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# NO FEAR OF GEORGE KINGLSLEY ZIPF<sup>1</sup>: LANGUAGE CLASSROOM, STATISTICS AND UNIVERSAL GRAMMAR

## Abstract

This paper offers a new insight into GenSLA classroom research in light of recent developments in the Minimalist Program (MP). Recent research in GenSLA has shown how generative linguistics and acquisition studies can inform the language classroom, mostly focusing on *what* linguistic aspects of target properties should be integrated as a part of the classroom input. Based on insights from Chomsky's «*three factors for language design*» - which bring together the Faculty of Language, input and general principles of economy and efficient computation (the third factor effect) for language development - we put forward a theoretical rationale for how classroom research can offer a unique environment to test the learnability in L2 through the statistical enhancement of the input to which learners are exposed.

*Key words:* Three Factors for language design, the Minimalist Program (MP), statistical and grammatical learning, enhanced frequency, language classroom.

### 1. A Place for the study of teaching in Generative Second Language Acquisition (GenSLA)<sup>2</sup>

There are two reasons why generative linguists – like non-generative ones – could be intrigued by L2 teaching. The first one is for the sake of the theory. Investigating teaching can be telling for the study of whether and how second languages are learned. The second reason is for the sake of the effectiveness of teaching itself. We believe that the former motivation is crucial, while the latter – although worth in itself – is derivative. While focusing exclusively on the former, in this paper we contend that the language classroom concerns language theory. We argue that teaching can be informative about whether and how languages can be learned by adults and therefore there is a convergence of interests between UG and language teaching. On the one hand, UG theory has always had a relevant transitional part which focuses on the learnability of the properties of I-language across a learner's ages. On the other hand, the aim of teaching has always been to impact on L2 learnability

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<sup>1</sup> George Kingsley Zipf was an Harvard linguist in the 1930s. The 'zipfian law' that was named after him states that when we speak or write, we use a small number of words very frequently. This law holds for every speaker of every language in the world. The discovery that frequency and ranking of words correlate inversely opened the way to the modern study of language statistics.

<sup>2</sup> The authors worked together throughout the paper. Stefano Rastelli wrote sections 1, 3, 4, 5, 6. Kook-Hee Gil wrote section 2.

especially in adulthood. Therefore teaching can be relevant at least for the «learnability part» of UG theory. Even more so after the Minimalist Program (MP) has made it clearer that language learnability is a close affair – perhaps closer than previously thought – between UG, the input and the third factor effect. This paper articulates the idea that teaching – alongside with other factors – can modulate the way in which UG and the mature cognitive system integrate and divide the labor of language acquisition. In section 2 we recap the contribution of GenSLA to the research on the interface between teaching and L2 acquisition and highlight some of the issues that arise within. In section 3 and 4 we focus on the relevance for teaching of some general ideas proposed by Chomsky in some recent papers (2005, 2013, 2014, 2017). In section 5 it is proposed that the language classroom is a privileged ground for testing the relationship between statistical and grammatical learning in adulthood. Finally, we conclude that – in comparison to other present and past generative approaches – the approach that combines statistics and the grammar provides new tools to explore whether, to what extent and for which domains UG constraints language acquisition in adulthood.

## 2. GenSLA: the story so far

Within generative linguistics, there has been a long standing belief that explicit teaching intervention may not bear a long term effect for the development of L2 knowledge (White, 1991). This, coupled with the acquisition vs. learning divide (Krashen 1982; Schwartz 1993), led to an assumption that L2 knowledge (the underlying linguistic representation) can restructure under positive input, but not very much so through classroom intervention. In recent years, however, GenSLA has increasingly engaged with the studies that can inform language teaching (Long and Rothman 2013, Bruhn de Garavito 2013; Slabakova 2013; Whong, Gil and Marsden 2013, a.o). There are three strands of research: (i) Generative L2 models that can be extended to the language classroom, (ii) those that seek to suggest an alternative focus to the present language teaching syllabi or textbook rules, informed by generative linguistics and GenSLA research findings and (iii) intervention studies to investigate to what extent those alternative grammatical instructions can contribute to L2 linguistic restructuring.

