CHAPTER 6

Languages and other abstract structures

Ryan M. Nefdt
University of Cape Town

My aim in this chapter is to extend the Realist account of the foundations of linguistics offered by Postal, Katz and others. I first argue against the idea that naive Platonism can capture the necessary requirements on what I call a 'mixed realist' view of linguistics, which takes aspects of Platonism, Nominalism and Mentalism into consideration. I then advocate three desiderata for an appropriate 'mixed realist' account of linguistic ontology and foundations, namely (1) linguistic creativity and infinity, (2) linguistics as a theory of types (and not tokens) and (3) independence but structural respect between language and the linguistic competence thereof. My own brand of mixed realism, what I call *ante rem* realism, is defended along the lines of an *ante rem* or non-eliminative structuralism, the likes of which has been offered for mathematics by Resnik (1997) and Shapiro (1997). In other words, grammars describe a mind-independent (but not necessarily unconnected) linguistic reality in terms of linguistic patterns or structures also known as natural languages. I further amend this picture to allow for the possibility of a naturalistic account of language acquisition and evolution by arguing against a particular view of the type-token distinction.

Keywords: foundations of linguistics, ontology, linguistic realism, Platonism, philosophy of mathematics

1. Introduction

The dominant picture of the foundations of linguistics and the ontological status of linguistic objects is provided by the conceptualism founded by the generative movement of Chomsky (1965). On this account, languages are mental states, or I-languages, of the individual language users. To 'cognize', or more controversially to *know*, a language is thus to be in a particular cognitive state of the language faculty. This is a physicalist view. All talk of the mind or mental states is just

DOI 10.1075/slcs.196.06nef

physical talk about the brain at a different level of description (see Chomsky 1986). Hence linguistics is really biolinguistics and is to be subsumed by neuroscience or biology itself.

In the wake of this picture of the foundations of linguistics, Linguistic Realism emerged. Drawing strength from the analogy with mathematics (specifically arithmetic and set theory) and issues within ontology that proved difficult for a physicalist account of the science (in its current form at least), Katz (1981), Katz and Postal (1991) and most recently Postal (2003) offer a radically different account of the objects of linguistic theory and the place of its science. It is my purpose among other things to show that this alternative holds genuine insights and approaches the field with bold honesty in interpreting linguistics as *it is* rather than as we *hope it to be*.

In this chapter, I will not mount a direct attack against Conceptualism. Rather I will take seriously the challenge presented by Platonism while attempting to develop a novel account which makes use of some of its core features. In many cases, I think the words of Katz and Postal lend themselves to my account more so than to naive Platonism (see Section 4).[1] I plan to depart from their picture to adopt a mathematical structuralist analog for linguistics itself. However, in so doing I will take a route which separates my view from Realism proper in linguistics to a rather more mixed account. Here, I take Realism to be the view that the subject matter of linguistic theory is a mind-independent realm of objects not purely characterisable in strictly physicalist terms.

Specifically, the strategy I plan to employ will be to identify three essential desiderata or properties of natural language for which any mixed realist theory of linguistic foundations and ontology ought to account. These properties stem from critiques of the biolinguistic or generative program offered by Realists such as Katz and Postal (and Nominalists such as Devitt). I will then show that one version of Platonism offers an approach to dealing with these desiderata at too large a cost. Finally, I shall suggest a non-eliminative structuralism for the foundations of linguistics as a competitor in accordance with a similar interpretation of mathematics (Shapiro 1997; Resnik 1997), thus maintaining an analogy with the formal sciences.

In the next section, I draw from the Platonistic (and Nominalistic) critiques of generative grammar in identifying the essential characteristics of a mixed realist theory of linguistic foundations. In Section 3, I hope to show that one variety

1. As pointed out to me by David Pitt, the Platonism of Katz and Postal is by no means the only game in town. Thus, in keeping with this volume, I reserve the term 'Linguistic Realism' for their account and Platonism for a more general ontological view found in metaphysics.

of Platonism cannot meet this challenge. In Section 4, I describe an alternative view which might fare better with these requirements and in addition offer a potentially more naturalistic account of the foundations of linguistic theory and its objects. This account offers a mathematical structuralist foundation for linguistic theory in which linguistics is a science of natural languages conceived as quasi-concrete structures (in terms of Parsons 1990). In order to tailor the mathematical structuralism of Shapiro (1997) and Resnik (1997) to linguistics, viewed here as a semi-empirical enterprise (or semi-formal, depending on your perspective), I argue against a particular view of the type-token distinction currently prevalent within the philosophy of language and linguistics. This is the primary task of Section 4.3.

2. Three desiderata for Mixed Realism

In this section, I shall outline three important properties of natural language that a Mixed Realist theory of linguistics should consider. Most of these properties are familiar from various critiques of the generative or biolinguistic program. The first argues for a central place for the concept of linguistic infinity, despite the fact that linguistic infinity is potentially irrelevant for linguistic creativity. The second concerns the so-called correct 'level of abstraction' for the objects of linguistic theory, namely sentences. Lastly, the final property deals with the relationship between a grammar as theory of linguistic structures and a theory of competence. While it denies their identification (in line with Platonism), it also argues for a particular account of their interaction (in line with Devitt 2006), namely that linguistic competence should respect aspects of the structure rules of the grammars and *vice versa*.

2.1 Linguistic creativity and infinity

2.1.1 *Creativity*

One of the most discussed properties of natural language is that of linguistic creativity (Drach 1981; Chomsky 1982; D'Agostino 1984; Pullum & Scholz 2010). Despite being assumed to be a cross-linguistic universal component of competence, the notion has not always been clearly described. Part of the problem is that the phenomenon of creativity has not always been separated from the concepts and terms used to model it, such as 'linguistic infinity', 'discrete infinity', 'generatively enumerable' etc.

Infinity issues have dominated the foundations of linguistics and often informed the rejection or acceptance of various frameworks (Langendoen &

Postal 1984; Katz 1996). For instance, as Searle (1972) notes "[w]ithin structuralist assumptions it is not easy to account for the fact that languages have an infinite number of sentences". For years, Chomskyans have placed the need for a computational system with recursive elements at the forefront of their linguistic project. Katz (1996) argued that due to the infinity of natural language, both Bloomfieldian Nominalism and Chomskyan Conceptualism fail as interpretations of linguistics because there are simply not enough concrete tokens to capture the generalizations of grammatical theories (essentially restaging the debate between nominalists and Platonists within the philosophy of mathematics). Langendoen and Postal (1984) produced a proof to the effect that the cardinality of natural language exceeds generative capacities, and thus standard accounts of competence, in being of the same magnitude as a proper class (see Langendoen (2018) for a refinement of this result).

However, it is not at all clear what linguistic creativity is or even if it requires linguistic infinity (and in fact the contrary has been convincingly argued by Pullum & Scholz 2010). I will not rehash this entire debate here, I will however try to make sense of the creativity claim and determine to what extent it goes hand-in-hand with the theoretical posit of infinity. My conclusion will be that infinity should in principle be accommodated within an account of the science of linguistics for reasons other than those usually offered for creativity, but only if one is a Realist.

What is linguistic creativity? A natural starting point to this discussion can be found in the comments of Chomsky who placed this property at the forefront of the discipline. For instance, consider Chomsky (1964) and (1966) respectively.

> The central fact to which any significant linguistic theory must address itself is this: a mature speaker can produce a new sentence of his language on the appropriate occasion, and other speakers can understand it immediately, though it is equally new to them. (Chomsky 1964: 50)

> The most striking aspect of linguistic competence is what we may call the 'creativity of language', that is, the speaker's ability to produce new sentences that are immediately understood by other speakers although they bear no physical resemblance to sentences that are 'familiar'. (Chomsky 1966: 74)[2]

There are a few things to notice about the above quotations. The first is that there is no mention of the concept of infinity in either. Given that the number of expressions which language users actually encounter can only be finite, the above

2. This criterion is not very strong. Simple cross-linguistic and even intralinguistic evidence can cast doubt on it.

characterizations potentially allow for an upper bound on the capacity to produce new sentences i.e. a limit to creativity. The second thing to note is the idea that creativity so conceived involves the cognitive ability to interpret novel expressions without prior analogy. Note the emphasis on 'new' or unfamiliar sentences here. Part of the reason behind this insistence is to block Hockett-like accounts involving creativity by analogy. Hockett (1968) attempts to cast doubt on the ubiquity of linguistic creativity by suggesting that corpus data indicates that most sentences encountered in daily life are merely variations of a more commonly used/ heard set of sentences (perhaps a precursor to contemporary Construction Grammar accounts?). Chomsky, however, is careful to distinguish the creative 'use' of language from the 'creative aspect of language' itself. The former may indeed be constrained by various limitations but the latter allows for much more freedom of expression, at least in principle (see Chomsky 1982 for discussion).[3] Nevertheless, freedom of expression still puts us quite significantly shy of infinity claims.

Consider a statement from Chomsky (1972) in which the concept of 'indefiniteness' of size surfaces.

> Having mastered a language, one is able to understand an indefinite number of expressions that are new to one's experience, that bear no simple physical resemblance and are in no simple way analogous to the expressions that constitute one's linguistic experience. (Chomsky 1972: 100)

Again in the above quotation, empiricist or analogy-based accounts of creativity are explicitly blocked but the idea of an indefinite number of expressions is also introduced, denying the possibility of a fixed upper bound on creativity. It is at this stage that one may be tempted to introduce infinity into the picture. However, we are still some distance from requiring linguistic infinity for the notion of creativity under discussion.

Consider the example, presented in Pullum and Scholz (2010), of a standard *haiku*. A haiku typically involves 3 lines with a maximum of 17 syllables (5 in the first and last lines and 7 in the second). The possibilities for haiku creation are clearly finite, yet seemingly 'indefinite' in the required sense (somewhere in the region of 10^{34} in Japanese). As Pullum and Scholz (2010: 127) note, "the set is large enough that the competitions for haiku composition could proceed continuously throughout the entire future history of the human race […] without a single repetition coming up accidentally". This is meant to be a case for the non-necessity of

3. It should be noted Chomsky has admitted over the years that linguistic creativity might be in some sense inexplicable or one of the 'hidden mysteries' of the science (Chomsky 2009).

infinity for creativity. We can see that if we relax the parameters on composition, the cardinality of the creative capacity increases dramatically, yet we are still well-within the bounds of the finite.

A similar sentiment on the separation between creativity and infinity is suggested in Evans (1981).

> It is unfortunate that Chomsky's writings have led people to equate the creativity of language use with the unboundedness natural languages display. Linguistic creativity is manifested in the capacity to understand new sentences, and the speaker of a finite language such as the one I have described can manifest it. (Evans 1981: 327)

Evans provides us with a simple language (with 20 axioms linked to a finite vocabulary and a composition axiom) which (similar to a haiku case) allows for a wide range of combinatorial expression (100 sentences) and a disposition towards the understanding of novel expressions. So far, we seem to have a few core components of an account of linguistic creativity, of which infinity is not one. These components include, genuine novelty in terms of non-analogy, indefiniteness in number and flexible composition.[4] It seems to me that all of these features can be comfortably accommodated by means of the principle of compositionality.

The principle of compositionality states that the semantic value of a complex expression is determined by the semantic value of its parts and their syntactic combination.[5] For one, compositionality is not usually thought of as a property of a given semantics or syntax. Following Montague, it is defined as a relationship between a syntax X and a semantics Y, often modelled as a homomorphism between generated algebras (see Janssen 1986 for details).[6] Clearly creativity is an important property of natural language and any theory of linguistics, realist or otherwise, should be able to account for it.

So at which point does infinity enter into the picture? The usual story is linked to recursion, iteration and infinite generation. However, I think this issue might go deeper than these specific mechanisms to the very idea of rule-following in linguistics and the philosophy of language.

---

4. Technically, 'indefiniteness' is not a property of Evans' example or the Haiku case.

5. This principle is also used in morphology.

6. The literature on compositionality is much too vast to go beyond an intuitive sketch here. Suffice to say that almost every aspect of its definition is up for grabs. See Shieber and Schabes (1991) for a promising account in terms of synchronous grammars.

2.1.2 *Rule-following and infinity*

In this section, I hope to show that realism places an added burden on linguistic theory in terms of infinity claims than do strictly physicalist frameworks. The idea that the theories of natural language are provided by rule-based grammar formalisms has held sway since the seminal *Syntactic Structures* (Chomsky 1957). Two related ideas informed both the inception of formal language theory and the centrality of syntax within the generative tradition in general. The first is that a language can be seen as a collection of sentences of finite length over a finite vocabulary and secondly that a grammar (viewed as a theory of language) generatively enumerates the sentences of that language. Chomsky (1959: 137) goes on to add "[s]ince any language *L* in which we are likely to be interested is an infinite set, we can investigate the structure of *L* only through the study of the finite devices (grammars) which are capable of enumerating its sentences". The rules or functions which we specify for a given language are informed by the specific constructions of the natural language under study.

Natural languages such as English allow for iterative constructions such as those involved in conjunction, subordinate clauses and adverbial modification. Consider the examples from Pullum and Scholz (2010: 114) below.

