Parallelism, Structural Isomorphy and Structural Analogy

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1 Introduction

In this article, I will discuss the *parallel architecture* approach to language (Jackendoff 2002, this issue; see also van der Hulst 2006, 2024a, Chapter 6), suggesting that this model does not account for the significant *structural isomorphy* between the semantic, syntactic and phonological representations of linguistic expressions. I propose a simple addition to the model that provides a better basis for explaining the direction of *isomorphy* between 'chunks of structures' (often just the size of *domains*) in phonological, syntactic and semantic representations of linguistic expressions. I then explore whether in addition to the notions of parallelism and isomorphy, a grammar model should also include the notion of *structural analogy*, i.e. the idea that different modules within the grammar (and in the mind at large, perhaps even beyond the mind) resemble each other in terms of the *kinds* of the structures that they work with.

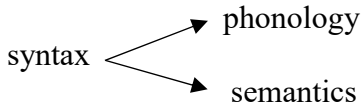
2 Parallelism

I assume that the basic claim of the *parallel architecture model* (PAM) is that the modules of the grammar (that deal with the three *layers* (also called *levels*) of linguistic expressions, i.e., the perceptible form, the syntactic structure and the meaning) define the wellformedness of representations autonomously, i.e., without regard to the wellformedness of the other two layers. This means that the three modules have equal status, with none having some kind of logical priority over the other two. In this respect, PAM differs from generative approaches in the Chomskyan tradition which are syntax-centric models, in the sense that syntax 'comes first', with phonology and semantics being seen as 'interpretive' modules.

3 Syntax-first and structural isomorphy

It is not wrong in principle to focus on syntactic wellformedness, while 'neglecting' the phonological and semantic sides of linguistic expressions. In fact, from the beginning, Chomsky's main point was that whatever determines syntactic wellformedness of an expression has nothing to do with its phonological and semantic properties. This was usually demonstrated by making up sentences that are syntactically wellformed, but semantically nonsensical (cf. *colorless green ideas sleep furiously*). The claim that what counts as syntactically wellformed is independent from what counts as wellformed phonologically or semantically is also essential in Jackendoff's parallel architecture. So why then did Chomsky flesh out this claim by assigning logical priority to the syntactic system, making phonology and semantics *interpretative* systems that take the output the syntactic module as their input?

(1)



One might think that putting syntax first was an unintended consequence of Chomsky's focus on formal languages, which were meant to account for the syntactic structure of sentences. However, putting syntax first had a deeper reason which was that even though wellformedness at each layer is autonomous, it is nevertheless the case that phonological and semantic structure were thought to be *dependent on* syntactic structure, in the sense of being influenced by it. This influence produces a certain degree of *structural isomorphy* between syntactic structures on the one hand and phonological and semantic structure on the other. Focusing on the dependence of phonological structure on syntactic structure, it has been claimed that morphological words correspond to phonological words, syntactic phrases to phonological phrases, and 'clauses' to intonation phrases. Of course, this isomorphy is not completely structure preserving since, for example, phonological words can both be smaller and larger than morphological words. A compound word like *kitchen table* is one morphological word but two phonological words, while the sequence *he's* (in *he's coming*) is two morphological words, but one phonological word. Similar mismatches can occur at the phrasal level. Such mismatches show that we need a theory of syntactic structure *and* one of phonological structure. The nature of the isomorphy between syntactic and phonological structure has been discussed in a long tradition of literature that provides algorithms that map phonological (often called *prosodic*) structure from the syntactic structure (see Nespor & Vogel 1999 for the essential work).[1]

The syntax-first model in (1) predicts that a similar direction of influence also applies between syntactic and semantic structure. However, in this regard, in the next section, I will take sides with the view that the former is actually dependent on the latter: syntax tries to cater to semantic/conceptual structure.

4 Structural isomorphy and the parallel architecture

It is important to see that PAM does not claim that a linguistic expression is wellformed if it is wellformed at each of its three layers. It is simply not the case that any combination of wellformed representations for each layer (i.e., the Cartesian product of three sets) will count as a wellformed expression in a given language. Many combinations are fixed and stored in the lexicon. To take the simplest case, the phonological representation for *dog* cannot co-occur with the conceptual representation for *cat*, nor can it co-occur with the category label Preposition. Many combinations are simply arbitrary, as is famously assumed for the combination of phonological form and meaning in spoken languages. Regularities also exist, for example, between meanings that involve the concept THING and the word label Noun. In Jackendoff & Audring (2021), correspondences across layers of lexical pieces are formally represented in terms of co-indexing.

A different type of limitation on the permitted co-occurrence of structures across layers involves the previously discussed matter of *isomorphy*. In a critical reflection on the parallel architecture, Marantz (2005) argued that parallelism does not explain that the structures in phonology, syntax and semantics tend to be isomorphic or 'match' to some extent. Marantz' point was that isomorphy, and specifically the dependence of phonological and semantic structure on

[1] To this day, it is debated whether a prosodic organization is actually needed. Some authors defend the view that all phonological processes that operate above the word can make exclusive reference to syntactic structure. See Selkirk's (2011) matching theory for a recent account of how phonological structure depends on syntactic structure.

syntactic structure, is explained if phonological structure and semantic structure is projected from the output of the syntactic system.