### *2.2 Generative L2 models and teaching implications*

Starting with some of the theoretical L2 acquisition models, the Bottleneck Hypothesis (BH) (Slabakova 2008, to appear) is one that bears on language teaching. The BH predicts why linguistics properties related to the functional morphology are persistently problematic for L2 learners, while other properties are readily acquired despite the lack of obvious input. Slabakova also articulates how the BH can be extended to implicate on language teaching.: if a certain property is predicted to be

hard/easy to acquire, those findings can be exploited directly in the language classroom such that the classroom time/input can target more those properties that are problematic, while adjusting appropriately for those that are readily acquired. In a similar vein, the Interface Hypothesis (Sorace and Filiaci 2006, Sorace 2011) is an L2 model that proposes that linguistic properties interfacing with discourse (e.g., the interpretation of null subjects) are more challenging to learners than those non-interfacing properties (e.g., *wh*-movement). Though this model in itself does not directly engage with classroom implications, a link to teaching implications has emerged. Recent studies suggest the importance of enhanced input through practices on discourse facing properties by providing sufficient interpretive contexts so as to raise learner's awareness of the role of discourse in determining the grammatical structure (Bruhn de Garavito 2013, Valenzuela and McComack 2013, Teixeira 2016). In principle, these generative L2 acquisition models make predictions about developmental constraints on L2 linguistic representations. At the same time, they identify what is easy or difficult for L2 learners, and therefore the extension to language classroom naturally follows regarding what properties should be paid attention to in language classroom and what not.

### *2.3 Generative L2 studies and language syllabi and textbooks*

Another line of research in GenSLA engaged in language teaching examines language teaching syllabi and textbooks and proposes modifications therein. For instance, Bruhn de Garavito (2013) looks at L2 Spanish word order and focus structure where focused subjects occur after the verb, resulting in VS word order. However this interacts with the lexical semantics of the verb whereby while the subject can freely appear before and after an unaccusative verb (though VS is preferred) whether or not the subject is focused, with unergative verbs, the focused subject can only appear after the verb. This subtle and complex interaction with the verb class, let alone the focus structure, imposes a challenge (and confusion) to L2 Spanish learners. Bruhn de Garavito points out that despite such difficulties, the current classroom does not provide sufficient input to make the connection between the verb class and the word order, nor do the textbooks or syllabus (for earlier learners) present the learners with sentences with post-verbal subjects though these are very frequent in Spanish. Her experimental study shows that given the targeted instruction on information structure and the word order, learners began to accept the VS word order and this is a change from the total rejection when no such instruction was not available. This confirms that such modified instruction made a change in learner's knowledge.

Similarly, Gil, Marsden and Whong (2018) proposes that the notion of negation should be approached more broadly as a semantic notion, rather than negation being represented as an explicit negator *not*, as in the current textbooks. The negative polarity item *any* is licensed by a c-commanding

negative element. The ‘negative’ element here goes beyond the explicit negator *not*. Any implicit negative elements can also license *any* as in ‘John regrets that he had eaten any fish last night’. Given this subtle notion of negation, Gil et. al. conducts a survey of instruction on *any* in widely used English textbooks and show a very brief and typical line of instruction such as ‘Use *any* in negative sentences’ without further information on what ‘negative’ entails. No textbook had a dedicated place to introduce the broad notion of negation. They conducted an experiment to investigate L2 knowledge of *any* by Chinese speaking learners in order to compare what the learners know with what they are taught. The results showed that while the learners tend to correctly accept *any* in sentences including *not*, they also show a strong tendency to reject *any* in all other sentences with implicit negators such as *sorry*, *deny* and *hardly*. This shows that the learner’s knowledge is limited to what they take from textbook instructions on *any* which does not represent the full distribution of *any*. From this, they propose that there is a place for the instruction of semantic notion of negation, not only for the sake of the distribution of *any*, but also for other grammatical constrains surrounding negation, including negative inversion and verb raising.

GenSLA studies as above attempt to consider both generative oriented linguistic generalizations and current language textbooks and syllabi, in order to point to what specific aspects of a given L2 property can be better exploited in the language classroom.

