Syntactic Categorization of Roots

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Summary

A root is a fundamental minimal unit in words. Some languages do not allow their roots to appear on their own, as in the Semitic languages where roots consist of consonant clusters that become stems or words by virtue of vowel insertion. Other languages appear to allow roots to surface without any additional morphology, as in English *car*. Roots are typically distinguished from affixes in that affixes need a host, although this varies within different theories.

Traditionally roots have belonged to the domain of morphology. More recently, though, new theories have emerged according to which words are decomposed and subject to the same principles as sentences. That makes roots a fundamental building block of sentences, unlike words. Contemporary syntactic theories of roots hold that they have little if any grammatical information, which raises the question of how they acquire their seemingly grammatical properties. A central issue has revolved around whether or not roots have a lexical category inherently, or whether they are given a lexical category in some other way. Two main theories are Distributed Morphology and the exoskeletal approach to grammar. The former holds that roots merge with categorizers in the grammar: a root combined with a nominal categorizer becomes a noun, and a root combined with a verbal categorizer becomes a verb. On the latter approach, it is argued that roots are inserted into syntactic structures which carry the relevant category, meaning that the syntactic environment is created before

roots are inserted into the structure. The two views make different predictions and differ in particular in their view of the status of empty categorizers.

Keywords

Categories, Distributed Morphology, Exoskeletal, functional, label, lexical, projection

1. Defining roots[1]

One of the most important goals for linguists who view language as a part of human cognition is to understand the mental building blocks of language across languages and how they interact. One unit that language users and many scientists can relate to and often take for granted, is the unit of a *word*. As Hamlet says when Polonius asks "What do you read, my lord?": "Words, words, words". Words seem to be the natural building blocks of sentences, and they serve as a tool for scientists when they test a range of phenomena ranging from priming to emotions. However, most theories agree that words should be decomposed into more basic units that are stored in our mental lexicon, although they disagree about what these units are (e.g., Katamba, 2004, Booij, 2010, Anderson, 2015, Siddiqi & Harley, 2016). As Katamba & Stonham (2006: 117) put it, "[…] difficulties in clarifying the nature of the word are largely due to the fact that the term 'word' is used in a variety of senses that usually are not clearly distinguished. In taking the existence of words for granted, we tend to overlook the complexity of what it is we are taking for granted". Different views on the nature of the basic units have a number of cascading effects for our understanding of language more generally and ultimately for all research that in some way or other relies on words. Determining the basic units and their nature is therefore a crucial research objective, and in this paper, we will approach roots from a syntactic point of view, acknowledging that there are many other approaches that assume a quite different notion of a root than the one discussed here.

[1] I am grateful to two anonymous reviewers for their helpful comments. Many thanks also to Tor A. Åfarli, Artemis Alexiadou and Nicholas Allott for their constructive comments and suggestions.

In the present paper, we will limit our attention to what Katamba & Stonham (2006: 42) label the "irreducible core of a word", namely a *root*. The question of what a root is can be approached from a range of different viewpoints, which include at least phonology, morphology, syntax, semantics, and their interfaces. From a morphological point of view, a root can be defined as follows: "A root is like a stem in constituting the core of the word to which other pieces attach, but the term refers only to morphologically simple units" (Aronoff & Fudeman, 2011: 2). Aronoff and Fudeman use *disagreement* as an example. In this word, *disagree* is the stem since *–ment* attaches to it, but the root is *agree*. The root can of course also be a free-standing morpheme, like the aforementioned *agree,* or in instances like *book*, *tea*, and *pain*.

Recently, roots have also become a prominent unit from a syntactic point of view, which will be the focus of the present paper, meaning that many other approaches which assume different notions of a root will not be covered. Several contemporary linguistic theories argue that roots are a basic syntactic unit and that word formation to a greater or lesser extent is syntactic. Borer (2014: 343) puts it as follows:

> [A] central role is played not by a 'word' or a 'lexeme' in the traditional sense, but rather, by a 'root'. Within all of these approaches, there is a general understanding that roots are at the very least devoid of syntactic category as well as of any discernible morpho-phonological complexity. Beyond that, however, what 'roots' are, exactly, is by no means agreed upon, and as a consequence, there is little agreement on how, exactly, they interact with the syntax or, indeed, whether they are altogether necessary.

As this quote makes clear, there is not a single identifiable theory of roots on offer. Rather, there is a family of theories where roots are employed and defined differently. The goal of the present article is limited to discussing the main approaches to how roots are categorized

syntactically. That will lead us to consider additional questions concerning what the fundamental properties of roots are, in particular of whether roots have meaning on their own and whether roots have sound properties attached to them.

This paper is organized as follows. Section 2 begins the discussion of whether or not roots have any category. In section 3, arguments in favor of the claim that roots are born without a category in the lexicon and have to be categorized in the syntax are presented and discussed. Section 4 is devoted to how acategorial roots actually get categorized, focusing on two different decompositional generative frameworks: Distributed Morphology in section 4.1, and what will be labeled the Exoskeletal approach in section 4.2. Section 5 concludes the paper.