> It is evident that *I exist* is a declarative clause, and so is *I know that I exist*, and so is *I know that I know that I exist*; that *came in and went out* is a verb phrase coordination, and so is *came in, turned round, and went out*, and so is *came in, saw us, turned round, and went out*; that *very nice* is an adjective phrase, and so is *very very nice*, and so is *very very very nice*; and so on for many other examples and types of example.

The idea is that at no non-arbitrary point can we stop the chain of grammatical constructions; or rather that at no stage in the sentence production can we say 'this is no longer English'. Thus, natural language seems to be 'closed' under recursive rules such as the rules characterizing the constructions mentioned above. In this way, we are confronted, in the philosophy of language, with a parallel of the Sorites cases. Given the nature of certain vague predicates such as *bald* or *tall*, we cannot determine the point at which the predicate disapplies to an object (which can have effects on the validity of rules such as *modus ponens* or principles such as bivalence in certain systems used to model the phenomenon).[7] If indeed we are dealing with 'closure' principles as in first-order logic (FOL), then the generated set (or 'theory' in the logical sense) would be unproblematic and denumerably infinite. However, in the case of natural languages as they are used, things are generally not this

7. I thank Henk Zeevat for suggesting this possible connection to me.

precise. The recursive rules of formal languages do not perfectly capture the nature of natural language use. If they did, then there would be no difference between formal and natural languages, or between ideal competence and actual performance, but presumably there is such a difference. Natural languages as they are used are sloppy and imprecise, their rules are malleable and violable. More controversially put, there might indeed be a point at which a further iteration of *very* yields an ungrammatical sentence (to borrow a phrase from David Pitt, we might 'generate ourselves out of the language'). Nothing I am saying here depends on taking 'grammatical' to be a vague predicate (although I think 'acceptable' certainly is). The point is that recursion might indeed be a useful element of the grammars we use to model natural language constructions but it is not necessarily a feature of the languages themselves, *mutatis mutandis* for infinity. Of course, if we follow Postal, natural languages are sets, or sets of sentences, and indeed they are capable of such characterization.

An important element of the above characterization and connection with Sorites series is that of natural languages as concrete objects and linguistic rules as modelling something in the messy physical world. However, if we accept that linguistics is a formal science, concerned with abstract objects, similar to mathematics and mathematical logic, this limitation is lifted. On this account, the rules of our grammars specify (not model) the features of our natural languages, much like the syntactic rules of, say, propositional logic (PL) specify the *wff*s it generates. If sentences are not constituents of mental states or concrete tokens, then we are free and indeed required to treat the rules of our grammars as determining the structures of our languages. Generativists themselves often make use of this formal analogy, for instance consider Pinker (1994: 86).

> By the same logic that shows that there are an infinite number of integers – if you ever think you have the largest integer, just add 1 to it and you will have another – there must be an infinite number of sentences.

As Pullum and Scholz (2010) correctly counter, the case for the discrete infinity of the natural numbers is established by the axioms of Peano arithmetic which include a successor function (and an induction axiom schema), and there is no analogy of this operation in the case of natural languages. But a Platonist (or Realist) could insist that there are other mathematical avenues available to arriving at the requisite cardinality (denumerable infinity or α_0). Perhaps one could avail oneself of the idea of weak limit cardinals which do not require anything like a successor function to arrive at denumerable infinity. Postal (2003) has a somewhat nuanced argument for the connection between natural numbers and natural languages. He argues, by *reductio*, that if one assumes an upper bound on an iterative series of sentences in English, then one can show that its

logical implications (that the iterations stop at sentence *m* rather than *m*+1 or *m* – 1) cannot be met. The above reasoning is meant to show that the posit of an upper-bound or fixed upper limit on the set of sentences is to be rejected (this is also compatible with my suggestion above that such constructions are vague not infinite).[8] Nevertheless, the realist has no principled reason for rejecting the idea of closure operations in natural language nor that of languages as sets or collections of expressions (as Chomskyans genuinely adherent to the concept of 'I-languages' are wont to do). The original 'vastness result' of Langendoen and Postal (1984) is testament to the limits of logico-linguistic reasoning. Returning to Katz,

> [G]rammars are theories of the structure of sentences, conceived of as abstract objects in the way that Platonists in the philosophy of mathematics conceive of numbers […] They are entities whose structure we discover by intuition and reason, not by perception and induction. (Katz 1984: 18)

On this view, natural languages themselves are systems of these sentences, and the rules of the grammars governing their interaction are proven in the same way as we would prove theorems in number theory, such as Fermat's last theorem.[9] Thus, linguistic infinity should be an element of any realist account of linguistic ontology and the foundations of the science, notwithstanding its relation or lack thereof to creativity. If recursion is an aspect of our best linguistic theory (grammar) then recursive structures are aspects of linguistic reality. If the set of sentences of a given natural language is closed under conjunction or other recursive operations, then much like the case for formal languages such as PL or FOL, NL is discretely (and trivially) infinite. In Section 3.1. I will discuss how a realist might escape a strict reading of this infinity requirement while maintaining the rule-following commitment.

---

8. I am not sure that this argument necessarily entails infinity. Following Hockett (1968), consider the rules of any baseball game. It is easy to see that for any real game, the ultimate score could always have been higher or lower than it in fact was but this does not mean that the score of any baseball game is potentially infinite. I think the analogy here is not with the denumerable infinity of the natural numbers but rather with their 'countability' which can be finite in set theory (i.e. a finite subset of n). In addition, it assumes that no sequence of sentences has a maximal length.

9. For example, proving that $a^n + b^n = c^n$ is true for any positive integers where $n > 2$ might be a similar task to proving $a^n b^n c^n d^n$ where $n \geq 1$ is a string not accepted by a context-free grammar. But the former is certainly a different task from showing that Swiss-German is not such a language (see Shieber 1985 for details).

2.2 Of tokens and types

Another core component of the realist persuasion in linguistics is the emphasis on the correct 'level of abstraction' for the interpretation of its theories. Originally presented in Katz (1984), it has undergone some variation and revision in Katz (1996) and Postal (2003, 2009). Thus, there are a number of related strands to this line of reasoning and I hope to do them justice in this section.

The idea can be summarized as follows. The same species of problem that befell the nominalist or American structuralist project affects the biolinguistic or mentalistic one, namely they were pitched at an insufficient level of abstractness. Linguistic theory needs to posit grammars which can account for natural language properties at the right level of abstraction.

> Thus, with conceptualism [mentalism], as with nominalism, there is a possibility of conflict between a demand that grammars satisfy an extrinsic, ideologically inspired constraint and the traditional demand that grammars meet intrinsic constraints concerning the successful description and explanation of the grammatical structure. (Katz 1984: 195)

In order to correctly meet the 'intrinsic' constraints such as infinity, recursion and structural hierarchy, the psychological level is inadequately abstract on this view (another way to understand the quotation above is that grammars do not need to go beyond 'descriptive adequacy').[10] Therefore, we need to ascend to a higher level of abstraction to capture these linguistic properties. In the absence of a systematic correspondence between the formal structure and the physical system, an extreme interpretation of this problem could be expressed as a charge of a category mistake at the heart of the biolinguistic movement (or 'incoherence' in Postal (2009)). Thus, a physical system (a human brain) is not something capable of possessing properties such as infinity (or capable of description in terms of the set-theoretic merge operation). Mental states and physical tokens cannot be recursive or infinite, only sets and other mathematical objects are amenable to such description.

The problem does not disappear with the limitation of structure either. In the Minimalist Program (1995), Chomsky investigates the *minimal* structural requirements needed to explain the gulf between the child's initial state and the adult's later competence, as well as language evolution. This marks a departure from the putative complex linguistic architectures of the Extended Standard theory (*circa* 1970) and Government and Binding (Chomsky 1981) which posit various levels of representation and interfaces between these levels. Once again, the central

10. Katz and Postal (1991) argue that the psychological level is also inadequate for the task of interpreting the various necessities that are involved in linguistic theorising.

explananda of linguistics is to account for the perceived discrete infinity of linguistic expression and the hierarchical nature of syntactic organization. According to Minimalism, in order to explain these features, one needs to only posit a binary merge function which takes two syntactic objects and outputs one. Technically, there are two merge operations, *external merge* which takes two distinct objects as input and *internal merge* which allows embedding and thus allows for recursion. Furthermore, *internal merge* involves duplicating items within the operation. For instance, if we merge syntactic objects α and β to form the unordered set {α, β} and there is a γ such that γ is a member of α and we merge this object with{α, β}, we would have two copies of γ in the resulting structure (see Langendoen 2003 for more details). In this way, we are supposed to be able to account for all the usual movement operations with very minimal apparatus in the syntax (and various constraints on the operations).

Merge, however, is a set-theoretic operation. The universe of set theory (non-denumerably captured by the universe *V*) generally takes sets to be outside of space and time, finite or infinite, and abstract. Before continuing, it is important to clear up one potential confusion here. The objection is not supposed to be that mathematical models are being used to describe a physical system. This is a commonplace practice in science and does not presuppose that all mathematical modelling generates incoherent ontologies. The reason for the specific problem in the biolinguistics tradition can be couched in terms of the lack of a systematic correspondence between elements of the model and elements of the target system. Behme (2015) admits to the coherence of such accounts for a notion of mathematical modelling in physical systems. But she adds that such a story is not available for a Chomskyan concept of I-language since "there is currently no proposal providing a systematic correspondence between neurophysiological structures in the brain and the elements of the set-theoretic linguistic model" (Behme 2015: 33). What is more is that we have no idea how elements such as the set-theoretic operation of merge could correspond to neurophysical structures and furthermore it is argued that there in fact cannot be such a correspondence.

On the one hand, we want to explain discrete infinity, recursion and syntactic hierarchy through the all-encompassing set-theoretic operation of merge. On the other hand, we want to provide a naturalistic explanation of language in terms of the human brain and biology. Postal (2009) believes that these requirements pull in opposite directions and thus cannot be met in the same object simultaneously, namely an I-language. Thus, biolinguistics is stuck with an untoward or 'incoherent' ontology (at least at its current stage). Or as Postal (2003: 242) puts it "[t]he received view claims that an NL is something psychological/ biological […] a state of an organ […] And yet it has been unvaryingly claimed in the same tradition at issue that NL is somehow infinite. These two views are not consistent".

The move made by Platonists then is simply to raise the level of abstraction of sentences to that of sets and other abstract objects, thereby proffering a coherent ontology for the interpretation of linguistics. Returning to Katz,

> Sentences, on this view, are not taken to be located here or there in physical space like sound waves or deposits of ink, and they are not taken to occur either at one time or another or in one subjectivity or another in the manner of mental events and states. Rather, sentences are taken to be abstract and objective.
>
> (Katz 1984: 18)

Postal (2009) presents a similar argument to this effect. However, he follows Katz (1996) in making use of the type-token distinction. If linguistic theory or grammars were indeed about brain-states etc. as the biolinguist would have it, then the sentences of these theories would have to be at the level of tokens, not types (which are here conceived of as abstract objects). There are two issues with this position, he claims. For one thing, it seems out of touch with linguistic practice in which grammars usually deal with "island constraints, conditions on parasitic gaps, binding issues, negatively polarity etc." (Postal 2009: 107). Importantly, these accounts are rarely, if ever, informed by evidence from neuroscience or psychology (as one would expect if they were truly concerned with brainstates). Therefore, he concludes that these accounts are concerned with sentence types conceived abstractly.[11]

> Sentence tokens exist in time and space, have causes (e.g. vocal movements), can cause things (e.g. ear strain, etc.). Tokens have physical properties, are composed of ink on paper, sounds in the air […] Sentences have none of these properties. Where is the French sentence *Ça signifie quoi?* – is it in France, the French Consulate in New York, President Sarkozy's brain? When did it begin, when will it end? […] Such questions are nonsensical because they advance the false presupposition that sentences are physical objects. (Postal 2009: 107)

11. For Katz (1996) the abstractness concern in linguistics is a special case of the general problem of abstractness in the formal sciences. An account such as the strict finitism or 'inscriptionalist nominalism' characterized by the Hilbert program, for instance, failed as an appropriate interpretation of mathematics according to Katz. In order to capture the infinity of mathematics via the empiricist scruples of nominalism, only reconstructed language about the infinite is permitted, "mathematics is about mathematical expressions" (Katz 1996: 273). The objection is simply that to make sense of such talk, we need either expression types, which take us back to abstract objects, or expression tokens, which need to allow for unactualized *possibilia* which in turn are no less metaphysically suspect than abstract objects. Katz, however, neglected the vast literature on actualist reinterpretations of quantified modal logic, some varieties of which posit *contingently nonconcrete* objects in an attempt to avoid commitment to *possibilia*.

These considerations lead Platonists to conclude that linguistics is concerned with sentences on the level of abstract objects, in the sense of non-spatio-temporally extended entities. Truth in linguistic theory or in its grammars is then determined by correspondences between the sentences of the theory and these objects. Thus, there is some kernel of truth to the notion that linguistic grammars and the theories they inform do possess a formal and abstract level of description through the analysis of sentence types (or whichever basic unit with which one begins). Furthermore, a Realist account of linguistics should provide an appropriate interpretation of this aforementioned level of abstraction and linguistic practice as it is.