#### *2.4 Generative L2 studies with language classroom intervention*

There also have been a growing number of classroom intervention studies within GenSLA, after a long hiatus since the 90s (White 1991, Trahey and White 1993, Trahey 1996). This reemerging line of research identifies linguistic properties that are not captured correctly or sufficiently in classroom instructions or those that are reported as persistently problematic for L2 learners. Based on this, an intervention study is carried out, by providing the learners with the treatment of alternative instructions informed by generative linguistics and comparing the learner’s knowledge before and after the treatment. A number of these intervention studies involves linguistic properties that also feature widely in the language classroom such as articles (Snape and Yusa 2013, Snape et. al. 2016, Umeda, M. et. al. 2017, Lopez 2017), passivization (Hirakawa 2013), adjective ordering (Hirakawa, Shibuya and Endo 2017) and negative polarity items (Gil, Marsden and Whong 2013).

To illustrate a few of these studies, Hirakawa (2013) tests L2 knowledge English passivization by Japanese speaking learners before and after the treatment instruction on the different classes of intransitive verbs: unaccusatives and unergative. This study takes on two assumptions on passivization within GenSLA. First, it has been widely reported that L2 learners, across different L1 groups, show a strong tendency of over-passivization with unaccusative verbs, e.g. `\*The incident

was happened', but not with unergatives (Oshita 2000, Sorace and Shomura 2001). Secondly, Hirakawa uses the Auxiliary Selection Hypothesis (Sorace 2000) which proposes that unaccusative and unergative verbs are not a dichotomy, but a continuum, that is, some unaccusative verbs are more unaccusative than others and the same for unergatives. Based on this, Hirakawa formulates the treatment instruction on English passives that, unlike existing instructions, specifically focuses on subtle differences between unaccusative and unergative verbs, while raising awareness that unaccusative passives are ungrammatical. The results showed that the effect of the treatment is confirmed by the analysis of individual results as they correctly rejected the ungrammatical passive sentences with unaccusative verbs but at the group level analysis, this was not consistently so in all tested structures. What emerges from the findings both Hirakawa (2013) and Bruhn de Garavito (2013) is that the subtle semantic difference between unaccusative and unergative verbs functions as a crucial constraint in different grammatical properties as well as L2 knowledge and that it should be exploited in the classroom instructions.

The English article system, known as the most problematic L2 property, has featured more widely in intervention studies. This target property has been looked at in terms of two subtypes of article use: anaphoric use (definiteness and specificity) and generic use (NP-level and Sentence-level genericity). For the anaphoric use of articles, Snape and Yusa (2013) and Lopez (2017) use two generative assumptions on the article use, namely, the Article Choice Parameter and the Fluctuation Hypothesis (Ionin, Ko and Wexer 2004, Ionin Zubizarreta and Philippov 2009). They identify that the indefinite specific context is most vulnerable in L2 acquisition of English articles resulting in the overuse of the indefinite article *the*. At the same time, they note that the current instruction lacks a clear explanation for the difference between definiteness and specificity, and if there were, the instruction often misleads the concept of specificity for definiteness. Snape and Yusa (2013) and Lopez (2017) conduct intervention studies where the treatment instruction focuses on learner's understanding of the subtle difference between definiteness and specificity in relation to the use of English articles. Yusa and Snape (2013) also provided a perception training to direct learner's attention to notice the articles. This training is shown to have a positive effect. However, overall, the results in both studies showed little effect of the instructions for which the authors speculate on the problems in terms of the length and clarity of instructions.

Yusa and Snape (2013) and Yusa et. al (2016) continue their intervention study on the use of English articles in the generic use. Similarly to the instruction on the anaphoric use of the articles, they also focus on providing instructions on the subtle differences of the article use in the NP and sentence level generic sentences. While the results in Yusa and Snape (2013) showed little effect, in Snape et. al (2016) the results showed a positive effect of instructions. The authors attribute the

improvement to longer instruction duration and the use of L1 (Japanese) as a medium of instruction which helped learner's better understanding of the instructions and target properties. However, the follow up study by Umeda et. al. (2017), the long term effect of this improvement was found.

### 2.5. Back to the WHAT and HOW question.

As the effects from these intervention studies remain inconclusive, a question arises. Does GenSLA prove to bear little impact for the language classroom? The answer is no. The studies outlined in the earlier subsections address what linguistic contents should be provided in the classroom instruction, informed by linguistic generalization and analyses in generative grammar and by GenSLA research findings. This alone contributes to accurate language descriptions specifically prescribed to the problematic areas for L2 learners. Outside GenSLA, very little is offered as to *what* should be taught. As most of the classroom studies engage with *how* the language rules should be delivered. Further, very little of language rules in the current language textbooks follows from research findings as to whether those textbook rules prove to be advantageous compared to others. Therefore, one step forward is taken in GenSLA by the articulation of what properties of language rules should be provided in the language classroom.