2. To have a category or not to have a category

The literature contains multiple and diverging views on the nature of roots. A major difference concerns whether or not roots have an inherent lexical category. Decompositional frameworks like Distributed Morphology (Marantz 1997, Embick & Marantz 2008, Emibck 2015) and the Exoskeletal approach (Borer, 2003, 2005a, b, 2013, 2014) all argue that roots do not have an inherent lexical category. Other approaches adopt roots, but they crucially assume that roots have an inherent category, as in e.g., Lieber (2006) and Ramchand (2008). Ramchand (2008: 58) argues that "[…] the lexical item contains category features, and that this performs the 'selectional' work that gives the verb its partial rigidities of usage". Lieber (2006) argues against three different theories that adopt acategorial roots: Distributed Morphology, the Exoskeletal approach, and Asymmetrical Morphology (Di Sciullo, 2005). Lieber argues that these three approaches cannot accommodate selection facts involving affixes which select for the category of their base. For example, *-er* attaches to nouns and verbs and forms nouns, whereas *-ize* attaches to adjectives and nouns and creates verbs. Affixes provide a good testing ground, Lieber argues, since "if roots lack category, then

affixes cannot select particular categories of roots" (Lieber, 2006: 248). Her claim is that roots need to have category information in order to be appropriately "choosy about what sorts of bases they attach to" (Lieber, 2006: 249). She argues that a semantic (see also Plag 2004) or morphosyntactic feature categorization such as the one in Lieber (2004) offer a better way of implementing selection information. Lieber admits that this does not argue against roots not having a syntactic category, rather, her claim is that roots "must have some category" (Lieber, 2006: 271).

Within theories that assumes that roots are category neutral, there is also a family of approaches. Gallego (2014: 192) provides a typology of various approaches, reproduced here in (1).

(1)

√ROOT	Category	Argument structure	Semantic type	Conceptual content
Partially bare	No	Yes	Yes	Yes
	No	No	Yes	Yes
Totally bare	No	No	No	Yes

As this typology illustrates, all approaches assume that roots are category-neutral. That is, roots are not stored in the mental lexicon with a category, rather, roots acquire a given category by being merged into a syntactic derivation. Approaches differ in terms of how this category acquisition is modeled, an issue we will return to below. Furthermore, there is also consensus in roots having some kind of conceptual content. For example, roots like √BOOK and √SING represent concepts and they become either a noun or a verb depending on which syntactic environments they occur in. Beyond this, opinions diverge as to whether or not roots have argument structure properties and semantic type. Some approaches argue that roots can

take internal arguments, that is, that a root can directly merge with an argument (e.g., Embick, 2000, 2004, 2015; Alexiadou 2001; Harley 2009, 2014, Coon in press). Others argue that roots can bear a semantic type and be classified into different semantic categories (e.g., Levin & Rappaport Hovav, 1995; Marantz, 1997; Rappaport Hovav & Levin, 1998; Alexiadou, 2001, 2009; Embick, 2004; Harley, 2005, 2009a 2009b; Levinson, 2007, 2010, 2014; Alexiadou & Anagnostopoulou, 2013; Alexiadou, Anagnostopoulou & Schäfer, 2006, 2015, Koontz-Garboden & Beavers, 2017, Coon in press). These issues will not be discussed further here as there is no consensus in the field, but see the references for extensive discussion.

3. Roots without syntactic category

In this section, we will consider some evidence for the claim that roots do not have an inherent category. Even though the claim that roots do not have a category inherently has become especially prominent with the advent of Distributed Morphology (Halle & Marantz, 1993; Marantz 1997), it has a longer history within the syntactic literature (see e.g., Simone & Masini, 2014a for a brief overview). From a different perspective, Lenneberg (1967, 1975) argues that linguistic categories are not categorical. The following quote is representative of his position.

> I think it is a mistake to look at categories such as noun phrase, noun, verb, adjective, and so on, as absolute constructs. Instead, these terms are the names of relations between concatenated words. A word such as 'green' is no more an adjective, a verb, a noun or a noun phrase when it appears in isolation than it is a subject or a predicate' (Lenneberg, 1975: 24).

Ross (1972) advocates a similar position when considering verbs, nouns and adjectives. Instead of discrete categories, he argues in favor of a 'quasi-continuum'. The distinctions

between the three categories and other intermediate categories is what Ross labels as 'squishy', more like cardinal vowels in the vowel space. He justifies this claim based on various tests that demonstrate that verbs are the most flexible units and nouns the least flexible, with a range of other categories in between. Since then, there has been a lot of discussion of word classes (e.g., Anward, Moravcsik & Stassen, 1997; Croft 1991, 2001; Baker, 2003; Dixon, 2004, 2010; Schachter & Shopen, 2007; Haspelmath, 2007, 2010, 2012; Chung, 2012; Panagiotidis, 2014; Baker & Croft, 2017) and as Simone & Masini (2014) highlight, there has been quite a bit of discussion of verbs and degrees of 'verbiness', and some emergent discussion of nouns and 'nouniness'. A whole literature on semi-lexicality has also emerged, that is, categories that combine properties of lexical and functional categories, creating semi-lexical verbs and semi-lexical nouns (e.g., van Riemsdijk, 1998; Vos, 1999; Corver & van Riemsdijk, 2001; Klockmann, 2017).