2.3 Mixed Realism and respect

The properties or desiderata of the previous sections emerged mostly from Platonist critiques of Mentalism. Thus, they pushed a specific agenda and ontological attitude. The next series of arguments stem from a very different ontological approach to linguistics, similar in its focus on *concreta* to mentalism but in line with Platonism in its rejection of representationalism or the idea that speakers of a language represent/ know/ cognize the grammar rules of their language. The chief proponent of what is called the 'linguistic conception' (as opposed to the 'psychological' of generative grammar) is Michael Devitt in his book *Ignorance of Language* (2006). Devitt claims to be a realist in some sense but not a Platonist. It might then be useful to consider his stance and its intersection with those of Katz and Postal. The goal of this section is to establish a *sui generis* position between Realism/ Platonism and Devitt's nominalism.

Given what I have said above, we might be tempted to consider Realism to be non-ontologically-committing (although this is not how it would be interpreted by Katz and Postal). One common claim between Linguistic realists and nominalists of Devitt's kind is that linguistics is *about* something outside of psychological reality. Theories of language, i.e. grammars, tend to describe this extra-mental reality and not the linguistic competence of speakers. In saying something more precise about what exactly this non-psychological reality is, these camps diverge. Platonists hold that it is an abstract extra-physical reality, while nominalists, such as Devitt, prefer a physicalist account. My own account will draw from aspects of both ontologies. Another way of putting this point is that both Platonists and Nominalists hold that language *qua* object of linguistic inquiry is not in the brain but where they say it is differs quite drastically from one view to the next.

However, the above characterization will lead to confusion. In the spirit of this chapter I will maintain the use of the term Mixed Realism to refer to the amalgamation of desiderata informed by Platonism and Nominalism.

So given the above characterization of Mixed Realism, unsurprisingly, part of the next desideratum of a mixed realist account of linguistic foundations will be the rejection of competencism or the view that linguistics concerns the psychological states of language users (what Devitt calls 'the psychological view'). Devitt (2008) describes his positon in the following way.

> [A]ccording to my 'linguistic conception' a grammar explains the nature of linguistic expressions. These expressions are concrete entities external to the mind, exemplified by the very words on this page. (Devitt 2008: 249)

I will follow Devitt one step further in adding another aspect to this desideratum and that is a notion of RESPECT between the posits of the grammars and the processing rules of competence.

> [A] theory of a competence must posit processing rules that respect the structure rules of the outputs. Similarly, a theory of the outputs must posit structure rules that are respected by the competence and its processing rules. (Devitt 2006: 23)

This is what Devitt calls the 'Respect Constraint'. This constraint is motivated by various examples, mostly designed to distinguish between mental competence in a particular act and the output of that competence. Although in the case of natural language these features are distinct, any of the former must respect the structures of the latter and *vice versa* according to Devitt. He goes on to describe his 'linguistic conception' or the view that "a grammar is about a non-psychological realm of linguistic expressions, physical entities forming symbolic or representational systems" (Devitt 2008: 203). Devitt claims that grammars of linguistics are true of linguistic reality (not to be confused with an abstract linguistic reality) and not human psychology. From this conception of grammars he defines his minimal position (M) below.

> A competence in a language, and the processing rules that govern its exercise, respect the structure rules of the language: the processing rules of language comprehension take sentences of the language as inputs; the processing rules of language production yield sentences of the language as outputs. (Devitt 2006: 57)

The onus is on the generativists or biolinguists to prove that we need more than this minimal posit, i.e. prove that representationalism is correct. This has been a notoriously difficult task, in most cases representationalism was merely assumed. In addition, early psycholinguistics was initially meant to determine the connection between the processing rules of performance and the grammar rules of competence. This was generally considered to be an unsuccessful venture (even by its own proponents at the time). Nevertheless, it is not my concern here to challenge Devitt's position from a conceptualist or mentalist perspective (see Collins 2007, 2008a, 2008b; Lawrence 2003; Rey 2006; Slezak 2007 for such arguments).

Unfortunately, there are a number of problems with this view, or Devitt's 'linguistic conception', in light of the other desiderata I consider and general issues about which a Mixed Realist might be concerned. For one thing, in this chapter (and Devitt's book) a lot is said about what linguistics is *not* about but so far we have not delved into the question of what linguistics *is* about and here lie the problems for the position I take in this chapter.

In the preface to *Ignorance of Language*, Devitt describes both his initial fascination with and initial resistance to linguistics. He states (of his thoughts during his graduate years) "Surely, I thought, the grammar is describing the syntactic properties of (idealized) linguistic expressions, certain sounds in the air, inscriptions on paper, and the like […] It rather looked to me as if linguists were conflating a theory of language with a theory of linguistic competence" (Devitt 2006: v). This thought is apparently the seed out of which the main ideas of the book grew. Now most Realists would agree on the last statement, in fact Katz (1981), (1984) and Postal (2003) stress the fallacy of conflating the knowledge of language and language itself allegedly present in generative linguistics. It is the first claim, that grammars are about 'sounds in the air' and 'inscriptions on paper', that seems to be at odds with Linguistic Realism (and Mixed Realism). Once again, we seem to be at the wrong level of abstractness. Concrete tokens are insufficiently abstract for the interpretation of most of what linguists do. We saw in the previous section that there is some kernel of truth to the type talk of Platonists and in so far as 'idealized token' means type, we are fine but I doubt that this is what Devitt has in mind.[12] To reiterate, grammars, on this view, describe structure rules which constitute representational systems outside of internal mental representational systems (but are respected by them). As we saw with the above characterization of (M), sentences are supposed to be inputs for processing and they are also outputs of processing, but what are sentences on this view? Are they physical tokens, 'inscriptions on paper' or 'sounds in the air', i.e. utterances? Surely not, since this would not be sufficient to interpret the theories of actual linguists as *per* Postal's objection in 2.2.

Another issue is brought out by Ludlow (2009: 394) when he claims that "while Devitt purports to be offering a proposal that is faithful to linguistic practice, the range of linguistic phenomena and explanation he surveys is limited". This limitation cannot, for instance, deal with postulates of covert material in syntax (which have no phonological expression), such as PRO (also see Collins 2007, 2008a) or traces and the like. If our structure rules concern physical tokens (sounds, writings etc.), then elements which do not overtly appear through these media pose a problem. Much of linguistic practice and methodology involves the use of assumed or

12. See quotation from Devitt (2008) above.

covert entities and items. Katz (1971) linked the Chomskyan revolution in linguistics to the Democritean revolution in early scientific thought in that it aimed to expose the underlying physical reality behind appearances.

Consider the PRO postulate in syntax. This element is a null noun phrase or a type of empty category which means it goes unpronounced phonologically. A common example is found in infinitival constructions in which PRO operates as a subject of infinitives, *Susan wanted John [PRO] to help her.* The behaviour of PRO is different from that of general anaphors, referring expressions and pronouns hence its need for its own category. PRO does not, however, figure in physical tokens as it is unpronounced.

On a related note, in Section 2.1.2, I argued that Mixed Realists have to take posits of the grammars (and their consequences) to be actual features of linguistic reality. Such posits include recursive structure rules and closure principles which seem to lead to infinity claims. Thus, either we need to be able to ascend beyond the level of physical tokens which fail to interpret such claims or provide a naturalistic account of infinity claims in linguistics (I attempt to do both below).

Lastly, despite the issues with the nominalism of this proposal, we will incorporate an element (or two related elements) from its core, namely that linguistics is the study of language not the study of linguistic competence (or knowledge) and that the study of language and the study of competence need to be connected by a RESPECT constraint (the latter is the specific contribution of Devitt's account).[13,14] My specific aim is to be able to tell a story about the production and comprehension of natural languages, even if linguistics itself is the independent study of language systems conceived of in a realist or nominalist manner. In this way, I hope to use insights from Platonism and nominalism to good effect. More on this task in the next section.

2.4 Taking stock

So far, I have been attempting to determine the key aspects of a Mixed Realist account of linguistics. I have argued that although potentially unrelated to

13. This moves in a direction that Realists of the Katz and Postal persuasion would deem unconvincing for a variety of reasons. One of these reasons is that linguistics need not concern itself with the 'knowledge of language' and only the language itself conceived of as an abstract object.

14. Seen in this light, Lewis (1975) can also be considered a Mixed Realist view. It posits that languages are abstract objects of a certain sort (functions from sounds to meanings) while holding that these *abstracta* model social patterns of linguistic behaviour in terms of truth and trust, i.e. a different take of the respect constraint.

creativity (which requires compositionality), linguistic infinity cannot be ignored by Realists. I affirmed the need to ascend beyond a level of physical tokens or mental ones in the interpretation of grammatical theory as argued by Katz (1996) and Postal (2009). And lastly, I accepted that linguistics is the study of a competence-independent linguistic reality but I restricted this claim by insisting (with Devitt 2006) that this reality be linked to linguistic competence *via* a structural respect constraint. The last aspect goes beyond Realism or Platonism. For clarity, I provide the list below as a guide for the ensuing discussion.

1. A mixed realist interpretation of linguistics ought to (a) account for creativity in terms of novelty, compositionality etc. and (b) account for the potential infinity (denumerable or otherwise) of natural language(s).
2. Linguistic theory is a theory of sentences at the level of types or more generally Mixed Realism needs to be pitched at the correct level of abstraction.
3. (a) Linguistics is the study of natural language, not the study of the knowledge of or competence in that language, and (b) grammatical structures (and rules) need to be respected by the structures of competence and *vice versa*.

What remains to be shown is that Platonism does not necessarily capture these three conditions on a mixed realist account of linguistic foundations.[15] This is the task of the rest of the chapter. Before I attempt to do this, however, I will briefly compare the view so far presented with a similar account in the literature, namely Hans Heinrich Lieb's 'Modified Realism'.

2.4.1 *Mixed Realism and Modified Realism*

At this stage of exposition, I think it expedient to compare and contrast my view with a similar account in the form of Lieb's 'Modified Realism' (Lieb 1992, Lieb 2018). Lieb offers an alternative account of linguistics to both the mainstream mentalist picture and the linguistic realism discussed in this volume. I will outline three aspects of his view and consider how they interact with the desiderata for a Mixed Realist account as I have described it above. I will ignore aspects of the view which do not directly concern my present purpose. The interested reader is directed toward Lieb's chapter in this volume for more details.

Lieb's account is said to be realist in that it considers the proper treatment of linguistics to require an 'abstract, extra-mental objects' interpretation of the linguistic structures of phonology and syntax, linguistic meanings, idiolects, languages conceived of as abstractions from idiolects and the respective systems

15. Again, Platonists are not aiming to do so. For instance, they would reject (3b) outright.

thereof. He identifies an ontological hierarchy in which lower levels are comprised of *concreta* and at higher levels *abstracta* generally pertain. Additionally, "[a] hierarchy of ontological levels is constructive in the following weak sense: entities of higher levels are ontological constructs based on lower-level entities" (Lieb 1992: 46).

Thus, he envisages a bottom-up Platonism similar to Bromberger (1989) in which linguistic types are archetypes which model tokens conceived of as (quasi) natural kinds. This process is based on the interrelationships between linguistic tokens (or 'projectible questions' that receive the same answers for all the tokens). However, Bromberger's account fails to capture certain properties of linguistic types not possessed by their tokens such as the number of centre-embeddings and the like (see Wetzel 2014). In terms of my dialectic, infinity judgements are left without explanation on Bromberger's account since properties such as infinity or infinite generation are generally not aspects of tokens or lower level ontological objects in Lieb's system. Lieb claims that:

> "This notion of 'abstract' as 'non-concrete' differs from a Katzian conception by being relativized to a hierarchy of ontological levels where the entities on a higher level are 'constructs' from entities of lower levels, in a purely ontological sense that does not imply anybody 'constructing' them in a literal sense.
>
> (Lieb 2018: 83)

The difference between the two views is that Bromberger's account involves a certain artefactual notion of construction or model in a bottom-up fashion as is common in scientific modelling.[16] Lieb, on the other hand, maintains that the objects at higher levels are not literally constructed from lower level entities but given by the ontological hierarchy posited in his 'Intentionality Hypothesis' (see below). In addition, he considers a purely bottom-up analysis to be too restrictive and thus allows for data to be derived from various sources (presumably including pure logic). This strategy may avoid the issue above but I think it might also run into some other problems as we will see in Section 4.3.[17]

One important commonality between Lieb's framework and the one outlined in this chapter is what he refers to as the 'Intentionality Hypothesis'. This claim requires that for anything to qualify as an 'object of linguistics' it has to be needed in some way "for describing the content of intentional mental states or events that

16. For an account of scientific modelling in linguistics, see Nefdt (2016a) and Nefdt (2016b).

17. Lieb conceives of linguistic grammars as texts or systems to which normal objects need to adhere, a special case of which are Carnapian axiomatic theories (see Tomalin 2006 for a discussion of Carnap's influence on the development of generative grammar).

are connected – in a non-contingent way – with (i) speaking, (ii) understanding speech, or (iii) judging speech from a communicative point of view" (Lieb 1992: 61–62). This is a means of fulfilling the respect constraint mentioned above. In addition, Lieb's view also pitches linguistic reality at the appropriate level of types, thus fulfilling the second desideratum as well.