Another emerging question is, should the GenSLA classroom studies then engage only with *what* should be taught in the classroom? Again the answer is no. The studies reviewed above often gloss over the instruction methods such as the specific instruction types including exercises, the frequency and length of the instructions. And yet, when the effect of instruction does not show a positive effect, it is followed by suggestions for 'longer and sufficient' instruction input, without specifying how longer or sufficient they should be. Admittedly, this 'how' question is not the main research question within GenSLA. However, we propose that, from a theoretical point of view, this question now emerges as an important question in generative linguistics, let alone the GenSLA research.

Recent developments in the MP, namely, the three factors, highlight the role of input as one of scaffolding tools to child language development (Yang 2010, Biberauer 2017). Given that a large population of L2 learners tested in L2 literature develop their L2 knowledge through language classroom, at least as a starting point, the type of input prevalent in language classroom emerges as a crucial variable and the extent of its role needs accounting for. Within the L2 classroom context, unlike child language development, the input presents itself in a variety of different ways, from "what" input L2 learners are directly exposed to and "how" the input is presented. As outlined above, studies in GenSLA has engaged with the question on the former: what are presented to learners and whether or not they attain the corresponding knowledge. However, the question on the latter has not

yet been fully explored since it has been outside the interest of GenSLA, while it has been extensively researched outside GenSLA. The “what” vs “how” dichotomy, however, should not divide theoretical paradigm, since both still manipulate the input that learners are exposed to (Whong, Gil and Marsden 2014). Therefore, the question on the input, beyond the contents themselves, should serve as an important variable in GenSLA studies to inform a more ultimate question of how language is developed, not just whether or not. In the following sections, we outline the relevance of the recent development in the MP to GenSLA classroom studies, justifying why, from a theoretical perspective, GenSLA research should engage with both *what* and *how* questions.

### 3. Moving ahead

Roumyana Slabakova and Kes de Bot engaged in a point-counterpoint debate about GenSLA and applied linguistics (De Bot, 2014; Leal et al., 2015; Slabakova et al., 2014). De Bot stated that generative linguists never contributed to our understanding on how languages should be taught. This is one of the reasons why most current SLA research is non-generative (de Bot, 2014: 2). Slabakova et al. (2014) replied that generativists’ original contribution to L2 teaching is in fact the idea that classroom time is more efficiently spent if teachers do not teach what is universal and acquired free of instruction. Instructors should therefore focus on properties that need a lot of input and practice to be fully acquired. De Bot eventually claimed that GenSLA has nothing to offer to applied linguistics and questioned whether it is actually moving anywhere. In our view, GenSLA is theoretically equipped and entitled to move ahead towards new directions of research from which the whole SLA and applied linguistics enterprises can benefit in the future. In order for that to happen, the horizons of GenSLA must be widened. This can happen in three ways at least. First, GenSLA should consider some themes and insights from the recent development in the MP. Second, GenSLA should encompass concepts, methodologies and techniques of statistical and cognitive investigation mostly developed outside the generative field. Third, GenSLA studies on language teaching should focus on topics other than the teaching of grammar rules. In the remaining of this section we focus on the latter point (whereas in § 3.2 and § 3.3 we will be concerned with the MP and in § 5 with statistics).

The language classroom – under current instructed SLA theory, which is mainly non generative – is far more than the explicit teaching of grammar. Teaching is first and foremost concerned about a learner’s capacity of parsing the input and of developing implicit and incidental representations of the L2 through spoken meaningful interactions with native speakers, communicative tasks, exposure to enhanced input, corrective feedback, rehearsal and immersion (Long 2017). These teaching-related aspects are not just a matter for teachers and practitioners. They have all been found to impact human cognition and human memory to such an extent that they have

