The Bottleneck of Second Language Acquisition[*]

Roumyana Slabakova

University of Southampton and University of Iowa

Explaining why some linguistic features and constructions are easy or difficult to acquire in a second language has become a prominent current concern in generative second language acquisition (SLA) research. Based on a comparison of findings on the L2 acquisition of functional morphology, syntax, semantics and pragmatics, the Bottleneck Hypothesis argues that functional morphemes and their features are the bottleneck of L2 acquisition; acquisition of universal syntax, semantics and pragmatics flows smoothly (Slabakova 2006, 2008, 2013). The article surveys experimental studies supporting this view. A pedagogical implication of this model is discussed, namely, that an enhanced focus on practicing grammar in language classrooms is beneficial to learners.

Introduction

In recent years, second language researchers have been interested in examining and explaining what is difficult and what is easy to acquire in a second language (L2). Within the Interactionist approach (Mackey, Abduhl & Gass 2012), researchers are interested in what linguistic structures benefit the most from classroom interaction, and more specifically, interactional feedback (Jeon 2007; Long et al 1998). DeKeyser (2005) has argued that a number of linguistic elements are hard or impossible to learn through mere exposure in the sense of communicating in the target language, because these elements have low frequency or otherwise lack salience, especially where form-meaning mapping is concerned. DeKeyser (2007) recommends that learners should

[*] This paper is a shortened and updated version of a chapter entitled "What is easy and what is hard in second language acquisition: A generative perspective," published in *Contemporary Approaches to Second Language Acquisition*, 2013, María del Pilar García Mayo, M. Junkal Gutierrez-Mangado & María Martínez Adrián (Eds.), pp. 5–28. Amsterdam: John Benjamins. The author is grateful to the editors for the useful suggestions.

systematically practice grammar in the classroom so that they can create explicit knowledge and skills in the L2. The generative framework of SLA takes a somewhat different slant to the same issue: it identifies the harder and easier to acquire properties based on their inherent characteristics as defined by linguistic theory. The goal of the present article is to introduce, explain and justify such an approach.

Generative theory argues that the linguistic competence of speakers can be described as a highly abstract unconscious grammatical system, which allows them to produce and comprehend language. The structure of sentences (syntax), the sound of sentences (phonetics/ phonology) and the meaning of sentences (semantics) are components of this unconscious system, or Universal Grammar (UG). Some properties that pertain to syntax, semantics and pragmatics are universal, i.e., the same for all languages; some other properties, however, mostly relating to functional morphology, are language specific and are described as subject to parametric variation. Since its inception in the 80ies, this approach to SLA has inherently been interested in how UG facilitates and constrains the process of acquisition. Universal properties such as principles of UG can be transferred from the native language; parameter values different from the native ones but available from UG have to be reset to the target value. The latter process has been discussed as creating difficulty in SLA.

As generative theory has evolved over the years, linguists and SLA theorists have reconsidered the fundamental issue of what parameters really are and what resetting a parameter in a second language involves. One recent hypothesis, Lardiere's (2005, 2009) Feature Re-assembly Hypothesis has essentially revolutionized our understanding of parameter resetting in SLA. Lardiere argues that morphological competence should be accorded a special status and highlights its difference from syntactic competence. In a nutshell, the hypothesis postulates that

learning a second language involves figuring out how to reconfigure the formal features of the native language and those available from UG into new or different configurations in the L2. It is precisely this assembly and re-assembly of formal features (which is almost never straightforward mapping) that is at the core of language acquisition. White (2003, chapter 4) askes the question of whether knowledge of functional morphology drives learning the syntax, or the other way around: knowledge of syntax comes before knowledge of functional morphology. She names the two views "morphology-before-syntax" and "syntax-before-morphology" (see more on this below). Slabakova (2006), building on the insights of White and Lardiere, and viewing the issue from the point of modular critical periods in SLA, argues that there is no critical period for the acquisition of semantics; that is, meaning comes for free if functional morphosyntactic competence is already in place.

Dividing linguistic processes and modules in this way is supported by principled distinctions, well understood in linguistic theory, and solid bodies of data. The ultimate goal of this endeavor is, of course, to explain the cognitive process of language acquisition. However, it can also inform language teaching by applying the insights achieved by generative SLA research and theory in the last thirty years. It makes practical sense that if teachers know what is hard to acquire and practice it more in the classroom, they will be able to help learners achieve better fluency and higher accuracy in the second language.

This article will make the case that generative SLA research findings are eminently applicable to the language classroom. I will argue for the Bottleneck Hypothesis as a partial answer to the question: what is easy and what is hard in acquisition. I will show that it is functional morphology that is the bottleneck of L2 acquisition; acquisition of syntax, semantics and pragmatics flows smoothly (Slabakova 2006, 2008, 2013). I will summarize and compare

findings from representative studies in these linguistic modules to make the main point: Functional morphology is the bottleneck of acquisition.

Language architecture and the location of functional morphology

In order to understand how the SLA of various linguistic properties proceeds, we need to have a clear idea of the various units that make up the language faculty and their interaction. The architecture of the language faculty is important because it directly bears on what has to be learned or not, and what comes for free in acquiring a second language. I will assume a widely accepted model of grammar, following Reinhart (2006), which is illustrated in Figure1.

