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The verbal structure in English synthetic compounds

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The question whether synthetic compounds should be analyzed as including a verbal core or as root compounds has issued a long theoretical debate in the linguistic literature since the '70s. It is precisely their mixed properties that make this debate so difficult to settle. We investigate compounds headed by suffix-based deverbal nouns and propose that they are ambiguous between true synthetic compounds, which include verbal structure, and root compounds. We trace this ambiguity back to Grimshaw's (1990) distinction between argument structure nominals (realizing verbal arguments) and result or simple event nominals (which do not realize verbal arguments). The true synthetic compounds are headed by argument structure nominals and realize the verb's internal argument as a non-head (e.g. *book reading, book reader*), but deverbal nouns may also head root compounds when interpreted as simple event or result nominals and realize a modifier as their non-head (e.g. *police questioning*). We account for the differences and similarities between synthetic compounds and argument structure nominals in the framework of Distributed Morphology and show how Voice-related properties account for further characteristics of synthetic compounds concerning event implication and accommodation of idioms.

1 Introduction

In this paper we focus on English noun-noun compounds known as a subclass of *synthetic compounds* (SynCs) (see (1)), which involve both compounding and derivation: they are headed by a deverbal noun, and their non-head is usually interpreted as the internal argument of the base verb. (1a–c) present examples with eventive, and (1d) with participant-denoting suffixes (see Roeper & Siegel 1978; Grimshaw 1990; Ackema & Neeleman 2004; Lieber 2004; 2016a; b; Olsen 2017 and many others). Next to *-ing*, we include Latinate suffixes that form event nominals such as *-al, -(at)ion, -ment, -age, -ance* in (1b–c), as they behave similarly for our purposes (see also Borer 2013; Lieber 2016a; b), but leave zero nominals (e.g. *claim* in *sovereignty claim*) for future research, as their morphological status and the properties relevant to our investigation are more controversial (Borer 2013: ch. 7; Lieber 2016a: ch. 8; Iordăchioaia 2020).

(1)   a.   book reading   <   read books
        b.   snow removal   <   remove snow
        c.   crop destruction   <   destroy crops
        d.   lawn mower   <   mow the lawn

This mixed structure of SynCs has issued a long debate in the literature since the '70s. On the one hand, they are formed of two nouns just like *root compounds*, shown in (2), which are headed by lexical (non-derived) nouns and retrieve their meaning from world knowledge or context. This led many researchers to analyze SynCs as a subtype of root compounds (Selkirk 1982; Di Sciullo & Williams 1987; Lieber 2004; Olsen 2017; Borer 2013).

(2)   a.   cat food   <   food **for** cats
        b.   tomato bowl   <   bowl **with** tomatoes; bowl **in the shape of** a tomato etc.

On the other hand, their deverbal nature and the interpretation of their non-head as an internal argument of the base verb led others to argue that they embed a VP (Roeper & Siegel 1978; Grimshaw 1990; Ackema & Neeleman 2004; Booij 2010; McIntyre 2015). In this respect they resemble *argument structure nominals* (ArgStrNs), shown in (3), which inherit the full event and argument structure of the base verb (Grimshaw 1990; Alexiadou 2001; Borer 2013).

(3)   a.   the reading **of the book by the student** (The student read the book.)
        b.   the removal **of the snow by the caretaker** (The caretaker removed the snow.)
        c.   the destruction **of the crops by the hurricane** (The hurricane destroyed the crops.)
        d.   the mow**er of the lawn** (Somebody mowed the lawn.)

The question we investigate is whether SynCs indeed preserve anything from the structure and behavior of ArgStrNs. Against this view, it has been argued that they lack the event implication that comes with compositional event structure (see Rappaport & Levin 1992; Alexiadou & Schäfer

2010; McIntyre 2014), that they cannot host external arguments, aspectual modifiers or purpose clauses, and that they express idioms, in contrast to ArgStrNs. See (4) from Borer (2013) on the last two points:[1]

(4) a. the breaking of the door **by Mary in two minutes in order to retrieve her locked-up dog**   (ArgStrN)

 b. (I watched) the door breaking (***by Mary**) (***in two minutes**) (***in order to retrieve her locked-up dog**)   (SynC)

 c. to blow the whistle: whistleblowing/blower; #the blowing/blower of the whistle

We will investigate these alleged differences and argue that true SynCs involve internal arguments, just like ArgStrNs, but not all of them include the full argument structure of the base verbs. In particular, instrument-denoting SynCs headed by *-er* nominals are structurally smaller than those denoting persons. We show that the difference between the two correlates with the presence of Voice properties, which turn out to be relevant also for event implication and the availability of idiomatic readings in SynCs. We account for these facts by offering a syntax-based analysis in Distributed Morphology. The theoretical implications of our empirical findings, however, go beyond this syntactic implementation and require a thorough reconsideration of the empirical domain of SynCs in English and other languages.

The paper is organized as follows. We start in Section 2 with a general presentation of ArgStrNs and the main properties of SynCs. In Section 3 we address an apparent conflict in the reported behavior of SynCs and bring evidence for a distinction between SynCs whose heads are ArgStrNs and whose non-heads are interpreted as internal arguments and SynCs whose heads are not ArgStrNs and whose non-heads may also receive, for instance, external argument-like readings. In Section 4 we offer a syntactic analysis for both eventive and participant-denoting SynCs and relate the lack of event implication to the absence of Voice properties. In Section 5 we closely investigate verbal idioms and their corresponding SynCs and ArgStrNs and show how the presence and absence of Voice properties account for idiomatic readings in verbal idioms and SynCs. We conclude on our results in Section 6.

2 Synthetic compounds and argument structure nominals

2.1 Argument structure nominals

Grimshaw (1990) argues that deverbal nouns are ambiguous between three readings: Argument Structure Nominal, Result Nominal, and Simple Event Nominal. ArgStrNs inherit the event structure of the verb, which accordingly licenses full argument structure as in (5a). Such nominals denote events, which are compatible with predicates of events such as *took a long time*, but not

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[1] We use "*" to indicate ungrammaticality and "#" for unacceptability under the intended interpretation. In (4c), Borer argues that the ArgStrNs cannot receive the corresponding idiomatic reading.

with predicates of individuals such as *was on the table* in (5a). When the deverbal noun does not realize arguments, it receives a more lexicalized reading. On the one hand, the noun *assignment* in (5b) is a result nominal (ResN) and denotes an entity just like *article*, which makes it compatible with *was on the table*. On the other hand, *assignment* may also combine with *took a long time* on its simple event nominal (SEvN) reading as in (5c), which denotes a conceptual event similarly to underived nouns such as *war* and *event*.

(5) a. The **assignment of the tasks** took a long time/*was on the table.   (ArgStrN)
     b. The **assignment**/article was on the table.   (ResN)
     c. The **assignment**/war/event took a long time.   (SEvN)

According to Grimshaw, this event reading is not enough evidence to say that simple event nominals inherit the verb's event structure, since lexical nouns like *war* also have such readings (cf. Lieber 2016a). Event structure is specific to verbs, depicting their aspectual make-up (whether they are mono- or bi-eventive), which requires and licenses argument structure (see Rappaport Hovav & Levin 1998 and later work). For instance, when a bi-eventive event structure is present (as with causative verbs), arguments are realized hierarchically (i.e. internal arguments come first) and identify the two sub-events of the verbal event. In the absence of an internal argument, there is no evidence for event structure in the use of *assignment* in (5c). As Roy & Soare (2013) put it, the noun in (5c) denotes a 'conceptual' but not a 'grammatical' event.[2]

Grimshaw offers several other tests to distinguish between ArgStrNs and ResNs/SEvNs, which we do not dwell on here, as we will restrict our attention to those relevant for our discussion of SynCs below (see Alexiadou & Borer 2020 for an overview).[3]

2.2 Synthetic compounds

SynCs have formed the grounds for long theoretical debates between lexicalist and syntactic models of word formation (e.g. Roeper & Siegel 1978; Selkirk 1982; Lieber 1983; 2004; Ackema & Neeleman 2004; Harley 2009 and others; see Borer 2013: ch. 12 for an overview). Although our final analysis will be couched within the syntactic framework of Distributed Morphology, it

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[2] The SEvN reading in (5c) has two possible sources: one obtained by coercion that refers to the time taken to complete the *assignment* on its (5b) reading and one that refers to the simple event of assigning (something).

