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Language, Biology and Cognition

A Critical Perspective

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Chapter 1: Introduction

This chapter introduces the readers to the core arguments that are to show that the transitions from biology to language and then from language to cognition are not only fraught with insuperable difficulties but also impregnated with hidden conundrums that put a brake on ambitious yet unfounded claims about the biological manifestation of language as it is coupled to cognition. While this forms the background of the critique to be developed in later chapters, the central purpose, as stated here, is to demonstrate that cognition is not transparent to biology, contrary to the current climate of opinions on the relationship between biology and cognition.

1.1 On the Notions of Language vis-a-vis Biology

Here different notions of language in relation to biology are considered in view of the fact that language is used to denote various things such as the mentally instantiated faculty of language, the acquired system of linguistic competence, language as a socio-cultural entity. The exact notion of language targeted in this book is taken from Mondal (2014) where the dimension of psychological/neurobiological implementation of language is distinguished from the dimension of symbolic abstractions of part of the axiomatic system of language.

1.2 Linguistic Cognition and the Underlying Biological Substrate

If cognition can be at all understood via something, it must be language. Then this chapter goes on to talk about two general ways in which cognition as manifested through language can be taken to be instantiated in the biological substrate. The first is the genetic level at which the basic biological layout of organisms along with their structures is specified, and the second is the level of neural organization from which cognition is naturally supposed to emerge.

This chapter first considers the genetic level for the biological instantiation of patterns of cognitive representation of linguistic structures. I take a few linguistic cases to demonstrate how they reveal patterns of cognitive representation. Then I argue that the forms of such cognitive representations are neither descriptively perspicuous nor explanatorily adequate when they are pitched at the genetic level. The generalizations about such cognitive representations predicated on linguistic structures lose their linguistic flavor. Plus they are also shorn of their cognitive content when looked at the genetic level of gene networks and gene expression. The problem becomes more severe when one considers genetic coding for the determination of the cognitive infrastructure underlying linguistic structures. The pitfalls associated with the notion of genetic coding brought to bear upon the present discussion can be easily laid bare if one concentrates on the underlying mechanisms of genetic coding. Since genetic coding operates *only* at the level of protein building in cellular networks (see Godfrey-Smith 2007), it is futile to look for the generalizations about the cognitive representation of linguistic structures at that level.

The discussion then turns to the level of neural organization. Since the neurobiological substrate provides the scaffolding for all cognitive capacities, it may seem reasonable to hold that the relevant generalizations about the cognitive representation of linguistic structures must be at that level. One of the ways of doing this is to introduce a series of reductive stages so that at the final stage the mental can be, possibly through a number of smooth transitions, traced to the neural at the bottom (see Churchland 1986; Churchland and Sejnowski 1992). If the cognitive level is supposed to be derived from the level of neurobiological organization by a series of reductive stages, the resulting derivation is not only uninteresting but also unconvincing. The reason is that the relevant derivation may be fortuitous or simply based on correlations. On way around this problem is to adopt the idea that most neuroscientific explanations are in essence non-reductive and mechanistic-functional (Craver 2007; Bechtel 2008). Higher-level cognitive phenomena are related to the neurobiological level only by virtue of the fact that they can be described by appealing to the neurobiological mechanisms and their component parts that realize them. But even this does not save us from the problems at hand. This is so because the mechanisms that operate at the level of neural structures are *not* the mechanisms that may underlie and support cognitive structures, capacities and processes as reflected within and through language. Besides, the mechanisms that support cognitive representations of linguistic structures cannot be decomposed into parts or components that can be directly found at the level of neural structures. While the cognitive representations of linguistic structures have things like variables, templates, indices, arrays, sequences etc., no decomposition of them can be akin to, or identified with, neural assemblies, activation patterns, spikes, synaptic transmissions etc. This is further evidenced by more linguistic cases that uncover the forms of cognitive structuring.

