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## Morphosyntactic sources for nominal synthetic compounds in English and Greek<sup>1</sup>

**Abstract:** We analyze English and Greek nominal synthetic compounds like *truck driver* and *truck driving* from a syntactic perspective couched within Distributed Morphology. We derive the main differences between the two languages from the different morphosyntactic status of the non-head nouns, which are roots in Greek but categorized words in English.

### 1. Introduction

In this paper we examine synthetic compounds focusing on N-N compounds headed by deverbal nouns that involve suffixes such as *-al*, *-ance*, *-er*, *-ion*, *-ing*, or *-ment* and whose interpretation can be retrieved from the corresponding verb phrases, as in (1).<sup>2</sup> While *er*-nouns denote external argument participants of the event, the others denote the event.

- (1) window cleaner (to clean windows); drug trafficking (to traffic drugs); car registration (to register cars); child abandonment (to abandon a child); house rental (to rent houses); aircraft maintenance (to maintain aircrafts); energy storage (to store energy)

All head nouns illustrated in (1) may appear in isolation outside compounds, but there are cases as in (2), from Olsen (2015), where the head is not used as a lexical noun, or if it is, it acquires a specialized meaning slightly different from the one in the compound. In a similar vein, *stealer* is lexically blocked by *thief*, but may appear in compounds like *scene stealer* (see Embick and Marantz 2008 for discussion and further references).

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2 We leave out compounds headed by *-ee* nouns, such as *city employee* (Lieber 2004), since an incorporation-based analysis has never been proposed for them and they have been argued not to exhibit a real argumental non-head (Bobaljik 2003), which means that they qualify as root compounds.

(2) housekeeper vs. ??a keeper; watchmaker vs. ??a maker

Most of the debate on the structure of synthetic compounds revolves around this issue. Do synthetic compounds first involve compounding and then derivation, or first derivation and then compounding? The two analyses are schematically illustrated in (3). (3a) represents what we call the *Synthetic Compound (SC) Approach* and (3b) the *Root Compound (RC) Approach*. The first analysis assumes a special status for SCs, in that they have a different make-up from that of root compounds, while the second argues that synthetic and root compounds are derived by similar morphosyntactic mechanisms, possibly, with a difference in interpretation that can be traced back to the base verb for SCs.

- (3) a. [[[truck]<sub>N</sub> + [drive]<sub>V</sub>] + -er]<sub>N</sub> (SC-Approach)<sup>3</sup>  
 b. [[truck]<sub>N</sub> + [[drive]<sub>V</sub> + -er]<sub>N</sub>]<sub>N</sub> (RC-Approach)

Proponents of the SC-Approach use the resemblance to verb phrases visible in (1) to argue that the first step in the derivation of SCs is the formation of a compound out of a verb and its internal argument, to which then a derivational suffix is attached (see, among others, Roeper and Siegel 1978, Grimshaw 1990, Ackema and Neeleman 2004, and Harley 2009). The technical implementation has taken different shapes, but an important claim is that the internal argument is morphosyntactically incorporated into the verb (see Harley 2009). This accounts for the fact that the non-head in synthetic compounds is typically interpreted as the internal argument of the base verb (cf. (1)). Under this view, SCs inherit some event structure from the verb, albeit a defective one, since a compound can accommodate only one (bare) argument, unlike the verbs and their corresponding Argument Structure Nominals (ASNs) illustrated in (4). In view of this reduced event structure, the non-heads of SCs can only be interpreted as the internal/ lowest argument of the verb (see the First Sister Principle in Roeper and Siegel 1978 and the thematic hierarchy in Grimshaw 1990).<sup>4</sup>

3 We use the following abbreviations: ADJ = adjectival suffix, COLL = collective, GEN = genitive, IND = indicative, LE = linking element, N = noun, NZ = nominalizer, PROG = progressive, V = verb, VZ = verbalizer, 3sS = third singular subject agreement.

4 Manner adjuncts as in participle-based SCs like *fast-acting*, *well-built* would also count as modifying some low event structure, but here we focus on the nominal SCs.

- (4) a. The parents abandoned the child.  
 b. the parents' abandonment of the child (ASN)  
 c. child abandonment (SC)

Although this analysis accounts for the argumental interpretation of the non-head in SCs, it predicts N-V compound verbs that incorporate internal arguments to be possible, which is contrary to fact: cf. *\*to child abandon*, *\*to housekeep*, *\*to watchmake*.<sup>5</sup> In addition, as one reviewer notes, it cannot account for the fact that the head noun preserves its specific suffix, even though this suffix is not particularly productive (e.g., *-ance* in *maintenance*).

The RC-Approach in (3b) avoids these problems by arguing that there is nothing special in the structure of SCs as such, they are just root N-N compounds whose interpretation is particularly influenced by the deverbal nature of the head. The argument interpretation of the non-head is retrieved by the deverbal noun head from the base verb via various mechanisms of argument inheritance (e.g., Selkirk 1982, DiSciullo and Williams 1987, Lieber 2004, Olsen 2015; cf. Lieber 2009, for an overview). This type of analysis has a less straightforward account for the observation that the default argument is the internal/ lowest one in the event structure of the verb: while purported external argument readings may be available for some well-established compounds as in (5), these are limited in number. In addition, not all deverbal nouns that appear in SCs are attested as lexical nouns (cf. (2)), which makes the hypothesis that two independent nouns form a root compound together hard to maintain.

- (5) student evaluation, teacher recommendation, police questioning

In a more recent approach, which we call the *Root-Root (RR-) Approach*, Borer (2013) offers an analysis between the two in (3), as given in (6). She argues that there is no event or correlated verb in the structure of SCs (contra (3a)). Her crucial argument is the existence of idiomatic compounds as in (7), which lack a VP with the corresponding interpretation. This observation also challenges the RC-approach in (3b), since the noun heads in (7) are lexically unavailable on the idiomatic interpretation of the compound (cf. *#writer*, *#lifter*, *??monger*).

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5 Note, however, that from a morphological point of view, it is not unusual to propose virtual but unattested words that are required by various derivations (see McIntyre 2016 for a recent discussion and references).