In the contemporary literature, there are several arguments in favor of roots not having a category. We will consider some of these arguments here, focusing exclusively on category and leave other features aside. As section 2 made clear, there is disagreement as to whether or not roots may have other grammatical features, and it won't be possible to review that issue in the current paper.

One argument comes from English and involves the fact that the same underlying root appears both as a verb and as a noun, often without any overt morphology. Some examples are provided in (2) (Borer, 2013: 372; but see also, among many others, Marantz, 1997; Borer, 2005a, b).

(2)	a.	a dance	b.	to dance
		a jump		to jump
		a walk		to walk
		a table		to table

a chair	to chair
a wardrobe	to wardrobe
a question	to question

In some cases, English displays overt morphology, as seen in (3)-(5).

(3)	a.	an employ**ment**	b.	to employ
		an advertise**ment**		to advertise
(4)	a.	a character	b.	to character**ize**
		an alphabet		to alphabet**ize**
(5)	a.	a form	b.	very form**al**
		a coast		very coast**al**

These endings are often taken to realize categorial heads in the syntax (Marantz, 1997; Embick, 2015; Borer, 2005a, b, 2013; though see de Belder, 2011 for a different view).

Other languages provide different evidence for roots. Hebrew is one such language, where roots mostly consist of segmental consonants √CCC. A single root can form multiple nouns and verbs. (6)-(8) provide examples from Arad (2003: 743-744) of roots that realize different categories and meanings.

(6) √ŠMN

a.	CeCeC (n)	*semen*	‘oil, grease’
b.	CaCCeCet (n)	*šamenet*	‘cream’
c.	CuCaC (n)	*šuman*	‘fat’
d.	CaCeC (adj.)	*šamen*	‘fat’
e.	hiCCiC (v)	*hišmin*	‘grow fat/fatten’

	f.	CiCCeC (n)	*šimen*	‘grease’

(7) √BXN

	a.	CaCaC (v)	*baxan*	‘test, examine’
	b.	hiCCiC (v)	*hivxin*	‘discern’
	c.	miCCaC (n)	*mivxan*	‘an exam’
	d.	CoCaC (n)	*boxan*	‘a quiz’
	e.	maCCeCa (n)	*mavxena*	‘a test-tube’
	f.	aCCaCa (n)	*avxana*	‘a diagnosis’

(8) √XŠB

	a.	CaCaC (v)	*xašav*	‘think’
	b.	CiCCeC (v)	*xišev*	‘calculate’
	c.	hiCCiC (v)	*hexšiv*	‘consider’
	d.	hitCaCCeC (v)	*hitxašev*	‘be considerate’
	e.	maCCeC (n)	*maxšev*	‘a computer/calculator’
	f.	maCCaCa (n)	*maxšava*	‘a thought’
	g.	CCiCut (n)	*xašivut*	‘importance’
	h.	CiCCon (n)	*xešbon*	‘arithmetic/bill’
	i.	taCCiC (n)	*taxšiv*	‘calculus’

Despite the apparent differences between the words listed beneath each noun, they all share the core root. The phonological core is obvious whereas the semantic core appears to be underspecified. Arad (2003) argues that it is possible to extract a highly general meaning for many roots, cf. (9).

(9)	a.	√ŠMN	‘material’
	b.	√XŠB	‘mental activity’

Although there is a quite general meaning that can be attributed to the root, each word has a unique meaning. The particular meaning assigned to each word is arbitrary: The meaning of each word is not a function of (merely) the meaning of the root and the contribution of the inflection that is applied to it.

Importantly, English and Hebrew are different in interesting ways. Arad (2003, 2005) was the first to emphasize differences between languages as to how roots are interpreted. She argues that there are two types of languages: Languages like English where each root is normally assigned one interpretation in a verbal or nominal environment, and languages like Hebrew where a single root can form multiple nouns and verbs (Arad, 2003: 740; see also Harley, 2005; Alexiadou, Anagnostopoulou & Schäfer, 2006; and Levin and Rappaport Hovav, 2008). The contrast between (10) and (11) shows the difference.

(10) a. √CREAM

b. √FAT

(11)	a.	CaCCeCet (n)	*šamenet*	'cream'
	b.	CuCaC (n)	*šuman*	'fat'

These examples illustrate that English uses two roots that are morphologically unrelated whereas Hebrew makes use of one root √ŠMN for both words. From the point of acquisition, this means that children who acquire English need to acquire two different roots, whereas children acquiring Hebrew need to acquire that one particular root can have possibly multiple interpretations (assuming that the roots themselves are stored). In an extension of Arad's pioneering work, Alexiadou & Lohndal (2017a) argue that English and Hebrew are the outer bounds on a typological scale and that languages can be positioned alongside such a scale in terms of how much meaning roots have.