[3] Lieber (2016a: ch. 3) offers a critical discussion of Grimshaw's diagnostics, arguing that most of her criteria to distinguish ArgStrNs from ResNs or SEvNs are challenged by corpus data, and nominalizations are generally 'malleable'. Lieber argues for a two-way distinction between Result and Event nominals, with the main difference that the former include a referential argument like lexical nouns. Both allow argument structure, though result nominals are more constrained. Beyond the theoretical differences, the question that Lieber's proposal raises for our discussion is whether ArgStrNs are indeed different from SEvNs, as they would both be included in her Event category predicting no difference between them. We believe that our discussion in §3 supports Grimshaw's distinction contra Lieber (2016a), since not all eventive SynCs show event structure properties (Iordăchioaia 2019).

is not our aim to argue for a syntactic theory over a lexicalist one, as this debate is orthogonal to our present goal to highlight some contrasts that any analysis should account for.

We focus on the behavior and morphosyntactic structure of nominal SynCs in comparison with the corresponding ArgStrNs headed by suffix-based nominals as in (1). This means that we do not aim to offer a unitary analysis for all constructions that have been previously labeled as synthetic compounds. It remains to be investigated whether our proposal for true SynCs may also need to include (some) SynCs whose non-heads resemble oblique arguments (as in (6a)) or those headed by participial heads as in (6b):

(6)   a.   pan frying, church going, moon landing
        b.   homemade, long-legged, blue-eyed

Nominal SynCs have received contradictory treatments in relation to ArgStrN. Below we present some of their properties following previous literature: we first focus on Grimshaw (1990) and Borer (2013), as the latter builds upon and argues against the former. We continue with Lieber's (2016a, b) analysis, which shares similarities with and differences from both other accounts. We close with a discussion of event implication in ArgStrNs vs. SynCs.

2.2.1 Grimshaw (1990)

Grimshaw argues that SynCs are headed by ArgStrNs and are distinct from root compounds (see further support in Di Sciullo 1992; Harley 2009; Alexiadou 2017b). Grimshaw relies on the observation that SynCs obey argument structure constraints, to the extent that, within her thematic hierarchy (Agent < Goal < Theme), they realize only the lowest argument, the theme (see Selkirk 1982). In (7a, b), taken from Grimshaw (1990: 14, 17), the derived noun can form a SynC with the verb's internal argument/theme, but not with its goal or external argument:

(7)   a.   gift-giving to children   vs. *child-giving of gifts (cf. to give gifts to children)
        b.   book-reading by students vs. *student-reading of books (cf. Students read books.)

Grimshaw further argues that compounds headed by zero-derived nominals, which she considers to always form ResNs/SEvNs and to lack any event structure, do not obey such constraints, so they qualify as root compounds.[4] The compounds with zero nominals in (8) contrast with their

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[4] Lieber (2016a) discusses some corpus examples with zero nominals which realize argument structure much like suffixed ArgStrNs but she does not consider these to be formed by derivation like suffixed nominals (Lieber 2016a: 112). Moreover, she does not investigate event structure properties in nominalizations, and, consequently, does not commit herself to a compositional morphosyntax-semantics mapping of argument structure licensing as we (and the literature we rely on, e.g. Borer 2013) do. Lieber's investigation is purely semantic. Iordăchioaia (2020) closely analyzes zero nominals built on change of state verbs that realize ArgStr and shows that not all of these do that. Whether such zero nominals may also form SynCs with true arguments is a matter to be settled by future research.

corresponding SynCs based on the suffix *-ing* (cf. also (7b)), which Grimshaw considers to always form ArgStrNs. Similarly, we may find zero nominal compounds like *baby gift* (vs. **baby giving*) with a goal argument; cf. (7a).

(8)   bee sting (vs. *bee-stinging); dog bite (vs. *dog-biting)

These observations have not remained unchallenged. Besides Borer's counterarguments below, in §3.1 we will see examples of SynCs headed by *-ing* nominals whose non-heads are interpreted as external arguments (contra (7b)). We will argue, however, that these do not involve verbal argument structure and qualify as root compounds.

2.2.2 Borer (2013)

Borer closely compares SynCs with ArgStrNs and argues that the two do not share any properties. First, she claims that if SynCs included any verbal event structure like ArgStrNs, they should realize external arguments and aspectual adverbials like *for/in-X-time*, which is not the case, according to her data. (9) illustrates SynCs corresponding to the ArgStrNs in (10) (Borer 2013: 581), which unlike the latter, disallow both external arguments (contra Grimshaw's (7b)) and aspectual adverbials. Borer concludes that the heads of SynCs are not ArgStrNs, but ResNs/SEvNs (in her terms 'R-Nominals'). These data have been and will be challenged by other literature and our discussion in §3.

(9)   a.   the house demolition (***by the army**) (***in two hours**)
        b.   the facility maintenance (***by the management**) (***for two years**)

(10)   a.   the demolition of the house (**by the army**) (**in two hours**)
        b.   the maintenance of the facility (**by the management**) (**for two years**)

Second, on the basis of examples like (11), Borer argues that an external argument reading is possible in SynCs (contra (7b)). In her analysis, the internal/external argument interpretation of a SynC as in (1) or (11) comes from context, like in the case of root compounds such as *expert job*, *court verdict*, which allegedly also receive an external argument reading.

(11)   **teacher** recommendation, **court** investigation, **government** decision

Third, based on data as in (4c) above, repeated below, Borer (2013) claims that only SynCs may form idioms for corresponding verbal constructions, and this is excluded for ArgStrNs, making the latter untenable as the source of SynCs. In §5 we will take data as in (4c) under scrutiny and show that the difference between SynCs and ArgStrNs is not as strong as claimed.

(4c)   to blow the whistle: whistleblowing/blower; #the blowing/blower of the whistle

On the basis of these arguments, Borer (2013) concludes that SynCs are headed by SEvNs or ResNs but not by ArgStrNs. This means that they are just a subtype of root compounds, do not share any morphosyntactic structure with ArgStrNs, and the argument-like interpretation of their non-heads shows no hierarchical restrictions, allowing both internal and external argument-like readings, depending on context and encyclopedia.

2.2.3 Lieber (2016b)

Lieber (2016b) challenges several previous claims about SynCs with counterexamples attested in natural text corpora and offers an analysis of these in her Lexical Semantic Framework.

First, like Borer (2013), Lieber argues that external arguments are possible as non-heads in SynCs (contra Selkirk 1982; Lieber 1983; Grimshaw 1990), as in (12):

(12)　a.　**body** vibration, **adult** grumbling (from unergative verbs)
　　　b.　**consumer** application, **adult** drinking (from transitive verbs)

Second, Lieber argues against Borer's claim that SynCs are incompatible with *by*-phrases and purpose clauses and quotes examples like (13) from COCA (Corpus of Contemporary American English: https://www.english-corpora.org/coca/), which come against Borer's (4b) and (9). (13a) includes a *by*-phrase and a temporal adverbial, (13b) illustrates a SynC with the aspectual adjective *continuous* and a *by*-phrase, and (13c) shows a *by*-phrase and a purpose clause. Lieber could not find SynCs with aspectual adverbials with *in/for*-PPs (cf. (9)) but these are close to unattested in corpora even with ArgStrNs, so their absence with SynCs is not surprising.[5] However, the presence of aspectual adjectives is indicative of event structure just as much as that of aspectual adverbial PPs is (Grimshaw 1990).

