Redundancy, Deficiency and Grammar Discovery: From the Possible to the Learnable via Tolerance

Dalina Kallulli (University of Vienna), Ian Roberts (University of Cambridge) & Charles Yang (University of Pennsylvania)

1. Since Chomsky (1995), the Borer-Chomsky Conjecture has been taken to define the parameters of UG. It is usually formulated as in (1):

(1) All parameters of variation are attributable to differences in the formal features of the functional heads in the Lexicon.

While (1) has the merit of clearly associating parametric variation with lexical items and indeed with a subset of lexical items, namely functional heads, it leaves open the question of the nature of formal features. Certainly the features in (2) are among the class of variable formal features:

(2) φ-features, Case features, categorial features, EPP-features, wh-features, …

(2) is at best an incomplete extensional definition of the set of formal features. No intensional definition of formal features has been put forward, to our knowledge. Such a definition should, for clarity, have the Tarskian form in (3):

(3) F is a formal feature of UG if and only if *p*.

We can then ask what the content of *p* in (3) is. At present there is no clear answer to this, which constitutes a serious problem for the theory as it currently stands, since formal features play a central role, e.g. in the Agree operation, labelling, etc., in addition to the BCC itself.

We propose the following alternative to (1):

(4) Parametric variation arises from the interaction of **Redundancy** and **Deficiency** of formal features of functional heads.

We propose the following definitions of **Redundancy** and **Deficiency** (note that these are somewhat different from those in Onea et al. 2023):

(5) a. **Redundancy** (**$\mathfrak{R}$**): a feature is redundant if it is invisible to LF.
b. **Deficiency** (**$\mathfrak{D}$**): a feature is deficient if it is invisible to PF.

So we restate (3) as (3´):

(3´) F is a formal feature of UG if and only if F is **$\mathfrak{R}$** or **$\mathfrak{D}$**.

2. The set of possible parameter-settings defines the set of possible I-languages, hence this set is characterised by variation in **$\mathfrak{R}$** and **$\mathfrak{D}$** of formal features. But, as Legate and Yang (2025: 51) point out, "attested grammars lie in the intersection between the possible and the learnable". The set of parameter settings defines the possible; the learnable is defined by algorithms that implement Yang's (2016) Tolerance Principle (TP), stated in Legate & Yang (2025: 16) as (6):

(6) A potential generalization *R* over a set of *N* unique types is productive if the cardinality of the positively attested subset is at least $N - \theta_N$ where $\theta_N = N/\ln N$. Otherwise the attested subset is memorized but *R* does not generalize.

(Here "ln*N*" is the natural logarithm of *N*). The TP is the core of learning theory, since it gives a precise definition of the "tipping point" from a collection of observations to a generalisation over those observations, where generalisations are statements conforming to UG. The TP makes possible a return to discovery procedures as the mechanism of language acquisition: the child **discovers** the set of parameter values underlying the linguistic data it is exposed to. Since the acquirer **discovers** rather than **compares** possible grammars, there is no role for an evaluation metric in this approach. This represents a major break with the post-1957 generative tradition, a return to Chomsky's earlier conception of these questions armed now with a learning theory based on the TP. We show how this approach fares in relation to some well-known parameters.

3. The TP can, given one natural but non-trivial assumption about person-number agreement marking, provide exactly the desired account of rich agreement, consistently predicting which languages are NSLs and which aren't. In determining the NSL property, take *R* to be the

generalisation that all person-number combinations must have distinct features and therefore the simplest mapping to PF is distinct inflectional exponence of these features. *N* will therefore be 6 (in languages with a separate dual number, *N* would be 9). The exceptions *e* are non-distinct person-number forms; such forms violate the rich-agreement principle just stated. The features agree, and are therefore a case of $\mathfrak{R}$ (in the form of uninterpretable features, absent at LF). Non-distinct forms arise through impoverishment rules, and as such are $\mathfrak{D}$. So the null-subject phenomenon is a case of parametric variation predicted by (3´). In Italian there are 7 synthetic paradigms (present, imperfect, *passato remoto*, future, conditional, present subjunctive and past subjunctive). So $N = 6x7 = 42$, $\theta_N = 42/3.74 = 11.23$. Of these 42 forms, 37 are distinct. So *e*, the difference between the number of possible distinct forms and the actual number of distinct forms, is 5. This is less than 11.23, so Italian is correctly characterised by the TP as an NSL. Compare French, with 6 synthetic paradigms (the past subjunctive is moribund), so $N = 36$, and therefore $\theta_N = 36/3.58 = 10.06$. There are 15 distinct forms so $e = 36\text{-}15 = 21$, a number greater than $\theta_N = 10.06$, so the TP characterises French as lacking rich agreement, and therefore a non-NSL. German has 4 synthetic paradigms (present, preterit, subjunctive I and II) so $N = 24$ and $\theta_N = 7.5$. There are 10 distinct forms, so $e = 14$, so German is correctly predicted to be a non-NSL. Icelandic, like German, has 4 synthetic paradigms too so $N = 24$ and $\theta_N = 7.5$. Weak verbs have 6 distinct forms (Thráinsson 2007: 8-9) and so $e = 18$. Therefore, Icelandic is predicted to be a non-NSL. We demonstrate the success of this approach across the rest of Germanic and Romance, as well as Welsh. The TP thus shows us how the acquirer discovers the value of the null-subject parameter in its language.