(6)  $[[\sqrt{\text{face}} + \sqrt{\text{lift}}] + \text{er}]_{\text{N}}$ 

- |        |              |               |                    |
|--------|--------------|---------------|--------------------|
| (7) a. | typewriting  | typewriter    | #to write (a) type |
| b.     | facelifting  | facelifter    | #to lift (a) face  |
| c.     | warmongering | warmonger(er) | *to monger (a) war |

Borer argues that SCs behave just like RCs, but to account for their idiomatic readings, she proposes the structure in (6), in which two uncategorized roots, e.g., *face* and *lift* are put together into a compound root *facelift* and receive a free interpretation from the encyclopedia. This may be close to an argumental relation as in (1), but it doesn't have to. To eliminate the possibility of deriving compound verbs from such compound roots, Borer claims that they are bound roots in English and, consequently, must be accompanied by a nominalizing suffix such as *-er*, *-ing* and others. There are several shortcomings that this analysis presents for the study of SCs in our view and we address them in Section 3.

Although SCs especially of the type in (2) received special attention as early as in Bloomfield (1933) and more extensively in Marchand (1969) (see Olsen 2015, for further references), the major debate arose after Chomsky's (1970) discussion of lexicalist vs. syntactic approaches to word formation. SCs were subsequently used to argue in favor of one or the other theoretical trend. In this paper, we abstract away from this framework-related controversy and aim at a better understanding of the empirical picture from a comparative perspective by looking at data in English and Greek and weighing the theoretical claims that have been made.<sup>6</sup> We pursue a syntactic analysis within the framework of Distributed Morphology (DM; cf. Halle and Marantz 1993 and more recent developments), which allows us to capture the diversity of SCs in English and Greek. Drawing on the differences between English as a word-based language and Greek as a stem-based language, we argue that what we call SCs correspond to three distinct morphosyntactic patterns, to which one may add some clear root compounds headed by deverbal nouns such as those in (5), which correspond to (3b). Importantly, in our understanding, SCs have a special status, like in theories that posit (3a), and this is given by the internal argument relation between the non-head and the head

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6 Interestingly, various arguments from the approaches considered here have been formalized in both lexicalist and syntactic approaches. For instance, while syntactic approaches have generally aimed to argue for the presence of event structure and grammar in SCs, Borer (2013) heavily relies on the contribution of the encyclopedia in compound roots and denies any compositional structure in SCs. This comes close to lexicalist analyses, if we correlate the encyclopedia with the lexicon. By contrast, the lexicalist account in Grimshaw (1990) specifically argues for the presence of event/ argument structure in SCs.

of the SC. In the interest of space, we focus here on SCs and the analyses in (3a) and (6), and leave root compounds as in (5) with the analysis in (3b) for another endeavor. In our study we rely on data from referenced literature, from the Corpus of Contemporary American English (COCA) for English, and a magnitude estimation test designed for Greek N-V compounds.

We first show that the standard incorporation-based SC-analysis in (3a) applies to Greek SCs. In support of (3a), Greek has argumental  $[N+V]_V$  compounds (e.g., *emodotó* ‘to blood.give’, *musikosinthéto* ‘to music.compose’, see Ralli 2013), unlike English. Second, we argue that Borer’s (2013) analysis applies only to English SCs like *babysitter*, *facelifter*, which have back-formed verbs (cf. *to babysit*, *to facelift*), but not to those like *truck driver*, which lack such verbs (cf. \**to truck drive*). The main difference is that in the former the non-head is not an argument of the head, while it is in the latter. Third, the difference between English *truck driver* and Greek *emodótis* ‘blood donor’ is that only the latter involves morphosyntactic incorporation. This originates in a morphological difference between the two languages, namely, while English is word-based, Greek is stem-based. This means that *emo* is a morphosyntactically incorporated root in *emodótis* ‘blood donor’, while *truck* is an independent word that is only semantically incorporated in *truck driver*. While morphosyntactically incorporated arguments will also be semantically incorporated, English SCs prove that the reverse does not hold. In our analysis, this comes out by assuming a structure similar to (3a) for Greek SCs, where we have clear morphosyntactic incorporation, and one closer to (3b) for English SCs. Importantly, however, unlike in RC-approaches, in our analysis, English SCs embed event structure from which the non-head originates as an argument and this is what makes these compounds different from root compounds as in (3b). We obtain three different patterns that derive what we call ‘synthetic compounds’ in the two languages and we will see that our DM-based approach turns out very useful in allowing us to capture various subtleties among these subclasses.

The paper is organized as follows. We start by presenting the Greek data in Section 2, which gives us a clear picture of the typical properties of SCs that involve morphosyntactic incorporation. In Section 3 we continue with the investigation of English, where we think that the picture is complicated by the fact that, as a word-based language, English does not present the characteristics of morphosyntactic incorporation in the structure of SCs, making it hard to distinguish them from root compounds. While we show that Greek SCs largely correspond to a structure as in (3a), for English there are two subclasses of SCs: root-root compounds of the type in (6) and SCs without incorporation. In Section 4 we present our conclusions.

## 2. Greek synthetic compounds

In this section we investigate Greek SCs in our attempt to achieve a better understanding of their morphosyntax in comparison to those in English. As we will see, Greek morphology allows distinctions that are more subtle or even absent in English.

Greek essentially differs from English in its rich inflectional system, which makes it a stem-based language in Ralli's (2013: 13) terms. With the exception of some Latinate bound roots such as *mit* in *submit*, *permit*, or *sist* in *persist*, *insist*, for English the distinction between root, stem, and word is futile, and this has important effects on the structure of SCs, as we will show in Section 3. By contrast, the distinction is very solid in Greek. In general, Greek words are bimorphemic, i.e., the root plus some inflection. Roots can never surface as words. In compounds, the distinction between stem and word becomes evident in the stress pattern. For instance, the word *spíti* 'house' bears a stress at the penult and the inflectional morpheme *i* for nominative, singular, and neuter. If it heads a compound as in *kuklóspito* 'doll house', the stress moves to the antepenult, signaling a compound made up of two stems (Ralli 2013). Compounding also leads to a change in the declension class, cf. the endings *-i* vs. *-o* in *spíti*.