Modified Realism is constituted by a specific construal of the respect constraint. It maintains that the *objects* of linguistics are extra-mental abstract entities but that the *data* (or source of data) of linguistics can be mental states. What is the relationship between these objects and the data? The answer is that mental states have *contents*. "Mental states and events have a content; the content is not considered an actual part of the states or events" (Lieb 2018: 83). These contents are abstract and extra-mental and thus appropriate objects of linguistic theory, the states of which they are not a proper part are spatiotemporal and thus serve only as data for such theories.[18]

The final aspect of Lieb's theory, relevant for this discussion, is a version of functionalism for speech acts with a proviso that such a functionalist account can be extended to language systems in general. In the following section, I aim to provide insights that dovetail with this latter possibility. Specifically, functionalism in the philosophy of mind acknowledges the definitive roles played by mental states in their characterization. Similarly, structuralism in mathematics identifies mathematical objects by the roles they play in larger mathematical structures. More details forthcoming in the following sections. Admittedly, my view does involve a more ontologically committing position in terms of the objects of actual structures.

---

18. Another mixed realist account which makes similar distinction is Stainton's 'Linguistic Pluralism' (see Stainton 2014). He distinguishes between difference senses of physical, mental and abstract. Physical$_1$ is related to the use of the word 'physical' in the hard sciences such as physics, i.e. *quantities*. Weeds, defined as unwanted plants, would not count as physical on this definition. On an extensional physical$_2$ definition, weeds show up since they have spatio-temporal and other physical properties. Mental$_1$ includes individual mental states such as pains and hallucinations etc., these too have physical$_2$ status ("[o]n a materialist position, mental states and events are spatiotemporal and concrete" (Lieb 2018: 85). Mental$_2$ involves a specialized notion of secondary qualities conditioned by the mental but not identifiable with mental items. Stainton uses the term 'mentally conditioned' to capture this variety of mind-dependence. Another way to go would be to separate the content of mental states from the mental states themselves (i.e. Lieb's route). Lastly, he contrasts abstract objects *qua* Platonic objects, with what he calls 'abstractish' objects, neither in the mind nor concrete particulars. Musical scores, models of cars and legislation form part of this latter category. The linguistic structures of the following sections might be amenable to such interpretation.

I think the best way to think of Lieb's framework is as a specific variety of Mixed Realism, of which another alternative will be provided in Section 4. The task of the next section, however, is to discuss the advantages a Mixed Realist perspective might have over its Platonist rival.

3. Against Platonism

In this section, I will be rather brief since my argument is straightforward. Simply put, Platonism is not the best way of capturing the three desiderata placed on linguistics above. I will start with an argument to the effect that the Platonism often associated with Linguistic Realism (but by no means necessarily for it) does not account for either the creativity or the kind of infinity I take to be associated with linguistics. Then I will argue on the basis of Benaceraff's famous dilemma for mathematical truth (1973) that the respect constraint cannot be met by Platonists in any plausible way and therefore as with mathematical Platonism a gulf is created between the truth of our linguistic theories and our knowledge of this truth (competence). Lastly, I will make a general claim (following Soames (1984)) that mathematics (as well as logic) and linguistics are conceptually distinct and if indeed linguistics is a formal science, it is a *sui generis* one.

Before we get to this task, however, let us review what the Platonist position is. Essentially, Platonism is an account of linguistic foundations which holds that linguistics is the study of abstract mind-independent objects. The Platonist takes all of the syntactic and semantic (and morphological, phonological and grapholinguistic, see Neef 2018) structure posited by grammars not merely as useful tools for describing mental states or physical tokens but as constituting an independently existing linguistic reality. A natural language, like a formal language, is an abstract object in the sense of being non-spatio-temporally extended and comprised of sets of sentences. On the view we have been considering (that of Katz and Postal), sentences are ontologically similar to numbers, sets and geometric figures.[19] Natural languages are simply systems of these sentences, describable by us through reason and intuition *a priori*.

19. Postal (2003: 237) states that "an NL is a set-theoretic object, a collection, in fact, a bit more precisely, a collection of sets, where each set is a complex object composed of syntactic, semantic, and expression objects. The traditional term for these sets is 'sentence', so that it is appropriate to say that an NL is a collection of sentences".

3.1 The right kind of 'wrong view'

In this section, I aim to distinguish my view from what a naive Platonist conception of language might look like. An aspect often assumed of the Platonist position (dubbed the 'Wrong View' by Fodor (1981)) is that it contends that there is a static universe of natural languages (and the sentences of which they are comprised) atemporally existing independently of human beings and language users and somehow known to us *a priori*. However, this view is not necessarily a part of Linguistic Realism (see Neef 2018) and thus the following criticism is rather limited in scope and designed to show how a Linguistic Realism or Mixed Realist view can avoid certain philosophical pitfalls associated with Platonism *simpliciter*. Nevertheless, it might be useful to separate the present view from what linguists in the mentalist camp often consider to be the Platonist position (see Chomsky 1990 on P-languages). On this naive view, we discover languages, we do not create them. Much like numbers and sets exist independently of mathematicians who study them or the bean counters who use them, if there were no speakers or users of natural languages, there would still be natural languages and sentences.

Once this metaphysical point is appreciated, I think naive Platonism's incompatibility with the type of creativity discussed previously can be gleaned. In Section 2.1.1. we looked at creativity in language and its role in linguistic theory. I argued that it involved the use and appreciation of novel sentences (to the user), the manipulation of composition rules and the indefiniteness of the number of expressions for which it allowed. The problem is that according to one variety of Platonism (the one mentioned above), every sentence of every language exists in an atemporal sense prior to being used or thought of. This opens up a new question. Is the mere instantiation of existing objects through production or comprehension to be considered novelty? A child counting to a previously uncounted number might be performing an impressive feat but it would not be deemed 'creative' in the sense that the term is used in linguistics. Of course, there is certainly an argument to be made that the mastery of sentences as Platonic objects is 'creative' in the sense above much like a theorem of mathematics still possesses insight whether or not it illuminates an ever-existing mathematical object or property.

Nevertheless, naive Platonism (not identical to Linguistic Realism necessarily) bears the burden of defining creativity in the absence of some more ontic notion of creation. Certainly, this sort of Platonism can accommodate a notion of novelty-to-a-speaker similar to the new number-to-a-counter but the stronger notion (involving genuine creation) would be inaccessible on this ontological account. And if we are redefining creativity in light of this view, then we should at least admit that the subject has changed from the concept discussed by Chomsky, Evans and others.

Platonists might want to bite the bullet on this one. But I think that it is related to a different issue in terms of linguistic methodology as is evinced by the problem of infinity often thought to be a virtue of Platonism. Part of the motivation for Platonism was to better capture infinity claims and the 'vastness of natural language'. In fact, Katz (1996) argues that without Platonism, the vastness result of Langendoen and Postal (1984) (the Cantorian proof that the cardinality of natural language is the size of the continuum or a proper class) does not go through as an objection to generativism or competencism. It seems as though Platonism and infinity go hand-in-hand conceptually. So how then, can I claim that Platonism is at odds with linguistic infinity?

My contention is that the infinity with which Platonism provides us is the wrong kind of infinity for linguistics, which is better underpinned with a rather more constructivist approach to infinite expression in my view. Before I present my case, it is important to remember that we are in the interpretation game not the revision one. Part of the merit I attributed to Katz and Postal's tenacious defense of Realism was due to their bold honesty in the face of often ideological opposition. In this section, I argue that linguistic infinity is not to be understood *statically*, as *per* naive Platonism, but rather *dynamically*, as *per* constructivism (or even strict finitism).

A brief history of the foundations of mathematics might be in order here. Constructivism, or intuitionism, starts with the idea that mathematics is the product of human thought and therefore should be accessible to human mental capabilities. Iemhoff (2015) describes Brouwer's initial conception as follows.

> The truth of a mathematical statement can only be conceived via a mental construction that proves it to be true, and the communication between mathematicians only serves as a means to create the same mental process in different minds.

A famous example is the rejection of rule of double-negation in classical logic which states the following equivalence: $\neg\neg p \equiv p$. Intuitionistic logic rejects this rule since the proof of the negation of a negated sentence is not the same as a proof of the sentence, or as Heyting (1956: 17) put it: "a proof of the impossibility of the impossibility of a property is not in every case a proof of the property itself". One consequence of the above reasoning is the failure of the law of excluded middle in intuitionistic logic. The reasoning goes that since there are statements in mathematics (such as the Continuum hypothesis or the Riemann hypothesis) for which there is neither a positive proof nor a refutation (nor a clear path to either), and since having a refutation means being able to show the positive proof false, the principle cannot hold in every case (and at every time). The underlying intuitionistic move responsible for the various departures from classical logic mentioned above (and beyond) is the link between truth and knowability present in the framework.

The notion of proof and construction appear within this redefinition of mathematics through the relocation of the human mathematician to the subject role in the mathematical process. For example, in Hilbert (1899) the claim 'one can draw' in geometry is taken to be synonymous with 'there exists'. Here again we see why classical principles such as excluded middle fail. Existence claims in intuitionism are equivalent to the production of exemplars and there are certain claims (such as the Continuum hypothesis etc.) for which we cannot do so (nor produce refutations). This is in turn coupled with a mentalistic approach to construction. As Heyting notes,

> Isolating an object, focusing our attention on it, is a fundamental function of our mind. No thinking is possible without it. In isolating objects the mind is active. Our perception at a given moment is not given as a collection of entities; it is a whole in which we isolate entities by a more or less conscious mental act.
>
> (Heyting 1974: 80)

Naturally, much of the philosophical motivation behind constructivism and intuitionism centered around the concept of infinity. The idea of an infinite series incapable of comprehension in its entirety by a human mind was contrary to the core precepts of this position. For instance, instead of starting with the successor function and the axioms of Peano arithmetic, for the intuitionist the natural numbers start with the process of counting. According to Heyting, this is the mental process of isolating perceptions of entities and then creating more of these entities in one's mind (and in time, importantly). A fuller survey of intuitionism in mathematics is unfortunately outside the scope of the present work. I do, however, want to draw a comparison between this picture of mathematics and the initial idealizations of the nature of linguistics as a science. Shapiro offers us a helpful way of thinking about constructions.

> I propose that we think of the constructions as performed by an imaginary, idealized constructor, obtained in thought by extending the abilities of actual human constructors. Then we can sharpen dynamic language and the various 'construction problems' by articulating exactly what abilities are attributed to the ideal constructor. (Shapiro 1997: 184)

The idea is that we can interpret dynamic talk of 'constructing' mathematical objects or following mathematical rules in terms of these ideal mathematicians not limited in the same way as actual mathematicians are. Thus, certain moves might still not be permitted by intuitionists (such as inferring p from $\neg\neg p$) but we are also not stuck in the very literal readings of such talk (bound by actual performance). Compare this to the opening lines of Chomsky's *Aspects of a Theory of Syntax*.

> Linguistic theory is concerned primarily with an ideal speaker-listener, in a completely homogeneous speech-community, who knows its (the speech community's) language perfectly and is unaffected by such grammatically irrelevant

> conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of this language in actual performance. (Chomsky 1965: 4)

Indeed, much of the talk surrounding the concept of generative grammars, recursively enumerable sets and discrete infinity is constructivist in linguistics. An ideal speaker is capable of expressing an infinite number of sentences of her language (has a generative grammar in her mind), but the infinity in question is a constructive not an actual one. It is the product of mental competence, it is a mental activity like counting is for intuitionists such as Brouwer and Heyting.[20] The ideal speaker is following a procedure set out by the rules of her grammar or the language, in that sense, provides instructions to performance systems (see Chomsky 2000). In addition, with this understanding of infinity, novelty can also be rescued. We, as human language users, genuinely create the structures of our languages as we produce and comprehend them. Thus, new sentences can be produced by following certain rules (the rules of the grammar of our language). In this way, linguistic infinity is understood as an infinite capacity to produce sentences of the language.

3.2 Benacerraf's dilemma and respect

The failure of the respect constraint, I argue, is due to another issue with Platonism in the philosophy of mathematics. The problem was famously identified by Benacerraf (1973) and has significantly altered the landscape in the foundations and philosophy of mathematics since. The dilemma posed by Benacerraf makes the claim that the quest for mathematical truth pulls in two opposing directions with relation to a uniform semantics and a (causal) epistemology. The argument takes the form of placing two demands on any theory of our knowledge of mathematics. Namely, that

> (1) the concern for having a homogeneous semantical theory in which semantics for the propositions of mathematics parallel the semantics for the rest of the language, and (2) the concern that the account of mathematical truth mesh with a reasonable epistemology. (Benacerraf 1973: 661)

Benacerraf held that all (or most) accounts of mathematical truth fail to find the appropriate balance between these two demands, in fact more than that, the

20. Pylyshyn (1973) makes similar comparisons between Chomsky and intuitionists like Heyting. Chomsky (1982: 16) himself states that "[o]ne could perhaps take the intuitionist view of mathematics as being not unlike the linguistic view of grammar".

demands seem inversely proportional in these accounts.[21] Consider Platonism, in providing a standard truth-conditional semantic account which dovetails with the semantics for the rest of language, Platonists make reference to abstract objects. In other words, the truth of mathematical statements about numbers, sets and the like is determined by their correspondence to abstract objects, non-spatio-temporally extended, in a similar way to how reference to physical objects is supposed to be fixed (in a Tarski-style semantics). However, in providing such a semantic account, we cannot begin to make sense of our causal contact with the former objects (by definition) and thus are left with no (causal) account of our mathematical knowledge the likes of which we have for ordinary physical objects. In the opposite direction, empiricist accounts of mathematical knowledge tend to root it in the familiar physical causal world (the Hilbert program or Devitt's analysis for linguistics) but fail to then specify how the necessary truth of these objects is obtained in a uniform semantics for ordinary discourse.