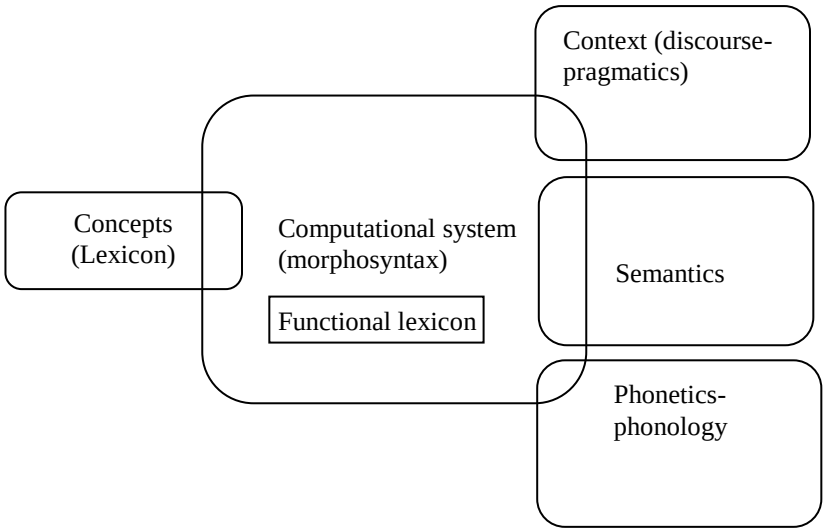

Figure 1: Modular design of the language faculty, modified from Reinhart (2006)

What is to be learned and what comes for free, keeping in mind the language architecture in Figure 1 above? Lexical items are drawn from the language-specific lexicon into the computational system. The latter can be imagined as a working space where syntactic operations like Select, Merge, and Agree combine lexical items into phrases, and then into bigger phrases.

Syntactic operations continue until all of the lexical items in the numeration are exhausted and all formal features are checked. Both visible and invisible movements take place here. Principles and language-specific parameters (leading to different grammatical rules in every language) reside in the computational system. The complete syntactic object (a tree) is then passed on by means of Spell-Out to the phonetic-phonological system for linearization and pronunciation and to the semantic system for interpretation. Context, for example the discourse-pragmatics of the message or the dialog, also impacts semantic processes and interacts with the computational system.

(1) He often take-**s** the bus.

Agree
[3rd person, singular subject]
[Tense: present]
[Aspect: habitual]
Overt Subject obligatory
Nominative Subject
Verb stays in Verbal Phrase

Let is consider the example in (1). The subject pronoun carries the features [masculine], [3rd person] and [singular]. These features are interpretable, that is, they contribute to the meaning of the sentence. The uninterpretable features on the verb ensure agreement with the subject. The morpheme *–s* also signals that the verb is in the present tense and habitual aspect. In addition to agreement, tense, and aspect, a host of other obligatory facts are captured by the features of the tense morphology: the fact that in English the subject is obligatory, that it is in Nominative case, and that the verb stays in VP, as signaled by its being on the left of the VP-edge adverb *often*. All these properties are English-specific; tense inflections in other languages signal different values. For example, the subject in Russian can be Dative; the subject in Spanish and Mandarin can be null (unexpressed), and the main verb in French and Italian go on the other

side of adverbs such as *often*.[1] As the reader can easily establish, the little morpheme *–s* on the verb packs a lot of information which impacts on the form and meaning of the whole sentence. All of that morphological, semantic and syntactic information has to be acquired, in order for the morpheme to be properly acquired. However, it is also conceivable that a learner does not acquire all of that information at the same time.

More generally speaking, the set of functional categories constitutes a sub-module of the computational system, namely, the Functional Lexicon. Each functional category is associated with a lexical item, or items, specified for the relevant formal features. Parameterization is a blueprint made up of a finite set of features, feature values, and properties (e.g., whether a certain feature will induce phrasal movement or will move on its own, what we call "strength of features"). Acquisition of L2 functional categories involves the functional properties of a set of lexical entries, but is manifested in syntactic reflexes *superficially unrelated* to these lexical entries, like displacement of a phrase away from its position of merging.

While the content of meaning (the concepts and relations between them) is arguably universal for all languages, different linguistic forms map different natural groupings of meanings. Languages also choose to signal universal meanings with different means. Various aspects of meaning can be *lexically* or *contextually* expressed in some languages while they are morphologically marked in other languages. For example, the grammatical meaning "plural" (i.e., more than one) can be expressed by *–s* in English, by reduplication in Indonesian and Malay, or left unexpressed morphologically as in Acehnese. Another well-known examples is the expression of Mandarin Chinese temporality. In the example below from Sybesma (2007), the verb form in (2a) is interpreted as present while that in (2b) is interpreted as past, but there is no morphological difference between the two verbs.

[1] See Adger 2003, chapter 2, for more examples of features across languages.

(2) a. Zhang San zhù zài zhèr.

Zhang San live at here

'Zhang San lives here.'

b. Zhang San 1989 nián zhù zài zhèr.

Zhang San 1989 year live at here

'Zhang San lived here in 1989.'

How do Chinese speakers know that a sentence denotes a past or a present event? In the case of (2b), the temporal adverb *in 1989* provides the event time. Other means of expressing temporality include discourse context and aspect marking such as aspectual particles (Smith & Erbaugh, 2005; Lin, 2003, 2006). We shall expand on this topic below. What is important to understand here is that acquiring the form-meaning mappings of functional morphology is at the core of second language acquisition.

To recapitulate this section, we will assume the Minimalist premise that the functional lexicon is where most language variation is encoded, while semantic, discourse and pragmatic meanings (the content of thought) are universal. Syntactic operations (Merge, Agree, etc.) are also universal. It follows logically from this language architecture that learning a second language entails learning the new configurations in which the native interpretable and uninterpretable features are mapped onto the target language functional morphology. The Bottleneck Hypothesis, illustrated in the Figure below, capitalizes on this language architecture. It is supported by comparing acquisition data across the various language modules. In what follows, each section will correspond to a building block of the Bottleneck Hypothesis.

