The Evolutionary Linguist's Divining-rod: Restrictive Theory[*]

Rudolf P Botha

Department of General Linguistics, Stellenbosch University, 7600
Stellenbosch, South Africa. E-mail: rpb@sun.ac.za

1.   Introduction

The question "How did language evolve?" has generally been taken to be about the identity and properties of the processes by which linguistic entities or their features evolved. And, on various accounts, a particular family of processes – referred to as "preadaptation", "exaptation", "reappropriation" or "co-optation" – was central to some phase in the evolution of language. These processes, roughly, are ones by which an existing structure or feature acquires a use or function for which it did not originally come into existence. Having acquired such a use, the structure or feature is accorded the evolutionary status of "exaptation". As characterized by Stephen Jay Gould (2002, p. 1234), an exaptation is "the evolutionary result of functional cooptation from a different source of origin". More technically, "[a]n exaptation is a trait of a population or larger taxonomic unit, than confers performance advantage in a particular way at a specific time but was not produced by natural selection directly for that use".[1]
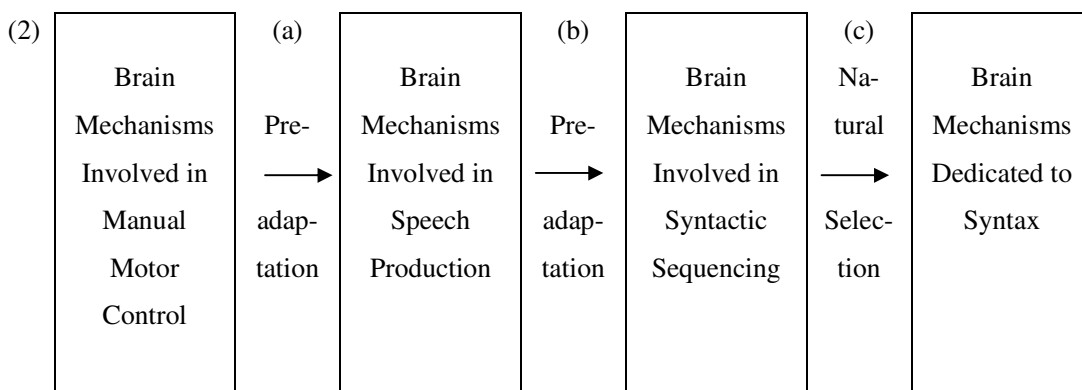

In this article, I aim to examine the way in which linguistic entities or their prelinguistic bases have been assigned the evolutionary status of "exaptations" in some highly rated accounts of language evolution. I will argue that these status assignments are problematic in not being underpinned by a restrictive general theory of exaptation.   And I will show how the lack of such a theory contributes to the paucity of the factual evidence bearing on accounts of language evolution.

2.   Exaptationist accounts

Let us begin by considering four specimens of accounts on which certain linguistic entities or some of their features arose through a process of exaptation. The first – and oldest – specimen is Philip Lieberman's (1990, 1991, 1995) model on which preadaptation played two roles in language evolution. These roles are specified in (1)(a) and (1)(b).

(1)   (a)   The brain mechanisms that control speech production evolved by preadaptation – i.e., exaptation – from brain mechanisms that facilitated precise one-handed manual tasks. (Lieberman, 1991, p.4)

         (b)   The brain mechanisms that handle syntactic sequencing evolved by preadaptation – i.e., exaptation – from the brain mechanisms that controlled speech production. (Lieberman, 1991, pp. 4, 107-108)

These two roles of preadaptation are represented by arrows (a) and (b) in the schematic representation offered in (2) of Lieberman's more comprehensive model of language evolution.