4. Word-order variation exhibits $\mathfrak{D}$, if rollup is triggered by a "weak" category in the sense of Chomsky (2015). Building on Greenberg (1963), Dryer (1992) showed, from a sample of 625 languages from all over the world, that there are 17 "correlation pairs" (VO/OV, AuxV,VAux, etc), predictable from the order of Verb and Object. The TP can enable us to determine the true pattern of a disharmonic language if *R* is the generalisation that languages are harmonic and *N* is the set of correlation pairs; so $N = 17$, $\theta_N = 6$, so if 11 pairs show the same directionality, then that defines the word-order type for that language. For example, according to Huang (1982/1988), Mandarin is head-initial in all categories other than NPs. That single exception is tolerable and so Mandarin can be characterised as head-initial. We investigate the wider predictions of this approach, especially given evidence in relation to the ordering of nominal modifiers (mainly numerals and demonstratives) that what were long considered canonical head-final languages such as Japanese and Korean are at least partially disharmonic (see Simpson 2022). But if there are only two head-initial categories (DemP and NumP), these languages are nonetheless characterised as head-final.

5. Schifano (2018) argues that Verb movement is determined by the Paradigmatic Instantiation (PI) of Tense, Mood and Aspect inflection, where PI involves maximal exponence of the relevant features. As with the null-subject parameter, $\mathfrak{R}$ and $\mathfrak{D}$ are involved, $\mathfrak{R}$ because Verb movement involves Agree between clausal functional heads and the Verb, $\mathfrak{D}$ because impoverishment rules eliminate distinct exponents. The TP functions analogously here to the case of null subjects too. So, following Schifano, we predict (Peninsular) Spanish to have the highest degree of PI, the morphologically richest set of TMA inflections, and therefore the lowest Verb placement, with French the opposite on all counts and Italian and Portuguese intermediate cases. English lacks Aspect/Mood inflection entirely and has highly impoverished Tense marking, therefore PI is not relevant here and the lexical Verb never leaves vP.

6. All of the cases studies above contribute to the overarching theoretical goal of developing the discovery-driven approach to language comparison and acquisition. The consequences of this work for linguistic theory are very far-reaching indeed: to name but one, the result that certain functional heads must be maximally specified in order for the TP to enable the discovery of the correct grammar. This kind of maximal specification is fully compatible with an overall

minimalist architecture of grammar of the kind commonly assumed in current syntactic theory. This work profoundly alters our conception of Universal Grammar.

References

Chomsky, Noam. 1995. *The Minimalist Program*. Cambridge, MA: MIT Press.

Chomsky, Noam. 2015. Problems of projection: Extensions. In Elisa Di Domenico, Cornelia Hamann and Simona Matteini (eds.) *Structures, Strategies and Beyond: Studies in honour of Adriana Belletti* 3 – 16. Benjamins.

Dryer, Matthew S. 1992. The Greenbergian word order correlations. *Language* 68: 81-138.

Greenberg, Joseph H. 1963. Some universals of grammar with particular reference to the order of meaningful elements. In Greenberg, Joseph H. (ed.) *Universals of Human Language* 73-113. Cambridge, Mass: MIT Press.

Huang, C.-T. James. 1982. Logical Relations in Chinese and the Theory of Grammar. PhD Dissertation, Massachusetts Institute of Technology.

Huang, C.-T. James. 1988. Wǒ pǎo de kuài and Chinese phrase structure. *Language* 274-311.

Legate, Julie and Charles Yang. 2025. A Null Theory of Movement. Mansucript, University of Pennsylvania.

Onea, Edgar, Boban Arsenijevic, Daniel Büring, Katharina Felka, Stefan Heidinger, Dalina Kallulli, Eva-Maria Remberger, Albert Wall, Susanne Wurmbrand. 2023. Language Between Redundancy and Deficiency. Special Research Area funded by the Austrian Science Fund. (https://sfb-redundancy-deficiency.uni-graz.at/en/our-research/)

Schifano, Norma. 2018. *Verb Movement in Romance: A Comparative Study*. Oxford: Oxford University Press.

Simpson, Andrew. 2022. Revisiting the structure of nominals in Japanese and Korean. *Natural Language and Linguistic Theory* 40: 573–597.

Thráinsson, Höskuldur. 2007. *The Syntax of Icelandic*. Cambridge: Cambridge University Press.

Yang, Charles. 2016. *The Price of Linguistic Productivity: How Children Learn to Break the Rules of Language*. Oxford: Oxford University Press.