Another argument for roots not having categories comes from the difference between lexical/open and functional/closed items. Borer (2005a, b,) argues that lexical items have great flexibility whereas functional items do not have the same flexibility. Consider the following quote from Borer (2005a: 3):

> An English word, such as *stone*, can be used in a multitude of syntactic contexts as either a noun or a verb, and it can have different meanings in different communicative situations. But not so for structures such as *three stones* and *much stone*, or *to stone a bird*, or *be stoned*. Each structure has defined properties; each is restricted to an extremely well-defined syntactic context, and each imposes relatively strict conditions on its interpretation. In some crucial sense, then, there is a difference between *words*, however we choose to define them, and *structures*, however constructed.

Borer provides a range of examples of this difference between lexical and functional elements. The flexibility can be illustrated by considering *siren*. This item can be coerced from a noun to a verb, and with this coercion, it can appear in five different syntactic contexts (examples in Borer, 2005: 8, taken from Clark & Clark, 1979).

(12) a. The factory horns sirened throughout the raid.
b. The factory horns sirened midday and everyone broke for lunch.
c. The police car sirened the Porsche to a stop.
d. The police car sirened up to the accident site.
e. The police car sirened the daylight out of me.

Borer (2017: 127-128) also adds the examples in (13), which show how similar interpretations are provided by different lexical items in similar syntactic structures.

(13) a. The bells rang throughout the raid.

b. The factory signaled midday and everyone stopped for lunch (*e.g., by sirening*).

c. The police forced the Porsche to a stop (*e.g., through sirening*).

d. The police car rushed up to the accident (*e.g., while sirening*).

e. The police car scared the daylights out of me (*e.g., with its sirening*).

There are other examples demonstrating a similar kind of creative flexibility. Borer (2005a: 8) provides the examples in (14).

(14) a. I windowed the north wall.

b. I lamped the room.

c. I screened the window.

She claims that these sentences can all be interpreted 'without too much difficulty', which arguably is to say that a bit of context is needed. In contrast, as the quote above makes clear, phrasal expressions do not exhibit the same kind of flexibility. Consider the examples in (15) from Borer (2005a: 9).

(15) a. *a lot of wine is/are many

b. *There are too much carpet in this room.

c. *too much carpets

It is not possible to coerce *a lot of wine* into a plural, and similarly, *carpets* cannot be interpreted as a mass noun. Other examples can easily provided; Borer (2005a: 8) gives the following:

(16) a. The alien stared at Kim.

b. The alien looked at Kim.

c. The alien stared Kim out of the room.

d. The alien looked Kim out of the room.

As Borer (2005a: 9) puts it: "Under no circumstances can *stare at* or *look at* be interpreted as forcing the departure of Kim – that is, as synonymous with *stare out of* or *look out of* […]". In general, then, when a lexical item is embedded into a larger functional structure, its interpretation is fixed.

Another argument involves redundancy in the lexicon and in the grammatical system, an argument that Borer (2005a) develops in great detail (see also Åfarli 2007, de Belder 2011, Lohndal 2014, among many others). For all items that can serve as both nouns and verbs, they would have to be doubly listed in the lexicon: For example, *picture* would have to be listed as a noun and as a verb. If we take lexical heads and their associated functional structure to be extended projections in the sense of Grimshaw (1991) (see also van Riemsdijk, 1990, 1998 for the term 'Macro projection'), then you need to stipulate that an N agrees with a D, and, correspondingly, that a V agrees with a T. Schematically we can illustrate this as in (17) (Borer, 2005a: 21), where 'FP' stands for any functional projection.

(17) a. $[FP\text{-}_{1N}\ [FP\text{-}_{2\{N,V\}}\ [picture^{max}{}_{N}]]]$

b. $[FP\text{-}_{3V}\ [FP\text{-}_{2\{N,V\}}\ [picture^{max}{}_{V}]]]$

However, as Borer (2005a, 21) emphasizes (see also van Riemsdijk, 1998), this agreement in categorical features 'is a stipulation': There is no particular reason why a DP should agree in features with an NP, or TP with VP, for that matter. If category is instead removed from the root, the root can inherit category from the functional structure, as seen in (18) (Borer, 2005a: 21).

(18) a. [FP-$_{1+N}$ [FP-$_{2\{+N\}}$ [picture^{max}]]]

b. [FP-$_{3+V}$ [FP-$_{2\{+V\}}$ [picture^{max}]]]

In (18a), *picture* will be nominalized if FP-$_1$ is DP and verbalized in (18b) if FP-$_3$ is TP. The intermediate functional category FP-$_2$ may either be specified for category or be category neutral and receive its category from the superordinate FP. Assuming category neutral roots, thus removes redundancy in the lexicon and in the grammatical system. The prediction is that every root can be inserted into a N-structure or a V-structure. As it stands, that would predict a flexibility that does not seem to exist, necessitating some kind of constraints on what kind of types of structure(s) a given root can combine with. Whether or not those constraints will be reproducing a theory with lexical categories on the roots themselves or not, is a problem that needs to be solved.