Finally, I argue that the present view must not be confused with *functionalism*. Functionalism is an approach in the philosophy of mind that adopts the view that the mind is like the software to be studied or described by abstracting away from the details of implementation in the biological hardware (that is, the brain) (see Block 1995; Fodor and Pylyshyn 2015). The view in the present book does not support functionalism, precisely because describing mental states, structures and functions (including those that are reflected within and through language) at the computational level is too trivial to have any explanatory import (see Mondal 2017). In addition, a computational-level description of cognitive representations of linguistic structures does not confer the uniqueness of language as a constitutive system of cognition on language. Any cognitive ability or process can be conceived of as a computation detached from the underlying mechanisms of implementation. This undercuts the uniqueness of a given cognitive capacity because a cognitive capacity ends up being as *functional* or computational as any other. But this cannot be sustained, in that the capacity for visual or olfactory cognition may be more attached to the underlying mechanisms of implementation than the capacity for, say, social cognition. Thus, this chapter prepares the ground for the main arguments of the sustained critique to be developed in Chapter 2.

Chapter 2: Biological Foundations of Linguistic Cognition

This chapter attempts to show that the biological foundations of language and language-cognition relations are rife with conundrums that are far deeper than is generally assumed among most researchers who delve into the connections obtaining between our biological infrastructure and linguistic cognition. The particular problems and troubles arise mainly from certain misunderstandings of the exact role of biological mechanisms that may mediate the manifestation of linguistic cognition.

2.1 Genetic Foundations of Language and Cognition

This section looks into the ways in which the genetic foundations of language and cognition can be thought to shed light on the nature of linguistic cognition. As careful scrutiny of the arguments and the underlying methodology reveals deeper problems hidden inside, this section impugns the assumed relation between linguistic cognition and the underlying genetic substrate.

First, it must be noted that modern thinking on the biological foundations of language and cognition can be traced to Lenneberg (1967), who established a connection between linguistic structures and the acquisition of language, and pointed to their roots in various biological structures, mechanisms and processes. But Lenneberg was aware of the gap, and was thus careful not to readily extend cognitive structures, representations and mechanisms that utilize linguistic structures into the domain of biological structures. Also, it must be recognized that a simple mapping from linguistic structures and representations to certain brain regions does not offer a mechanistic explanation (Marshall 1980), and so a similar argument applies to a conceivable mapping from linguistic structures and representations to certain genomic targets either in gene expressions or in nucleotide morphisms. This is so because no genomic expressions are driven by the coding of specific cognitive structures and mechanisms, or directly construct specific cognitive structures and mechanisms.

In this connection, it may seem that one way of seeing genetic constraints operating on the emergence of, or simply determining the character of, linguistic cognition is to look at the *critical period* for language acquisition that constitutes a time window for the biological growth of language. The case of Genie who at an age around 13 did not succeed in learning the syntax of English after having remained alienated from all human contacts from the age 2 is a turning point for the current discussion (see Curtiss 1994). But it is noted that not every part of language is under equal genetic control. While semantics and vocabulary are less sensitive to the limits posed by the critical period, learning syntax appears to be under a tighter genetic control (Newport, Bavelier and Neville 2001). Plus the postulated critical period is seldom a kind of all-or-nothing affair--it often acts a valve that shows characteristics of sporadic opening and blocking (Herschensohn 2007). Structural representations of linguistic cognition cannot be said to genetically coded or rooted in our genetic foundations, just because genetic constraints shape the temporal window within which language can be acquired. For instance, even though binocular vision develops in humans under a strict genetic control, from this it does not follow that many intrinsic properties of the visual system uncovered by a number of perceptual illusions are directly instantiated in the genetic infrastructure for our binocular visual capacity.