been now present in the agenda of cognitive science for decades (see section 5 and also Ullman & Lovelett 2016, Rastelli 2016). Unfortunately in the research agenda of GenSLA, the study of how teaching-related factors (other than teaching explicit grammar rules) modify memory and attention or modulate a learner's access to input and therefore impact the acquisition of grammar is largely absent. Hypotheses in this much hoped new stream of GenSLA research would be the following (among many others): can teaching maximize the contribution of cognition for the acquisition of those aspects which are no longer accessible to adult learners through UG? Can teaching make at least *partly* learnable (in the sense specified by Bley-Vroman 2009) also the features of the language that in theory cannot be learned in the adulthood? Can teaching enhance the probability that a learner can represent abstract grammatical categories out of the available input simply by tracking transition probabilities among items? We envisage that these and other questions are important and could be addressed within the framework provided by the MP. The MP and Chomsky's subsequent papers re-define the relationship between UG and the whole cognitive system. In sections 4 and 5 we explain why the language classroom is a good testing ground to observe how UG and non-linguistic factors (especially frequency) can divide the labor of language acquisition in adulthood. In the remaining of this section we focus on the MP and its relevance for language teaching.

### 3.2 *The Minimalist Program*

Chomsky's (1995) MP and subsequent papers concern, to a much greater extent than was done in the past, how the Faculty of Language (FL, henceforth) is accommodated into the general properties of the mind and the other way round. The term «modularity» does not mean that the FL is completely encapsulated. First, the FL too is supposed to include a cognitive system that stores information (Chomsky, 2000a, 4). Moreover, the FL has to meet legibility conditions on linguistic expression which are not inherently linguistic, but are imposed by the mind (Chomsky, 2000b: 9, 2002: 61–70). The sensorimotor and conceptual-intentional systems themselves in fact predate the FL; that is, they are the conditions for the FL to work and to integrate with other modules in the mind. More technically, the sensorimotor and conceptual-intentional systems are the «boundary conditions» which are imposed on language by the architecture of the mind (Chomsky, 2012: 36–38). It might even be that some principles of optimal computation which are held to be at work in some linguistic phenomena (such as island conditions) are not coded in UG, but descend from more general laws of nature that define and constrain the scope and the length of constituent movement (Chomsky, 2009: 21). According to Yang and Roeper (2011), the MP has forced researchers to reconsider the relationship between the FL and the general cognitive and perceptual system. This marks a shift from the earlier inclination to attribute the totality of linguistic properties to UG. Chomsky (2007b)

explains that while in the past the problem was how much must be attributed to UG to account for language acquisition, the MP now seeks to establish how UG is reduced to minimal means<sup>3</sup>, yet with maximal effects, while relying on general domain cognitive principles. Some general-domain learning mechanisms «shift some explanatory burden out of the innate UG device» (Yang & Roeper, 2011, 555). Within the MP framework, the attention of generative developmental linguists can be drawn to some algorithmic mechanisms of language acquisition with the aim of observing how probabilistic distributions such as transition probabilities (TP) and variously modeled associative patterns can operate over grammatical hypotheses which are domain specific. We return on this point in section 5, where we discuss a recent definition concerning which properties of the L2 can be taught and learned and which ones cannot.

### 3.3 *The three factors for language design*

Chomsky (2005, 2013; 2014; 2017) describes three factors whose interaction determines the (I-)languages attained by speakers. These factors are (i) genetic endowment, (ii) experience (the input) and (iii) language-independent principles. The latter have been defined recently as organism-independent' principles – distinct from other cognitive processes – which abide with the laws of nature and pre-exist the FL (Chomsky 2017, p. 2). Among them are listed the principles of computational efficiency, principles of hypothesis formation and principles of data analysis. In another venues, Chomsky (2007a) specifies that the laws of nature which constitute the «third factor» include: (a) memory limitation on storage; (b) the need to externalize; (c) the constraints on linearization; and (d) the effect of word frequency and word repetition on the ease or difficulty of neural activation (on this last point, see also Paradis 2004; Shtyrov et al., 2010). Chomsky does not address how the three factors can be arranged in adult SLA, and of course the theory is not oriented specifically for L2. Therefore we can have only indirect implications for L2. UG – as being the initial state of the FL<sup>4</sup> – is designed by genes, triggered by the input and rooted in the architecture of the brain. The three factors altogether «enter into the growth of language in the individual» (Chomsky, 2005, p. 6), thus accounting for language learnability. Humans can acquire any language(s) because they are biologically endowed to do so, because they can find all that is necessary in the input and because the architecture of their mind/brain supports the learning, storing and retrieving of any kind of knowledge (language comprised). The analysis of the three factors for language design can suggest new directions where GenSLA can move ahead, well beyond traditional generative topics and also beyond the topic of the effectiveness of teaching explicitly the rules of grammar. For instance, if adult

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<sup>3</sup> The basic operations of Merge and recursion, and a feature template ([F]) (Biberauer 2017).