(13)　a.　Saturday demonstrations include **wood carving by Cal Wright from noon to 2:30**.
　　　b.　These procedures […] allowed for **continuous data collection by trained observers**
　　　c.　Soil Eating by Animals to Correct Mineral Deficiencies

For now, let us summarize that SynCs show both internal and external argument readings of their non-heads, allow *by*-phrases, purpose clauses, and at least aspectual adjectives. In relation to ArgStrNs, this picture looks contradictory: external argument readings indicate that no hierarchical constraints apply as has been argued for ArgStrNs and verbal event structure, but

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[5] Iordăchioaia et al. (2020) automatically searched the English Gigaword, one of the largest corpora of English, for *in/ for*-adverbials in combination with twenty-five derived nominals for each of the suffixes *-ing, -ment, -(at)ion, -al, -ance* (i.e. a total of 125 deverbal nouns). They found no examples in which the adverbial modified the telic/atelic aspect of the base verb, as employed by Grimshaw (1990) and Borer (2013). The few available were largely temporal modifiers (e.g. *She returned in the evening*) or, occasionally, result state modifiers (*Sue went out for 30 minutes* => Sue was out for 30 minutes). See, however, a constructed and acceptable example in (25).

by-phrases, purpose clauses and aspectual adjectives should only be possible if there is event structure as in ArgStrNs. We will return to these facts in §3.

2.2.4 Absence of event implication

An important difference between SynCs and ArgStrNs has been argued to lie in the lack of event implication. Rappaport Hovav & Levin (1992); Van Hout & Roeper (1998); Alexiadou & Schäfer (2010); Roy & Soare (2013); McIntyre (2014), and Cohen (2016) have observed that ArgStrNs are understood as referring to an actual event, which their correlate SynCs fail to refer to. For our purposes, the crucial contrast is between the ArgStrN *wiper of windshields* in (14b), which restricts the interpretation of *wiper* to that of a person who has participated in an actual event of wiping windshields, and the SynC *windshield wiper* in (14c), which may refer to a person or a tool, neither of which must have participated in a corresponding event. It is enough for a person to have such a qualification and for a tool to be designed for such purposes. (15b) and (15c) make a similar case.

(14) a. a wiper (a person or a tool)
b. a wiper **of windshields** (a person who has actually wiped windshields)
c. a wiper **for windshields** (a tool intended for wiping)
d. a windshield wiper (a person or a tool)

(15) a. a grinder (a person or a tool)
b. a grinder **of imported coffees** (a person who has actually ground imported coffees)
c. a coffee grinder (a person or a tool)

Rappaport Hovav & Levin (1992) argue that this contrast is parallel to that between ArgStrNs and ResNs introduced by Grimshaw (1990), to the extent that the realization of argument structure entails the presence of an event (with event structure). Alexiadou & Schäfer (2010: 20) explain the same difference between the ArgStrNs and SynCs in (16a) and (16b) in terms of their realization of episodic vs. dispositional aspect.

(16) a. a saver of lives, a fighter of fire (necessarily experienced in action)
b. a fire-fighter, a lifesaver (possibly educated but not necessarily experienced in action)

While the contrast between the person vs. tool/instrument reading in (14) and (15) clearly correlates with the presence vs. absence of event implication, it has been controversial whether compounds referring to persons as in (16a) indeed lack an event implication: the usual assumption is that one who is educated to be a fire-fighter must have fought with fire. What Rappaport Hovav & Levin (1992), however, argue is that one could be employed on such a position and be called so without having been involved in actual events, a scenario which is entirely excluded when the corresponding ArgStrNs are used (see the dispositional reading in Alexiadou & Schäfer 2010).

The reported lack of event implication in SynCs by comparison to ArgStrNs leads one to think that SynCs cannot embed ArgStrNs as their heads, since if they did, they should also reference events (cf. McIntyre 2014). More recent work such as Cohen (2016), Lieber (2016a), Lieber & Andreou (2018) calls attention to examples such as (*child*) *murderer*, which always imply an event and cannot be dispositional. We return to this discussion in §4.

3 Disentangling synthetic compounds

In an attempt to understand the conflicting evidence we found in §2, in this section we argue for a systematic difference between SynCs that are headed by ArgStrNs and realize only internal arguments as their non-heads and compounds whose non-heads behave like SEvNs or ResNs and may receive also external argument interpretations of their non-heads.

3.1 Arguments and modifiers in deverbal compounds

Both Borer (2013) and Lieber (2016b) argue that external argument non-heads are possible in SynCs but with a crucial difference in their modeling. Namely, for Borer, who considers argument realization to be hierarchical and bound to syntactic event structure as in Grimshaw (1990), this entails that SynCs do not realize argumental non-heads but just some modifiers that receive a contextual argument-like reading otherwise available also in root compounds. SynCs are root compounds for Borer (2013). Lieber has a purely conceptual understanding of argument structure (ignoring syntax-semantics linking) and takes the non-heads of SynCs to realize true verbal arguments. In her Lexical Semantic Framework, the head of a SynC has the same semantic structure as an ArgStrN. By means of a Principle of Coindexation, the non-heads of the two SynCs in (17) get coindexed either with the first or the second argument of the base verb *celebrate*, depending on their semantic specification. If the non-head is sentient, like *family*, it may get coindexed with the first argument of the verb as in (17a), and if it is not, like *birthday*, it can only be coindexed with the second argument.

(17)   a.   family celebration
            $[+\text{material} ([_{\text{sentient-i}}\ ])]$ $[\text{-material, dynamic} ([+\text{dynamic} [_{\text{sentient-i}}\ ], [\ ]])]$

                family   *-ation*   *celebrate*

    b.   birthday celebration
            $[\text{-material} ([_{\text{i}}\ ])]$ $[\text{-material, dynamic} ([+\text{dynamic} [\ ], [_{\text{i}}\ ]])]$

                birthday   *-ation*   *celebrate*

In what follows we bring evidence that the empirical picture is somewhere in between Borer's (2013) and Lieber's (2016b) approaches. Namely, we argue that non-heads that look like external arguments in SynCs are modifiers and not arguments, and that only those that are interpreted

as internal arguments can be true verbal arguments. For ease of presentation, we refer to SynCs whose non-heads receive an internal argument-like interpretation as *Obj-SynCs* and those whose non-heads resemble an external argument as *Subj-SynCs*. We keep the term *argument* for syntactic arguments licensed by event structure as in Grimshaw (1990) and Borer (2013) (unlike Lieber 2016a). This means that we argue for a systematic difference between Subj-SynCs as in (17a) as taking a modifier non-head like root compounds and Obj-SynCs as in (17b) as possibly realizing an internal argument non-head.

A first difference between Subj- and Obj-non-heads is that when they co-occur they require a strict order in which the Obj-non-head must be closest to the head noun as in (18) (cf. Selkirk's 1982 *tree pasta eater* vs. **pasta tree eater* and McIntyre 2009 on the internal cohesion of compounds with internal arguments). If they were both modifiers like in root compounds, as Borer argues, they should be free to appear in either order, which is clearly not the case.

(18) a. government house demolition   vs. *house government demolition
      b. state tax collection   vs. *tax state collection
      c. government education funding   vs. *education government funding
      d. consumer product acceptance   vs. *product consumer acceptance
      e. college transfer admission   vs. *transfer college admission

The test in (18) shows that the Obj-SynCs are more internally cohesive than the Subj-SynCs. Compounds are known to be syntactically inseparable: inseparability is a standard test for compoundhood (cf. **ugly** [*black bird*] vs. *black **ugly** bird*, the latter forming a phrase), but they are also known to exhibit this property to various degrees between compoundness and phrasehood (see Ziering & van der Plas 2020). At a reviewer's suggestion, we also tested the order of Subj-SynCs in comparison to what may count as root compounds and found that the former are less separable than the latter: e.g. informants prefer *spring* [*jury hearing*] over *jury* [*spring hearing*] and *winter* [*farm production*] over *farm* [*winter production*], showing that the Subj-SynCs *jury hearing* and *farm production* are more cohesive than *spring hearing* and *winter production*, the latter coming closer to phrases.