This concludes our discussion of why roots have been argued to be category neutral. In the next section, we will turn to a different question, namely how roots then can become categorized.

4. Categorizing roots

In this section, I will outline two different approaches to how roots are categorized. In Distributed Morphology, roots combine with a categorizing head in the syntax, whereas in the

Exoskeletal approach, roots are categorized by virtue of the syntactic environment in which they are inserted.

4.1. Distributed Morphology

Distributed Morphology (DM) holds that word formation is essentially based on the same principles as syntax. That is, there is no word formation in the lexicon, words are created within the syntax (Halle and Marantz, 1993, 1994; Marantz, 1997, 2013; Harley & Noyer, 1999; Embick & Noyer, 2001, 2007; Embick & Marantz, 2008; Harley, 2014; Embick, 2015). In the words of Julien (2002: 297): 'morphologically complex words are the outcome of the manipulation of morphemes that takes place in syntax'. Within DM, there is furthermore no centralized lexicon; rather, the information that other theories posit are part of the lexicon, is 'distributed' across the grammar through what is known as 'lists'. There are three lists: i) The syntactic terminal nodes which are the object of syntactic operations, ii) the Vocabulary items, which provide syntactic feature bundles with morphophonological content, and iii) the Encyclopedia, which provides 'instructions for interpreting terminal nodes in context' (Harley, 2014: 228). Focusing here on the syntactic terminal nodes, DM assumes that there are two types of nodes. These are exemplified in (19) following Embick & Marantz (2008: 5).

(19) *Terminals*

a. *Functional morphemes* are composed exclusively of nonphonetic features, such as [past], [pl], or the feature (or features) that make up the determiner node D of the English definite article *the*.

b. *Roots* make up the open-class or "lexical" vocabulary. They include items such as √CAT, √OX, and √SIT.

Furthermore, DM holds that roots have to be categorized (though see Bauke & Roeper, 2017; Borer 2013, and de Belder, 2017 for additional discussion). This can be stated through the following principle (20) (Embick & Marantz, 2008: 6).

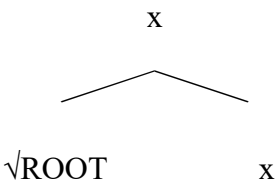
(20) *Categorization assumption*

Roots cannot appear (cannot be pronounced or interpreted) without being *categorized*; they are categorized by merging syntactically with category-defining functional heads.

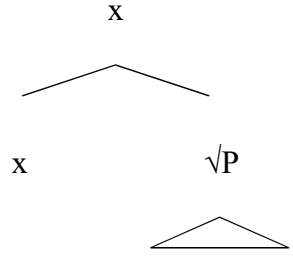
As for the functional categorizers, Embick & Marantz (2008: 6) elaborate by saying that "we assume that there exist different types of n, v, and so on, distinguished by virtue of their feature content (although we will not provide a theory of such features here)". The latter parenthesis is quite important, because the DM literature has not really discussed what the set of possible categorizer heads is. Does it only apply to the two most commonly discussed categories, or does it also cover adjectives and possibly prepositions? Future research will hopefully address this question in more depth.

Within DM, roots are categorized syntactically, typically in a structural configuration such as (21a). Whether or not this structure is created by way of first merge, or affixation of the root to the head x (21b), is an unresolved question (Embick, 2015: 44).

(21) a.



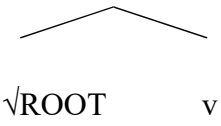
b.



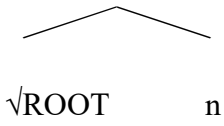
… √ROOT …

This would then yield different structures for the lexical categories verb, noun, and adjectives, as depicted in (22). Categorized roots often look like stems, but stems have no privileged position in DM (cf. Embick & Halle, 2005).

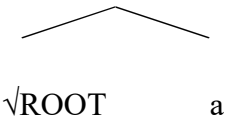
(22) a.



b.

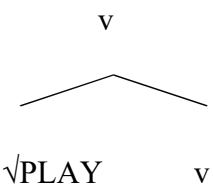


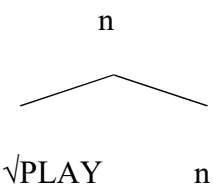
c.



These tree structures make it clear that roots have a clear syntactic position. Different scholars within DM have taken different positions on the nature of this position. Marantz (1995) (see Harley 2014: 229-230 for a summary) argues that roots are undifferentiated in the syntax; any root could be inserted at any root node, given that whatever licensing conditions were respected. This view predicts that roots do not compete for insertion in a specific environment. For example, *cat* will not be able to compete with *dog*. This view has since largely been abandoned, in particular based on arguments from root suppletion. As Marantz (1995, 1997) already pointed out, undifferentiated roots in the syntax are not compatible with a scenario in which a root has two phonologically unrelated forms, and where one of them blocks the insertion of the other in a specific morphosyntactic context (cf. Harley 2014: 231). The jury is still out on whether or not there are true instances of root suppletion; see Harley (2014) vs. Borer (2014).