(2)

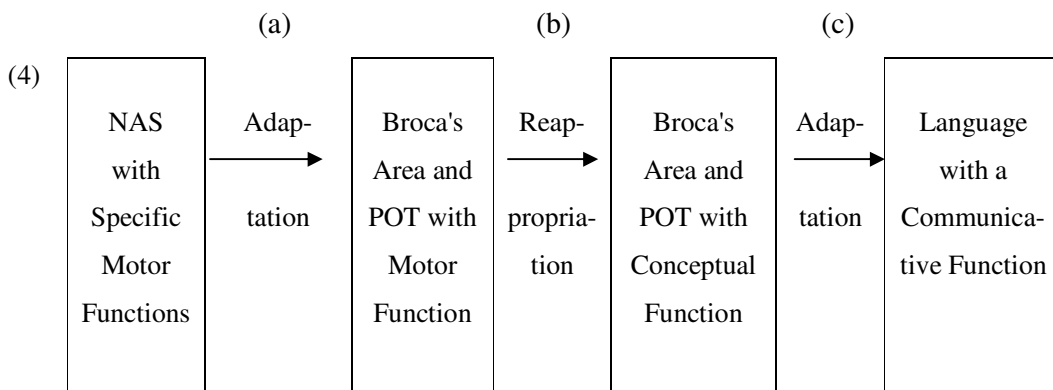|	(a)		(b)		(c)	
Brain Mechanisms Involved in Manual Motor Control	Pre-adap-tation →	Brain Mechanisms Involved in Speech Production	Pre-adap-tation →	Brain Mechanisms Involved in Syntactic Sequencing	Na-tural Selec-tion →	Brain Mechanisms Dedicated to Syntax

Lieberman's Preadaptationist Model

The second specimen account is Jenny Wilkins and Wendy Wakefield's (1995, 1996) scenario of the origin of the neuroanatomical structures that underlie linguistic ability. On this scenario, reappropriation – their term for exaptation – played the role specified in (3) in the origin of these structures.

(3)   The neuroanatomical structures associated with Broca's area and the POT – the junction of the parietal, occipital and temporal lobes of the brain – that (initially) had a motor function were reappropriated – i.e., exapted – for the new function of processing sensory input into conceptual structures. (Wilkins and Wakefield, 1995, p. 175)

The role assigned to Wilkins and Wakefield to reappropriation is represented by arrow (b) in the schematic representation offered in (4) of Wilkins and Wakefield's reappropriationist scenario.

(4)

|	(a)		(b)		(c)	
NAS with Specific Motor Functions	Adap-tation →	Broca's Area and POT with Motor Function	Reap-propria-tion →	Broca's Area and POT with Conceptual Function	Adap-tation →	Language with a Communica-tive Function

("NAS" = neuroanatomical structures")

Wilkins and Wakefield's Reappropriationist Scenario

The third specimen is a theory by William Calvin and Derek Bickerton (2000) on which exaptation played a role in the evolutionary development of structured strings of words. The central exaptationist claim of this theory is represented as (5).

(5)   A social calculus provided for the categories of AGENT, THEME and GOAL – also referred to as "thematic roles" – and these categories were exapted to

produce a basis for sentence structures that include arguments. (Calvin and Bickerton, 2000, pp. 136-137)