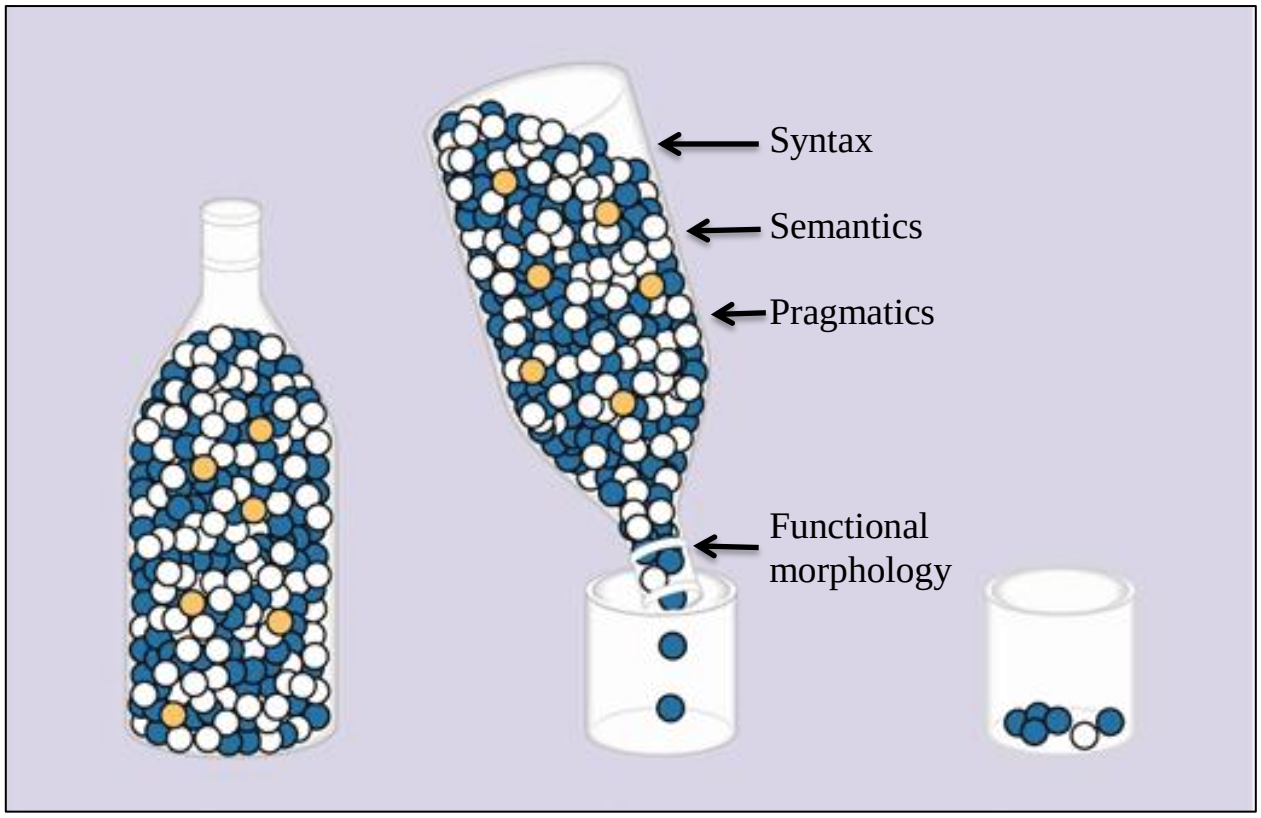

Figure 1: The Bottleneck of second language acquisition

Syntax is easier than functional morphology

Recall that the functional morphology exemplified in (1) above represents a lot of morphosyntactic information. I suggested that the various features might be acquired at different times. It is also possible that learners acquire the syntactic meanings encoded in a piece of inflectional morphology before they realize that the same morphology is obligatory to produce in that language. Thus when learners of English do not produce the past tense morphology *-ed*, this fact does not mean that they do not understand English past sentences, or that they have not posited the functional category of Tense in their English L2, with all the syntactic consequences

this category entails. In other words, overt expression and underlying knowledge of abstract syntactic features might be dissociated (White 2003: 182-184). Evidence for this separation comes from child and adult production of L2 English (Lardiere1998a, b; Li 2012). Lardiere's subject, Patty is a Cantonese-native adult learner of English. Li's participants are 6 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, after they had been in the USA for four months.

Table 1. L2 English suppliance of functional morphology in obligatory contexts (in %)

	3 sg. agreement	Past tense on lexical verbs	Suppletive forms of *be*	Overt subjects	Nom. case	V in VP
Lardiere (1998a,b)	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 1 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 overt subjects, 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, but they know what the morphemes stand for. Knowledge of all the properties reflected in Table 1 is purportedly knowledge related to the same underlying functional category,

Tense, 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.

Using functional morphology to comprehend grammatical meanings is hard for some native speakers, too. The research program of Dąbrowska offers support for such a claim. For example, Dąbrowska and Street (2006) test comprehension of pragmatically plausible and implausible passives by English natives and L2 learners. The researchers tested four subject groups: highly-educated native speakers with more than15 year of education, typically with MA/PhD degrees, low-educated natives with no more than high-school education, highly-educated non-native speakers with MA or PhD degrees, and low -educated non-native speakers who had not studied beyond high-school. Participants were asked to listen to the experimental sentences and then to answer the question of who was the doer of the action (the agent). They heard sentences in four conditions: plausible and implausible actives and passives as in (3). Accuracy of comprehension and standard deviations are given in Table 2.