SCs in Greek are head final, as in English, don't allow recursion, and form a single stress domain. While stress may not reliably distinguish compounds from ordinary NPs in English (see Plag 2006), it is crucial for the distinction between different types of compounds and phrases in Greek. According to Ralli (2013), Greek SCs inherit their stress from the head:

- |                              |                            |   |
|------------------------------|----------------------------|---|
| (8) kapn-o- <u>kaliérgia</u> | kapn-o- <u>kaliérgitís</u> | (cf. <i>kapnós</i> ; <i>kaliérgia</i> ;<br><i>kaliérgitís</i> ) |
| tobacco-LE-<br>cultivation   | tobacco-LE-<br>cultivator  | tobacco; cultivation;<br>cultivator                             |

Unlike in English, SCs in Greek include a semantically empty linking element, which marks compounding in general and is realized as /o/. Ralli (2013: 59) convincingly distinguishes the linking element from the inflectional endings of the non-head: see (8). Interestingly, besides SCs, Greek may also form what we call "analytic compounds" as in (9), which are closer to phrases and ASNs (see Alexiadou 2017, Ntelitheos to appear for reasons to consider these compounds). By contrast to SCs, analytic compounds are left-headed, allow recursion, and form two stress domains, pointing to two words in their make-up. Their non-heads bear genitive case.

- (9) *kalergitís/ kaliérgia*      *kapnón*  
 cultivator/ cultivation      tobacco.GEN  
 ‘cultivator/ cultivation of tobacco’

Ralli (2013) speaks of morphological compounding for SCs and syntactic compounding for analytic compounds. In our approach, the difference lies in the complexity of the pieces that make up the compound, in particular, the morphosyntactic status of the non-head, which is a root in the former, but a word (i.e., a morphosyntactic phrase) in the latter. Although we do not aim to address analytic compounds here, this distinction is relevant for our comparison to English, where the non-head in SCs has the status of a morphosyntactically independent word, more precisely, a nP (i.e., a root categorized as a noun by some suffix under n).

For the sake of the comparison between the two types of languages we will often speak of *roots* and *words*. *Root* is a term that straightforwardly finds its place in DM on its traditional understanding as the minimal part of a word contributing lexical meaning. The term *word* will be used with reference to spell-out, namely, a word corresponds to some functional projection that can be realized on its own. Words have to be at least as small as categorized roots within DM. For nouns, the smallest word would be a nP. Other phrases above nP and below DP (e.g., ClassifierP, NumberP) might also be spelt out as words, and we will see that the non-heads in Greek analytic compounds represent such cases.

## 2.1. Subclasses of Greek synthetic compounds

Greek SCs present one strong argument for an SC-approach of the type in (3a) – namely, they build N-V verbal compounds of the kind we only rarely find in English. There are three classes of SCs in Greek: i) SCs that do not have any N-V compounds; ii) SCs that build back-formed N-V compounds; iii) SCs with independent N-V compounds.

First, like English (cf. *watchmaker* – \**to watchmake*), Greek has SCs that we can call “frozen”, since they do not allow N-V compounds and most of them do not even allow event-denoting SCs, as in (10) (see Kriaras 1969, Anastasiadi-Simeonidi 2002, Kechagias 2005).

- |      |    |                    |                     |                      |
|------|----|--------------------|---------------------|----------------------|
| (10) | a. | <i>anthopólis</i>  | * <i>anthopolo</i>  | * <i>anthopolisi</i> |
|      |    | flower seller      | to flower-sell      | flower selling       |
|      | b. | <i>anemodiktis</i> | * <i>anemodikto</i> | * <i>anemodiksi</i>  |
|      |    | wind pointer/ vane | to wind-point       | wind pointing        |

Second, again like English (cf. *babysitter* – *to babysit*), Greek has SCs that build back-formed N-V compounds, as illustrated in (11). Other examples are *xartodetó* ‘to paper-bind’ from *xartodētis* ‘paper binder’ or *daniodotó* ‘to loan-give’ from *daniodótis* ‘loan giver’.

(11) a.	<b>vivliodētis</b>	vivliodesía	<b>vivliodetó</b>	(cf. <b>déno</b> )	
	book binder	book binding	to book-bind	to bind	
	b.	<b>forokléptis</b>	foroklopí	<b>forokleptó</b>	(cf. <b>klévo</b> )
	tax evader	tax evasion	to tax-evade	to steal	

As Ralli (2013: 227) notes, we know that these N-V compounds are back-formations, because they essentially differ from the lexical verb in morphology and stress pattern if we compare the third and fourth columns in (11). Thus, *vivliodetó* can only be back-formed from *vivliodētis*, since the lexical verb *déno* is obviously not present in this N-V compound.

Third, unlike English, Greek shows cases of SCs where an N-V compound co-exists in parallel with the nominal SC, as in (12) (cf. Ralli 2002, Anastasiadi-Symeonidi 2002).

(12) a.	<b>krasopótis</b>	krasopóti	<b>krasopíno</b>	( <b>píno</b> )	
	wine drinker	wine drinking	to wine-drink	to drink	
	b.	<b>thiriodamastís</b>	thiriodamasmós	<b>thiriodamázo</b>	( <b>damázo</b> )
	beast tamer	beast taming	to beast-tame	to tame	

Unlike in (11), where the N-V compound doesn’t include the lexical verb, in (12) it is clear that the latter is part of the compound. A magnitude estimation test revealed various degrees of acceptability among different ‘unestablished’ N-V compounds. On a scale from 1 (good) to 7 (bad), *pliroforiodotó* ‘to information-give’ received the score 1.6, *musikosinthéto* ‘to music-compose’ – 1.9, *emodotó* ‘to blood-give’ – 2.9, *trofosilégo* ‘to food-collect’ – 3.9, *xartokóvo* ‘to paper-cut’ – 4.6, *aftokinitokataskevázó* ‘to car-construct’ – 5.4, and *grammatokomízo* ‘to letter-convey’ – 6.4. We also find variation among speakers, which shows the potential of these compounds to get established and confirms the productivity of this compound pattern.

Besides the N-V compounds corresponding to nominal SCs, Greek also presents some for which nominal SCs are more restricted, as illustrated in (13).