This is not the place to go into too many details about Benacerraf's dilemma, but suffice to say that by endorsing Platonism for linguistics, Katz and Postal essentially accept its lot.[22] Postal (2003: 251) admits that "[a] formal, abstract object-based view of linguistic ontology, of course, faces the classic epistemological problem often raised in connection with mathematics and logic of how knowledge of abstract objects can be obtained". He defers discussion, however, to Katz' *Realistic Rationalism* (1998). We will get to a discussion of some of these ideas below but for the sake of this dialectic I would like to recast Benacerraf's dilemma in terms of the 'respect constraint' discussed in the previous section.

In the previous section, in accordance with Devitt (2006), I advocated the need for a mixed realist condition on the relationship between the structure rules of grammars and the structures of linguistic competence (whatever these may be). This move was made in part to 'ground' realist accounts of linguistic theories (of the outputs of language comprehension and production) in the mental activities of language users and *vice versa*. In relation to this point, I further argued for an interpretation of all talk of infinity and generative grammars in terms of

---

21. Of course, many contemporary philosophers of mathematics are unconvinced by this dilemma on either the reference or epistemic side.

22. Katz's (1995) response to this dilemma utilises what I call an *argument from linguistics* (now prevalent in the philosophy of language, see Stanley and Szabo (2000) for one such case), to dismantle Benacerraf's case. He argues that surface form is not always a guide to deep structure (by means of the famous *eager to please* versus *easy to please* case) and that causal theories of knowledge are not the only game in town. His idea is that Platonism needs neither a uniform semantics for countenancing its objects nor a causal theory of knowledge. Unfortunately, in the absence of concrete proposals on either side, this position is hard to evaluate.

constructivist mathematics. In a sense, this condition was suggested (imposed) to prevent language use from getting away from linguistic theory.

The issue with Platonism in linguistics is that, much like the Benacerraf problems for Platonism in mathematics, its ontology pulls in an opposite direction *vis-á-vis* the respect constraint. More precisely, if the structure rules of the grammars designate objects in a Platonic realm, i.e. abstract objects without spatial or temporal dimensions, then how are we to account for their relationship with the physical competence of language users in their use or acquisition of such objects? In other words, how does the abstract ontology of linguistic Platonism account for our knowledge of language, i.e. our linguistic competence?[23] Furthermore, if we take linguistic constructivism seriously, there might indeed be mathematical structures which are incapable of being comprehended by a human mind but surely there are no such linguistic structures. We cannot impose the condition that competence respects the structures of linguistic reality if it is possible that this reality completely outstrips human comprehension. In the other direction, why would linguistic grammar rules or the structures they posit *qua* abstract objects need to correspond in any way to real world constraints any more than higher-order set-theoretic entities should respect our abilities to conceive of them? In this way, intuitionism in mathematics can be interpreted as the attempt to establish a RESPECT constraint on mathematical theory and the mental competence from which it is spawned. Nevertheless, whatever the status of Platonism is for mathematics, it could be seen as posing a particular problem for understanding or respecting the relationship between natural languages and the speakers (or knowers) of these languages. A mixed realist account might fare better in this way.

3.3 Conceptual distinctness

In the previous subsections, I aimed to show that Platonism cannot meet my first and last desiderata of a mixed realist theory of linguistic foundations. In this section, I will briefly concern myself with another corollary of the Platonist view of linguistic objects. This is the view that given Realism, linguistics itself must be a formal science on par with mathematics and logic. In order to show this reasoning to be fallacious, I will apply a similar (realist) strategy employed by Soames (1984) to the effect that linguistics is not cognitive psychology.

The strategy proceeds in the following way. In order to establish that two types of theories are *conceptually distinct*, one has "to show that they are concerned with

23. Again, Platonists would argue that they do not need to offer such an account.

different domains, make different claims, and are established by different means" (Soames 1984: 155).[24] Challenge accepted.

I think the first two requirements are relatively uncontroversial (although potentially question-begging against Platonists), namely that linguistics and mathematics are concerned with different domains and make different claims. Linguists are concerned with natural languages such as English, Swahili, and Tamil. They care about the structures of these languages, their cross-linguistic similarities and differences and how they change over time. When linguists write grammars for specific languages or attempt to capture certain formal properties of various constructions, they are constantly required to make sure that their grammars and properties correspond to actual languages spoken (or signed) in the world. This is accomplished sometimes by means of checking linguistic intuitions (their own and those of other native speakers) or corpus data. To put the point somewhat differently: the linguistics practiced on a planet of speakers cognitively and socially distinct from humans, might look very different from our own, or at least the grammars and constructions might (the linguist's job might still be the same though). Linguists might ask the same questions but the content of their answers would be different. On a standard Platonistic account of mathematical theory, this is not the case. Set theory on earth looks exactly the same as set theory on Pluto or Mars (even if they were populated with different sorts of creatures).[25] I think that this is generally the case because the two types of theories are 'established by different means'. Mathematicians consult their intuitions *a priori* while linguists are bound by certain contingent linguistic phenomena and behaviour (at least in part).

Linguists, like empirical scientists, might use mathematics (as in formal language theory and truth-conditional semantics) as tools or even essential tools but this is different from mathematics as method. Even in its strongest form, the disanalogy persists. Without sets, functions, morphisms etc. linguists might not be able to describe linguistic reality (or competence). But there is a difference between saying 'we can't describe-without-mathematics linguistic reality' and

24. Soames also uses the tool of what he calls *empirical divergence*, i.e. linguistic structures are unlikely to be isomorphic to psychological structures, which on the face of it seems to be in contrast to my RESPECT constraint. Empirical divergence, however, is a much stronger claim on the relationship between linguistic theory and the theory of competence, and respect certainly does not require anything as strong as a morphism or structure-mapping.

25. Of course, these creatures could have a different logic and this might affect the mathematical structures they discover or postulate. But certain structural relations seem to be ubiquitous. Consider group theory which deals with a basic notion of symmetries. By studying the symmetries of structures, we shed light on the nature of these structures themselves whatever they may be.

'we can't describe linguistic reality-without-mathematics'. This is the Berkeley fallacy, mentioned by Yablo (2013: 1016), that statements like 'we can't imagine a tree non-perceptually' do not entail statements of the form 'we can't imagine an unperceived tree'. I would opine that linguistic research constitutes, at most, the use of (perhaps essential) mathematical tools but not necessarily mathematical methodology.

Furthermore, mathematical methods are different from tools. The methods of mathematics involve things like postulation, induction, implicit definition, impredicative definition and construction.[26] Such methods are generally absent from linguistic theorizing and grammar construction. The linguist's job is not done after postulating a mathematical possibility; the possibility only becomes linguistic if it is instantiated by some real world language. For decades, research into finite-state grammars was abandoned due to Chomsky's claim to have shown that such formalisms did not concern natural language constructions in any significant way (see Pullum (2011) for the falsity of that claim). In specific cases, if a particular syntactic or phonological combinations are never realized in any natural language, they lose linguistic relevance. The task of a mathematician has no such empirical restriction.[27] In opposition to this, Postal (2003: 240) claims that there are natural languages for which no knowledge exists (or even could exist).[28] To be a natural language is just to obey certain constitutive laws and if we can specify an object that obeys these laws and is unlearnable, then there are unlearnable natural languages. This is an implicit definition and a corollary of the Vastness theorem (see Langendoen & Postal 1984). Still, it is not clear to me why learnability is not one of the constitutive laws of natural languages as formalisability might be for their formal counterparts. In addition, allowing for such unrestricted uses of implicit definition violates the *respect* constraint.

Linguistics certainly seems to use mathematical tools in identifying the properties of its objects (as do many sciences) but it does not seem to mathematically define the objects of its inquiry *a priori* or rather use mathematical methods. In Lewisian terms, linguistic and mathematical objects seem to be *orthogonal* to one another or as I have put it (following Soames), the fields are 'conceptually distinct'.

---

26. See Chapter 5 of Shapiro (1997) for an overview of the place of these methods in the history of mathematics.

27. This point is debatable. Although much linguistic research focus has been spent of the discovery of universals (following Greenberg 1963), unrealized patterns could also shed light on realized structure.

28. This might be a point at which Postal's idiosyncrasy diverges from the strict Linguistic Realist position.

Of course, one could argue that not all formal sciences are alike and linguistics is unique (a similar line is taken in Katz (1981)). In the rest of the paper, I aim to lend some credence to this idea.

4. *Ante Rem* realism and the foundations of linguistics

So far I have argued that Platonism (and nominalism) do not aim to capture certain conditions or desiderata of a mixed realist interpretation of linguistic theory.[29] I proffered these desiderata in accordance with arguments presented for these very positions. What remains to be shown is that there is an alternative that can account for (1) linguistic creativity and infinity, (2) the appropriate level of abstraction present in current linguistic accounts or grammars and (3) both the separation of linguistic reality from competence and the mutual respect constraint between them.

In the following sections, I will describe a view of the foundations of linguistics in terms of a non-eliminative structuralism similar to that offered for mathematics by Shapiro (1997) and independently by Resnik (1997), I call this view *ante rem* realism. I hope to show that the ontology that this position brings with it is coherent in the spirit in which Platonism was offered but does not suffer from some of the problems as described in the previous section, such as Benacerraf worries. Furthermore, this account allows for a more naturalistic interpretation of linguistics as an empirical science with formal aspects by offering an alternative account of abstract objects.

4.1 Mathematical structuralism

The motivation behind mathematical structuralism can be traced back to Benacerraf and the dilemma he presented (see Section 3.2). The core idea of this foundational picture in mathematics is that mathematics is a theory of structures and systems of these structures. In this way there is a shift from the traditional (perhaps) Fregean concept that numbers, sets and other mathematical entities are abstract objects, unidentifiable in space and time. The important insight is that it is structures and not objects which are the vehicles of mathematical truth (and knowledge). This presents an entirely different conception of the nature of the enterprise as well as the concept of a mathematical object itself. Structuralism is a broad framework with historical antecedents ranging from the Bourbaki group

29. Stainton (2014) can also be thought of as aiming for a mixed realist account of linguistic theory in which physical, mental and abstract(ish) objects are countenanced.

and Dedekind to Hilbert and even Benacerraf himself. Thus, there are a number of varieties of the idea at work within the contemporary philosophy of mathematics. I will try to stay as broad as possible for the moment, although I do plan to endorse and develop a particular variety of what is referred to as *ante rem* or non-eliminative structuralism for linguistics in the next section.

In order to understand this view on the foundations of mathematics, we need to answer a few preliminary questions. Firstly, what are structures on this view? And how do they relate to traditional objects of mathematics? Secondly, whatever they are, how do we come to know about them? Then finally how does understanding mathematics as a theory of these structures get us out of Benacerraf-types worries? I hope to provide some potential answers to these questions in this section.

Shapiro starts his book with the slogan 'mathematics is the science of structure'. He continues by way of example,

> The subject matter of arithmetic is the *natural-number structure*, the pattern common to any system of objects that has a distinguished initial object and a successor relation that satisfies the induction principle. Roughly speaking, the essence of a natural number is the relations it has with other natural numbers.
>
> (Shapiro 1997: 5)

This holds true for groups, topoi, Euclidean spaces and whichever mathematical structure is studied by mathematicians. Let us focus on the natural-number structure for a moment and consider its objects. What is a number on this view? Essentially, it is nothing more than a place in a natural-number structure. The only way to talk about the number 2 or 5 or 4892001 is with relation to other places in that structure, i.e. 2 is the successor of the successor of 0 or the number 2 is the third place (if we start from 0 as Frege did) of a natural-number structure, it is in the second place of an even-number structure and the first place of a prime number structure and so on. The same holds for other mathematical objects, the idea being that these objects are only interpretable in accordance with some background theory. As Parsons (2004: 57) puts it, "the idea behind the structuralist view of mathematical objects is that such objects have no more of a 'nature' than is given by the basic relations of a structure to which they belong".

The concept of a group is often taken as a canonical example of a structure. A group *G* consists of a finite or infinite domain of objects and a two-place function called the group operation. This function satisfies four properties (or axioms). It is associative (associative property), there is some identity element (identity property), it is closed (closure property), and every element in the domain must have a reciprocal or inverse (inverse property). Now there are many different types of groups which mathematicians may wish to study. We could look at finite groups (groups with finite domains) or Abelian groups (groups whose elements are also

commutative). The basic group structure is the same and the structure is given to us by the relations its objects have to one another (according to the four properties). The objects themselves are of no importance to us, they might as well be point-particles, Martians, jelly-beans or Rice Krispies, it doesn't matter.[30] What matters is the structural relations one object (whatever it is) has to another in the group, we only care about the structures. In fact, we can even talk about structures in isolation from any objects. Shapiro characterises his own position in the following way.