<sup>4</sup> And of course also and the general theory of (I-) languages

SLA is different from children SLA, this could be not just because adults have incomplete or no access to UG, but because the ways in which the cognitive system interact with the FL may change depending on a learner's age. Not only does the mature cognitive system capitalize on a learner's experience with the L1 and on a different availability of memory resources, but also the way in which learners rely on statistics too changes with age (e.g. Yang et al 2017).

#### 4 The «three factors» and the language classroom

The language classroom is a privileged point for observing how the three factors for language design may interact in adult L2 acquisition. First, in the language classroom the input to which learners are exposed can be manipulated and artificially enhanced (see section 5). In no other place can the frequency factor be experimentally controlled for and its effects observed for such long periods and to this extent (surely not in the language lab). Knowing whether adult learners through classroom practice can resort to «statistical patches» (Bley-Vroman 2009) where supposedly UG fails could be of great interest for genSLA. The second reason is that the language classroom (like no other place on earth) normally incorporates more or less extensive practice, such as drilling and repetition. This kind of practice has been shown to impact on the functioning of the memory system and the functional organization of the brain (Shtyrov et al 2010, Paradis 2004). The third reason is that corrective feedback too – another exclusive feature of the classroom – has been shown to affect how new implicit linguistic knowledge is incorporated (Davidson & Indefrey 2011). In the last section of this paper we focus on how the frequency factor can be modulated in the language classroom in order to test some generative assumptions about what can be derived from the input and be eventually learned and what cannot.

#### 5. Statistical and grammatical learning

VanPatten & Rothman (2015) divide language in three categories. Category I concerns the aspects of the language that are derived only from UG properties, that is, from our common biological (genetic) endowment for language. These aspects – such as the Overt Pronoun Constraint<sup>5</sup> - are not taught, cannot be induced from the input and cannot be learned. Category II gathers aspects of the language «that are derived, but not learned». For instance, a learner of a null subject language such as L2 Spanish – once the parameter is set on the [+null subject] value – comes to know for free from the input that expletive subjects – such as those in weather expressions in Spanish – are prohibited (e.g. *\*ello està lloviendo* ‘it is raining’). Category III comprehends aspects of the language that are

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<sup>5</sup> The OPC is a universal restriction that blocks co-reference between an overt embedded subject and the subject of the matrix clause like in the Spanish sentence *\* Cada hombre<sub>i</sub> piensa que el<sub>i</sub> es muy inteligente*

learned basing on the frequency of items in the input. The pragmatic value of the alternation between overt and null subject pronouns (in the  $\pm$ Topic Shift conditions) is an example of this kind. Provided that this subdivision is theoretically valid, we wonder whether it is also testable experimentally. Are those L2 features belonging to category I and II really impermeable to a significant variation in the amount and in the quality of input *adult learners* (italics added purposely) may be exposed to? Are there by chance «statistical patches» available to adults also for those allegedly unlearnable L2 features? Can the acquisition of features belonging to category III be accelerated if learners are exposed to statistically enhanced input in the classroom? To our knowledge, generative L2 studies in which the frequency of both (supposedly) learnable and unlearnable items has been controlled and statistically manipulated to test their acquisition in adulthood still await to be done. If anyone ever dared in the future, the language classroom would be a perfect pitch to run such experiments.