- |         |               |               |               |
|---------|---------------|---------------|---------------|
| (13) a. | plakostróno   | *plakostrótis | plakóstrosi   |
|         | to plate-lay  | plate layer   | plate laying  |
| b.      | afalodéno     | *afalodétis   | ??afalodesía  |
|         | to navel-bind | navel binder  | navel binding |

The data in (13) further enforces the claim that Greek can form synthetic N-V compounds, as predicted by the SC-analysis in (3a) above, a matter we address in more details below. In preparation of our analysis, which follows (3a), we note that some SCs have both back-formed and independent N-V verbs without any meaning differences, as pointed out by Ralli (2002) and Anastasiadi-Symeonidi (2002) and exemplified in (14). These cases of free variation indicate that the structures of the two types of N-V compound must be similar with only small differences, which we will capture in our analysis in Section 2.4.

- |         |               |             |   |               |                 |
|---------|---------------|-------------|---|---------------|-----------------|
| (14) a. | xartopézo     | (< pézo)    | – | xartopektó    | (< xartopéktis) |
|         | to card-play  | (to play)   |   | to card-play  | (card player)   |
| b.      | xartodéno     | (< déno)    | – | xartodetó     | (< xartodétis)  |
|         | to paper-bind | (< to bind) |   | to paper-bind | (paper binder)  |

## 2.2. In favor of morphosyntactic incorporation in Greek synthetic compounds

We typically speak of incorporation in cases such as (15) from the Chilean language Mapudungun (see Baker 2009: 149). In (15b) the nominal root *waka* ‘cow’ corresponding to the DP argument *tachi pu waka* ‘the cows’ in (15a) combines with the verb to form what looks like a verb compound and is a near-paraphrase of (15a). This verb compound behaves like a single morphological object – a verb, so *waka* has incorporated into the verb in (15b). There are several degrees of incorporation that languages display and we refer the reader to Baker (2009) for a recent overview. Here we focus on the characteristics of Greek SCs that point towards an analysis in terms of incorporation.

- |         |                                      |                        |
|---------|--------------------------------------|------------------------|
| (15) a. | <i>Ñi chao kintu-le-y</i>            | <i>ta-chi pu waka.</i> |
|         | my father seek-PROG-IND.3sS          | the-ADJ COLL cow       |
|         | ‘My father is looking for the cows.’ |                        |
| b.      | <i>Ñi chao kintu-waka-le-y.</i>      |                        |
|         | my father seek-cow-PROG-IND.3sS      |                        |
|         | ‘My father is looking for the cows.’ |                        |

There are three important morphosyntactic properties of Greek SCs that speak for incorporation and, implicitly, for an analysis as in (3a): i) non-heads in SCs are roots and, thus, morphosyntactically dependent, ii) SCs have limited productivity, which indicates a purely morphological process, and iii) their non-heads realize the internal argument both in SCs and N-V compounds, which supports the presence of some event/ argument structure.

First, following Baker's (1988, 2009) syntactic approach to incorporation as head-movement, the simplest heads that incorporate into other heads should be bare roots.<sup>7</sup> As Ralli (2013: 133–134) also observes, non-heads in SCs disallow both derivational and inflectional suffixes. A derived noun like *player* is not possible in a compound as in (16a). Such nouns are categorized words and have to be part of analytic compounds, as in (16b) (cf. (9)).

- (16) a. \**peh-t-o-timoría*                      vs.    b. *timoría*            *pek-t-ón*  
           play-NZ-LE-punishment                      punishment    play-NZ-GEN

Therefore, non-heads in Greek SCs cannot be morphologically complex, they must be roots. As a stem-based language, Greek does not allow roots to surface as words, where it essentially differs from English (cf. Section 3). The obligatory presence of the linking element /o/ and the absence of any inflectional marking for a declension class (cf. Ralli 2013) enforces the idea that non-heads in Greek SCs are roots, which are morphosyntactically incorporated.

Second, it has long been argued that at the interface between morphological and syntactic processes, word formation that is closer to morphology is more restricted than that closer to syntax (see, most notably, Ackema and Neeleman 2004; cf. Ralli 2013). Morphosyntactic incorporation of roots per se should be closer to morphology and this is confirmed by the limited productivity we find in Greek SCs. Although SCs are productive as a word formation process in Greek in that new SCs are constantly produced (Ralli 2013), there is limited productivity on non-heads for the different noun heads. Even for SCs that build (back-formed or independent) N-V compounds, we cannot freely insert lexical nouns as non-heads, as illustrated in (17) (cf. the N-V compounds in (11a) and (12b)).

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7 There is an ongoing debate as to whether 'incorporated NPs' that restrictedly allow simple modifiers in some languages should be analyzed as head-movement: see Baker (2009) and references therein. This question does not arise for Greek SCs, since their non-heads are unquestionable roots. For English, we will see in Section 3 that non-heads may be morphologically complex, and we will propose an alternative analysis.

- (17) a. vivliodétis                      xartodétis                      \*tetradiodétis  
           book binder                    paper binder                   notebook binder
- b. thiriodamastís                \*alogodamastís  
           beast tamer                    horse tamer

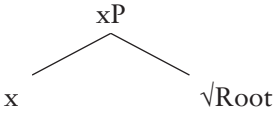
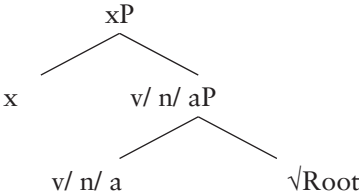
This limited productivity of SCs reinforces our observation that these compounds represent cases of incorporation of roots in ways that will become clear in Section 2.4.

Third, in line with incorporation-based analyses, non-heads in Greek SCs act as arguments of the base verbs. This is evidenced by the fact that neither SCs, nor their N-V corresponding verbal compounds allow the realization of a phrasal argument next to the incorporated one. This holds both for independent and back-formed verbs in (18a) and (18b).