The role assigned by Calvin and Bickerton to exaptation is represented schematically by arrow (a) in schema (6).
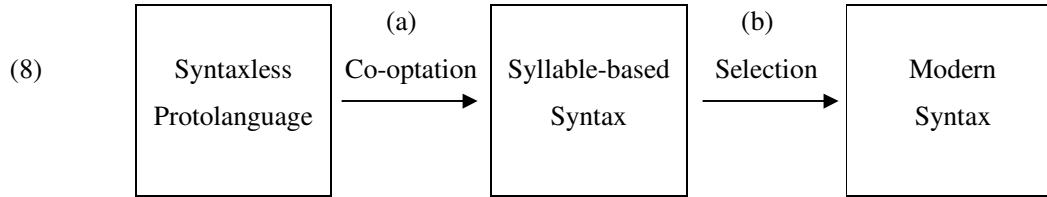
(6)
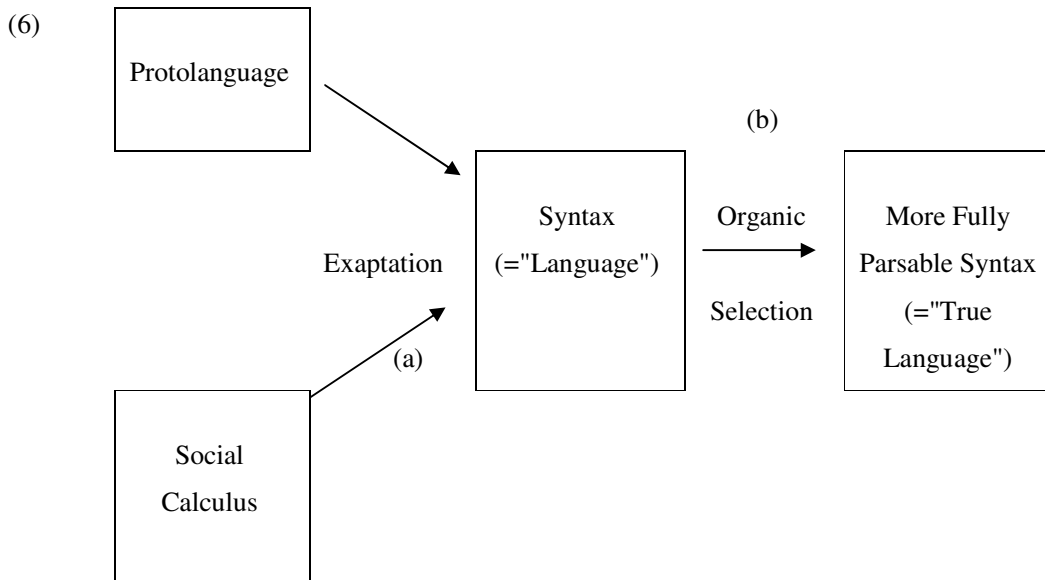
Calvin and Bickerton's Exaptationist Theory

The fourth and final specimen of an exaptationist account of language evolution to be considered in this article is Andrew Carstairs-McCarthy's co-optationist scenario. On this scenario, co-optation – his term for exaptation – played the role in the origin of syntax specified in (7).

(7)   The neural organization underlying syllable structure was co-opted – i.e., exapted – to provide a syntax for strings of "words". (Carstairs-McCarthy, 1999, pp. 147-148)

This role of co-optation is represented by arrow (a) in the schematic representation given in (8) of Carstairs-McCarthy's scenario of language evolution.

(8)

| Syntaxless Protolanguage | (a) Co-optation → | Syllable-based Syntax | (b) Selection → | Modern Syntax |

Carstairs-McCarthy's Co-optationist Scenario

3.   Assumptions about exaptation

Assigning entities a particular evolutionary status, of course, cannot be an exercise in stipulation. This applies to claims (1), (3), (5) and (7) as well. To be able to assign the linguistic entities in question the status of "exaptation" one should, on the one hand, have a theory of the properties by which exaptations are distinguished from entities that evolved by other evolutionary processes – in particular by natural selection. On the other hand, one should be able to furnish evidence indicating that the linguistic entities in question do have these distinctive properties.

A first question that arises in this regard about claims (1), (3), (5) and (7), then, is: What is the general theory of exaptation by which they are underpinned? The short answer is that none of the four exaptationist accounts draws on an explicitly articulated general theory of exaptation. Lieberman (1990, p. 742) as well as Wilkins and Wakefield (1995, p. 162) do refer in this connection in a general way to Darwin's concept of "preadaptation". But they don't derive from it a theory of exaptation which (a) clearly articulates the properties that are distinctive of exaptations or (b) draws a distinction between different kinds of exaptations. As for Calvin and Bickerton, and Carstairs-McCarthy, they make no explicit reference to Darwin's concept of "preadaptation". Strangely, the theory of exaptation developed by Stephen Jay Gould and Elisabeth Vrba from Darwin's observations on preadaptation does not feature in any of the four specimen accounts.[2]

But perhaps it is wrong to require that exaptationist claims such as (1), (3), (5), (7) be underpinned by an explicit theory of exaptation. Perhaps, in appraising such claims, one should read between the lines, as it were, and attempt to reconstruct the implicit assumptions about exaptation presupposed by these claims. Perhaps, when made

explicit, these assumptions might even be found to add up to the required theory of exaptation.