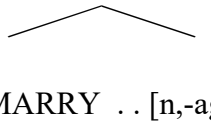
The categorizer can be either overtly expressed or silent. In the case of √PLAY, this can be either verbal or nominal, but there is no morphological difference on the noun or verb itself. This is shown in (23).

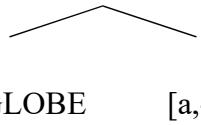
(23) a. 

b. 

However, in other cases, the categorizer can be morphologically realized. Three examples are provided in (24) (Embick, 2015: 46).

(24) a. 

b. 

c. 

Categorizers are subject to Vocabulary Insertion on a part with other functional elements. That is how the specific exponents are inserted into the structures in (24). Further constraints on the licensing on specific categorizers are arguably also necessary, cf. the discussion in section 2.

The majority of DM scholars currently argue that roots are identified by non-phonological indices or labels in the syntax (Pfau, 2000, 2009; Embick, 2000; Embick & Noyer, 2007; Acquaviva, 2009; Harley, 2014; Kramer, 2015). Kramer (2015: 9) provides the following example of the root identified as √HAMMER where (25a) provides the syntactic representation, (25b) is the Vocabulary Item that is inserted at PF, and (25c) is the semantic interpretation interpreted at the Encyclopedia.

(25) a. √169

b. √169 ↔ hammer

c. [$_{n\text{P}}$ *n* [√169]] is interpreted as a type of tool with a long narrow handle and a hard, specially shaped head, often used for pounding nails, etc ...

Roots are typically identified with the words of the language in question in specific examples and derivations; however, it is important to note that this is only for expository convenience.

When it comes to the structural relationship between the root and the categorizer, multiple analyses have been pursued in the literature (see, among others, Harley, 2005b; Embick, 2010; De Belder & van Craenenbroeck, 2015, Anagnastopoulou & Samioti, 2014, Acquaviva, 2009). Alexiadou & Lohndal (2017b: 205-206) identify the following alternatives:

(26) a. Roots are merged as complements of v (e.g.,; Harley, 2014 and literature cited there).

b. Roots are merged as v modifiers (Marantz, 2013).

c. Some roots are merged as v's modifier while others as v's complement (Embick, 2004, 2010; Alexiadou & Anagnostopoulou, 2013)

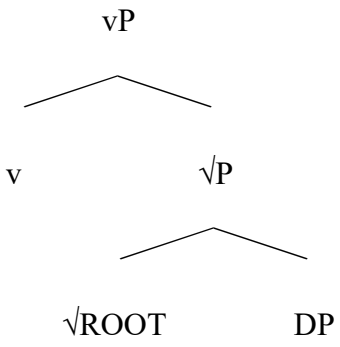
d. Roots are inserted post-syntactically, thus they cannot take any complements or modify v (de Belder and van Craenenbroeck, 2015).

Based on the discussion in Alexiadou & Lohndal (2017b), we now consider these alternatives.

The first alternative holds that roots are complements of the categorizer. We already saw this illustrated in (21) and (22) above. This view is often coupled with the claim that roots themselves can take complements and that a root can project into a root phrase. Such a

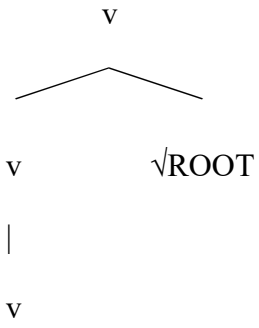
structure could would for example look like (27) (cf. Alexiadou 2014, Harley 2014, Embick 2015, and Alexiadou & Lohndal 2017b for further discussion).

(27)



The second alternative is to argue that roots are modifiers of their categorizer (Marantz, 2013). Technically that means that roots are adjoined to their categorizing head, e.g., represented as in (28).

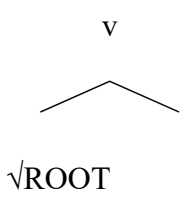
(28)



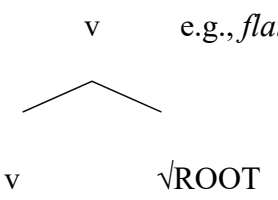
If γP adjoins to another phrase δP, normally δP projects (though see Donati 2006, Cecchetto & Donati 2015). As Alexiadou & Lohndal (2017) make clear, since adjunction is optional, this predicts that roots do not have to be categorized, unless the categorization assumption is an interface filter. Based on a study of primary compounds in Dutch, De Belder (2017) argues that this prediction is welcome from an empirical perspective: According to her, roots are able to survive the derivation without being categorized.