Then this section goes on to debunk the assumption that twin studies provide the perfect case for the genetic constitution and determination of linguistically structured cognition. It has been observed that even if monozygotic twins and diozygotic twins share the same perinatal and postnatal environments, monozygotic twins are found to possess more similar linguistic abilities than dizygotic twins (see Stromswold 2001). Additionally, Stromswold (2006) observes that epigenetic factors (facts about how genes are expressed in organisms) as well as perinatal factors do account for the differences in linguistic abilities in monozygotic twins, whereas postnatal factors may contribute to differences in non-linguistic cognitive abilities in monozygotic twins. But this does not provide a case for the genetic constitution of linguistic cognition. The reason is that if individual co-twins within a zygotic type (the monozygotic type, for example) are similar or dissimilar in their linguistic abilities or a certain pair of twins across the zygotic types is similar or dissimilar in certain linguistic abilities with respect to the other pair, this does not enlighten us as to the underlying cause of the respective similarities or dissimilarities. That is because the similarities or differences in the linguistic abilities could be due to many co-varying factors inextricably intertwined with one another. To link the similarities in linguistic abilities in twins in a non-trivial manner to the genetic similarities, one has to furnish the relevant correspondence principles or the bridging constraints that may help connect the two ontologically distinct scales. But this is never shown.

Finally, the case of FOXP2 is also dealt with. FOXP2 is a transcription factor in the translation of DNA into proteins through RNA. A family (called the KE family) in London had a severe form of speech and language disorder (Gopnik 1990; Hurst et al. 1990), and this was traced to a mutation in FOXP2. Even though this raised hopes about the genetic basis of the linguistic capacity, it has subsequently turned out that the expression and the role of FOXP2 in many of the language and speech disorders can be shown to be driven by factors involved in certain global developmental disorders which are not consistently found in the individuals/families in which the mutation of FOXP2 has been detected (see Bishop 2006; Newbury and Monaco 2010). Nor is FOXP2 essentially involved in the unfolding of linguistic cognition since it is also responsible for the control of muscles and articulation (Vargha-Khadem et al. 1995; Kang and Drayna 2011). This largely undercuts the exclusive functional role of FOXP2 either for language or for linguistic cognition. Beyond that, I also emphasize that neither linkage studies nor association studies for language/cognition disorders provide a substantive description of instantiation relations between the genetic substrate and the relevant facets of the linguistic system. This sets the stage for explorations into an alternative territory. This is what the next section does.

2.2 Neurobiological Foundations of Language and Cognition

The standard methods of neurobiological investigations into language structure and its processing such as brain imaging studies, lesion studies and neurological disorders of language are examined to figure out how and in what ways the logical texture of linguistic cognition can be said to be neurobiologically instantiated. The problems unmasked point to a deeper chasm unrecognized and unexplored. Thus, I argue that this does not in any way admit of any compromise between the manifestation of linguistic cognition and the neurobiological substrate. The studies considered for the discussion at hand are described below.

A. Brain imaging studies

The temporal sequence of brain activities is best captured by electroneurophysiological studies. They are non-invasive in nature. There are two main techniques that are employed--one is the electroencephalographic method (EEG) and the other is the magnetoencephalographic method (MEG). While the former works by measuring electrical activities of the brain at the scalp over which some electrodes are placed, the latter works by means of the estimation of the data gathered from the magnetic fields induced over the brain which help determine the location of electrical activities in the brain. While electroneurophysiological studies provide significant information about the cognitive signatures of linguistic processes occurring in real time, I point out that these electroneurophysiological studies provide no evidence whatsoever about the (neuro)biological grounding of language. All they index is the time flow of particular events in the brain which are correlated with certain parameters of the tasks concerned. Thus, for example, N400 is evoked in cases of lexical selection or access as well as in cases of semantic anomaly, whereas ELAN and P600 are strongly observed in syntactic anomalies and violations of grammatical rules (Friederici 2004). But this does not in any case offer an understanding of the causal connection between the linguistic parameter which is part of a task in question and the relevant brain response.