> The first [*ante rem* structuralism] takes structures, and their places, to exist independently of whether there are any systems of objects that exemplify them. The natural-number structure, the real-number structure, the set-theoretic hierarchy, and so forth, all exist whether or not there are systems of objects structured that way. (Shapiro 1997: 9)

The other versions of structuralism offer similar accounts. They differ, however, in important respects. For instance, the question of whether or not structures can themselves be considered mathematical objects. For set-theoretic structuralists, inspired by model theory, the answer is yes. Structures are set-theoretic entities themselves. For modal structuralists, structures are not objects of study. Hellman (1989) utilizes this framework to avoid reference to individual mathematical objects altogether (by replacing such talk with talk of *possible* mathematical objects or number-systems in his case); it is thoroughly eliminative. The point is that there is no one answer to the question of the nature of structures themselves, different structuralists will provide radically different accounts. Another question concerns the background logic, which varies from first-order with identity to second-order and modal logic given different accounts of structuralism.

We have looked at the question of what structures are and what traditional mathematical objects are within them, i.e. merely places-in-structures devoid of individual meaning or importance. The last question to confront in this section is how this framework aims to avoid Benacerraf's dilemma. Recall that Benacerraf's claim was that the more uniform the semantics, i.e. the more the objects of mathematics were treated on par with the objects of ordinary discourse in terms of reference, the further we get from a tractable epistemology. The semantic problem was that we were forced to the treatment of abstract objects as singular terms referring to non-spatio-temporal entities. This created an ontological gap untraversable

30. Compare this to the desciption of a category in category theory. "A category is *anything* satisfying the axioms. The objects need not have 'elements', nor need the morphisms be 'functions' […] we do not really care what non-categorical properties the objects and morphisms of a given category may have" (Awodey 1996: 213).

by standard causal accounts of knowledge. But with structuralism, there is no such reference since there is an ontological difference between an object and a place in a structure. Neither numbers nor sets commit us to individual abstract objects (as with Platonism),[31] but merely to places-as-objects in natural-number structures or set-theoretic structures. The existence of these kinds of objects is provided by the axioms (as we saw with group theory) or relational properties of the structures. These axioms and structural relations, in turn, can be known by us in a presumably sounder epistemic manner.[32] I shall leave matters here for now and more details will follow when we consider a specific structuralist proposal for linguistics in the next section.

4.2 Linguistic structures

Previously, I described a general framework, neither obviously Platonist nor nominalist in nature, which confronted Benacerraf's dilemma by eliminating the need for reference to individual abstract objects. Importantly for our purposes, the *ante rem* structuralism of Shapiro and Resnik is a realist theory of the foundations of mathematics. As Shapiro (1997: 6) states, "as articulated here structuralism is a variety of realism". He distinguishes between two kinds of realism within a model-theoretic semantics (such as Tarski's). 'Realism in ontology' or the idea that singular terms in the language of mathematics denote mathematical objects which genuinely exist and 'realism in truth value' which states that grammatical sentences in mathematics have definite truth values (either true or false). He claims that his version of structuralism is realist in both senses.

In order to appreciate the realism of this proposal, one has to delve into the notion of an 'object' – as a position in a structure – which it incorporates. The claim is that natural language provides as with two uses of the concept. In the one more frequent case, we treat positions as offices or roles, which are multiply realizable in terms of entities. For instance, some uses of *President* or *rook* are examples of these cases. They do not denote individual objects as in *The President has the right*

---

31. Although they are referential in a manner consonant with ordinary discourse as I will show in the next section.

32. Of course, knowledge of axioms also results in further epistemological questions but of a much different order to knowledge of Platonic objects. For example, for Gödel, the truth of axioms of set theory "force themselves upon us" so much so that "despite their remoteness from sense experience, we do have something like a perception of the objects of set theory" (Boolos 2000: 266). Boolos attenuates this extreme claim somewhat to suggest that perhaps only certain axioms have the desired effect (e.g. extensionality and pairing). Parsons (1990) attempts to pick up on the 'perception' analogy for mathematical intuition and claims that there is indeed a phenomenon which answers to it.

to overrule the senate or *The rook can move three places*. Shapiro calls this 'places-as-offices'. There is another sense of the term in which we treat positions not as the offices or roles they occupy but as genuine singular terms denoting objects. Examples are sentences such as *The President had lunch with the Dalai Lama today* or *The rook ate the queen at d7*. This is the 'places-are-objects' perspective. *Ante rem* structuralism takes this latter concept as primary. Of course, as Shapiro (1997: 11) notes, "[w]hat is an office from one perspective is an object – and a potential officeholder – from another".

Now from the above, we can see how this form of structuralism is realist in ontology and realist in truth value (albeit in a different sense to the 'realism' of Linguistic Platonism). In arithmetic or number theory we take numbers to be objects, but in set theory they are offices. Consider the number 2, "[i]n one system, [finite von Neumann ordinals] {Ø{Ø}} occupies the 2 place, and in the other [Zermelo numerals] {{Ø}} occupies that place" (Shapiro 1997: 11). In either case, the numeral 2 is a name picking out an object *qua* position in a structure and statements involving the numeral are true or false but in neither case are we committed to an individually existing number in the Platonic sense. All we need is for the structure to exist (and there are various ways of ensuring this, see Chapter 3 of Shapiro (1997)). In fact, this example presents one of the advantages of this theory over Platonism. According to Platonists, numbers are individual mathematical objects and mathematical objects are sets. If this is the case, then there is a fact of the matter as to which sets constitute the natural numbers. But von Neumann ordinals and Zermelo numerals have different set-theoretic consequences for numbers, since on the former account '$2 \in 4$' is true while on the latter it is not. How do we decide which theory is correct? With structuralism we don't have to decide, since both theories are true in virtue of being concerned with the same natural-number structure, not the individual numbers and their correspondence to specific abstract entities or individual sets.

The account I offer essentially makes use of the same claims. If 'mathematics is the science of structures', then linguistics is the science of linguistic structures. In this sense, my view is a Linguistic Realistic one, since it admits for *abstracta*. *Ante rem* realism is the position on the ontology of language that states that linguistics is concerned with abstract patterns or structures and grammars are theories of those structures. My account does depart from that of Shapiro (and Resnik) in significant ways by specifying what kind of *abstracta* linguists are committed to. Consider the following remark made by Resnik concerning linguistics.

> Take the case of linguistics. Let us imagine that by using the abstractive process […] a grammarian arrives at a complex structure which he calls *English*. Now suppose that it later turns out that the English corpus fails in significant ways to instantiate this pattern, so that many of the claims which our linguist made

> concerning his structure will be falsified. Derisively, linguists rename the structure *Tenglish*. Nonetheless, much of our linguist's knowledge about *Tenglish qua* pattern stands; for he has managed to describe *some* pattern and to discuss some of its properties. Similarly, I claim that we know much about Euclidean space despite its failure to be instantiated physically. (Resnik 1982: 101)

In linguistics we seem to be concerned with a specific class of structures, those which are instantiated in the real world. These are the structures that are produced by human linguistic competence, i.e. the outputs of competence. In this way, I amend the structuralism of Shapiro to include what Parsons (1990) calls quasi-concrete objects. These objects or positions-in-structures, in my view, are comprised of a mixed ontology. Parsons offers the existence of such objects as an objection to structuralism but I see no serious reason for why this cannot be compatible with it for the case of linguistics (Shapiro himself takes this concept as a friendly amendment). Parsons (1990: 304) states that there are "certain abstract objects that I call quasi-concrete, because they are directly 'represented' or 'instantiated' in the concrete" and he includes as an example of such an object "symbols whose tokens are physical utterances or inscriptions". The idea is that there is an additional relation to the axioms of such structures that goes beyond pure structuralism, a 'representational' (or instantiation) relation. I think that this third kind of ontological category merely marks the boundary (which is vague) between the structures of pure mathematics and those of applied sciences in which I place linguistics. This marks a departure from the Realism of Katz and Postal but not from commonsense to a certain extent. Consider Boolos' comments below.

> Numbers do not twinkle. We do not engage in physical interactions with them, in which energy is transmitted, or whatever. But we twentieth-century city dwellers deal with abstract objects *all the time*. We note with horror our *bank balances*. We listen to *radio programs: All Things Considered* […] Some of us write *pieces of software* […] And we draw *triangles* in the sand or on the board. Moreover bank balances, reviews, palindromes, and triangles are 'given' to us 'in experience,' whatever it may mean to say that. (Boolos 2000: 265)[33]

What Boolos calls 'abstract objects', I call *quasi-concrete*. And 'what it means to say that' they are 'given to us in experience' is just to say they have either instantiation or representation relations in the concrete. The difference between Boolos' list and

33. Within the context of linguistics, Stainton seems to describe a similar class of objects. "There is another sense of abstract, however – namely, things that are not inside the mind yet are not concrete particulars either. They are neither fish nor fowl. Let me coin the term abstractish for these" (Stainton 2014: 6). Within this list he mentions objects very similar to those found in Boolos' catalogue above.

linguistic (and some mathematical) objects is that many of the abstract objects on his list are fully determined by the physical objects to which they relate whereas linguistic objects, as I conceive of them, have a generally structural nature in addition to concrete instantiation or representation.

In *Realistic Rationalism* (1998), Katz offers a similar account for what he calls 'composite objects'. Examples of objects like the equator or impure sets (which have physical objects as members) push him towards accepting a third metaphysical category of objects. These are not just objects with dualist parts or feet in both worlds but they stand in a 'creative' relationship with one another, i.e. their composition creates a new object distinct from either part.[34] For instance, the equator is neither a perfect circle nor a line that exactly bisects the circumference of the earth, since "[i]t didn't exist before the earth was formed and will cease to exist when the earth ceases to exist" (Kaufman 2002: 219). In terms of impure sets, in *Skeptical Linguistic Essays* (2003), Postal identifies classes of sentences, involving direct discourse, whose ancestral elements actually include physical objects.

> This entails that the sets that comprise NL sentences must be able to contain as members or submembers something that can instantiate the endlessly distinct physical properties involved in direct speech. The only way I see that this can be the case is if direct speech segments involve sets that contain the physical properties themselves and not, as in the case of more standard (regimented) linguistic elements, symbols that represent instructions (to a fixed physical apparatus) to produce physical things. (Postal 2003: 193)

My account in some ways corresponds to the position Katz and Postal suggest at times despite differing from the one they officially endorse. Furthermore, I think that this is a very intuitive picture of the science of linguistics. What after all is syntax, if not the study of the structural relationships between sentences and their subphrases? Of course, these structures should be additionally exemplified by real world languages but this is merely the addition of the respect constraint for which I argued earlier. The syntax of a particular language is an abstract object much like the *University of St Andrews*. Following Ryle, we cannot ask where the university is exactly since it is the organization of different ever-changing units, it is a quasi-concrete structure. The positions various buildings occupy could change, the chemistry building could house the biology faculty at some stage and thus change its assignment, some buildings can be removed and others erected. If the entire structure is destroyed, then it no longer exists *in toto*. But it existed once in

34. This creation relation vastly overgenerates and thus in the end fails to maintain the concept of a concrete object since concrete objects stand in indefinitely many relations to abstract objects. See Kaufman (2002) for details.

a temporal and partially physical sense. The syntax (and semantics) of a particular natural language is similarly abstract, it is the organization of linguistic units or sentences in terms of their structural relationships to one another. If the language dies, so do the systems (physical instantiations of structures) which governed it. Of course through records we could still study the language on a more abstract / formal level as with the University blueprints, we could even resurrect the language based on the structures as in the case of Hebrew. Hale (1987) assumes that natural languages, like mental states, have temporal parts notwithstanding their lack of physical dimensions.

We can now see that this account can meet all of the desiderata of a realist theory of linguistics. Linguistic creativity and infinity are easily represented as there are no size limits to the linguistic constructions we employ. In addition, we can avail ourselves of the *dynamic* discourse of constructivists, as the linguistic structures which we create as language users could be conceived of as direct products of our mental faculties, despite being amenable to study independent of those faculties. Much like the natural-number structure could have been created or constructed by initial counting procedures of human agents through abstraction (see Shapiro (1997) Chapter 4 for a suggestion and Resnik (1982) for a more speculative account), natural language patterns or structures could have been created by the dual need for thought and communication among human cognizers. The rules of either activity lead to a potential or constructive infinity.[35] In terms of the appropriate 'level of abstraction', we have an arguably more sound account than Platonism offered us. After all, *ante rem* structuralism drew inspiration from the classical position on universals and particulars (as Hellman calls structures on this view '*sui generis* universals'). Unlike the previous dualist picture, we have a potentially naturalistic picture available to us. Linguistic grammars are concerned with sentences as positions-in-linguistic-structures. Immediately, we do not run into Benacerraf-type worries about how we as physical beings use abstract objects like sentences if they are not extended in space-time. Sentences, like numbers, have purely relational and structural components, c-command, governance, scoping relations etc. But unlike numbers, I argue, sentences are part of quasi-concrete structures which include instantiation relations. In the same sense as the non-eliminative or *ante rem* structuralism discussed above, sentences on this account

35. The research of Simon Kirby is especially interesting with relation to this point. Kirby (1999) designed a series of experiments to computationally test the emergence of structure in a population over time with the result that "[t]he simulation results […] show that compositional, recursive language emerges in a population which initially has no language […] Purely through the process of being repeatedly mapped from an internal form as a grammar to an external form as utterances and back again, language evolves" (Kirby 1999: 14).

are *bona fide* objects (in the places-as-objects sense) and linguistic statements concerning them have definite truth-values. Thus, sentences are not to be taken as tokens or 'words on a page' and 'sounds in the air' or mental states for that matter but abstract objects conceived as places or positions in linguistic structures which are in turn represented or instantiated by those tokens.