(3) a. The dog bit the man. (plausible)

b. The man bit the dog. (implausible)

c. The man was bitten by the dog. (plausible)

d. The dog was bitten by the man. (implausible)

Table 2. Accuracy and SD (%) on active and passive sentences from Dąbrowska and Street (2006)

	Plausible actives	Implausible actives	Plausible passives	Implausible passives
Hi Ed natives	100 (0)	100 (0)	100 (0)	96 (13)
Hi Ed non-natives	98 (6)	100 (0)	100 (0)	98 (6)

Lo Ed natives	98 (6)	**64 (30)**	98 (6)	**36 (26)**
Lo Ed non-natives	94 (13)	90 (11)	98 (6)	94 (10)

It is clear from Table 2 that all experimental groups were quite good at comprehending plausible sentences, that is, when knowledge of the world could be used to help them identify the agent of the action. However, low-educated native speakers had trouble comprehending implausible actives, while their understanding of implausible passives went down to 36% (see percentage in bold). These results suggest that the speakers were not using the passive inflectional morphology to process these sentences. Dąbrowska and Street concluded that native speakers sometimes process sentences non-syntactically, relying on simple processing heuristics such as an Agent-Verb-Patient template. This suggestion is not new, it has been proposed by a number of psycholinguists: Townsend and Bever's (2001) two-tiered processing, Clahsen and Felser's (2006) 'shallow' processing, Ferreira, Bailey and Ferraro's (2002) 'good-enough' representations.

The results of Dąbrowska and Street's (2006) study, however, also suggest that some non-native speakers process syntactic cues such as functional morphology much more reliably than less educated native speakers. In this respect, they surmise, the second language may even give an advantage to these speakers. Bilingualism may actually enhance attention to formal cues in language processing. Furthermore, input or exposure to a particular construction is not a completely decisive factor in comprehension, since the low educated non-native speakers did better than the low-educated non-native speakers on processing plausible and especially implausible passives. Interestingly, Street and Dąbrowska (2010), who tested and then trained a similar low academic achievement native speaker group on the same passive sentences, showed that, after a brief training session on the passive, test performance improved dramatically: from a

mean accuracy of 48% to 94%. Delayed post-tests indicated that the increased recognition of the passive morphology persisted for at least 12 weeks after the training. The authors attribute the findings to the speakers' previous lack of sufficient exposure to the passive.

While most studies looking at acquisition of functional morphology have relied predominantly on off-line measures, there has recently been an increased interest in studying the processing of morphologically complex words with on-line measures such as comprehension and production latencies, eye-tracking and event-related brain potentials (see Clahsen et al. 2010 for a recent review). One influential view stemming form the work of McDonald (2006) is that L1-L2 differences in processing functional morphology are explainable in terms of domain-general processes (memory, attention, etc.), L2 processing being slower and more memory-demanding than L1 processing (McDonald 2006). However, it is also established that processing demands over and above the task requirements are reflected in a similar way by native and L2 speakers. McDonald (2006) compared the performance of native speakers and that of L2 speakers on a variety of linguistic structures. In a second experiment, the native speakers performed the same task under additional stress. The differential accuracy on the various constructions was remarkably similar for the natives under stress and the L2 speakers, with articles, regular past tense and subject-verb agreement being affected the most, while SVO word order remaining unaffected.

Furthermore, there appear to be correlations in emergence and error rates in the processing of functional morphology versus syntax across adult native speakers, children and L2 speakers. For example, McDonald (2008a,b) looked at a wide range of grammatical constructions and general cognitive measures in the grammar of 7 to 11 year-old children and adult speakers. Half of the adult participants in McDonald (2008b) processed the test items under

additional memory load (memorizing numbers), thereby reducing the processing resources they could allocate to linguistic processing. When relative construction difficulty for the children was compared to that of unstressed and stressed adults, it was found that children resembled adults under increased memory load. The latest features to emerge and the hardest to process were subject-verb agreement and regular past tense: not even the oldest group (11 years) had reached adult levels. McDonald concludes that later acquired and less resilient grammatical properties impose higher working memory and phonological demands on children as well as adults.

Why would these particular functional morphemes pose the most problems? Relative salience and frequency of the morphemes, factors proposed by DeKeyser (2005), go only some way in explaining the discrepancy. From the perspective of linguistic theory discussed in this article, the grammatical information (expressed in the number of features and syntactic effects) that subject-verb agreement and past tense marking carry is much higher as compared to plural, for example, and affects the syntactic analysis of the whole sentence. If this is the case, then the fact that the same morphemes are hard for children, stressed adults and L2 learners makes perfect sense.

Summarizing my main points about functional morphology, I have argued that it is by definition the sticking point of acquisition because it encodes all the formal features of the grammar; it is hard not only in production but also in comprehension and it is hard for native speakers who do not pay attention to syntactic cues. Processing studies confirm the differential difficulty of functional morphology not only for L2 learners, but for children and native adults as well. Functional morphology posits a higher cognitive load in processing because it carries higher syntactic information. The next issue we look at concerns the differential difficulty of functional morphology and narrow syntactic properties.

Relative difficulty of syntax for native and non-native speakers

In the previous section, the relative difficulty of subject-verb agreement and past tense was compared to that of word order, indicating that the latter emerged early in the grammar of children and was not adversely affected in processing by additional memory load. In this section, I will speculate on the relative difficulty of syntax. According to the linguistic theory I have espoused here, apart from limited language-specific parsing strategies, processing syntax involves universal, therefore transferable, operations. Once the features encoded in functional morphology and the lexical items of the L2 are acquired, learners should have no trouble understanding complex syntax. This prediction actually follows from the language architecture discussed above and from the assumption that differences between languages are captured by formal features reflected in functional morphology. This prediction is largely supported and has been amply documented in the work of Dekydtspotter, Sprouse and colleagues (e.g., Dekydtspotter, Sprouse & Thyre 1999/2000 among many other works; see Slabakova 2006, 2008 for review). However, it is a less known fact that processing complex syntax such as multiple embeddings or long-distance *wh*-movement may be affected by lack of experience with specific constructions as well as working memory or processing limitations. Is what is difficult for non-native speakers easy for all native speakers? Next, we shall look at one study that points to a negative answer.