In a parallel model, with all three modules being independent, no isomorphy is expected (in whatever direction). But this does not mean that PAM has nothing to say about isomorphy. The rebuttal to Marantz' complaint is that the three grammatical modules in the parallel architecture are not *informationally encapsulated* in the sense of Fodor (1993). Jackendoff adds *interface rules* to the model which stipulate structural correspondences that are thought of as being bidirectional. Interface rules do not only link syntactic structure to both phonological and semantic structure, but also phonological structure 'directly' to semantic structure which is manifested in iconicity, when the phonological form resembles the semantic structure in some way. However, iconicity is also manifested in syntactic structure and this means that it is not the case that semantic structure is simply dependent on syntactic structure, which in my view it isn't to begin with. There is also a dependency in the other direction, and perhaps one could even say that syntactic structure caters to (i.e., tries to mimic) semantic/conceptual structure. It is also very important to emphasize that while the phonological structure of morphologically complex words or syntactic units does mostly follow the morpho-syntactic structure, isomorphy is limited by the fact that phonology must also cater to phonetic structure. While phonetics is dependent on phonology, in the sense that the phonetic submodule *implements* the phonological structure in terms of articulator motor programs and corresponding acoustic patterns, the nature of the phonetic substance has a role to play in how the phonology models this substance.

One can say that syntactic structure tries to deliver structures that optimally encode semantic/conceptual structure, but as such it has its limits, one limit being that syntactic structures involve linearity (if we ignore this property being dispatched to phonology in more recent syntactic theories). However, another factor that limits syntax is that processes of language change (known as *grammaticalization processes*) 'pack' semantic information into complex morphological structures that differ radically from one language to the next, being subject to various processes of phonological reduction and compression, giving rise to derivational morphology (word formation) and inflectional systems.[2]

We see here an interesting analogy between grammaticalization and *phonologization*. The former process in some sense denaturalizes the perfect syntactic encoding of conceptual structure, while the latter denaturalizes the perfect phonological encoding of phonetic structure. This makes syntax and phonology systems of the same type, not only because both capture the form of language in the broadest sense, but also because both have their limitations in being able to represent the 'substances' that they are grounded in (conceptual structure and phonetic structure, respectively). These limitations are in part the result of diachronic processes, but they must also be due to cognitive constraints that limit the kinds of structures that both modules can accommodate.

Arguably, the parallel model, while it allows syntax to interface between semantics and phonology, differs from the syntax-first approach by not providing a basis *for the prevailing direction of isomorphic dependencies*. In this respect, it could be argued that semantics-first

[2] In the minimalist approach, the syntactic structure of complex words (word formation) has been incorporated into the same syntactic system that accounts for phrase and sentence structure, while inflection is encoded in terms of syntactic features. Phonological form is inserted on the phonological path from syntax to phonology. This means that Minimalism, unlike PA, does not make a principled distinction between words and phrases/sentences. For a defense of separating the grammar of words and that of phrases/sentences, see also van der Hulst (2006).

models that were proposed in the 1970s as a response to the syntax-first model, and that went under the name *Generative Semantics* (Seuren 1974), were more adequate:

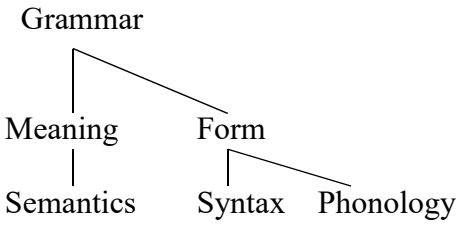
(2) Semantics ⟶ Syntax ⟶ Phonology

One could claim that the direction that is implied in the semantics-first approach is more realistic in that it can be understood as a production-oriented model.

Here I want to suggest another way to account for the prevalent direction of isomorphy that preserves the basic design of the parallel model. In so-called dependency approaches to grammar, relations between words in a sentence are represented in terms of dependency relations (Tesnière 1959; Hays 1964). The resulting dependency structure was originally proposed as a replacement of constituency-based grammars. In generative grammar head/dependency relations have been integrated with the constituency format. In the dependency approach of John Anderson, the notion of head/dependency has been applied to all components of the grammar, including phonology (Anderson & Ewen 1987) and in my own work I have followed the lead of Dependency Phonology (van der Hulst 2020). However, we do not have to limit head/dependency relations to linguistic representation (in syntax, phonology and semantics). Rather we can think of this relation as much more general and assume that this relation will always be imposed on units that are combined. This follows the idea in Volk (1995) that identifies a number of *metapatterns* such as 'borders', 'binaries', 'centers', 'layers', 'hierarchies', 'cycles' and several others that are rather easy to connect to notions that play a role in language. For example, the notion of 'centers' captures the idea of headedness. Following this idea, I would like to suggest that we can think of the parallel modules of the mental grammar as engaging in a head/dependency relation, but I must emphasize that this is not the same thing as imposing an ordering on the modules of the grammar (as in syntax-first and semantics-first models).