Once again, the emerging picture seems rather intuitive in light of actual linguistic practice. Consider a determiner phrase (DP). On most syntactic accounts, it is a structurally designated linguistic item in a hierarchical structure or tree, and any word or object (sometimes nothing, as in the case of null determiners) can satisfy the position. And whatever is in that position is a DP. The postulation of covert material is usually supported by structural reasoning in linguistics, i.e. something must be there since this structure requires it or it stands in a structural relation to something else. The UG hypothesis itself can be considered structuralist in that it aims to discover the underlying structures of the human faculty of language, the particular items or objects of various languages are rendered inconsequential (this is often a criticism of the claim). Furthermore, consider Jackendoff's Parallel Architecture, a highly modularized account of the language faculty which consists of various individual generative systems with interface principles or relations between them. On this view, the syntax is not the only generative system (as it is with traditional generative accounts) but semantics and phonology are systems (or "a collection of objects with certain relations" (Shapiro 1997: 73)) in their own right. The interfaces are concerned with the structures, i.e. the systems at a higher level of abstraction, where non-relational elements are ignored.

With relation to realism, one significant advantage of this foundational framework is that it can provide an answer to Quine's (1972) famous challenge to Chomsky concerning equivalent grammar formalisms. Quine's challenge was initially posed to a conceptualist framework, i.e. if two grammar formalisms are weakly equivalent (generate the same set of sentences) then how can we divine which one is cognitively realized in the human mind/brain? Similarly for the Platonist, if sentences are sets and two weakly equivalent grammar formalisms pick out the same sets of sentences (sets of sets), how can we tell which sets constitute the language in question? This is essentially a parallel of the arithmetic case involving the finite von Neumann ordinals and the Zermelo numerals (and also Benacerraf's (1965) objection to Quine's version of Platonism). The answer for the *ante rem* realist is analogous, they both pick out the same natural language structure and thus we have no reason to decide between them.

Another related aspect in favour of this view over its Platonist alternative might be the level at which languages themselves are pitched. As previously mentioned, sentences are abstract objects for Platonists. But so too are languages as

they are defined as 'systems of sentences'. As Carr (1990: 123) put it, "while it is perfectly reasonable to assume that sentences are linguistic objects and thus susceptible to such Platonic interpretation, it is rather novel to argue that particular languages […] should be taken to be objects of linguistic theory". The worry here is that even if we consider the notion of 'sentence' to be a theoretical one, considering an entire language as a theoretical concept seems singular.[36] Generally, the boundaries between external languages like Dutch, English and German are not sharply defined. Likewise, the Platonist claim is that there is a fact of the matter as to which distinct abstract objects (or sets) Serbian and Croatian correspond to respectively. However, languages in this sense are often politically defined and classified (hence Chomsky's initial reservations about E-languages). In general, these types of languages are within the realm of sociolinguistics and not objects of grammatical theory. On the *ante rem* realist account, Serbian and Croatian, Urdu and Hindi and other such cases have structural overlap. The systems of sentences to which our grammars of these languages correspond are the same or similar natural language structures identified by syntactic theory; they need not be identical to achieve this end nor need there be a fact of the matter as to which structures they correspond to exactly.

For the last desideratum, I propose we treat the instantiation relation of our quasi-concrete linguistic structures as the RESPECT constraint itself. Thus, the way in which our linguistic structures or patterns are instantiated in the physical world is by respecting the rules of our competence and by those same rules respecting the rules of the structures in turn. This could be achieved by persisting with the idea that the quasi-concrete linguistic structures are comprised of sentences which are the output of our linguistic competence but distinct from that competence, like the waggle dances of Devitt's bees. I think that on this view we have even more options than these available to us for capturing the interdependence of structure and mind while maintaining their distinct natures. Furthermore, if linguistic structures are the outputs of competence and competence is within the evolutionary order of things in the physical world, then given the RESPECT constraint, our linguistic structures are also related to a naturalistic story of language evolution. However, much more needs to be said about this matter before it could be considered an advantage over rival views.

36. Of course, Platonism about language is not a theoretical point about how we should treat natural languages but an ontological point about what they in fact are. If I am correct in my interpretation of Carr's point, then his line might be somewhat misguided.

4.3 Natural types

In Section 2.4., I promised that I would show that Platonism incorporated a type-token distinction that might question the correct level of abstraction of linguistic theory. In the previous section, I suggested a different (Aristotelian) notion of this distinction in terms of quasi-concrete structures in which "the relation of linguistic types to their tokens (and in general of quasi-concrete objects to their concrete 'representations') is not an external relation" (Parsons 1990: 337). Admittedly, this commits us to *abstracta* of a certain sort. I further claimed that this account of the requisite abstraction level was more in line with the *ante rem* realism I proposed for the foundations of linguistics as well as some comments and accounts suggested by Katz and Postal themselves. Despite the fact that a mixed ontological attitude towards abstraction is well-supported in the literature (Hale 1989, Parsons 1990, Stainton 2014 etc.), a Platonist could insist that there is no independent justification for jettisoning the clearer traditional account of types as abstract objects and tokens as their physical instantiations. The claim that quasi-concrete structures seem to 'go better' with the ontology I propose is not independent reason for accepting these structures nor sufficient justification for my earlier claim that Platonism fails to do abstraction justice. In this final section, I will make the case for questioning the traditional view of types as non-spatio-temporal abstract objects outside of the causal order. This will require a detour into the philosophy of science. First, however, consider these passages cited in both Katz (1996) and Postal (2009).

> There will ordinarily be about twenty *thes* on a page, and of course they count as twenty words. In another sense of the word *word*, however, there is but one *the* in the English language; […] it is impossible that this word should lie visibly on a page or be heard in any voice. (Peirce 1958: 423)

> ES IST DER GEIST DER SICH DEN KÖRPER BAUT: [S]uch is the nine word inscription on a Harvard museum. The count is nine because we count *der* both times; we are counting concrete physical objects, nine in a row. When on the other hand statistics are compiled regarding students' vocabularies, a firm line is drawn at repetitions; no cheating. Such are two contrasting senses in which we use the word *word*. A word in the second sense is not a physical object, not a dribble of ink or an incision in granite, but an abstract object. In the second sense of the word *word* it is not two words *der* that turn up in the inscription, but one word *der* that gets inscribed twice. Words in the first sense have come to be called tokens; words in the second sense are called types. (Quine 1987: 216–217)

Characterizations of objects such as those presented in the quotations above aim to establish a distinction between abstract and ordinary objects (e.g. tables, chairs, Chomskies etc.). Once this distinction is in place, there are two options for

describing the relationship between these respective types of objects. We could go the traditional Platonist route of removing abstract objects from the causal order by conceiving of them without physical and temporal parts. This might be less desirable for the reasons we saw in Section 3.2. Another option is adopting a position called 'Naturalized Platonism' (Linsky & Zalta (1995)). This position makes the empiricist claim that properties and sets and other *abstracta* are well-within the causal order and knowable *a posteriori*. In some ways, Quine falls within this camp by constraining abstract objects through the same principles (such as Ockam's razor) that constrain other theoretical entities. Still we are left in some confusion as to how we come to know these entities in the first place.

In order to offer a genuinely naturalized account of Platonistic underpinnings and abstract objects, Linsky and Zalta (1995) propose what they call 'Platonized Naturalism' (not to be confused with Naturalized Platonism above). The details of this proposal are tangential to my purpose here.[37] However, the aspect of the project that does have significance for the current discussion is their particular identification of the genesis of the issues with the Platonistic positions mentioned in the previous paragraph.

> We believe that there are two mistakes in that conception: (i) the model of abstract objects as physical objects, and (ii) the piecemeal approach to theorizing about abstract objects. (Linsky & Zalta 1995: 9)

The first prong of this analysis is particularly important here and I think the main issue with the some accounts of the type/ token distinction as presented by Quine and repeated by Katz (1996) and Postal (2009) above. Some philosophers have taken abstract objects to be analogous to physical objects (Armstrong, Maddy) within the causal order. "Most Platonists conceive of abstract objects on the model of physical objects. That is, they understand the objectivity and mind-independence of abstract objects by analogy with the following three features" (Linsky & Zalta 1995: 9), namely: if physical objects are 'sparse', then so are the abstract objects to which they correspond; if physical objects are 'complete' as in have more properties than we know and are entirely determinate, then abstract objects are knowable in their entirety and determinate in detail (either true or false for all properties); and lastly if physical objects have 'backsides' or underlying hidden structures, then abstract objects are similarly complex. In some sense,

37. Although a careful reader might note the similar motivations behind this view and Mixed Realism itself. However, within *ante rem* realism, structures can be defined independently of theoretical or naturalistic concerns. For instance, we could be interested the amalgams of unrealized linguistics patterns for the purpose of shedding light on realized ones. These structures can be described outside of the respect constraint.

this picture is natural since abstract objects are often determined by 'abstracting' from physical objects. But this dichotomy brings with it some problems. Linsky and Zalta go as far as to assert that it is the root of Platonism's conflict with naturalism. I take no stance on those issues here. I do, however, believe that the analogy with physical objects is responsible for some of the properties of type/token distinction presented by some Platonists (such as Bromberger (1989)), specifically by forcing a singular denoting term reading of abstract objects analogous to that of physical objects.

If we persist in modelling the type/ token distinction with this definition of abstract objects as abstract physical objects, we might be stuck with an irreconcilable ontology and an epistemological problem as to how we can know the latter in the first place. *Ante rem* realism aims to avoid this particular issue, among other things. For instance, if types are on the level of offices (in the sense discussed above) the analogy with physical objects is dropped, since these offices are not complete, do not have hidden natures and are certainly not sparse (offices can be created *ad infinitum* independently of entities to fill those positions). For instance, for Millikan (2005) two semantic tokens are of the same type only if they are copied from the same pool of linguistic patterns or 'reproducing conventions' within a given community. Once we relax the strict type-token distinction of Quine and Peirce (above), many of the alternatives can be favourably illuminated.

5. Conclusion

Since the late 1950's linguists have discussed linguistic structures, their implementation in grammar formalisms and their interrelations. Very little has been said specifically about what these structures are and how they relate to other non-linguistic structures. I have attempted to give the beginnings of an account here. Much work still needs to be done. Nevertheless, *ante rem* realism provides not only an account of the foundations of linguistics and its subject matter but also aims to demystify the concept of structure used throughout the discipline as an abstract pattern produced by competence but distinct from it in ontology.

The question remains, what kind of science is linguistics? Is it a formal science in terms of mathematics or an empirical science like psychology? On the view I have been pushing, the answer is that it is a little bit of both. One could either take it to be an empirical science with formal aspects or a formal science with empirical aspects (depending on your funding grant). Linguistics lies in the same disciplinary lacuna that most applied sciences do.

In this paper, I have attempted to extend the contributions of Katz and Postal in the foundations of linguistics by considering a mixed ontology and a mathematical structuralist interpretation thereof. In many ways, my project can be seen as a natural progression of the ideas presented in Katz (1981) and defended in Postal (2003). I argued for three conditions or desiderata on a mixed realist account of linguistic ontology in light of critiques found in the Platonist and Nominalist literature, namely creativity and infinity, the correct level of scientific abstraction and RESPECT between the distinct structures of the mind and linguistic world respectively.

I then drew from the philosophy of mathematics to suggest a novel account of the nature of the linguistic enterprise and the natural languages it studies, in terms of an *ante rem* or non-eliminative structuralism with the inclusion of quasi-concrete structures, which I called *ante rem* realism. This account aimed to meet all of the aforementioned desiderata of a mixed realist linguistic account in a way more amenable to naturalism.

However, there are still many questions to answer. Some of these pertaining to *ante rem* structuralism and whether or not it is in fact an advancement on Platonism or simply 'Platonism in disguise' (Hellman 1989)? Other questions pertain to the exact relationship between *abstract* structures and concrete realizations, i.e. between linguistic types and their tokens. In light of these challenges, the present work serves to continue a conversation started by Katz and Postal many years ago and to show that this conversation still has many avenues and insights to offer contemporary theoretical linguistics and its philosophy.

Acknowledgements

I am extremely grateful to Christina Behme, Josh Dever, Ephraim Glick, Patrick Greenough, Tanmay Inamdar, Terry Langendoen, Martin Neef, David Pitt, Geoffrey Pullum, Kate Stanton, Zoltán Szabó and Bernhard Weiss for comments on previous drafts of this chapter or for helpful discussion of some of the issues within it. This chapter was written while I was a visiting scholar in the Department of Philosophy at the University of Texas at Austin.