Dąbrowska (1997) tested 5 groups of native speakers differing in levels of education: cleaners, janitors, undergraduate students, graduate students, and lecturers at the same UK university. She tested them on the comprehension of two types of parasitic gaps, complex NP, and *tough*-movement constructions. I will illustrate here with just one example in (4). Sentences

were presented visually and aurally. Then participants were asked the following comprehension questions:

(4) Paul noticed that the fact that the room was tidy surprised Shona.

What did Paul notice?

What surprised Shona?

Table 3. Accuracy percentage on complex NP comprehension from Dąbrowska (1997)

Cleaners	Janitors	Undergrads	Graduates	Lecturers
29	14	38	66	90

What these results point to is the fact that complex syntactic structures, as exemplified here by the complex NPs, are not inevitably processed problem-free by native speakers.[2] Furthermore, a speaker's accuracy on comprehension was highly correlated with the amount of schooling the individual had received. This finding highlights the importance of exposure and input for the linguistic performance of native speakers. While functional morphemes may be comparatively harder to process than simple syntax, complex syntax poses difficulties of its own, certainly affected by exposure to a construction, construction frequency (Street & Dąbrowska 2010) as well as working memory limitations.

We can tentatively conclude, indeed, that what is difficult for non-native speakers is also difficult for low-educated native speakers who have had little exposure to complex syntactic constructions or little exposure to test environments. After they learn the formal features, non-

[2] It is possible that the low educated participants in Dąbrowska's studies show task effects; specifically, lack of familiarity with test environments. Since criticism of this body of work is beyond the scope of the present article, I refer the interested reader to the *Linguistic Approaches to Bilingualism* epistemological issue on this topic, particularly the comments therein.

native speakers roughly pattern with their native speaker education peers in processing complex language. In processing syntax, as well as in the processing of morphology, learning an L2 may afford some advantages in terms of attending to syntactic cues in processing.

Universal semantics

I shall exemplify the L2 acquisition of universal grammatical meanings with a recent Mandarin L2 experiment. At the heart of this experiment is the dissociation between cognitive grammatical categories and their linguistic expressions, or realizations. As exemplified above, it is well documented that Mandarin Chinese does not have a dedicated inflection to mark past, present or future. However, Smith & Erbaugh (2005) and Lin (2003, 2006) have argued that the traditional explanation of temporal information being conveyed in Chinese by adverbials and discourse context is only partially correct. They propose that the main pattern of marking Mandarin temporality is the so-called *deictic pattern*: aspectual lexical class and viewpoint aspect convey information that allows speakers to locate the situation in time, in the absence of explicit tense marking. Bounded (complete) situations are normally located in the past, unbounded (incomplete and ongoing) situations are typically interpreted as present, in the absence of temporal adverbials. Thus English and Mandarin differ in the ways they express past and present, something that Mandarin learners have to acquire.

Slabakova (2012) investigates whether intermediate and advanced classroom learners of Mandarin Chinese are able to adequately comprehend the temporal reference of sentences in isolation and in context, in the absence of dedicated temporal morphology. The effect of lexical aspect, viewpoint aspect such as *le, zai, zhe* and *guo,* and temporal adverbials on temporal interpretation is scrutinized. The experimental design involves processing Mandarin sentences

without temporal adverbials for meaning and choosing from various interpretations that differ only in their value of temporality: past, present or future. An example sentence is given in (5).

(5) Lǐsì chī-le wǎnfàn (both Chinese characters and pinyin were provided)

Lisi eat-Asp supper (gloss not provided to test participants)

- ☑ Lisi ate supper.
- ☒ Lisi is eating supper.
- ☒ □□□□□□□□□□□□□□□□□□□□□□□□□□.
- ☒ □□□□□□□□□□□□□□□□□□□□□□□□□□□□

One line of reasoning about acquisition difficulty (DeKeyser, 2005; Slabakova, 2009, among others) predicts that this acquisition task would be complicated by the one-to-many relationship between the temporal meanings and their expressions. On the other hand, since learners are using universally available meaning computation mechanisms and have access to universal pragmatic principles, another line of reasoning suggested by Dietrich, Klein and Noyau, (1985) and based on Smith and Erbaugh (2005) predicts that acquisition would be easy. The results are very clear: although diverging slightly from the native speakers, advanced learners of Mandarin were highly accurate in interpreting the temporal values of sentences. The intermediate learners deviated from native patterns considerably more, but they were still high above chance on all conditions, indicating that they were capable of interpreting temporal references adequately. Thus the findings suggest that a universal temporality-calculation mechanism is at play in the grammar of the learners, and the acquisition of temporality in L2 Chinese, as investigated in comprehension, does not present a huge difficulty.

This is just one study among many. Scrutinizing the combined findings of the already vast literature on acquisition of semantics summarized in Slabakova (2006, 2008), one can safely submit that semantics does not present insurmountable difficulties to L2 learners.

Universal Pragmatics

Next, we will review some recent work on the acquisition of properties on the interface between semantics and pragmatics, that is, how universal pragmatic principles influence interpretation. Work on L2 acquisition of such properties is in its very early stages, but there is already a considerable body of findings on the child knowledge of such properties. An ideal property to study at the semantics-pragmatics interface is scalar implicature. It involves additional calculation of meaning over and beyond what compositional semantics brings. For example:

(6) Some professors are smart. ➔ IMPLICATION

(7) Not all professors are smart. BUT NOT

(8) All professors are smart.