However, when an internal argument is also present, the Subj-non-head is preferred as the outmost non-head, following the modifier: informants prefer *state* [*spring* [*tax collection*]] over *spring* [*state* [*tax collection*]] for the interpretation 'collection of taxes by the state in spring' and *college* [*spring* [*transfer admission*]] over *spring* [*college* [*transfer* [*admission*]] for 'admission of transfer by colleges/the college in spring'. This means that *spring tax collection* and *spring transfer admission* are more cohesive compounds than the corresponding Subj-SynCs in (18b) and (18e), which are also compounds. If Subj-non-heads were arguments like the Obj-non-heads, we wouldn't expect them to be separable by modifiers, just like Obj-non-heads cannot be separated by Subj-non-heads in (18). This difference between Subj- and Obj-SynCs suggests that the latter is closer to a modifier-head configuration (and ultimately, a phrase) than the former, which lexicalizes a predicate-argument structure as a compound.

Despite (18), one may still argue that Subj-SynCs involve external arguments, which may be syntactically more independent of the head. Below we provide further contrasts between Subj- and Obj-non-heads that support the proposed argument/modifier difference.

The second difference between Subj- and Obj-SynCs is in terms of productivity. Taking them both to have a similar make-up (whether as root or argumental compounds), a prediction of both Borer's and Lieber's analyses is that Subj- and Obj-SynCs should be similarly available. Yet, there is a striking difference between the two. Obj-SynCs are just as productive as their corresponding ArgStrNs: see (19c, d). It is hard, if not impossible, to find a verbal or ArgStrN construction that does not already have an established Obj-SynC.

(19) a. Whenever he sees some pet, this boy feeds it.
      b. Everybody knows about **this boy's feeding of pets**.
      c. This boy is well-known for his **pet feeding**.
      d. This boy is **the pet feeder** I was telling you about.

By contrast, Subj-SynCs cannot be productively constructed, as noted already by Selkirk (1982); Grimshaw (1990); Bobaljik (2003) and most of the literature. The examples in (20) could at best be interpreted as Obj-SynCs, to the extent that the base verb is transitive.

(20) #boy feeding, #kid eating, #boy scratching, #girl swimming

As highlighted by Borer and Lieber, Subj-SynCs do exist; however, they are much less frequent than the Obj-SynCs. In an independent study on noun-noun SynCs built on transitive verbs and automatically collected from natural text corpora, for a dataset of 1864 SynCs on which all three American native speaker annotators converged, Iordăchioaia (2019) reports that only 12% were labeled as Subj-SynC, by comparison to 68% for Obj-SynCs and 20% for other modifier readings (e.g. *a surprise demolition*). This means that Obj-SynCs are five to six times more frequent than Subj-SynCs. If Obj-SynCs and Subj-SynCs had a similar syntactic status (as for Borer or Lieber), this asymmetry would be entirely unexpected. Most importantly, if they were structural arguments introduced by event structure, they should be available for any possible verbal construction, as they would be compositionally licensed. As noted just above (19), only Obj-SynCs behave like this.

Further examples of Subj-SynCs are given in (21), which shows that many of these SynCs involve a limited set of collective non-head nouns, which refer to organizations or groups: e.g. *government, state, police, parliament, court, union, community, opposition, church, council, jury, media,* as observed in Abrosimova (2017).

(21) **farm** production, **government** demolition, **parent** abandonment, **satellite** retrieval, **police** enforcement, **community** acceptance, **board** approval, **police** questioning, **jury** hearing

This shows that many Subj-SynCs belong to a restricted class with conventionalized non-heads that are typically conceptualized as agents/subjects. Yet, this subject-like interpretation cannot

originate from verbal event structure, i.e. the non-heads of these compounds are not external arguments. If they were, they would be formed by a compositional event structure and there would be no explanation as to why those in (20) are not possible, while objects always are. Therefore, compounds as in (21) match the pattern of root compounds posited by Borer, unlike Obj-SynCs.[6]

Bobaljik (2003) makes a similar point concerning compounds headed by *-ee* nominals as in (22), which Lieber (2004; 2016b) takes to involve external argument non-heads. First, Bobaljik shows that the non-heads of these compounds typically cannot appear as *by*-phrases, which standardly introduce external arguments in ArgStrNs; see (23).[7]

(22)   **city** employee, **UN** evacuee, **US** bombardee

(23)   *an employee **by the city,** *an evacuee **by the UN**, *a bombardee **by the US**

Second, he notes that the non-head in these compounds is restricted to institutions, it excludes persons. The examples in (24) could at most be interpreted as dvandva compounds, while such non-heads make typical external arguments for the base verbs. This in line with Abrosimova's (2017) observation about the collective flavor of subject non-heads in (21), although not all Subj-SynCs headed by action-denoting suffixes behave like participant-denoting *-ee* nominals. In general, Iordăchioaia (2019) shows that there are even Subj-SynCs headed by SEv nominals, which do not show external argument behavior (see examples in §3.2).

(24)   **#boss/#manager** employee (one who the/a boss/manager employs)
        #rescuer evacuee/bombardee (one who the/a rescuer(s) evacuated/bombarded)

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[6] A similar claim is made in Ackema & Neeleman (2004: §3.3.3; §3.6) on slightly different grounds. In their competition-based analysis, they argue that *truck driver* cannot be derived as [$_N$ *truck* [$_N$ *drive -er*]] with an internal argument reading of *truck*, since this is blocked by the syntactic construction (here, ArgStrN) *driver of trucks*. On this derivation, *truck driver* could only receive a non-compositional interpretation, as a root compound, where *truck* is not an internal argument of *driver*.

[7] As a reviewer notes, one may find corpus examples with *-ee* nominals followed by a *by*-phrase (e.g. *the seventh such honoree by the Denver Post* cited by the reviewer from COCA). However, this does not mean that such nominals involve verbal event structure with external arguments. *By* is ambiguous: it may be semantically empty and mark external arguments of a verb (when the verb's event structure is available) or it may be contentful and assign its own affector-role to its own argument (Fox & Grodzinsky 1998: fn. 24; Alexiadou 2001). In examples such as *a book by Chomsky*, where there is no verb whose external argument *by* may introduce, it modifies the lexical noun *book* and assigns its own affector-role to its complement *Chomsky*. The fact that *-ee* nominals that head compounds as in (22) do not systematically realize the non-head with a *by*-phrase clearly shows that, whenever available, such a *by*-phrase cannot represent a verbal argument licensed by compositional event structure, since such a structure would not allow exceptions as in (23). This is the same argument as for (21) vs. (20). Structural arguments are always realizable, and so are objects/internal arguments in §3.2 but not subject-like modifiers as in (21) to (24). Of course, we have to keep in mind that Lieber's concept of an external argument is semantic only and less restricted.

Bobaljik concludes that compounds as in (22) receive a reading such as 'employed/evacuated/ bombarded *under the auspices of* or *on behalf of* the city/UN/US', a modifier interpretation typical of root compounds. The Subj-SynCs in (21) are slightly different, which shows us the diversity of these modifier readings by contrast to structural external arguments.

In the next section, we provide structural tests that show that Obj-SynCs indeed present event structure properties that license argument structure, while Subj-SynCs do not.

3.2 Event structure in synthetic compounds

In §2 we saw already that Lieber (2016b) brings corpus evidence against Borer's (2013) claim that SynCs lack event structure properties. Lieber's data in (13) indicate that SynCs license *by*-phrases, purpose clauses and aspectual adjectives. Below we add further evidence from Iordăchioaia (2019) that it is in fact only Obj-SynCs that have these properties, and Subj-SynC do not, in support of our claim that only the former involve argumental non-heads, while the latter involve modifiers. Iordăchioaia (2019) carried out a questionnaire study with minimal pairs of Obj- and Subj-SynCs and found a clear contrast between them in terms of event structure. In (25) and (26) we see data that test the presence of aspect by means of *in/for*-adverbials and aspectual adjectives. As the two examples show, the grammaticality of the Subj-SynCs is substantially lower than that of the corresponding Obj-SynCs.[8]

(25) **Language** learning/??**Machine** learning **in a short time** is what we are hoping for with this program.

(26) **Frequent/constant player** recruitment/??**college** recruitment can only have positive effects in the long run.