- (18) a. I Maria thiriodamazi (\*to alogo).  
           the Mary beast-tames      the horse
- b. I Maria daniodotise (\*mia perusia).  
           the Mary loan-gave        a fortune

### 2.3. Background on Distributed Morphology (DM)

We assume a DM view on word formation, according to which language has atomic, non-decomposable elements, called *roots*, which combine with the functional vocabulary to build words. Roots are category-neutral and receive a category by combining with category-defining functional heads like *n*, *v* or *a*(djective) (Arad 2005, Embick 2010, Marantz 2013a). Thus, roots are lexically underspecified – the same root may, in principle, combine with any lexical category. There are two cycles of word-formation (Marantz 2013a), i.e. two levels at which a categorizing affix can appear: the root cycle and the outer cycle. Affixation at the root cycle leads to word formation out of roots, as in (19a), while affixation at the outer cycle, which is above a categorizing affix, involves word formation out of words, as in (19b).

- (19) a. 
- b. 

The two processes have different properties. First of all, a locality condition requires that roots receive an interpretation when they combine with the first category-assigning head at cycle (19a). Once this interpretation is assigned, it is carried along throughout the rest of the derivation (see Arad 2005, Embick 2010). According to Marantz (2013a), an element derived by (19a) has the following two properties (among others): 1) it may receive an idiosyncratic meaning as the result of the root appearing in the context of that particular morpheme *x*; 2) it exhibits reduced productivity, i.e., some roots are more natural than others with that morpheme *x*. Second, by contrast to (19a), if a morpheme *x* is merged above a category-determining morpheme as in (19b), we obtain an element that 1) has a compositional meaning predicted from the fixed interpretation of the stem (i.e., vP, nP, or aP in (19b)), and 2) exhibits apparent complete productivity (i.e., no sensitivity to particular stems).

To take an example, the roots *clums* and *malic* are idiosyncratic in forming adjectives, as they require different morphemes: *-y* and *-ous*. We have *clumsy* and *malicious*, but not *\*clumsous* or *\*malicy*. These are instances of word formation from roots as in (19a). But once they are categorized as adjectives, they can both combine with *-ness* to form deadjectival nouns, following (19b): *clumsiness* and *maliciousness*. Adjectival formation with *-y* and *-ous* is only restrictedly productive, since these suffixes are sensitive to particular roots, but noun formation with *-ness* is fully productive, since *-ness*, in principle, attaches to any adjective.

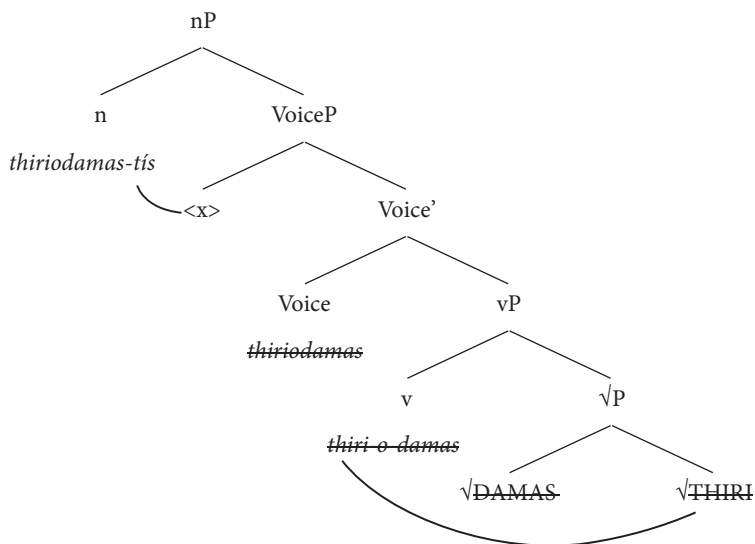
#### 2.4. A DM-analysis for Greek synthetic compounds

Following our arguments above, we offer here an incorporation-based analysis for Greek SCs. For the third class, which builds independent N-V compounds, as in (12), the verb within the N-V compound is identical to the corresponding lexical verb. This means that the verbal root is categorized as a verb before the nominal root incorporates into it, as in (20). By contrast, back-formed N-V compounds from the second class of SCs given in (11) involve a new verb form. To account for this we take the verbal root in the latter to incorporate the nominal root before the whole complex root is categorized as an N-V compound verb, as in (21) below.

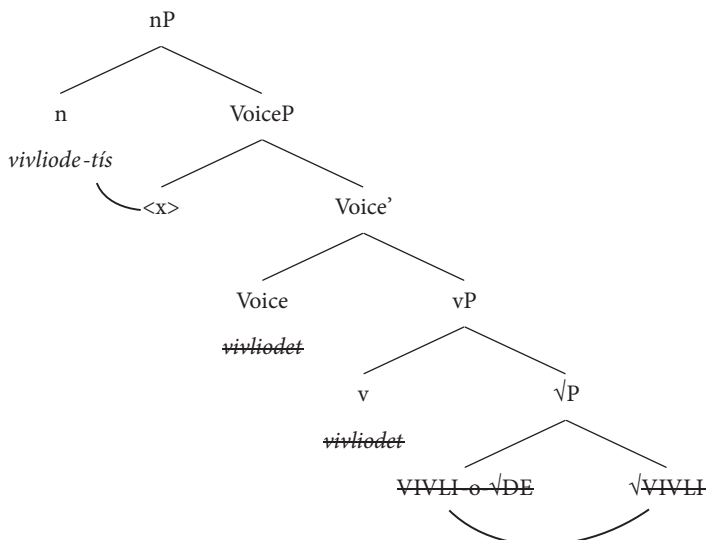
In both (20) and (21) we start with two roots – let us call them the verbal and the nominal root – of which the latter is an internal argument of the former (see Harley 2009, 2014). This relies on the intuition that the lexical semantics of a verbal root is in close relationship with its internal argument, by contrast to the external argument, which is more independent and is realized in a different projection VoiceP (see Marantz 1984, Kratzer 1996). In (20) the verbal root is categorized as a verb, forming the stem *damas* for the lexical verb *damazó* ‘to tame’ and then the nominal root *thiri* ‘beast’ moves to v and incorporates into

it, forming the N-V compound *thiriodamázo*, a vP. In (21), the incorporation of the nominal root happens before the categorization of the verbal root. Here, we essentially have a root incorporation analysis as in Harley (2009) for English (cf. Michelioudakis and Angelopoulos 2013). Following Ralli (2013), the linking morpheme *-o* has no syntactic status, it is simply a phonological reflex.

