequency words account for the most linguistic tokens. A Zipfian distribution in learning is one where a prototypical, salient & low-variance exemplar is introduced and learned first, while a full breadth of exemplars is acquired later.

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