Besides aspect, Voice properties that indicate the presence of event structure licensing external arguments were also tested with similar results. For the verbal domain, modifiers like *intentionally*, *deliberately*, *carefully* and control into purpose clauses are known to require the presence of Voice (see Kratzer 1996; Alexiadou et al. 2015 and references therein), as shown in (27a) and

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[8] One reviewer is drawing attention to corpus examples with Subj-SynCs that can be modified by adjectives like *frequent, constant, intentional, deliberate* contra our data in (26) and (27c) (see *constant/frequent/intentional government intervention*). We do not claim that such constructions are not possible. These adjectives may even appear with lexical nouns and ResNs (see *frequent guest, constant problem, intentional lie*), so they do not require event structure or the event structure may be retrieved from some underspecified verb, if anything. Grimshaw (1990) never claimed that aspectual adjectives alone diagnose event structure, she always used them in combination with other evidence. Our data in (25)–(27) are insightful precisely because pairs of Obj- and Subj-SynCs were judged in parallel, such that the consultants were made aware of their minimal differences. The clearly contrastive judgments support the difference between the two types of compounds, which must originate in their different internal make-up: with event structure for Obj-SynCs and without for Subj-SynCs. More details are given in Iordăchioaia (2019), showing that these compound pairs were even selected to denote events.

(28a).[9] (27b, c) illustrate modification by the adjectives *intentional* and *deliberate*, and (28b, c) purpose clauses with SynCs. Again, we find a strong contrast between Obj-SynCs, which are fully grammatical, and their corresponding Subj-SynCs, which are unacceptable.

(27)   a.   The army **intentionally/deliberately** demolished churches during the war.
         b.   I have heard of **intentional/deliberate church** demolition during the war.
         c.   *I have heard of **intentional/deliberate army** demolition during the war.

(28)   a.   Paparazzi$_i$ chase celebrities [PRO$_i$ **in order to obtain an autograph**].
         b.   I have heard of **celebrity** chasing **in order to obtain an autograph**.
         c.   *I have heard of **paparazzi** chasing **in order to obtain an autograph**.

This contrast is particularly surprising, if we consider that Voice is responsible for the licensing of external arguments: if anything, we expect the SynCs whose non-heads are interpreted as subjects to be compatible with Voice properties and not those whose non-heads are interpreted as objects. And yet, (27b) vs. (27c) and (28b) vs. (28c) show precisely the opposite. Despite the fact that such Obj-SynCs do not overtly realize the external argument of the base verb, they prove to include the necessary event structure of verbal constructions with Voice. That is, in (28b), they must include the variable of an implicit external argument that controls the PRO subject of the purpose clause just like the overt agent in (28a).[10]

3.3 Interim conclusion

To conclude on our empirical picture of SynCs, we saw in §2 that both Subj- and Obj-SynCs are available, as observed by Borer (2013) and Lieber (2016b), and that SynCs also exhibit clear properties indicative of event structure, as argued in Lieber (2016b), contra Borer (2013). While Borer argues that all SynCs are root compounds and involve modifier non-heads, Lieber proposes the opposite, namely, that all SynCs are argumental, realizing either internal or external arguments. The presence of event structure properties is problematic for Borer's analysis but compatible with Lieber's semantic account. In this section we have shown, however, that the empirical picture is in between the two scenarios. In particular, we provided evidence that there is a strong structural contrast between Obj- and Subj-SynCs and that only the former exhibit event structure properties and are truly argumental, as in Lieber's (semantic) approach, while the latter behave like root compounds, as in Borer's approach.

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[9] We are aware of the limitations of purpose clauses as a test for Voice (see Manzini 1983; Alexiadou et al. 2015: 20–21), but the contrast between Obj- and Subj-SynCs remains and we take it to support our hypothesis together with the other evidence on Voice. Following Bruening (2013), one could also use comitatives and instruments to test Voice. However, such arguments are usually introduced by the preposition *with*, which is very polysemous, and for compounds it turned out particularly difficult to create natural contexts where *with* would unambiguously introduce a comitative/an instrument for the compound and not the main verb. Corpora also did not provide clear examples.

[10] The controler of PRO in purpose clauses need not be overt; cf. passives: e.g. Celebrities$_i$ are chased [PRO$_{j \neq i}$ in order to obtain autographs] (see Bruening 2013; Legate 2014; Legate et al. 2020).

4 A syntactic analysis of synthetic compounds

In this section we propose an analysis of Obj-SynCs by focusing on their similarities and differences from ArgStrNs. We start with a brief introduction to Distributed Morphology and the analysis of ArgStrNs and ResN/SEvNs to then proceed with SynCs.
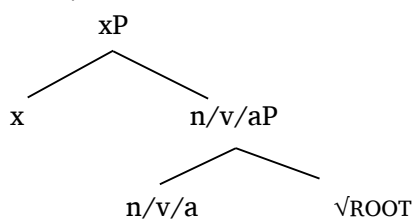
4.1 Background on Distributed Morphology

Marantz (2001; 2013) and Arad (2005) propose two types of word formation in Distributed Morphology (DM): i) inner derivation (from the root) and ii) outer derivation (from a stem), as illustrated in (29):

(29) a. inner/root-based derivation

```
            xP
          /    \
        x       √ROOT
```
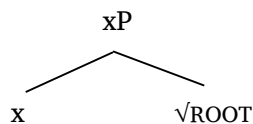
  b. outer/stem-based derivation

```
            xP
          /    \
        x       n/v/aP
              /      \
          n/v/a      √ROOT
```

The two display different properties. Inner derivation presents the following: 1) negotiated (idiosyncratic) meaning of the root in the context of the functional morpheme (e.g. in combination with little n the root √GLOBE may mean 'sphere' or 'the world/planet', but a realizes only the latter meaning in *global*; Marantz 2013); 2) selectional restrictions (i.e. some roots are better than others with a particular morpheme: see adj. √MALIC-(i)ous/*y vs. √CLUMS-y/*ous, Arad 2005); 3) the meaning of the construction depends on root semantics independent of argument structure operations from functional structure. Outer derivation has opposite properties: 1) compositional meaning predicted by the stem (e.g. [glob-al]-*ize* 'make global'/*'make into a sphere' preserves the adjectival meaning it is derived from); 2) no selectional restrictions (see [malici-ous]-*ness*, [clums-i]-*ness*); 3) the meaning of the construction may involve arguments from functional structure. The third point will be illustrated in (30) below.

4.2 Argument structure nominals in Distributed Morphology

With these tools we can analyze the different readings of deverbal nominals from §2.1. For the ArgStrN reading in (5a) the suffix nominalizes the full event structure of the base verb up to AspectP (Alexiadou 2001) as a stem-based derivation: see (30). The root √DEMOLISH undergoes head-movement up to n and acquires the syntactic and semantic contribution of each functional head on
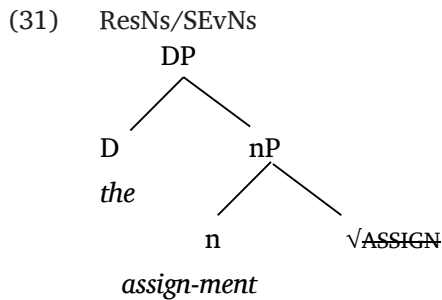
its way. The presence of AspectP allows the adverbial *in two hours*, and VoiceP accommodates the *by*-phrase as the external argument. ResNs/SEvNs as in (5b) and (5c) do not involve any event or argument structure, so they are root-derived as in (31) (cf. (29a)). The root √ASSIGN is polysemous: it may denote an event or its result. Both readings are preserved in the negotiation of its meaning with the n head realized by the suffix *-ment*, and we obtain the SEvN and the ResN *assignment* as the output of allosemy (Marantz 2013; see Wood 2021: 5 for a recent summary of layering approaches to nominalizations).[11] In the syntax n is an abstract nominalizer, for which a suffix allomorph will be lexically inserted at Spell-Out (see Late Insertion) depending on the root. This is how n is spelled out as *-ion* for √DEMOLISH and *-ment* for √ASSIGN (see Embick 2010: ch. 2 for a detailed discussion).