An intermediate position constitutes the third alternative. Embick (2004) was the first to propose this approach, which has since been developed by other scholars (Alexiadou & Anagnostopoulou, 2013; Alexiadou, Anagnostopoulou & Schäfer, 2015). The approach holds that, structurally, roots can either be adjuncts/modifiers or complements. This builds on the work by Rappaport Hovav & Levin (2010), who suggest that there are two types of roots: Manner roots and state/result roots. These appear either as modifiers of an event, or as arguments of primitive predicates. Embick (2004), instead, views manner roots as modifiers of categorizers, whereas state/result roots are complements of categorizers. Embick's approach is illustrated in (29).

(29) a. modifiers of v, *direct Merge*

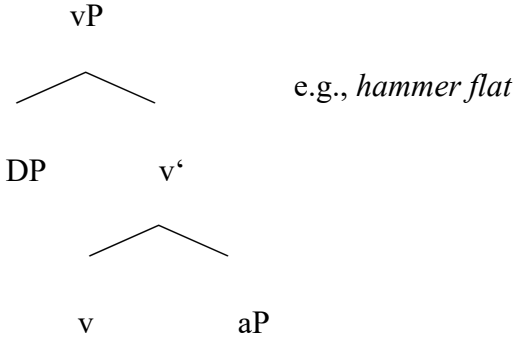


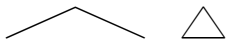
b. complements of v



Crucially, on this approach, roots belong to different semantic classes, and these classes contribute to license the structural positions a given root can appear in. However, as Alexiadou & Lohndal (2017b: 221) note, the two structures in (29) are practically impossible to distinguish. Embick (2004) argues that (29a) can also feed secondary resultative predication, as in the structure in (30).

(30)





√ROOT v

In this structure, v's complement has to be phrasal because were it a bare root, it would be uncategorized and thereby not in line with the categorization assumption.

The last view holds that roots are special because of the structural position they occupy in the syntax. Alexiadou & Lohndal (2017b: 221-226) outline two different implementations of this. Let us consider them in turn based on their discussion.

The first way of ensuring the uniqueness of roots comes from Adger (2013). Adger argues that Self Merge (Guimarães, 2000; Kayne, 2010) is a fundamental operation, and a root is an entity which is able to undergo Self Merge. Self Merge is a subcase of binary Merge where two token identical inputs are merged. For example, if √DOG underwent Self Merge, it would yield {√DOG}, i.e., the set which contains only the root. Furthermore, Adger develops a system of projection/labeling which excludes roots from its domain. An implication of this system is that roots can never take any complements. However, roots can be labeled after they have undergone Self Merge, but this label is inserted after the structure itself has been built.

De Belder and van Craenenbroeck (2015) develop a second implementation. They argue that roots should be defined structurally and not lexically. That is, it is not an item's inherent characteristics that determine whether or not it is a root, but rather its structural syntactic position. This blurs the distinction between lexical and functional items, and De Belder and van Craenenbroeck (2015) provide a specific technical implementation of this idea that won't be discussed here for reasons of space. Suffice it to notice that their system does not account for the property that is inherent in the categorization assumption, namely that roots cannot survive the derivation uncategorized.

By way of summary, the DM literature contains a range of different approaches to how roots are syntactically categorized. As Alexiadou & Lohndal (2017) point out, on the one

hand, Occam's razor would favor a unified way of categorizing roots, but on the other hand, there are theoretical and empirical arguments in favor and against all of the four approaches. Only future research will tell whether one view is more or less likely than the others.

4.2. The Exoskeletal approach

What is labeled the Exoskeletal approach here is associated mainly with the work of Borer (2003, 2005a, 2005b, 2013, 2014), although, more generally, the term is also used in recent work that divorces syntactic structures from their morphological realizations (see, e.g., Åfarli, 2007; De Belder, 2011; Lohndal, 2014; Riksem, 2017, Grimstad, Riksem, Åfarli & Lohndal, 2018). The Exoskeletal approach shares with DM the emphasis on structures being independent of morphological realizations. There are a range of other similarities and differences (see e.g., Riksem, 2017 for discussion), but here we will focus on roots and their categorization as developed in Borer (2013, 2014).

Concerning roots, Borer (2013) argues that roots are an index place holder, and furthermore, that the index is phonological. A phonological index is 'a packet of root-related phonological information' (Borer, 2013: 27). Borer's annotation $_{\pi}\sqrt{}$CAT is to be interpreted as a phonological index that may be available for merge, and which in a specific environment, would be spelled out as /$_{\pi}$cat/ (Borer, 2013: 27). These phonological indices are crucially not related to any meaning (labeled Content in Borer's approach). This also sets Borer's approach apart from DM approaches that pursue the intuition that roots have a semantic ontology of some sort.

Returning to the syntax of categorization, we have seen that in DM, roots can either be categorized by way of overt affixes, or by way of affixes that have no morphophonological realization. For Borer, the architecture is different. She argues that null morphemes as in (23) are superfluous (see Borer, 2013, 2014). Instead, Borer argues that when there is no overt categorizer, the root is inserted directly into a specific position. This position, by virtue of its

structure, provides the root with a category. Technically, the root is not '*assigned* a category as such' (Borer, 2014: 115). Instead, the root becomes what Borer calls N-equivalent or V-equivalent. She illustrates this with examples such as the ones in (31).