If the temporal course of neural events is measured well by electroneurophysiological studies, the spatial layout of brain activations is better captured by other imaging methods such as fMRI (Functional Magnetic Resonance Imaging) scan, PET (Positron Emission Tomography) scan etc. While fMRI relies on the emission of radio frequency pulses by the atoms in different neural tissues induced by the magnetic fields placed over the brain, the PET scan technique captures the signatures of glucose consumptions by neuronal cells induced by some radioactive tracers administered to the subjects, and these signatures of glucose consumptions by neuronal cells give form to the images of the activated areas in the brain. The basic problem with such studies is that these studies gather information from the lower scales of neuronal organization from molecules and neuronal cells, and hence it is not automatically established that the relevant linguistic property that characterizes the component involved in the linguistic task(s) is instantiated in the brain areas that are (more) activated. The other deeper problem with such studies is that additive or subtractive calculations of brain signals in such studies may be profoundly misguided for an understanding of brain-language relationships (see also Van Lancker Sidtis 2006).

B. Lesion studies, language disorders, and other neurological cases

One may now suppose that lesion studies and other neurological cases affecting a part of the language capacity may provide unequivocal evidence for the neurobiological instantiation of the level of cognitive organization the language capacity gives rise to. Broca's aphasia and Wernicke's aphasia epitomize the most illustrative cases at hand. While Broca's aphasia is associated with a disruption of the neural network that subserves the syntactic and (morpho)phonological components of the linguistic system, Wernicke's aphasia involves disruptions of brain functions for the conceptual and lexical-semantic components of language (Caplan 1996). The underlying logic of most aphasic studies is that a particular brain function or a set of brain functions is supposed to be subserved by a certain brain area, especially when that specific brain area is damaged, and consequently, the observed behavior resulting from the brain damage displays signs of poor performance in the individuated brain function(s) that the damaged area presumably executes. This turns out to be fundamentally flawed under closer scrutiny. On the one hand, similar lesions within the closer boundaries of the same brain locus may produce distinct profiles of aphasia across individuals. On the other hand, the same brain locus affected during a kind of aphasia or any other syndrome does not always produce the same (unique) functional disturbance in any linguistic ability. This is the case because the patterns of errors in a given linguistic ability observed in a patient often depend *not on* the neuronal groups and pathways that participate in carrying out the linguistic ability concerned *but rather* on those neuronal groups and pathways that do not perform the functions involved in that particular linguistic ability (Geschwind 1984). This consideration applies to global aphasia (which affects virtually the whole linguistic capacity) as well. Besides, the manifestation of any cognitive function rests not merely on the mediation by the neurobiological substrate but also on the representational properties of the system that constitute the cognitive function concerned. Moreover, the emergence of errors in any cognitive function involves a plethora of factors other than those solely restricted to the cognitive function at hand. Hence one cannot advance a case for the neurobiological instantiation of the level of linguistically structured cognitive organization by extrapolating from disruptions of a cognitive function of language resulting from brain damage.

Finally, one may nonetheless insist that if it is found that the structural configuration of language and the rest of cognition is rooted in separable biological mechanisms, this would provide solid evidence *for* the constitutive contribution of biological mechanisms to the level of cognitive organization dedicated to language. Savant studies offer this possibility since linguistic savants possess magnified linguistic capacities at a fairly young age with often reduced or compromised non-linguistic cognitive abilities. I argue that studies of linguistic savants do not establish this. The significant question is how one marks out the boundaries of non-linguistic cognition that can be shown to be used or not used for supporting linguistic cognition. It is rather doubtful, or at least not clear, that linguistic savants had no cognitive capacities that could have structured or supported their linguistic cognition as it was manifested in them (see also Bates 1997). This cannot also be supported by *double dissociations* whereby language and other cognitive capacities are checked for independent and segregated disruptions. The problem here is that if the grain size for comparison is made finer, many of the apparent disparities between one cognitive capacity and certain other cognitive capacities cashed out in terms of heterogeneous manifestations may disappear (see also Karmiloff-Smith 1992). What is observed in linguistic savants is that some non-linguistic cognitive capabilities are compromised. This does not at all demonstrate that these linguistic savants have *no* cognitive capacities preserved, or even that *all* cognitive capacities that can support language are impaired. Therefore, this does not gain a purchase on the desired relation of instantiation between the neurobiological level of organization and what is patently linguistically structured within the realm of cognition.

2.3 Summary

The insights gained are collated to make way for a better understanding of the nature of language and cognition with respect to their biological underpinning.