An attempt at reconstructing the assumptions about exaptation made implicitly by Lieberman, Wilkins and Wakefield, Calvin and Bickerton and Carstairs-McCarthy yield assumptions such as (9) – (12).

(9)   Preadaptation is the evolutionary process by which an organ originally constructed for one purpose may be converted into one with a wholly different purpose. (Lieberman, 1975, p.3; 1990, p. 742)

(10)   Reappropriation is a process that takes a moment only. (Wilkins and Wakefield, 1995, p. 162)

(11)   In exaptation, there are no intermediate stages in the evolution of the entity in question. (Bickerton, 1998, p. 354)

(12)   An entity X – e.g., a syntax for strings of "words" – can be assigned the evolutionary status of "co-optation" if there are close parallels between the structure of X and the structure of a precursor entity Y (e.g., syllable structure). (Carstairs-McCarthy, 1999, pp. 151ff.)

Of the four accounts, Carstairs-McCarthy's is the richest in regard to implicit assumptions about what exaptations are. In this paper I can consider assumption (12) only; in a recent book, *Unravelling the Evolution of Language* (= Botha, 2003), I analyze some of the other assumptions made by Carstairs-McCarthy about what exaptations are.

4.   Shortcoming of the assumptions

The question, then, is whether assumptions such as (9) – (12) are fit to serve as a basis on which a linguistic entity can be accorded or denied the status of "exaptation". On my analysis, these assumptions fail a minimal condition of adequacy – one adopted in work on exaptation that was done by Gould and Vrba as well as by some of their followers and critics. This condition can be stated as (13).

(13)   Assumptions (or theories) about what exaptations are need to be restrictive.

Condition (13) requires that the assumptions in question should make it possible to discriminate in a non-arbitrary way between entities that are exaptations and entities that are not exaptations, in particular entities that are adaptations. Such discrimination is possible only if the distinctive properties of exaptations are characterized with a high degree of preciseness.

Returning to assumptions (9) – (12), they do not meet the condition of restrictiveness. This is so because they are not framed in terms of concepts that capture the distinctive properties of exaptations in a sufficiently determinate way. Within the confines of his paper, I can flesh out this point with reference to two of these assumptions only. The first is Lieberman's assumption stated as (9). The question arising in connection with this assumption is: How much must the new purpose of an organ differ from its original purpose for it to be a wholly different purpose? To see what this question is about, three things should be noted: First, the brain mechanisms involved in manual control are used for the purpose of sequencing: sequencing of movements carried out in performing one-handed manual tasks. Second, the brain mechanisms involved in speech production are used for the purpose of sequencing as well: sequencing of articulatory actions. Third, the brain mechanisms involved in syntax, likewise, are used for the purpose of sequencing: sequencing of words in a sentence.

So the question is: Why should the brain mechanisms at issue not be taken as being used for fundamentally the same purpose, namely sequencing? The problem is that it is not clear how much one purpose has to differ from another to be a "wholly new purpose". This means that the Darwinian notion of a "wholly new purpose" invoked by Lieberman is not sufficiently determined. As a consequence, assumption (9) does not offer a basis for discriminating in a non-arbitrary way between a structure that is an exaptation and one that is an adaptation. The general point has been clarified in a concrete way by Hudson Reeve and Paul Sherman (1993, p. 3) in their critique of Gould and Vrba's theory of exaptation. They illustrate it with reference to the evolutionary status of the human ear bones, asking whether these bones are exaptations because, in addition to their original function, they now mediate social communication via telephones. According to Reeve and Sherman, the answer depends

on how finely one subdivides roles or functions. If the original function is broadly defined – say, as that of facilitating the detection of acoustic stimuli – then human ear bones are adaptations. If however this function is narrowly defined – say, as that of facilitating the detection of pre-Bell or prelinguistic acoustic stimuli – then our ear bones are exaptations.