(30)   ArgStrNs

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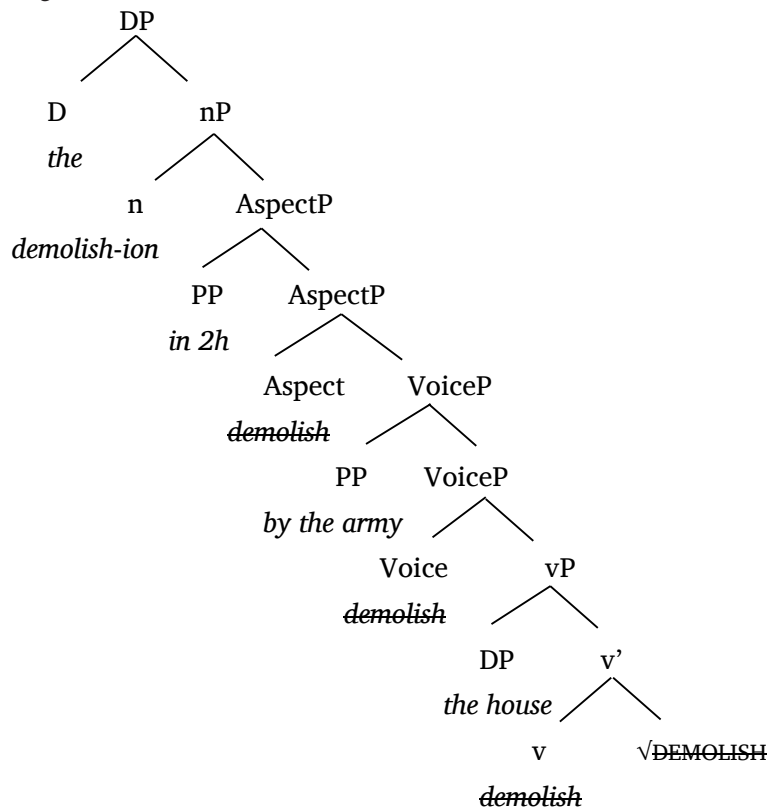
[11] In combination with the n head *-ion* in *assignation*, the same root yields yet another interpretation, which may also be event or result. A possible challenge to (31) is ResNs that include a morphological verbalizer (see Borer 2013 for discussion). For example, *justification* contains the verbalizer *-ify* (cf. *just > justify > justification*) and, besides the ArgStrN reading in (30), it has a ResN reading 'reason that justifies some act'. This latter reading should involve a structure as in (31), yet one that includes a vP with categorial but not eventive properties. Anagnostopoulou & Samioti (2013) discuss similar cases of Greek participles and argue that such categorial *v*Ps allow allosemy as in (31), unlike eventive *v*Ps as in (30). As a reviewer points out, in Moskal's (2015) theory of locality, one could also assume that v (available in all these nominals) is polysemous and not the root. This distinction can be implemented in our system, but we keep it simple, since our concern is the structure in (30) for ArgStrNs and SynCs.

(31) ResNs/SEvNs

```
              DP
           ╱      ╲
         D          nP
        the       ╱    ╲
                n       √ASSIGN
           assign-ment
```

4.3 Synthetic compounds in Distributed Morphology

A first analysis of SynCs in DM is offered in Harley (2009), which relies on root incorporation. Like us, Harley assumes that SynCs include internal arguments (but does not discuss the existence of Subj-SynCs), and, for a compound like *truck driver*, she takes the verbal root √DRIVE to incorporate the internal argument noun *truck* and to then get nominalized as a compound by the suffix *-er*, without ever creating a verb, as shown in a simplified version in (32). This way, Harley excludes unavailable compound verbs like **to truck drive*. However, as Borer (2013) points out, this analysis cannot account for SynCs that include an overtly verbalized verb (e.g. *root verbal-**iz**-ing, water pur-**if**-ication*), given the assumption that in (32) there is not even a simple verb in the structure of such compounds.

(32) Harley (2009)

```
                 nP
              ╱      ╲
            n          √P
       [truck drive]-er  ╱   ╲
                     √DRIVE    nP
                            ╱     ╲
                          n        √TRUCK
```
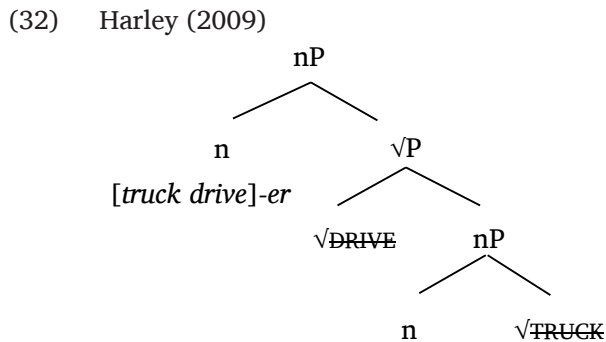
Iordăchioaia et al. (2017) investigate SynCs with *-er* nominal heads in Greek and English and formulate a distinction between SynCs that involve incorporation of their root non-heads, as in Greek, and English SynCs, whose non-heads are morphologically complex (e.g. *dispos-**ition** lifter*) and should not be incorporated. In (33), we adjust that analysis to our argumental Obj-SynCs such as *house demolition by the army*. Following Iordăchioaia et al., the non-head *house* moves to Spec nP, as its lack of a DP structure prevents it from receiving (prepositional genitive) case in an ArgStrN configuration, and it thus cannot stay in its original argumental position (see Longobardi 1994). This accounts for the internal cohesion of SynCs, which we observed in (18), without assuming root incorporation as in Harley (2009). Given that the non-head nP moves to Spec nP,

there is no formation of a compound verb such as **to house demolish*. Moreover, this structure contains a vP layer for the base verb, which can accommodate verbalizing suffixes to account for SynCs like *root verbal-iz-ing* and *water pur-ifi-cation*.

However, in contrast to Iordăchioaia et al. (2017), the data in (13b), (25) and (26) indicate that aspectual properties are also available in Obj-SynCs, which leads us to posit a verbal event structure identical to that of ArgStrNs in (30), including AspectP. Consequently, the only difference between ArgStrNs and SynCs concerns the non-head, which is a full DP in the former and stays in situ receiving genitive case, while it is a simple nP in the latter and must move to Spec nP for lack of case. The last position of the nP non-head is the same as in root compounds such as *house roof*, but in SynCs the non-head is an argument introduced by the event structure of the vP, which gives it the interpretation of an internal argument, unlike the non-heads of root compounds, which are interpreted by means of encyclopedia or context (see Delfitto et al. 2011). The so-called Subj-SynCs in (21) are built on a ResN head without verbal event structure (see (31)) and have a structure identical to that of root compounds built on lexical nouns.