### 5.2 *The frequency factor in adult SLA*

Frequency of items is one of the most powerful predictors of their learnability, regardless of a learner's age. Frequency – explicitly acknowledged also by Chomsky to be one central component also in language – innervates all aspects of human cognition. The generative study of language acquisition has paid neither sufficient nor systematic attention to the role of frequency (Yang et al 2017; Rankin and Unsworth 2016). This delay is partly motivated by the idea – still strong in some generative circuits – that «grammar is grammar and usage is usage» (Newmeyer 1993). Whether the resistance to investigate input is theoretically motivated or not, in research on adult SLA the delay in factorizing the input by means of proper statistical models is harmful for a scientific enterprise and no more tenable. Bley-Vroman (2002, 212) articulates the point in the following terms:

*“Suppose we concede that human knowledge of language may not make direct, central use of frequency in production and comprehension. Might there, nonetheless, be a place for frequency in second language acquisition? Here, the arguments for frequency effects are much stronger. In order for something to be acquired, it must be encountered (or deduced from something encountered). Something that does not occur, or occurs only rarely, is, ceteris paribus, less likely to be encountered and “noticed” than something that occurs frequently. Put somewhat differently, the target of acquisition is not knowledge of frequency; rather, the (epiphenomenal) statistical structure of the input may affect acquisition”.*

We believe it is time for GenSLA to engage in an upfront manner with the hypothesis that statistical manipulation of the input and cognitive learning principles may impact on how both the peripheral and the core properties of the L2 grammar are learned. Non-generatively oriented research has long been observing two important learning mechanisms linked to cognitive processes. These

mechanisms are boosted when the frequency with which items would naturally occur in the input is artificially manipulated by researchers. One process is called «contingency learning». It occurs when language learners are repeatedly exposed to prototypical exemplars of a category rather than to members of that category that are sparse randomly in naturalistic input. The other one is called «category formation». It occurs when learners are exposed to an input where the repetition of a given target structure encompasses a controlled high degree of variation at definite points of that structure. Again, we maintain that the language classroom – and not only the lab using artificial languages – is the optimal place where both such hypothesis can be tested.

### 5.3 *Contingency learning in the classroom*

Contingency learning is learning based on the peculiar (not yet readily generalizable) features of a given situation. In language, «situations» are the sentences that learners encounter every day in the written and spoken input. These sentences are made of isolated words, chunks and smaller parts (affixes, suffixes). Within the limited number of sentences a learner may encounter in the input, some words or parts of words co-occur with above than average frequency. After a certain amount of repeated exposure to those sentences, human cognition – crucially, not UG<sup>6</sup> – will naturally drive L2 learners to interpret the occurrence of one item as a probabilistic cue for the occurrence of the other. This predictive phenomenon is called the «cue-outcome association» and it can be measured with bidirectional or unidirectional association scores such as log-likelihood, (pairwise) mutual information or  $\Delta PI$  (delta-pi). For instance if one predicate is often at the past perfective, especially initial L2 learners will tend to link the presence of the perfective morpheme to that particular verbal lexeme. In such a case, it is said that the acquisition of the past perfective is «contingent» on the presence of the lexeme. Only in subsequent developmental steps the learners will eventually learn to consider the morpheme and its functions in isolation, that is, independently of the verbal lexeme in which it occurs most frequently<sup>7</sup>. In this view, contingency learning developmentally precedes a learners' abstraction and generalization of the functions of the morpheme. The consideration for the «three factors for language design» drives us to think that – if such a contingency learning mechanism is entrenched in human cognition – then it must be somehow accommodated also into the FL (and the other way round). This is a logical necessity: there must be an interface that allows contingency learning and UG to interact when a L2 is acquired. If teaching cannot impact UG directly, maybe it can shape this interface indirectly. For instance, the acquisition of some L2 grammatical features in adulthood can be accelerated or even made possible not by asking instructed learners to abstract away

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<sup>6</sup> The same phenomenon holds in fact well beyond language, for any kind of signals in the semiotic system: sounds, lights, noises, shapes, physical phenomena.

<sup>7</sup> This also bears on the so-called «emergence criterion» debate, see Rastelli (in press).

the grammatical features from concrete situations, but first by enhancing learners' natural tendency to consider initially just the contingency of items. This is precisely the position held by some non-generative scholars (e.g. Wulff et al 2009). The hypothesis that an initial, statistically-modulated contingency learning may impact on the subsequent generalization of grammatical features can be adopted by genSLA linguists and easily implemented in the L2 classroom. Take, for instance, the perfective vs imperfective distinction in the past tense of languages such as Spanish or Italian. Past perfective is held to be contingent upon inherently telic verbs because inherently terminative telic verbs – such as *arrivare* 'arrive', *cadere* 'fall', *morire* 'die' – are prototypical of perfective (bounded) events (Andersen and Shirai 1996). In UG theory, telicity of predicates is a parameter which is sensitive to crosslinguistic variation (Slabakova 2001). Manipulating the quality of input by exposing L2 learners of Italian to prototypical exemplars (rather than to random input) could facilitate the process of parameter resetting and ultimately the acquisition of all abstract aspectual distinctions that falls from it.