Chapter 3: Cognition from Language or Language from Cognition?

In this chapter, the exact role of language in cognition and of cognition in language is taken into consideration in order to understand whether the logical directionality of dependence is from language to cognition or the other way round. The relationship between language and cognition is examined from both the directionalities, and then it is observed that they have a co-evolving and co-constructive relationship.

3.1 Language from Cognition

The assumption that the structure and nature of language can be bootstrapped from the basic format of cognition has been articulated in several theoretical circles. Different ways of looking at the cognitive presence behind linguistic constructions are examined in this section. To this end, I begin with several linguistic examples that show that various linguistic constructions bear marks of the underlying cognitive machinery at work. This is demonstrated by showing effects of unacceptability co-varying with linear disruptions of linguistic dependencies between certain expressions (between a predicate and its argument, for example). Likewise, that the dependencies between a predicate and its arguments are cognitively constrained is further evidenced by cases of linguistic constructions that can be augmented by iterative linguistic expressions such as relative clauses (as in 'I know a girl who sees a doctor who visits the university ...').

Then I focus on the relation between language and thought as language parallels our cognitive organization in virtue of carrying imprints of thought. Assuming that language is a second-order system that formats sensory-perceptual-motor representations which are transduced into linguistic representations via a number of mapping stages, we can say that it is thought as part of the general fabric of cognition which constitutes one of these mapping trajectories feeding sensory-perceptual-motor representations into language. In fact it would not be unreasonable to think that language is in its epistemic functions a reflex of thought and thinking is due to the ontogenetic and phylogenetic trajectories that connect language, thought and thinking together. Whatever the path of evolution has actually been, it seems clear that language was perhaps initially more like an unstructured form that was immersed in the structures of thought which supported and thus formatted language for good. A similar line of reasoning can be found in Bickerton (2014) who has argued that a system of language not fully developed and realized, also called 'protolanguage', evolved to become the full-blown language we see now, but its form without any externalization by the articulator apparatus constituted thoughts as available through language. This underscores the point that language has evolved to draw into itself the representational forms that were part of the cognitive system at its initial stage. Quite apart from the aforementioned view of language as a re-formatted system of the cognitive machinery, language can also be reckoned to be a system of cognitive structures. This is the view adopted and elaborated on in Cognitive Grammar (Lakoff 1987; Langacker 1987; Talmy 2000). On this view, syntactic-phonological units of language are symbolic units which are mapped onto representations of conceptualizations. Hence linguistic structures themselves wear cognitive representations. In this connection, I also discuss a parallel line of thinking developed in Conceptual Semantics (Jackendoff 1983, 2002), and touch on the problem of conceptual primitives being articulated in terms of linguistic expressions themselves. But I note that the expression of cognitive imprints in language can be made more viable if the description of the cognitive texture of linguistic structures is couched in non-linguistic terms. The theory of *conceptual spaces* (Gärdenfors 2004, 2014) offering a geometric rendering of linguistic concepts is just such a step towards this goal, although it is also observed that not all linguistic expressions can be said to be structured around conceptual spaces. Thus, for instance, the conceptual spaces for verbs such as 'impugn', 'learn', 'understand' etc. or for nouns such as 'sincerity', 'compunction', 'honesty' etc. may be difficult to characterize. I thus conclude that a residue of the cognitive imprint in language may forever remain hidden from our view.