(33)   Argumental SynCs: (*frequent*) *house demolition by the army*
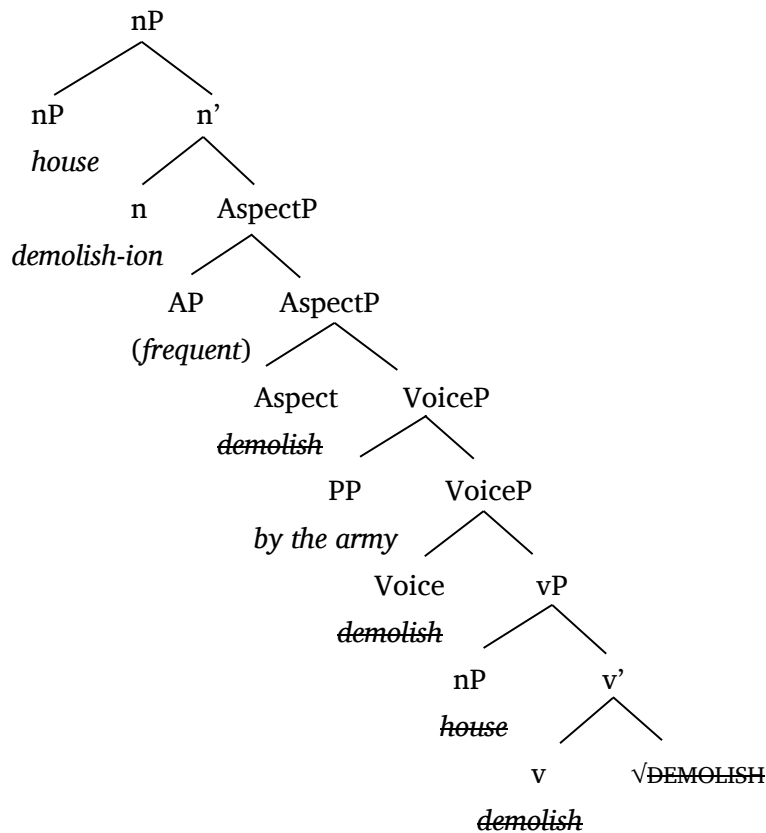
The structure in (33) strictly accounts for the morphosyntax and the lexical semantics of argumental SynCs but for a DM approach it may raise questions about the locality domains involved and the availability of contextual allomorphy or allosemy in compounds. Although such cases have been pointed out for other languages in Harðarson (2021), we are not aware of any contextual allomorphy or allosemy that would appear in English SynCs and be absent in the corresponding ArgStrNs. To the extent that the meaning of the non-head *globe* were indeed sensitive to the root of the compound head in *globe trotter* 'world traveler' vs. *globe smasher* 'smasher of spherical objects', exhibiting a case of contextual allosemy in a SynC, as Harðarson (2021) claims (cf. §4.1), it seems to us that the same meaning distribution would appear in the corresponding ArgStrNs (*the trotter of the globe* vs. *the smasher of the globe*). We agree though that more intricate examples of such contrasts may become available upon further study, and then we assume that Harðarson's (2021) account could cover those as well.

4.4 Presence and absence of Voice in *-er* synthetic compounds

While eventive SynCs headed by *-ing* or Latinate suffixes were found to exhibit both external arguments and aspectual properties, this does not carry over to participant SynCs headed by *-er* nominals, as Lieber (2016b) also observes. *-er* nominals are known to show more restricted verbal properties even as ArgStrNs (e.g. *the driver of the truck*; see Alexiadou & Schäfer 2010; Roy & Soare 2013). We focus here on *-er* nominals that denote external arguments of their base verbs (i.e. agents, causes, instruments), as this is the most productive meaning of the suffix and the one that originates in compositional event structure (see Booij 1986; Booij & Liber 2004; Alexiadou 2014; Lieber & Andreou 2018 on less productive patterns). Since they usually denote external arguments, such *-er* nominals have been argued to nominalize the VoiceP of their base verb (see Schäfer 2008a; Alexiadou & Schäfer 2010; but cf. Baker & Vinokurova 2009). The question is whether *-er* SynCs also involve VoiceP like the corresponding ArgStrNs and whether they always do so.

Importantly, *-er* SynCs could be argued to involve VoiceP, as long as they denote persons; instruments and inanimates, in general, cannot act agentively, as required by Voice. While ArgStrNs built on *-er* nominals usually denote agents, as shown in Alexiadou & Schäfer (2010), SynCs are more diverse. Alexiadou & Schäfer (2010: 19–20) and others before (see §2.2.4) have shown that many *-er* SynCs denote both persons and instruments/tools, as in (35).

(34)   a.   a coffee-grinder   (person or tool)
         b.   a grinder of (imported) coffee   (necessarily a person)

We propose that the different readings of *-er* SynCs and their contrast to ArgStrNs originate in the presence, respectively, absence of Voice. In essence, we argue that *-er* SynCs are ambiguous:

they may or may not include Voice with effects on their interpretation. On the one hand, in the presence of Voice, we obtain the person/agent reading of the *-er* SynC, whose functional structure is identical to that of *-er* ArgStrNs, as shown in (35). Unlike in (30), the *-er* suffix does not form action but external argument nominals. That is, it appears in a configuration in which it becomes coreferential with an external argument variable in the event structure of the verb, which cannot be independently occupied by another DP (see Booij's 1986 analysis with *-er* binding the verb's theta-role). Following Schäfer (2008a), the suffix *-er* – and eventually the noun – is coindexed with the external argument introduced by Voice, which must be an agent/person.

(35)   Person/agent-denoting *-er* deverbal compounds: *coffee-grinder* (as a person)
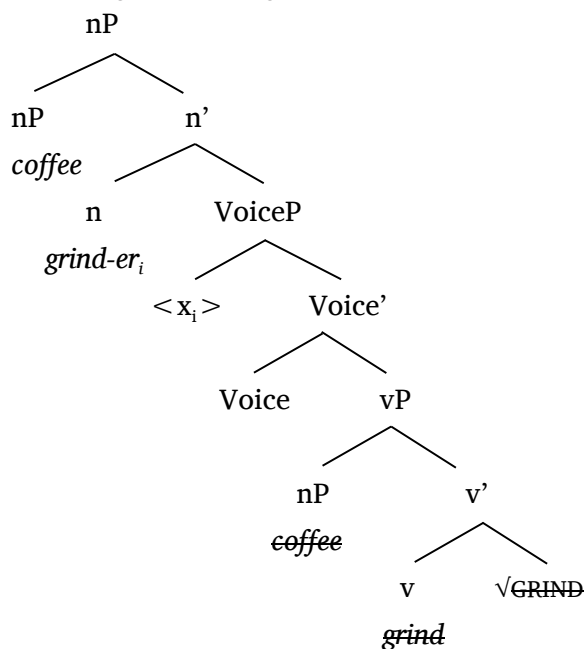
This analysis suggests that person-denoting *-er* SynCs and the corresponding ArgStrNs share the event structure in (35), which is what we are aiming for. Like in the case of eventive ArgStrNs and their corresponding Obj-SynCs, the difference is that the internal argument in SynCs is a bare nP and must move to Spec nP, while in ArgStrNs it receives *of*-genitive case.

On the other hand, in the absence of Voice, an agentive reading of a SynC is unavailable, and the closest possible compositional interpretation that the *-er* SynC may obtain is that of an instrument/tool, which cannot act on its own in an event but may contribute to its coming about. They behave like the causer instruments described in Alexiadou & Schäfer (2006). Concretely, this means that, instead of an external argument variable provided by VoiceP (see (35), Schäfer 2008a), *-er* would bind the causer of a causative vP like causers of unaccusative verbs, which also lack Voice (e.g. *The door opened **from the wind***). Such causers typically take over the subject position of the causative verb when an agent is missing: cf. ***The wind** opened the door* (see v-CAUS

in Alexiadou et al. 2015: 30–36, which corresponds to our v in (36)). We obtain the instrument-denoting *-er* SynCs from the structure in (36), which uses Schäfer's (2008a) implementation of the suffix *-er,* now nominalizing a simple vP structure (without VoiceP) and coindexing its variable with the x_i variable of a *causer* in this case.

(36)   Instrument-denoting *-er* SynCs: *coffee-grinder* (as a tool)
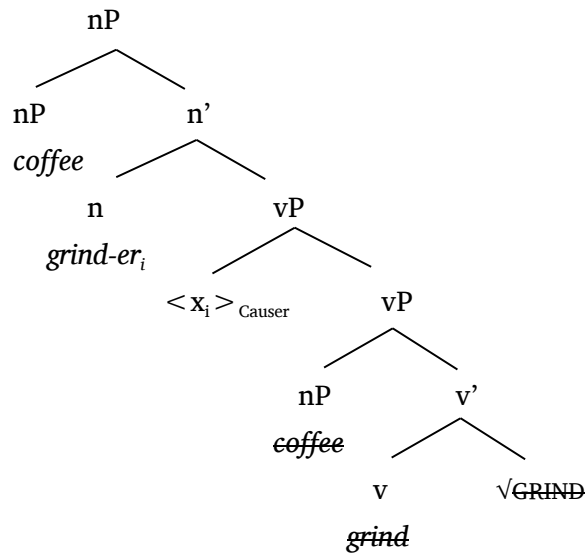
4.5 Event implication

Let us now turn to the contrast between ArgStrNs and SynCs in terms of event implication reported in §2.2.4. If we take person-denoting *-er* SynCs to be essentially headed by ArgStrNs, we predict that they should pattern similarly in terms of event implication: see (14), (15), and (16). Recall that the debate on event implication is unsettled with respect to person-denoting compounds, since it seems unnatural to say of somebody that s/he is a truck driver without their ever having driven a truck. In the case of instrument readings, this situation is clear: a lawn-mower need not even be functional to qualify as such. Our analysis in (35)–(36) offers a straightforward explanation for this dilemma: the complex structure including Voice of person-denoting *-er* SynCs also triggers event implication, but the smaller structure of instrumental compounds does not.