(20) *thiriodamastís* ('beast tamer'); *thiriodamazo* ('to beast tame')



(21) *vivliodetís* ('book binder'); *vivliodetó* ('to book bind')



For Greek, this analysis perfectly captures the intuition that back-formed N-V compounds do not involve a lexical verb, but just a ‘verb stem’ in Ralli’s (2013) terms. In our terms, this is the verbal root *de* from the verb *déno* ‘to bind’, which never gets categorized as a lexical verb on its own, but only as a N-V compound: in (21), the whole complex becomes a v. The morphological information that realizes the categorizer v consists of the special stress pattern and the new declension that the verbal root acquires in back-formations: cf. *vivliodetó* ‘to book-bind’ vs. the lexical verb *déno* ‘to bind’ (cf. Panagiotidis, Revithiadou, and Spyropoulos to appear). In (20) the verb within the N-V compound *thiriodamázo* ‘to beast-tame’ has the same declension and stress pattern as the lexical verb *damázo* ‘to tame’ (cf. (12)).

In conclusion, the difference between back-formed and independent N-V compounds that correlate with SCs in Greek lies in the lower level of the structure, below the vP. The structure that follows is identical in both: a nominalizing suffix *-tís* ‘-er’ or some eventive nominalizer. Any analysis of nominalizations could apply without special consequences on the profile of SCs. In (20) and (21) we illustrate the *-er* suffix, which we take to bind the external argument variable <x> introduced by the Voice projection, following Schäfer (2008) (cf. Alexiadou, Anagnostopoulou, and Schäfer 2016 on VoiceP, and Alexiadou and Schäfer 2010 on *-er* nominals). Importantly, our incorporation-based analysis correctly accounts for the fact that the non-head in SCs and their N-V correlates is an internal argument, at the same time capturing the differences between the two types of N-V compounds. Moreover, the crucial piece of our account is the root status of the non-head, which accounts for the fact that Greek SCs do not allow any derivational or inflectional suffixes on non-heads, but also for the limited productivity of SCs. As shown in Section 2.3, in DM, structure above the categorizing node should be more productive than structures that involve roots. In this respect, we can interpret the limited productivity of Greek SCs as an idiosyncrasy of the non-head roots: some can undergo incorporation, but others cannot, depending on the encyclopedia and use of world knowledge. As we will see, the opposite holds for English synthetic compounds.

A final note is in order. As mentioned above, the first class of Greek SCs does not build N-V compounds. The question arises as to how those would be analyzed, since our analysis predicts N-V compounds. We think that these compounds are historically somewhere between the two structures in (20) and (21): they used to be like in (20) and are on their way to become like (21). As Lujan (2015) shows, Ancient Greek had incorporation-based N-V compounds, many of which are not available in Modern Greek anymore (e.g., *moshopio* ‘to calf-make’, *karykopio* ‘to sauce-make’, *theronomeo* ‘to beast-feed’). These were independent formations as in (20). The examples in

(22) show Modern Greek SCs that used to have an N-V compound that is not available anymore (see also Pompei and Grandi 2012).

- |         |                            |                                      |
|---------|----------------------------|--------------------------------------|
| (22) a. | gelotopios (Modern Greek)  | gelotopio (Ancient/ *Modern Greek)   |
|         | laughter-provoker          | to laughter-provoke                  |
| b.      | ikodespotis (Modern Greek) | ikodespoto (Medieval/ *Modern Greek) |
|         | host (lit. 'house ruler')  | to house-rule                        |

What this shows is that most likely many of these SCs in Modern Greek must have had independent N-V compounds at earlier stages of the language, which came out of use, and back-formations have not been developed yet, but might appear in the future. In support of an analysis as in (21), note that the example in (23) includes the verbalizer *-is* and yet, the corresponding N-V compound is not available. (23b) shows that *-is* forms verbs from adjectives in Greek (see Alexiadou 2009, Anagnostopoulou and Samioti 2014).

- |         |   |           |                         |                          |
|---------|---|-----------|-------------------------|--------------------------|
| (23) a. | <i>ial</i>  | <i>-o</i> | <i>-kathar-is-tiras</i> | <i>*ialokatharistiro</i> |
|         | glass   | LE        | clean-VZ-er             | to glass-clean           |
| b.      | katharo 'clean' – kathar-iz-o 'to clean' – kathar-iz-meno 'cleaned' |           |                         |                          |

Furthermore, remember that Modern Greek also presents the opposite pattern, i.e., N-V compounds including a lexical verb for which the correlate nominal SCs have disappeared or may be formed restrictedly as in (13). These compounds are captured by the analysis in (20) and show us that historical change applies in both directions.

### 3. English synthetic compounds

With this picture of Greek in mind, let us now have a look at English SCs. Most importantly, English does not productively build N-V compounds. There are a few back-formations noted already in Marchand (1969), but although they are made up of a noun and a verb, the noun is not an internal argument of the verb, but a modifier. In (24) only *to brainwash* and *to babysit* retain some flavor of an argumental relation inside the compound. Yet, these can realize a phrasal internal argument, as illustrated by the examples in (25), taken from COCA.

- (24) to stage-manage, to tape-record, to vacuum-clean, to brainwash, to proofread, to ghostwrite, to spoon-feed, to babysit, to color code
- (25) a. Teresa **babysits** a set of twins.  
 b. We used to think that they brainwashed **the uneducated**.

This evidence speaks against an incorporation-based analysis of the type in (3a) and reformulated in (20) and (21), for English SCs, especially in the context of a language like Greek, where this analysis is well motivated. On the basis of data as in (7) above, Borer (2013) proposes the analysis in (6), in which a compound root is first formed and interpreted depending solely on the encyclopedia and context. While Borer uses this analysis for all SCs in English, we would like to argue here that it only applies to SCs that build back-formations. More precisely, among Borer's 'idiomatic' SCs of the kind in (7), we differentiate two subclasses: i) SCs that build back-formations and ii) SCs that do not. The former are analyzed as root-root compounds, while the latter receive an analysis as in SC-approaches.

### 3.1. Two classes of English synthetic compounds

The difference between the two classes of compounds we propose here is best illustrated by comparing Borer's examples *facelifter*/ *facelifting* and *warmonger*/ *warmongering*. There are two crucial differences between these types of compounds.