If we impose a head/dependency relation on the parallel modules, the question that then arises is what the head pillar is and which other two pillars are closely or more remotely dependent on the head pillar. The tentative suggestion that I put forward here is given in (3):

(3)



The head/dependency structure in (3) depicts grammar as connecting meaning to form, the latter comprising syntactic form and phonological form.

5 Structural Analogy and the parallel architecture

What I want to discuss in this section is the notion of *Structural Analogy* (SA; see Anderson 2006), which, in the most general sense, states that we expect different mental modules to be organized

in similar ways.[3] This is different from the notion of isomorphy in that analogy is about the general principles that underlie possible structures in all modules, while isomorphy is a claim about similarity between *actual structures* in different modules.[4]

Structural Analogy has played a prominent role in certain linguistic theories such as *Glossematics* (Hjelmslev 1953) and John Anderson's *Dependency Grammar* (Anderson 1992).[5] The basic idea of SA is that phonological and syntactic structure (here leaving semantic structure aside) appeal to the same structural principles, notably that structures are *headed* and (predominantly, perhaps exclusively) *binary*. In Anderson's dependency approach a further analogy is that in both modules, features are *privative* (which contrasts with the idea that features are binary, consisting of a feature name and a binary value: [±F]). Some might say that the notion of structural analogy is at odds with the idea of modularity. If syntax and phonology are different modules, wouldn't we expect that they are different due to trying to be optimal encodings of conceptual and phonetic structure, respectively? Now, we have already seen that grammatical modules are not informationally encapsulated; there is interaction and determination between the structures in the different modules. The SA idea is that syntax and phonology, while being autonomous, are subject to the same cognitive principles of hierarchical grouping, headedness, binarity and privativity. Differences between modules are due to their grounding in different 'substances', conceptual structure and phonetic structure, which produce different sets of building blocks ('primitives', features) and limitations on the complexity of the hierarchical structure. The rationale for pursuing structural analogy is *cognitive economy*, i.e., the idea that it is simpler for different cognitive systems to share the same design than for them to be completely different; see Carruthers (2006) for the same point.

9 Conclusions

In this article I have explored the notions *parallelism*, *structural isomorphy* and *structural analogy*, all of which, I have argued, must play a role in our quest for the best model for human languages (as well as other semiotic systems). I have augmented Jackendoff's notion of parallelism (which I support as a view on the autonomy of grammatical modules) with a notion of headedness in order to explain how different modules can influence each other such that a degree of structural isomorphy is the result. I then argued that a case can be made for exploring the fact that different modules are structurally analogous, which here means that the same structural principles are

[3] In geometry, two lines are said to be parallel when at each point they are equidistant. In the PA, parallelism has a different meaning, namely *simultaneity* or 'happening at the same time' (as in parallel processing models). Interestingly, parallel lines do not have to be straight lines. They can have curves that form different shapes. That said, I will not suggest to subsume the notion of isomorphy under parallelism as it is used in PA.

[4] In this section, I will not discuss the logical possibility that recurrent organizational properties of grammatical modules can be attributed to factors that go beyond human language and even beyond human cognition. There has been a trend in Chomsky's work to promote such other factors, which he calls 'third factors', some of which bear on general cognitive principles that impact on language, but also on other cognitive systems, while other third factors are sought in properties of the brain and, ultimately, in physical laws. Another, earlier voice in this matter is Abler (1979) who sees analogies between language, chemistry and genetics, which he refers to as particulate, self-diversifying systems, meaning that they all allow the generation of infinite possibilities based on finite means. Not that this definition has become a typical one for human language. I refer to van der Hulst (2024b: Chapter 4) for a general discussion of third factors.

[5] See Bauer (1994) for a critical evaluation of the structural analogy notion.

available to them, even though they may use them to different degrees. Here I mostly focused on syntax and phonology, although I believe that the analogy extends to semantics as well.

In my discussion of structural analogy, I considered different modules within the same modality (focusing on syntax and phonology in spoken language), but the idea can be extended to the visual modality, i.e., on sign language and on the visual medium of drawing. Elsewhere, I have explored the extent of structural analogy between sign language phonology and spoken language phonology (incorporating a dependency approach to structure in both modalities); see van der Hulst (1993); van der Hulst & van der Kooij (2021). With respect to drawing, I submit that there is room for developing a dependency phonology of drawing that displays structural analogies with semiotic systems in other modalities, but space limitations prevent me from making concrete suggestions for how we might go about that. With these ideas in mind, I call for the development a general theory of *formology* of semiotic systems.

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