Logically speaking, *some* means *some and possibly all*. For pragmatic felicity, however, *some* means *some but not all*. Thus the sentence in (6) actually implies the meaning in (7) but not that in (8). The logic goes like this: If the speaker wanted to say that *some and possibly all* professors are smart, she would have uttered (8), being maximally informative. Since she did not, she must really mean (7), *not all* professors are smart. Understatements of this sort in human speech are regulated by Gricean maxims, and more specifically, the Maxim of Quantity: Make your contribution as informative as is required; do not make your contribution more informative than is required (Grice 1989). Lexical items that induce such calculations are arranged on a scale: *<some, most, all>*, *<start, finish>*, etc, where uttering the lower-placed item implies that the

higher placed item is not true. Since the scalar implicature computation mechanism is universal, the learning task in L2 acquisition involves transferring this purportedly universal mechanism from the L1. Therefore, we expect L2 learners to be accurate in scalar implicature derivation once they know the scalar lexical items, but that processing resources may have an impact on accuracy and speed. Findings from child language acquisition (e.g. Papafragou & Musolino 2003; see also Reinhart 2006) point to processing resources being essential for the calculation of implied meaning.

Slabakova (2010) tested knowledge of scalar implicatures by English and Korean native speakers, advanced and intermediate Korean learners of English. The two native speaker groups were intended to ascertain that the scalar implicature calculation mechanism is indeed universal. In Experiment 1, subjects read 8 universally true sentences (*All elephants have trunks*), 8 sentences infelicitous with *some* (*Some elephants have trunks*), 8 sentences felicitous with *some* (*Some books have color pictures*), 8 sentences false with *all* (*All books have color pictures*), and 8 absurd fillers (*All/some garages sing*). Percentages of logical responses across participant groups are given in Table 4.

Table 4. Percentage of Logical Responses across participants groups in Experiment 1

Groups	True *all*	False *all*	Felicitous *some*	Infelicitous *some*
English controls	75.5	98.9	96.7	55.4
Korean controls	88	98.5	99	61.2
L2advanced	82	98	98	39.2
L2Intermediate	78	97	90	41.8

The results in Table 4 confirm that English and Korean adult native speakers give roughly 60% logical answers and 40% pragmatic answers. In addition, individual results reveal that these participants fall roughly into two groups: people who consistently give logical answers and people who consistently choose pragmatically felicitous answers. Importantly, Korean learners of English attribute more pragmatic interpretations to scalar implicatures without context than they do in their native Korean, and significantly more than English native speakers. When asked to judge sentences with *some* in context, they offer pragmatic judgments around 90% of the times (Experiment 2). These findings suggest that L2 learners observe Gricean maxims even at an intermediate level of attainment, and probably right after they learn the scalar lexical terms. Much more research on properties at the semantics-pragmatics interface is necessary before we come to any solid conclusions. However, it is safe to say at this point that the first findings point to no real difficulty at this interface.

Taking stock

Concluding the theoretical part of this article, let me reiterate the main points of the argument. I have argued that syntactic knowledge comes before accurate production of the functional morphology in production and comprehension (Lardiere 1998a,b; Li 2012). Functional morphology is harder for low-educated native speakers than for non-native speakers (Dąbrowska & Street 2006). In processing complex syntax, low-educated native speakers who have had little exposure to complex constructions may be at a disadvantage compared to non-native speakers (Dąbrowska 1997). I have also argued that the expressions of universal meanings such as temporality are easy to acquire (Slabakova 2012). L2 learners transfer universal pragmatic properties like Gricean maxims from their native grammar (Slabakova 2010).

The rationale of the Bottleneck Hypothesis is as follows:

1) Functional morphology reflects syntactic and semantic differences between languages;

2) Narrow syntactic operations and meaning calculation are universal;

3) In order to acquire syntax and meaning in a second language, the learner has to go through the functional morphology;

4) Hence, morphology is the bottleneck of acquisition!

Implications for teaching

It is fairly common to assert that the generative approach to L2 acquisition does not really have any predictions to make about how we should teach language. As a cognitive discipline with a theoretical perspective inherently not interested in the process of learning (as opposed to the process of acquisition), this approach has frequently turned its attention to the L2 acquisition of subtle phenomena that are never discussed in language classrooms, and language teachers have no explicit knowledge of these properties. Subjacency, the linguistic constraint that regulates how far a *wh*-phrase can move away from its original position and how many other phrases it may jump over, is one such example among many. Generative studies of L2 acquisition rarely incorporate classroom instruction as part of their design.[3] Thus, it is generally believed that the generative framework has nothing valuable to offer to language teachers (but see Whong, Gil & Marsden, 2013). In a break with tradition, however, I argue that the Bottleneck Hypothesis has clear pedagogical implications.

In language classrooms, teaching techniques that emphasize communicative competence (Canale & Swain 1980; Savignon 1983) become popular in the 80ies and are still quite prevalent

[3] The White and colleagues studies investigating the verb movement parameter are the notable exception (e.g. White 1991). Their general conclusion on the effect of targeted instruction was quite pessimistic.