First, while *facelifter* may build a back-formed N-V verb *to facelift* in contexts such as (26a), this is not possible for *warmonger*. The only verb associated to the latter that we find in the NOW (News on the Web) corpus, for instance, is *to monger* itself as in (26b) (contra Borer's (7c)). (26a) additionally shows that the verb *to facelift* behaves just like the back-formations in (25), in that *face* is not an argument anymore, *the Figo* plays that role instead.

- (26) a. Ford recently **facelifted the Figo** with 140 changes.  
 b. He never **mongered war** since it is fought with guns.

Second, SCs with back-formed N-V verbs are not productive on their non-heads. While we have *to facelift* from *facelifter*, we do not have *\*to eyelift* or *\*to noselift* from *eye lifter* and *nose lifter*. This is in accordance with a RR-analysis as in (6), since we expect compound roots to be idiosyncratic and unproductive (see (19a)). By contrast, SCs that do not build back-formed N-V verbs, such as those headed by *monger* and even *lifter*, combine with various non-heads, including morphologically complex nouns (examples from COCA):



- (27) a. eye/ nose/ bottom/ disposition/ confidence/ pressure lifter  
 b. cheese/ fish/ war/ fear/ conspiracy/ publicity monger

In line with the DM assumptions in (19b), we take productivity to correlate with the presence of compositional functional structure in the make-up of SCs such as (27). For our analysis, this means that *facelifter* is derived by means of a RR-account, as in (28), while *eye/ nose lifter* and *war/ fear monger* are typical SCs in English, which include the categorized lexical verb and its argumental relation with the non-head (see the discussion on (30) below).

- (28) [<sub>NP</sub> *facelift-er* [<sub>VoiceP</sub> <x> *facelift* [<sub>VP</sub> *facelift* [<sub>√</sub>FACELIFT [<sub>√</sub>FACE <sub>√</sub>LIFT]]]]

A few remarks are in order with respect to (28). First, unlike in Borer (2013), we need not speculate that N-V compounds are bound roots in English, because the compounds we analyze under (28) do build N-V compounds, as predicted.<sup>8</sup> Second, this analysis also predicts that no categorized verbs or nouns should be part of such compounds, that is, no derived non-heads and no heads based on derived verbs with suffixes such as *-ize* or *-ify* should be available. As far as we can tell, this prediction is borne out. The standard back-formations from SCs involve two simple roots (e.g., *babysit*, *facelift*, *brainwash*). We take these RR-compounds to instantiate a typical pattern of creating compound verbs in English, in which the left member modifies the right member, in the spirit of, e.g., *to ninja walk* (see Marantz 2013b and Rimell 2012 for discussion).

Let us now concentrate on the English SCs illustrated in (27). As shown there, they allow morphologically complex non-heads in the shape of derived nouns; even compound words are possible, as illustrated in (29). Interestingly, this also applies to heads like *maker* that are unnatural on their own (cf. (2)), so they cannot be analyzed as root compounds.

- (29) season ticket holder, air traffic controller, flight data recorder, child care provider, science fiction writer, ice cream maker, documentary film maker, sports car maker

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8 We might add that, independently of this, Borer's (2013) claim that N-V compounds are bound roots seems rather unfounded and controversial. As we noted in our comparison to Greek, English is a word-based language and has very few bound roots, usually of foreign origin. By contrast, SCs are fully productive. Within this background it seems contradictory to claim that English should productively derive bound roots for SCs only.

In Borer's analysis (6) (which correlates with our (28)), these cases remain unaccounted for and so do SCs headed by nouns based on derived verbs such as *tax simplification* or *data standardization*. In our terms, these show that in the structure of these compounds both heads and non-heads are categorized by functional structure, so a RR-analysis cannot do justice to them.<sup>9</sup> A difference from Greek that becomes crucial in this context is that non-heads in English SCs are not roots, but necessarily words. The same holds for the base verb. Let us summarize the properties of English SCs of the second class.

First, as shown above, their non-heads express internal arguments: the base verbs and the non-heads can be used in a verb-argument relationship as illustrated in (1) and this holds even for more idiomatic SCs like those headed by *monger*, for which a corresponding verb was created later than the compound (e.g., (26b)). Second, they are fully productive; new SCs can always be built on the basis of a noun head, as in (27). Third, they involve categorized heads and non-heads. To account for these properties, we propose the structure in (30).

(30) [<sub>nP</sub> [<sub>nP</sub> *disposition*] *lift-er* [<sub>VoiceP</sub> <X> *lift*-[<sub>vP</sub> *lift* [<sub>√LIFT</sub> [<sub>nP</sub> *disposition*]]]]

In (30), which presents the formation of the SC *disposition lifter*, *disposition* is a categorized noun, a nP, which appears as the internal argument of the verb *to lift*, originating as the complement of the verb's root, just like in the Greek structures in (20) and (21). The difference is that the non-head *disposition* is a noun and not a root. Like in (20), the verbal root gets categorized as a vP and we obtain the structure for a VP *lift disposition*. Next, unlike in Greek (20), in (30) the non-head does not incorporate into the verb. What happens is that the verb gets nominalized by the suffix *-er* and the noun *disposition* moves to the Spec nP of the nominalized structure. This way, we correctly exclude the derivation of independent N-V compounds in English, which are available in Greek (20) and (21).

Three important questions arise at this point: i) why doesn't the non-head incorporate into the verb in English, just like in Greek?; ii) why does it have to move?; iii) why doesn't the non-head in Greek SCs undergo the same kind of movement as in English?

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9 Harley's (2009) analysis with root-incorporation cannot account for these facts either, although this analysis recognizes the internal argument interpretation of the non-head (unlike Borer 2013).

### 3.2. Against incorporation in English synthetic compounds

The first two questions are closely related. For Greek, we argued that incorporation is motivated primarily because the non-head is a root and, consequently, has a dependent morphological status, which is well accounted for by head-movement and incorporation into the verb or the verbal root. In English, the non-head is a categorized noun. Roots in English are often words, but, most importantly, SCs may include morphologically complex non-heads, which cannot be roots (see also McIntyre 2016). Thus, morphosyntactic incorporation is not motivated in English.