References

Awodey, Steven. 1996. Structure in mathematics and logic: A categorical perspective. *Philosophia Mathematica* (3)4: 209–237. doi:10.1093/philmat/4.3.209

Benacerraf, Paul. 1965. What numbers could not be. *Philosophical Review* 74: 47–73. doi:10.2307/2183530

Benacerraf, Paul. 1973. Mathematical truth. *The Journal of Philosophy* 70(19): 661–679. doi:10.2307/2025075

Behme, Christina. 2015. Is the ontology of biolinguistics coherent? *Language Sciences* 47: 32–42. doi:10.1016/j.langsci.2014.07.012

Boolos, Geoffrey. 2000. Must we believe in set theory? In *Between Logic and Intuition: Essays in Honor of Charles Parsons*, Gila Sher & Richard Tieszen (eds), 257–268. Cambridge: CUP. doi:10.1017/CBO9780511570681.013

Bromberger, Sylvain. 1989. Types and tokens in linguistics. In *Reflections on Chomsky*, Alexander L. George (ed.), 58–90. Oxford: Basil Blackwell.

Carr, Philip. 1990. *Linguistic Realities*. Cambridge: CUP.

Chomsky, Noam. 1957. *Syntactic Structures*. The Hague: Mouton.

Chomsky, Noam. 1959. On certain formal properties of grammars. *Information and Control* 2: 137–167. doi:10.1016/S0019-9958(59)90362-6

Chomsky, Noam. 1964. Current issues in linguistic theory. In *The Structure of Language*, Jerry A. Fodor & Jerrold J. Katz (eds), 50–118. Englewood Cliffs NJ: Prentice Hall.

Chomsky, Noam. 1965. *Aspects of the Theory of Syntax*. Cambridge MA: The MIT Press.

Chomsky, Noam. 1966. *Cartesian Linguistics: A Chapter in the History of Rationalist Thought*. New York NY: Harper & Row.

Chomsky, Noam. 1972. *Language and Mind*. Cambridge: CUP.

Chomsky Noam. 1981. *Lectures on Government and Binding*. The Hague: Mouton.

Chomsky, Noam. 1982. A note on the creative aspect of language use. *The Philosophical Review* XCI(3): 423–434. doi:10.2307/2184692

Chomsky, Noam. 1986. *Knowledge of Language: Its Nature, Origin, and Use*. New York NY: Praeger.

Chomsky, Noam. 1990. Language and the problems of knowledge. In *The Philosophy of Language*, Aloysius P. Matinich (ed.), 581–598. Oxford: OUP.

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

Chomsky, Noam. 2000. *New Horizons for the Study of Mind and Language*. Cambridge: CUP. doi:10.1017/CBO9780511811937

Chomsky, Noam. 2009. The mysteries of nature: How deeply hidden? *Journal of Philosophy* 106 (4): 167–200. doi:10.5840/jphil2009106416

Collins, John. 2007. Review of Devitt 2006. *Mind* 116: 416–423. doi:10.1093/mind/fzm416

Collins, John. 2008a. Knowledge of language redux. *Croatian Journal of Philosophy* 8: 3–43.

Collins, John. 2008b. On the Linguistic Conception of Linguistics. Ms.

D'Agostino, Francesco. 1984. Chomsky on creativity. *Synthese* 58: 85–117. doi:10.1007/BF00485363

Devitt, Michael. 2006. *Ignorance of Language*. Oxford: OUP. doi:10.1093/0199250960.001.0001

Devitt, Michael. 2008. Explanation and reality in linguistics. *Croatian Journal of Philosophy* 8(2): 203–231.

Drach, Margaret. 1981. The creative aspect of Chomsky's use of the notion of creativity. *Philosophical Review* 90: 44–65. doi:10.2307/2184372

Evans, Gareth. 1981[1985]. Semantic theory and tacit knowledge. In *Gareth Evans: Collected Papers*, Antonia Philipps (ed.), 322–342. Oxford: Clarendon.

Fodor, Jerrold A. 1981. Some notes on what linguistics is about. In *Readings in the Philosophy of Psychology*, Vol. II, Ned Block (ed.), 197–207. Cambridge MA: Harvard University Press.

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

Hale, Robert. 1987. *Abstract Objects*. Oxford: Basil Blackwell.

Hellman, Geoffrey. 1989. *Mathematics without Numbers: Towards a Modal-Structural Interpretation*. Oxford: Clarendon Press.

Heyting, Arend. 1956. *Intuitionism: An Introduction*. Amsterdam: North Holland.

Heyting, Arend. 1974. Intuitionistic views on the nature of mathematics. *Synthese* 27(1–2): 79–91. doi:10.1007/BF00660890

Hilbert, David. 1899. *Grundlagen der Geometrie*. Leipzig: Teubner; *Foundations of Geometry*, trans. by E. J. Townsend. 1959. La Salle Il: Open Court.

Hockett, Charles. 1968. *The State of the Art*. The Hague: Mouton.

Iemhoff, Rosalie. 2015. Intuitionism in the philosophy of mathematics. In *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta (ed.). <http://plato.stanford.edu/archives/spr2015/entries/intuitionism/>

Janssen, Theodore. 1986. *Foundations and Applications of Montague Grammar*, Part 1. Oxford: OUP.

Katz, Jerrold J. 1971. *Linguistic Philosophy: The Underlying Reality of Language and its Philosophical Import*. London: Allen & Unwin.

Katz, Jerrold J. 1981. *Language and Other Abstract Objects*. Totowa NJ: Rowman & Littlefield.

Katz, Jerrold J. 1984. An outline of Platonist grammar. In *Talking Minds: The Study of Language in the Cognitive Sciences*, Thomas G. Bever, John M. Carroll & Lance A. Miller (eds.), 17–48. Cambridge MA: The MIT Press.

Katz, Jerrold J. 1995. What mathematical knowledge could be. *Mind* 104(415): 491–520. doi:10.1093/mind/104.415.491

Katz, Jerrold J. 1996. The unfinished Chomskyan revolution. *Mind and Language* 11(3): 270–294. doi:10.1111/j.1468-0017.1996.tb00047.x

Katz, Jerrold J. 1998. *Realistic Rationalism*. Cambridge MA: The MIT Press.

Katz, Jerrold J. & Postal, Paul M. 1991. Realism vs. conceptualism in linguistics. *Linguistics and Philosophy* 14(5): 515–554. doi:10.1007/BF00632596

Kaufman, Daniel. 2002. Composite objects and the abstract/concrete distinction. *Journal of Philosophical Research* 27: 215–238. doi:10.5840/jpr_2002_32

Kirby, Simon. 1999. Learning, bottlenecks and infinity: A working model of evolution of syntactic communication. In *Proceedings of the AISB'99 Symposium on Imitation in Animals and Artifacts*, Kerstin Dautenhahn & Chrystopher Nehaniv (eds). Hove: Society for the Study of Artificial Intelligence and Simulation of Behavior.

Langendoen, Terence. 2003. Merge. In *Formal Approaches to Functional Phenomena: In Honor of Eloise Jelinek* [Linguistik Aktuell/Linguistics Today 62], Andrew Carnie, Mary Willie & Heidi Harley (eds), 307–318. Amsterdam: John Benjamins. doi:10.1075/la.62.22lan

Langendoen, D. Terence. 2018. Languages as complete and distinct systems of reference. In *Essays on Linguistic Realism*, Christina Behme & Martin Neef (eds). Amsterdam: John Benjamins. (this volume).

Langendoen, Terence & Postal, Paul M. 1984. *The Vastness of Natural Languages*. Oxford: Blackwell.

Lawrence, Stephen. 2003. Is linguistics a branch of psychology? In *Epistemology of Language*, Alex Barber (ed.), 69–106. Oxford: OUP.

Lewis, David. 1975. Languages and language. In *The Philosophy of Language*, Aloysius P. Matinich (ed.), 3–35. Oxford: OUP.

Lieb, Hans-Heinrich. 1992. The case for a New Structuralism. In *Prospects for a New Structuralism* [Current Issues in Linguistic Theory 96], Hans-Heinrich Lieb (ed.), 33–72. Amsterdam: John Benjamins. doi:10.1075/cilt.96.05lie

Lieb, Hans-Heinrich. 2018. Describing linguistic objects in a realist way. In *Essays on Linguistic Realism*, Christina Behme & Martin Neef (eds). Amsterdam: John Benjamins. (this volume).

Linsky, Bernhard & Edward N. Zalta. 1995. Naturalized Platonism vs. Platonized naturalism. *Journal of Philosophy* xcii(10): 525–555. doi:10.2307/2940786

Ludlow, Peter. 2009. Review: Ignorance of language. *The Philosophical Review* 118(3): 393–402. doi:10.1215/00318108-2009-009

Millikan, Ruth. 2005. *Language: A Biological Model*. Oxford: OUP. doi:10.1093/0199284768.001.0001

Neef, Martin. 2018. Autonomous declarative phonology: A realist approach to the phonology of German. In *Essays on Linguistic Realism*, Christina Behme & Martin Neef (eds). Amsterdam: John Benjamins. (this volume).

Nefdt, Ryan. 2016a. Linguistic modelling and the scientific enterprise. *Language Sciences* 54: 43–57. doi:10.1016/j.langsci.2015.10.002

Nefdt, Ryan. 2016b. Scientific modelling in generative grammar and the dynamic turn in syntax. *Linguistics and Philosophy* 39(5): 357–394. doi:10.1007/s10988-016-9193-4

Parsons, Charles. 1990. The structuralist view of mathematical objects. *Synthese* 84: 303–346. doi:10.1007/BF00485186

Parsons, Charles. 2004. Structuralism and metaphysics. *The Philosophical Quarterly* 54(214): 56–77. doi:10.1111/j.0031-8094.2004.00342.x

Peirce, Charles. 1958. *Collected Papers of Charles Sanders Peirce*, Vol. 4. Cambridge MA: Harvard University Press.

Pinker, Steven. 1994. *The Language Instinct*. New York NY: Morrow.

Postal, Paul M. 2003. *Skeptical Linguistic Essays*. Oxford: OUP.

Postal, Paul M. 2009. The incoherence of Chomsky's 'biolinguistic' ontology. *Biolinguistics* 3(1): 104–123.

Pullum, Geoffrey. 2011. On the mathematical foundations of syntactic structures. *Journal of Logic, Language and Information* 20(3): 277–296. doi:10.1007/s10849-011-9139-8

Pullum, Geoffrey & Scholz, Barbara. 2010. Recursion and the infinitude claim. In *Recursion in Human Language* [Studies in Generative Grammar 104], Harry van der Hulst (ed.), 113–138. Berlin: Mouton de Gruyter. doi:10.1515/9783110219258.111

Pylyshyn, Zenon. 1973. What the mind's eye tells the mind's brain: A critique of mental imagery. *Psychololegical Bulletin* 80: 1–24. doi:10.1037/h0034650

Quine, Willard. 1972. Methodological reflections on current linguistic theory. In *Semantics of Natural Language*, Donald Davidson & Gilbert Harman (eds), 442–454. Dordrecht: Reidel. doi:10.1007/978-94-010-2557-7_14

Quine, Willard. 1987. *Quiddities*. Cambridge MA: Harvard University Press.

Resnik, Michael. 1982. Mathematics as a science of patterns: Epistemology. *Nous* 16: 95–105. doi:10.2307/2215419

Resnik, Michael. 1997. *Mathematics as a Science of Patterns*. Oxford: Clarendon Press.

Rey, Georges. 2006. Conventions, intuitions and linguistic inexistents: A reply to Devitt. *Croatian Journal of Philosophy* 6: 549–569.

Searle, John. 1972. Chomsky's Revolution in Linguistics. *New York Review of Books*, June 29, 1972.

Shapiro, Stewart. 1997. *Philosophy of Mathematics: Structure and Ontology*. Oxford: OUP.

Shieber, Stuart. 1985. Evidence against the context-freeness of natural language. In *The Formal Complexity of Natural Language* [Studies in Linguistics and Philosophy 33], Walter J. Savitch, Emmon Bach, William E. Marsh & Gila Safran-Naveh (eds), 320–334. Dordrecht: Reidel. doi:10.1007/978-94-009-3401-6_12

Shieber, Stuart & Schabes, Yves. 1991. Synchronous tree-adjoining grammars. In *Proceedings of the 13th International Conference on Computational Linguistics*, Hans Karlgren (ed.). Helsinki: Helsingiensis Universitas.

Slezak, Peter. 2007. Linguistic explanation and psychological reality. lingbuzz/000453.

Soames, Scott. 1984. Linguistics and psychology. *Linguistics and Philosophy* 7: 155–179. doi:10.1007/BF00630811

Stainton, Robert. 2014. Philosophy of Linguistics. *Oxford Handbooks Online*. <http://works.bepress.com/robertstainton/126/>

Stanley, Jason & Szabó, Zoltan. 2000. On quantifier domain restriction. *Mind & Language* 15(2–3): 219–261. doi:10.1111/1468-0017.00130

Tomalin, Marcus. 2006. *Linguistics and the Formal Sciences*. Cambridge: CUP. doi:10.1017/CBO9780511486340

Wetzel, Linda. 2014. Types and Tokens. In *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta, (ed.). <http://Plato.stanford.edu/archives/spr2014/entries/types-tokens/>

Yablo, Steven. 2013. Explanation, extrapolation, and existence. *Mind* 121(484): 1007–1029. doi:10.1093/mind/fzs120