(although see Kumaravadivelu 2006 for a critique). Such techniques encourage learners to use context, world knowledge, argument structure templates, and other pragmatic strategies to comprehend the message, capitalizing on the fact that learners almost certainly use their expectations of what is said to choose between alternative parses of a sentence. In fact, Clahsen and Felser's (2006) Shallow Structure Hypothesis proposes that context, pragmatic knowledge, and argument structure are the only processing strategies available to adult learners. However, many L2 researchers question the direct connection between comprehending the L2 message and figuring out how the L2 syntax works (Cook 1996:76; Gass & Selinker 2001: 317). It is believed that some attention to, or focus on, *grammatical form* is beneficial and necessary for successful learning (Long 1996). In this respect, communicative competence approaches—with their exclusion of focus on form—may not be the best way to accomplish the ultimate goal of L2 learning: building a mental grammar of the target language.

The Bottleneck Hypothesis supports such a conclusion and endorses increased emphasis on practicing grammar in the classroom. The functional morphology in a language has some visible and some hidden characteristics. Firstly, it may have phonetic form, and if it does, its distribution is in evidence and learnable. Secondly, it carries syntactic features that are responsible for the behavior of other, possibly displaced elements and phrases in the sentence. Thirdly, it carries one or more universal units of meaning. While the first trait of functional morphology is observable from the linguistic input, the second and third characteristics may not be so easy to detect. It is suggested here that practicing the functional morphology in language classrooms should happen in meaningful, plausible sentences where the syntactic effects and the semantic import of the morphology is absolutely transparent and non-ambiguous. In a sense, drilling of the functional morphology is inevitable if the form has to move from the declarative to

the procedural memory of the learner and then get sufficiently automatic for easy lexical access.[4] Practicing functional morphology in context should be very much like lexical learning (because it *is* lexical learning), and, as everybody who has tried to learn a second language as an adult (or even a teenager) knows, learning lexical items is painful. Although rooted in a different theoretical foundation, the Bottleneck Hypothesis is akin in its pedagogical implications to the Focus on Form approach (Doughty 2001; papers in Doughty & Williams 1998; Long 1996), the Input Processing theory of VanPatten (1996, 2002a, 2002b, 2007) and the Skill Acquisition theory of DeKeyser (1997, 2001, 2007).

Thus the bottom-line of the chapter is: Practice your functional morphology! In ample clear, unambiguous context! As in learning other lexical items, it may be painful, but – no pain, no gain!

References

Adger, D. 2003. *Core Syntax: A Minimalist Approach*. Oxford: Oxford University Press.

[4] My view in this respect is opposed to the position of linguists like Michel Paradis (e.g., Paradis 2004, 2009) and Bonnie D. Schwartz (e.g., Schwartz, 1993, going back to Krashen's 1982 Monitor Model) that declarative knowledge cannot 'be transformed' into procedural knowledge. I am grateful to an anonymous reviewer for suggesting this contrast.

Canale, M. & Swain, M. 1980. Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics* 1: 1-47.

Clahsen, H. & Felser, C. 2006. Grammatical processing in language learners. *Applied Psycholinguistics* 27: 3-42.

Clahsen, H., Felser, C., Neubauer, K., Sato, M. & Silva, R. 2010. Morphological structure in native and nonnative language processing, *Language Learning* 60(1): 21-43.

Cook, V. 1996. *Second Language Learning and Language Teaching*. (2nd edition). London: Edward Arnold

Dabrowska, E. 1997. The LAD goes to school: A cautionary tale for nativists. *Linguistics* 35: 735-766.

Dabrowska, E. & Street, J. 2006. Individual differences in language attainment: Comprehension of passive sentences by native and non-native English speakers. *Language Sciences* 28: 604-615.

DeKeyser, R. 1997. Beyond explicit rule learning: Automatizing second language morphosyntax. *Studies in Second Language Acquisition* 19: 195-221.

DeKeyser, R. 2001. Automaticity and automatization. In *Cognition and Second Language instruction,* P. Robinson (ed.), 125-151. New York, NY: Cambridge University Press.

DeKeyser, R. 2005. What makes learning second-language grammar difficult? A review of issues. *Language Learning* 55: 1-25.

DeKeyser, R. 2007. Skill Acquisition Theory. In *Theories in Second Language Acquisition*, B. VanPatten and J. Williams (eds.), 97-113. Mahwah, NJ: Lawrence Erlbaum Associates.

Dekydtspotter, L., Sprouse, R. & Thyre, R. 1999/2000. The interpretation of quantification at a distance in English-French interlanguage: Domain-specificity and second language

acquisition. *Language Acquisition* 8: 265-320.

Dietrich R., Klein, W. & Noyau, C. (ed.) 1995. *The Acquisition of Temporality in a Second Language*. Philadelphia, PA: John Benjamins.

Doughty, C. 2001. Cognitive underpinnings of focus on form. In *Cognition and Second Language Acquisition*, P. Robinson (ed.), 206-257. Cambridge: Cambridge University Press.

Doughty, C. & Williams, J. (eds.) 1998. *Focus on Form in Classroom Second Language Acquisition*. Cambridge: Cambridge University Press

Ferreira, F., K. Bailey & V. Ferraro. 2002. Good enough representations in language comprehension. *Current Directions in Psychological Science*, 11: 11-15.

Gass, S. & Selinker, L. 2001. *Second Language Acquisition: An Introductory Course*. Mahwah, NJ: Lawrence Erlbaum.

Grice, P. 1989. *Studies in the Way of Words*, Cambridge, MA: Harvard University Press.

Jeon, K. 2007. Interaction-driven L2 learning: Characterizing linguistic development. In *Conversation Interaction in Second Language Acquisition: A Collection of Empirical Studies*, A. Mackey (ed.), 379-403. Oxford: Oxford University Press.

Krashen, S. 1982. *Principles and Practice in Second Language Acquisition.* Oxford, UK: Pergamon.

Kumaravadivelu, B. (2006). *Understanding Language Teaching: From Method to Postmethod.* Mahwah, NJ: Lawrence Erlbaum.