However, non-heads in English SCs present some *semantic* evidence for incorporation, which must be the reason why they have been analyzed as cases of incorporation before. Two properties are relevant: i) they do not introduce a discourse referent and ii) they are number-neutral. In (31), we see that non-heads of SCs cannot be referred back anaphorically, by contrast to bare nouns, which also lack an overt determiner.

- (31) a. He is a driver of **trucks<sub>i</sub>** who takes good care of **them<sub>i</sub>**.  
 b. \*He is a **truck<sub>i</sub>** driver who takes good care of **them<sub>i</sub>**.

In (32) the verb *collect* requires a plural internal argument. But inside the synthetic compound the bare non-head *stamp* can satisfy this requirement of the base verb.

- (32) John collects **stamps**/ \***a stamp**. He is a **stamp** collector.

In Farkas and De Swart (2005), number-neutrality is a manifestation of semantic incorporation, which is not identical to morphosyntactic incorporation. While the latter entails the former, the reverse does not always hold. We saw above that non-heads in SCs may be morphologically complex, which speaks against morphosyntactic incorporation. The semantic effects that correlate with semantic incorporation can be derived from the bare nP status of non-heads in (30) – namely, they lack any functional projections that could host semantically relevant inflection. In particular, the lack of reference illustrated in (31) proves that a DP cannot be available, while the number neutrality in (32) shows that no NumberP is present. With this observation we can answer our second question: why the non-head has to move. If the non-head were a DP, it would either receive accusative case from the verb, or genitive case from the nominalization (like in ASNs such as in (4b)). But as a nP, the non-head cannot be marked for case and is illicit in this argumental position (cf. Longobardi 1994), so it has to move. Our proposal that it moves to the Spec nP position resonates well with two previous approaches to related

phenomena. On the one hand, it resembles Marchis Moreno's (2015) analysis of thematic relational adjectives, whose non-heads are also taken to originate as argumental bare nouns that move to Spec nP and whose adjectival realization is argued to be only a spell-out matter. Interestingly, constructions with thematic relational adjectives in Romance languages, where they are more common than in English, often correspond to English SCs, as illustrated in (33). Our approach in (30) conveniently captures the similarity between the two constructions.

- |         |                   |                  |    |                       |                  |
|---------|-------------------|------------------|----|-----------------------|------------------|
| (33) a. | Spanish           |                  | b. | Romanian              |                  |
|         | <i>producción</i> | <i>petrolera</i> |    | <i>consum</i>         | <i>alcoholic</i> |
|         | production        | oil.ADJ          |    | consumption           | alcohol.ADJ      |
|         | 'oil production'  |                  |    | 'alcohol consumption' |                  |

On the other hand, the movement of the non-head to Spec nP also accounts for the internal cohesion of SCs, namely, that no modifiers can intervene between the non-head and the head. In (30), there is no intermediate level between the n head and its Spec that a modifier could adjoin to. In this respect, this analysis reminds of Koopman and Szabolcsi's (2000) and Massam's (2001) analysis of 'pseudo-incorporation', where apparent cases of (semantic) incorporation are taken to involve phrasal movement to a Spec position.

### 3.3. Roots and words in English and Greek compounds

The answer to the third question – why Greek non-heads do not move to Spec nP – is straightforward. As argued above, non-heads in Greek SCs are roots and, consequently, morphosyntactically dependent. They are not categorized words to build phrases that move to a Spec position; they can only move as (root) heads to incorporate into the verb. The Greek compounds that come closer to English SCs in this respect are the analytic compounds as in (9) and (16b), whose non-heads are categorized as nouns and act as words. However, these non-heads in Greek seem to be more complex than nP projections, since they bear genitive case. Importantly, they are not number-neutral. As (34) shows, in the analytic compound, *stamp* must be in the plural, which contrasts with English (32).

- |      |                 |                                   |
|------|-----------------|-----------------------------------|
| (34) | <i>silektis</i> | <i>gramatosimon/ *gramatosimu</i> |
|      | collector       | stamp.GEN.PL/ stamp.GEN.SG        |

Alexiadou (2017) argues that non-heads in analytic compounds are NumberPs in Greek. So the difference between the non-heads of English SCs and

non-heads in Greek analytic compounds is that the former are smaller in structure, simple nPs, while the latter are more complex, NumberPs, and may be marked for case.

In conclusion, it turns out that Greek does not use simple categorized nPs in (analytic or synthetic) compounds of the kind that English has in SCs. We think that this is due to the more fundamental difference between English and Greek pointed out in Section 2 – namely, that the former is a word-based language and the latter a stem-based language, cf. Alexiadou and Anagnostopoulou (2015). As such, non-heads in English SCs are words which are morphosyntactically more independent than the root non-heads in Greek SCs (see (30) vs. (20)/(21)). And yet, they are less independent than the word non-heads in Greek analytic compounds, which carry number inflection and may receive genitive case (see (34)). To become a word, a Greek root must acquire some minimal inflectional morphology, in our case, number, which for an English root is not necessary, it suffices to have a noun categorizer. Thus, the morphosyntactic complexity of non-heads in English SCs lies between the roots and the simplest words in Greek.

#### 4. Conclusion

In this paper we offered a syntactic analysis of Greek and English SCs, by focusing on fundamental morphological differences between the two languages, which we find reflected in the behavior of their SCs. We evaluated the three previous approaches to SCs on the background of these data and argued that an analysis that involves morphosyntactic incorporation, as proposed by SC-approaches, is entirely motivated for Greek, where non-heads in SCs are morphosyntactically dependent roots. In English, non-heads in SCs are words, which makes the incorporation analysis untenable. The reduced productivity of Greek SCs is again explained by the root status of their non-heads. In DM, roots are taken to behave idiosyncratically, so it is expected that some roots will form compounds with incorporation, while others will not. The non-head in English SCs is a categorized word allowing productive SC formation. We have related this contrast to a typological difference between Greek and English, as stem-based, respectively, word-based languages. While incorporation of an argument into a verb may appear in both types of languages, these would differ in how incorporation is morphosyntactically realized. Namely, stem-based languages make incorporation visible in the morphosyntax and incorporated roots can be recognized as such (see Greek SCs). This does not apply to word-based languages, where a semantically incorporated argument may be a morphosyntactically independent word (see English SCs).

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