3.2 Cognition from Language

That cognition in itself is derived from the structural format of language is not new as it has been propounded in many different versions in different theoretical frameworks. The claims made and the stakes involved are here scrutinized to see how far or to what extent cognition can be said to emanate from language. First, I look at the *linguistic relativity hypothesis* that posits that structural differences in language reflect differences in the interpretative categories or contents of thought across linguistic communities (Whorf 1956). Apart from the concerns raised about the tenability of this hypothesis, I note that there cannot be enough cognitive constraints that can filter out possible cognitive profiles or patterns of categories of thought that parallel all natural languages that have ever existed, presently exist and will emerge in future. However, I show by taking relevant linguistic examples of reduplication that it is certainly plausible that linguistic structures (re)shape or mold certain structural representations of thought. Then I turn to the question of whether language itself (re)structures thought which is both the content and the process of the cognitive system. While both Davidson (1984) and Dennett (1991) have argued for the *ontological* dependence of thought on language, Grice (1989) has advocated the opposite view supporting an *epistemological* priority of thought over language. While it can be held that propositional thoughts derive from, or are even akin to, propositional linguistic expressions (see also Carruthers 1996), thoughts are not in themselves clothed in language. Besides, there could be many forms of thought (such as visual, proprioceptive or tactile thoughts) that are not couched in language. From another vantage point, it is not unreasonable to view linguistic structures as streams of thoughts (Chafe 1998, 2018). An examination of linguistic structures uncovers the deployment of thoughts in a sequence that unfolds from thought conglomerates in which some thoughts precede others, and the paths these thoughts take depend not just on the speaker's inner conceptualization but also on the behaviors, actions, reactions, thoughts and uttered expressions of the hearer(s). But surely that is not all that there is to the linguistic constitution of the texture of cognition.

There is a sense in which the operational character of cognitive processes is inherently reorganized, restructured and 'scaffolded' by linguistic structures (Clark 1997, 1998). Various aspects of visual-spatial learning, cognitive processes of memory, reasoning, calculations, emotional processes etc. are shaped, augmented and enhanced by language when we frame the relevant cognitive contents in language. The case of mathematical calculations with the aid of linguistic labels for numbers held in the working memory is an illustrative example. At this stage, one may wonder to what extent language re-organizes the structure of cognition. Thus, it would be comforting to discover that the structure of cognition is, at least in part, akin to the structure of language. Although not all of cognition can be encompassed this way, the structural parallels between the organization of motor actions and the hierarchical structure of linguistic expressions can serve to mark the relevant homology (Jackendoff 2007), although I note that there are, of course, significant dissimilarities between the two (one example being the absence in motor actions of potentially infinite levels of self-embedding found in language). Finally, I take a number of linguistic cases including event representation in language, linguistic predicates etc. that demonstrate that the structure of human categorization, perception and conceptualization can be said to be shaped or influenced by linguistic categories and expressions in non-trivial ways.

3.3 Language-Cognition Synergy

Closer scrutiny of both the logical directionalities of dependence between language and cognition reveals that it is not simply a matter of one-way dependence. Rather, the considerations compel us to look at the relationship in a much more nuanced and enriched perspective allowing for a co-emerging and co-creating relationship between language and the cognitive superstructure. This is as refreshing as it is integrative.

3.4 Summary

The emerging insights permit certain generalizations that are fleshed out with possible ramifications for the nature of language-cognition relations.

Chapter 4: Linguistic Structures as Cognitive Structures

Given that the structure of (linguistic) cognition is what we intend to understand and that the relation to the underlying biological infrastructure is not the intermediate tool that we want to deploy, language seems to be the most optimal bridge that can take us inside the arena of cognition. With this goal, this chapter advances the idea the linguistic structures are themselves cognitive structures (in linguistic garb), and demonstrates this by taking into account a number of interesting and yet intricate linguistic phenomena revealing the logical texture of linguistic cognition.

4.1 The Cognitive Constitution of Linguistic Structures

This section considers a number of cases of linguistic phenomena such as variable binding, quantification, complex predicates, word order etc. that are logically intricate and defy a unifying linguistic explanation, and then demonstrates that their structural formats unmask a hidden cognitive texture which has been hitherto overlooked and unexplored. Many of the principles underpinning the cognitive constitution of linguistic structures may also be taken to be the 'laws' of our underlying cognitive organization.