Let us next consider Carstairs-McCarthy's assumption (12) about what exaptations are. The problematic notion here is that of a "close parallel" between two structures. The question is: How close should the parallel be for the structures to be related by exaptation? Interestingly, Fritz Newmeyer (2000, p. 389) has argued in this regard that the structural parallels between syllable structure and syntactic structure identified by Carstairs-McCarthy are not sufficiently close. In phonological structure, for example, there is nothing that, in Newmeyer's view, closely parallels the lexical categories N, V, P and A. So, the question arises: Are the structural parallels between phonological structure and syntactic structure close enough to justify assigning syntactic structure the evolutionary status of "exaptation", as is done by Carstairs-McCarthy? His notion of a "close parallel" is simply not precise enough to allow one to use assumption (12) for discriminating between entities that are exaptations and entities that are not. An additional problem with assumption (12) is that it is ad hoc: Carstairs-McCarthy refrains from showing – as one should do – that the essence of this assumption generalizes to other, nonlinguistic, entities that may be evolutionarily related by exaptation.

The assumptions made by Lieberman and Carstairs-McCarthy about exaptations are not unique in being insufficiently restrictive. In this respect, they are representative of the assumptions presupposed by many exaptationist accounts of language evolution, a point argued in some detail in the book (= Botha, 2003) referred to above.

5.   Restrictiveness and evidential paucity

The point, then, is that to be able to discriminate in an account of language evolution between entities that are exaptations and entities that have some other evolutionary status, more than loose assumptions of the sort of (9) – (12) are required. What is needed is a general theory of exaptation within which such assumptions are replaced by restrictive constraints on assigning exaptation status to entities. This theory has, of

course, to be complemented by a theory which characterizes – in an equally constrained way – the products of adaptation by natural selection. Indeed, on certain theories of evolutionary processes an entity is considered an exaptation if it lacks the properties of an adaptation.[3]

This brings us to the second purpose for which a restrictive theory of exaptation is needed. The constraints included in such a theory are needed for determining what the evidence is which is required for assigning or denying linguistic entities the status of "exaptations". In terms of their core concepts, the constraints included in such a theory point to possible sources of evidence for or against exaptationist claims such as those expressed in (1), (3), (5) and (7). The more restrictive these constraints are, the more clearly they indicate what evidence would be relevant and what evidence would not be relevant to such status assignments. Assumptions about exaptation which are stated in terms of concepts that are vague, fuzzy or very general are evidentially indeterminate: they do not point in a relatively specific way to evidence that would be relevant to assigning or denying exaptation status to linguistic entities. Thus, because of the fact that Lieberman's assumption (9) is stated in terms of the fuzzy concept of "wholly different purpose", it is unclear precisely what evidence would be needed for assigning a linguistic entity the status of exaptation. And because Carstairs-McCarthy's assumption (12) is stated in terms of the insufficiently restrictive concept of "close structural parallel", it fails in a similar way. Wilkins and Wakefield's assumption (10) is similarly flawed in having at its core the fuzzy concept of "a moment". And Calvin and Bickerton's assumption (11) is less than determinate in being based on the overly general notion of "no intermediate stages".

To conclude: to the extent that they are restrictive, constraints on exaptation function as "divining rods" – devices for detecting evidence that may be relevant to assigning or denying exaptation status to linguistic entities. Adopting such constraints will, accordingly, lead to an expansion of the limited evidential basis of accounts of language evolution.[4]

Notes

*This article is based on a paper presented at the Fifth International Conference on the Evolution of Language held on 31 March – 3 April 2004 in Leipzig.

1. For this characterization, see Arnold (1994, p. 126).
2. For this theory, see Gould (1991, 2002); Gould and Vrba (1982).
3. For this point, see Arnold (1994, p. 126).
4. I argue in some detail in Botha (2003) that work on the evolution of language has to draw on theories which give restrictive characterizations of various kinds of entities. These include –
   (i)   the linguistic entities that are believed to have undergone evolution;
   (ii) the processes – of which exaptation and adaptation are two instances – by which these linguistic entities might have evolved;
   (iii) the sources of data that could yield indirect evidence about aspects of the evolution of language;
   (iv) the nonfactual considerations that could add to or subtract from the scientific value or status of accounts of language evolution.

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