#### 5.4 *Category formation and variation sets in the classroom*

«Category formation» is another central asset of human cognition. It is the learner's capacity of putting together and consider the items that share one or more aspects, regardless of other dissimilarities. These aspects may range in their degree of abstractness: from shape, sounds and color to function, position in a sequence, co-occurrence, conditional probability and causal relationship. If our reading of the «three factors» is correct, then also the capacity that allows such category formation in humans predates UG. In some sense, this capacity may even allow UG play its part in L2 acquisition in adulthood. Category formation in language acquisition is a learner's capacity of attributing a word a category membership. Note that – unlike in non generative approaches such as usage-based or emergentist approaches – we maintain that abstract categories are not «properties that emerge from usage» (Ellis and Colling 2009) of the input», but properties that predate the input. Categories such as «noun», «verb», «tense», «nominative», «pronoun» are UG-driven, but the process of attributing L2 items a membership – and also of extending this membership by analogy – to these categories is a cognitive, non linguistic one. Some non-generative studies suggest that it is possible to impact on how L2 syntax and abstract grammatical categories are learned by controlling and modulating the amount of variation in the input L2 learners are exposed to. A key factor in ensuring category formation and learning is high structured variability in the input. Cognitive science showed that subjects learn to recognize the same object more efficiently if this object is repeatedly presented in a highly variable context while keeping the same function(s). High contextual variability ensures that subjects learn to ignore the specifics of the object, and rather learn to extract more general

principles about object category (see Bavelier et al 2009 and references quoted there). Onnis et al (2008a; 2008b) hypothesize that L2 learners massive exposure to «variation sets» can maximise learners' ability of category formation out of the available input<sup>8</sup>. Variation set is the partial overlap of a sequence of utterances which occur repeatedly in an array of space/time which is significantly shorter than that offered in naturalistic input. For instance, given Sentence (1), sentences (2)-(5) form its variation set:

- (1) *You got to push the kids to school*
- (2) *push them*
- (3) *push them to school*
- (4) *take the girls to school*
- (5) *drive them to school*

This variation set (modified from Onnis et al 2008b) focuses on the formation of the category «pronoun» in a learner's mind. The item «them» alternates with sequences «the kids» and «the girls». This alternation would allow learners to implicitly record which features «them» share with the two NPs (postverbal position and syntactic object function) and what features instead are irrelevant in English (gender). When different distributional properties are linked to the pronoun through repeated exposure to variation sets, then its functions are abstracted away and eventually acquired. Again, language classroom is a place where the mechanism of variation set can be expanded, exploited and practised well beyond the possibilities that are offered by naturalistic input.

## 6. Conclusion

We put forth an alternative criterion of L2 learnability-teachability with respect to that proposed by VanPatten & Rothman (2015). The first factor (biological endowment) is not designed in such a way that it can determine alone what can (because subject to parametric variation) and cannot (because it abides with universal principles) be learned. Since UG is framed within human cognition, then general laws such as contingency and category formation will always underlie, support and impact the learnability of whatever gets eventually learned. Does this mean that every aspect of the L2 can be learned and taught also in adulthood? We suggest an alternative way to address this question: the crucial difference lies between which L2 grammatical properties can be learned statistically and which ones cannot be learned statistically. For instance, those aspects of the second

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<sup>8</sup> Onnis et al. (2008b) report that about 20% of child-directed speech appears with a variation set. They claim that this mechanism both facilitates word segmentation in continuous speech and identifies phrasal constituents.

language which require a computation over invisible features (e.g. filler-gap dependencies, island constraints, null subjects) cannot be supported by statistics and therefore could be more difficult to learn than aspects that imply counting (and statistical tracking) over concrete, visible instances (e.g. overt stem-affix alternation in morphology, Rastelli 2014). This hypothesis implies that the relationship between grammatical and statistical learning is reconsidered. Charles Yang (2010) asked rhetorically «who's afraid of George W. Zipf?». We definitively are not.

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