First, I look into the complex linguistic patterns of variable binding in English (for example, in 'The guy over there knows what he wants to do here.' the pronominal variable 'he' is bound by 'the guy'), and show that a linguistic account in terms of notions of hierarchy or command relations fails to capture the fundamental structure of the linguistic phenomenon. I also look at van Hoek's (1996) account of variable binding in terms of cognitively grounded schemas governed by figure-ground relations, but it turns out to be inadequate on several counts. I, therefore, propose an account in terms of two distinct cognitive principles that unmask the underlying cognitive constitution of the linguistic phenomenon of variable binding.

Second, I examine the peculiar linguistic behaviors of quantifiers such as 'all', 'some', 'any' in English. It is known that all natural language quantifiers except 'only' and 'many' obey the Conservativity Constraint (van Benthem 1983; Keenan and Stavi 1986). The exact reason for this idiosyncrasy is investigated, and it turns out that an alternative formulation of the Conservativity Constraint known as the Witness Set Constraint (originally conceived in Barwise and Cooper 1981) can bring all these quantifiers under the same formal compass (Fortuny 2015). But I observe that even though this is formally sufficient, it does not appear to be cognitively necessary. Therefore, I propose an account that reveals the underlying cognitive constitution of quantificational structures in language, by borrowing notions of convexity from Gärdenfors (2000). This not only covers the behaviors of all the major quantifiers in natural language but projects newer insights into the very nature of quantification in natural language.

Third, then I move on to complex predicates in natural language. Complex predicates in natural language are of two basic types: (i) bipartite complex predicates which are formed by one light verb and another co-verb and (ii) serial verb constructions. While Baker and Harvey (2010) postulate that bipartite complex predicates encode the conceptualization of simplex events and serial verb constructions encode complex events, this proposal is contested by Foley (2010). The subtly complex facets of both types of complex predicates are examined. I find that the apparatus of Lexical Conceptual Semantics (see Jackendoff 1990, 2002; Levin and Hovav 2005) is too general to offer any relevant yet sound cognitively grounded account of the complexities. I offer a wholly new way of looking at complex predicates. Two distinct cognitive principles as part of the proposed account are shown to unify and also explicate the observed linguistic patterns more comprehensively. These principles thus unveil the underlying cognitive structuring of complex predicates.

Fourth, word order is one of the most easily observable aspects of syntactic structure on the surface of linguistic structures. While syntactic principles are held to be uniformly common for all natural languages, word order varies across languages. Different word order systems thus exist in languages--some have a rigid word order, some have a flexible system and yet some others have a curious mix of rigidity and flexibility. But there are certain regularities in word order systems in languages. Hence it appears that there cannot be any unifying cognitive principle that can be said to be constitutive of the untamed linguistic variation in word order. Far from it, this section shows that complexities in word order systems can be shown to follow from two distinct cognitive principles that are constitutive of the linguistic patterns found in word order systems across languages.

Finally, I focus on the representational distinctions in grammar types prevalent in linguistic theory. Borrowing ideas from Mondal (2014), I distinguish between a *derivational* type of grammar (for example, Generative Grammars) and a *representational* type of grammar (reflected in Lexical-Functional Grammar, Head-Driven Phrase Structure Grammar etc.). I demonstrate that the difference between them is not simply *notational*. Rather, they constitute and also reflect two distinct modes of organization of linguistic representations in the mind. That they are sometimes equivalent in expressing linguistic facts and sometimes diverge in descriptions of other linguistic structures is explained by appealing to the idea that there exists an *intensional* 'gap' between the two modes of cognitive organization of linguistic structures. The distinction between an abstract system of grammar (akin to the competence grammar) and the parsing grammar (akin to the performance grammar) is also aligned with the distinction between the derivational and representational modes of cognitive organization.

4.4 Summary

This section summarizes the main findings of this chapter and projects further possibilities lying at the intersection of language and cognition.

Chapter 5: Conclusion

Finally, this chapter stitches together the threads of arguments running all throughout the book. Even though the book overall argues that biological relations are ultimately irrelevant to the logical texture of linguistic cognition, this chapter does emphasize that what has been demonstrated does not, however, scale down the role of biological structures in the growth and evolution of cognition. Rather, its role of biological implementation, rather than of biology itself, in the present context has been miniatured but not certainly eliminated.

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