(31) a. $[_{T}$ WILL$_{T}$ $[_{C=V}$ $\pi\sqrt{}$COAST] … → *will coast*

b. $[_{T}$ PST$_{T}$ $[_{C=V}$ $\pi\sqrt{}$COAST] … → *will coast*

c. $[_{CL}$ DIV$_{CL}$ $[_{C=N}$ $\pi\sqrt{}$COAST] … → *coasts*

d. $[_{A}$ C$_{A[N]}$ $[_{C=N}$ $\pi\sqrt{}$COAST] … → *coastal*

In (31a) and (31b), the root is equivalent to a V, whereas in (31c) the root is equivalent to an N. (31d) is different. Here there is what Borer defines as a C-functor, which takes an N in its categorial complement space and projects an A. A particular realization rule determines what $C_{A[N]}$ can be realized as, shown in (32).

(32) $C_{A[N]}$ → /πal, ic, ous/

In general, as (31) illustrates, it is the functional structure that determines categorization, not any properties of the root itself.

Importantly, Borer dispenses with zero categorizers based on a range of conceptual and not at least empirical arguments. For her, there simply is no categorizing head for nouns like *walk* and *chair* and verbs like *walk* and *chair*. Borer (2014: 124) provides the following structures.

(33) a. [D $[_{C=N}$ $\pi\sqrt{}$WALK]] b. [D $[_{C=N}$ $\pi\sqrt{}$CHAIR]]

(34) a. [T $[_{C=V}$ $\pi\sqrt{}$WALK]] b. [T $[_{C=V}$ $\pi\sqrt{}$CHAIR]]

As (33) and (34) show, setting technical implementation details aside, the analysis shares a lot with DM: There is no basic categorially marked form, there is no direct derivational relationship between the nominal and verbal versions, and there are not different levels of morphological complexity between them either (Borer, 2014: 124). Despite these similarities, there are also two core differences that Borer (2014: 125) highlights: i) (33) and (34) do not involve the merger of an additional (zero) head, and ii) the forms are non-branching, meaning that they are mono-morphemic both morpho-phonologically *and* syntactically. Borer (2013, 2014) provides a range of detailed arguments against zero categorizers, which space prevents us from discussing further here.

Borer (2013: 371-378) makes an important observation which bears highlighting. The following quote presents the puzzle:

> Adjectives, to all intents and purposes a well-defined categorial class, nonetheless present an enduring categorial puzzle for any systematic look at categories. From the present perspective the puzzle is multi-dimensional, as numerous distinct diagnostics that have been described and elaborated on in the previous chapters appear to apply fairly systematically to nouns and verbs, but not to adjectives (Borer, 2013: 371).

Whereas roots have been argued to become both nouns and verbs, based on their structural context, that is not the case for adjectives. Items, which may be roots, that can occur as adjectives, can seldom if ever occur as nouns or verbs. The examples in (35) and (36) illustrate this (Borer, 2013: 372).

(35)	a.	a dance	b.	to dance	c.	*too dance
		a jump		to jump		*too jump
		a walk		to walk		*too walk

		a table		to table		*too table
		a chair		to chair		*too chair
		a wardrobe		to wardrobe[2]		*too wardrobe
		a question		to question		*too question
(36)	a.	*a mean	b.	*to mean	c.	too mean
		*a green[3]		*to green		too green
		*a fat		*to fat		too fat
		*the tall		*to tall		too tall
		*a smart		*to smart		too smart
		*a wide		*to wide		too wide
		*a big		*to big		too big

Borer notes in a footnote that there are instances such as *to thin* and *to yellow*, but not *to red* or *to fat*, meaning that there is no general or predictive process here. It can be added that *to green* is also commonly used, often transitively. Therefore, Borer argues that adjectives are complex and derived, and are listed as such.

Data such as (35) and (36) have not been discussed in the DM literature, where the main focus has been on nouns and verbs. It is not clear how a theory where roots can merge with a (zero) categorizer head would capture such an asymmetry, or what the cross-linguistic picture is when it comes to categorial flexibility. Given that such flexibility is a major piece of evidence for syntactic approaches to roots, it appears to be an important area of future investigation to elucidate what is going on in English and other languages.

5. Conclusions

[2] This must be referring to a coerced used of *wardrobe* as a verb, as dictionaries like Oxford English Dictionary do not list it

[3] Oxford English Dictionary lists several different meanings of the noun *green*.

This essay has discussed roots from a syntactic point of view. We have considered arguments in favor of assuming roots as syntactic primitive objects to begin with, but the main focus has been on how roots are categorized. Two main approaches have been discussed: Various implementations within Distributed Morphology, and the Exoskeletal approach. We have also identified some unanswered questions for future research, in particular whether a root-based approach to lexical categories is sufficiently general. Empirical evidence demonstrating dissociations between verbs and nouns on the one hand, and adjectives on the other, shows that further work is needed.

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