Lardiere, D. 1998a. Case and tense in the 'fossilized' steady state. *Second Language Research* 14: 1-26.

Lardiere, D. 1998b. Dissociating syntax from morphology in a divergent end-state grammar. *Second Language Research* 14: 359-375.

Lardiere, D. 2005. On morphological competence. In *Proceedings of the 7th Generative Approaches to Second Language Acquisition Conference (GASLA 2004),* L. Dekydtspotter et al. (eds.), 178-192. Somerville, MA: Cascadilla Proceedings Project..

Lardiere, D. 2009. Some thoughts on the contrastive analysis of features in second language acquisition. *Second Language Research* 25(2): 173–227.

Li, Ming-Ching. 2012. The acquisition of tense and agreement by early child second language learners. Unpublished PhD dissertation, University of Illinois at Urbana Champaign.

Lin, J. 2003. Temporal reference in Mandarin Chinese'. *Journal of East Asian Linguistics 12,* 259–311.

Lin, J. 2006. Time in a Language Without Tense: The Case of Chinese. *Journal of Semantics 23*, 1–53.

Long, M. 1996. The role of the linguistic environment in second language acquisition. In *Handbook of Second Language Acquisition,* W. C. Ritchie & T. K. Bhatia, (eds.), 413-468. New York, NY: Academic Press.

Long, M., Inagaki, S. and Ortega, L. 1998. The role of implicit negative feedback in SLA: Models and recasts in Japanese and Spanish. *The Modern Language Journal* 82: 357-371.

Mackey, A., Abduhl, R., & Gass, S. 2012. Interactionist approach. In *The Routledge Handbook of Second Language Acquisition,* S. Gass & A. Mackey (eds.), 7-23. Abingdon, UK and New York, NY: Routledge.

McDonald, J. L. 2006. Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language* 55: 381–401.

McDonald, J. L. 2008a. Grammaticality judgments in children: The role of age, working memory, and phonological ability. *Journal of Child Language* 35: 247-268.

McDonald, J. L. 2008b. Differences in the cognitive demands of word order, plurals, and subject-verb agreement constructions. *Psychonomic Bulletin & Review* 15: 980-984.

Papafragou, A. & Musolino, J. 2003. Scalar implicatures: Experiments at the semantics-pragmatics interface. *Cognition* 86: 253-282.

Paradis, M. 2004. *A Neurolinguistic Theory of Bilingualism*. Amsterdam: John Benjamins.

Paradis, M. 2009. *Declarative and Procedural Determinants of Second Languages.* Amsterdam: John Benjamins.

Reinhart, T. 2006. *Interface Strategies*. Cambridge, MA: MIT Press.

Savignon, S. 1983. *Communicative Competence: Theory and Classroom Practice*. Reading, MA: Addison-Wesley.

Schwartz, B. D. 1993. On explicit and negative data effecting and affecting competence and linguistic behavior. *Studies in Second Language Acquisition* 15(2): 147-163.

Slabakova, R. 2006. Is there a critical period for the acquisition of semantics. *Second Language Research* 22(3): 302-338.

Slabakova, R. 2008. *Meaning in the Second Language,* Berlin: Mouton de Gruyter.

Slabakova, R. 2009. Features or Parameters: which one makes SLA easier, and more interesting to study? *Second Language Research, 25*, 2, 313-324.

Slabakova, R. 2010. Scalar implicatures in second language acquisition. *Lingua* 120: 2444–2462.

Slabakova, R. 2012. Acquisition of temporal meanings without temporal morphology: The case of Mandarin Chinese, *Generative Approaches to Language Acquisition North America* (GALANA) conference, University of Kansas, Lawrence, KA (in review, *Language Acquisition*).

Slabakova, R. 2013.What is easy and what is hard in second language acquisition: A generative perspective. In *Contemporary Approaches to Second Language Acquisition*, 2013, María del Pilar García Mayo, M. Junkal Gutierrez-Mangado & María Martínez Adrián (eds.), pp. 5–28. Amsterdam: John Benjamins.

Smith, C. & Erbaugh, M. 2005. Temporal interpretation in Mandarin Chinese. *Linguistics 43*(4), 713–756.

Street, J. & Dabrowska, E. 2010. More individual differences in language attainment: How much do adult native speakers of English know about passives and quantifiers? *Lingua* 120: 2080–2094.

Sybesma, R. 2007. Whether we Tense-agree overtly or not. *Linguistic Inquiry 38*(3), 580-587.

Townsend, David J., & Thomas G. Bever 2001. *Sentence Comprehension: The Integration of Habits and Rules*. Cambridge, MA: MIT Press.

VanPatten, B. 1996. *Input Processing and Grammar Instruction: Theory and Research*. Norwood, NJ: Ablex.

VanPatten, B. 2002a. Processing instruction: An update. *Language Learning* 52: 755–803.

VanPatten, B. 2002b. Processing the content of input processing and processing instruction research: A response to DeKeyser, Salaberry, Robinson and Harrington. *Language Learning* 52: 825-831.

VanPatten, B. 2007. Input processing in adult second language acquisition. In *Theories in Second Language Acquisition,* B. VanPatten & J. Williams (eds.), 115-135. Mahwah, NJ: Lawrence Erlbaum.

White, L. 1991. Adverb placement in second language acquisition: Some effects of positive and negative evidence in the classroom. *Second Language Research* 7: 133-161.

White, L. 2003. *Second Language Acquisition and Universal Grammar*. Cambridge: Cambridge University Press.

Whong, M., Gil, K. H. & Marsden, H. (eds.) (2013). *Universal Grammar and the Second Language Classroom*. Berlin: Springer.