That the crucial projection relevant for event implication is Voice is confirmed by the use of Voice-modifiers with these compounds. In (37), the addition of *careful* (or *accidental*, see Schäfer 2008b, cf. Reed 2011) eliminates the instrument interpretation of these compounds.[12] The default reading of *lawn-mower* and *coffee-grinder* seems to be that of a tool rather than a

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[12] The data in (37) are based on a questionnaire with three American native speakers, whose ratings from 1 (bad) to 5 (perfect) greatly converged. * stands for a rating below 2, ? for a 3–4, and no mark indicates a rating above 4.

person, but once we introduce the Voice modifier, the tool reading disappears and only the person reading is possible:

(37) a. a lawn-mower   i. ?person   ii. instrument
          a careful lawn-mower   i. person   ii. *instrument
          an accidental lawn-mower   i. person   ii. *instrument

      b. a coffee grinder   i. ?person   ii. instrument
          a careful coffee grinder   i. person   ii. *instrument
          an accidental coffee grinder i. person   ii. *instrument

      c. a windshield wiper   i. person   ii. instrument
          a careful windshield wiper   i. person   ii. *instrument
          an accidental windshield wiper i. person   ii. *instrument

In our study we also checked whether *careful* is interpreted in relation to the action or the person: i.e. whether *a careful lawn-mower* denotes a possibly careless person who carefully mows the lawn (action reading) or a generally careful person who may carelessly mow the lawn (person reading) (cf. *beautiful dancer* in Larson 1998). While the person-related reading is available, the event-related one is always preferred; *accidental* is only compatible with the latter. In addition, our consultants find that, e.g. *a careful/accidental lawn-mower* must have mown the lawn at least once, confirming that the presence of Voice also brings about event implication, just like in ArgStrNs.[13] Without Voice-modifiers, these SynCs are underspecified, but *child murderer* is not, as *murder* is an agentive verb and always requires Voice with event implication, leaving no room for Voice-less instrumental readings of *murderer*.

A final note is in order. Given our focus on the fully productive and compositionally formed readings of *-er* nominals, as also acknowledged in Lieber & Andreou's (2018) corpus work as the most frequent ones, we cannot address all possible readings of *-er* nominals here. Lieber & Andreou (2018) identify several contextual factors that contribute to the interpretation of *-er* nominals but they do not offer a comprehensive account of this interaction either (see p. 214). We believe that the influence of context is modulated by the kind of (modal or quantificational) operator that eventually binds the event variable embedded by the suffix, and this is a matter to be dealt with by formal semantics in the Logical Form, which is not within our scope (see how habitual readings are accounted for in Romanian supine nominals in Iordăchioaia & Soare 2015). Here we have argued for a structural difference between the compositional agentive vs.

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[13] Compounds and derived nominals as in (37) realize Voice-modifiers as adjectives. We take this to be due to their nominal internal structure with an nP and their lack of a TP projection, the latter of which would trigger verbal agreement. The spell-out of adjectives/adverbs would depend on the nominal (D and n) or verbal heads (T and v) with which these would check their agreement features, following Pesetsky & Torrego (2007); see Alexiadou (2002). As a reviewer remarks, one might also assume a difference between nominal and verbal Voice modified by adjectives vs. adverbs.

instrumental readings of *-er* SynCs in terms of presence/absence of Voice, which is supported by (37) and further facts with idioms in section 5.

To conclude, we have argued that true SynCs realize internal arguments, while those with apparent external arguments are root compounds. The former include event structure with (at least) a vP, which introduces the internal argument as in (33). The latter are headed by ResNs/ SEvNs as in (31), and their non-heads, although syntactically occupying the same Spec nP position as in SynCs, are interpreted as modifiers (rather than arguments) of the heads. Importantly, we also showed that Voice (with agentive properties) is available in most SynCs, with important consequences on the interpretation of *-er* SynCs and event implication. We essentially argued that person-denoting *-er* SynCs involve Voice, while instruments do not.[14] These insights on Voice in SynCs will be further tested and confirmed by looking at idioms.

5 Idioms in synthetic compounds

Another difference that has been posited between SynCs and ArgStrNs is the alleged ability of the former to express idioms and the inability of the latter. Borer (2013: 593) cites examples with verbal idioms and corresponding SynCs as in (38), for which she argues that there are no ArgStrNs. In her analysis, this contrast suggests that SynCs cannot be built on a similar structure as that of ArgStrNs.

(38)		Verbal idiom	SynC	ArgStrN
	a.	to blow the whistle	whistleblowing/blower	#the blowing/blower of the whistle
	b.	to catch (one's) eye	eye-catching/catcher	#the catching/catcher of (one's) eye
	c.	to break the ice	ice-breaking/breaker	#the breaking of the ice
	d.	to pull (one's) leg	leg-pulling/puller	#the pulling/puller of (one's) leg

Verbal idioms represent themselves a complex phenomenon, which goes beyond our scope here (see Fraser 1970; Katz 1973; Pulman 1993; Nunberg et al. 1994; Stone 2016). However, if verbal idioms originally involve a derivation with event structure that additionally acquires an idiomatic meaning, in our analysis SynCs would inherit the same structure, which should also appear in ArgStrNs. The question to be asked about the data in (38) is why ArgStrNs should differ so much from the underlying verbal constructions.

Let us first have a closer look at how verbal idioms interact with SynCs and ArgStrNs, as it seems that not all idioms based on transitive verbs yield idiomatic SynCs, and those that do so do not always block ArgStrNs. Idioms such as *to kick the bucket* do not build SynCs or ArgStrNs, while

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[14] To the extent that person-denoting SynCs may refer to a function that a person fills without their ever having been involved in a corresponding event (see §2.2.4), this reading would again be captured by the structure in (36) without Voice, since there is no agentive action involved, and the *-er* nominal refers again to a causer rather than an agent.

others such as *to spill the beans* and, contra (38a) from Borer, *to blow the whistle* allow both SynCs and ArgStrNs, as in (39).[15] While *the blowing/blower of the whistle* in (39c) are disfavored over the corresponding SynCs, using more context and an external argument substantially improves the ArgStrN in (39e).[16]

(39) a. to kick the bucket: ??the kicking/*kicker of the bucket; ??bucket kicker/kicking
     b. to spill the beans: ?the spilling/spiller of the beans; ?bean-spiller/spilling
     c. to blow the whistle: ??the blowing/*blower of the whistle; whistleblower/blowing
     d. Mary's spilling of the beans
     e. John's blowing of the whistle on his colleague

(40) illustrates data attested in corpora that correlate with the examples in (39b–e), confirming the parallel use of idiomatic ArgStrNs and SynCs (contra Borer 2013):[17]

(40) a. Please allow me to do *the spilling of the beans*. (GloWbE)
     b. … while Conte was the initial *spiller of the beans*, so to speak. (GloWbE)
     c. Trump's former National Security Adviser Michael Flynn has asked for immunity in exchange for *bean-spilling* (NOW)
     d. Most of last year's dancers return (with the exception of tabloid *bean-spiller* Nicole Cutler) (GloWbE)
     e. The quality of life, and the future employability, of formal whistleblowers pretty much crater with *the blowing of the whistle*. (GloWbE)

Other verbal idioms are in between these two. While *to break the ice*, *to catch the eye* and *to pull one's leg* do not exclude ArgStrNs, the corresponding SynCs are perceived as more natural (see (41a–c); cf. (41g) from GloWbE). What differentiates these idioms from those in (39) is that expressing the external argument overtly in the *-ing* ArgStrN in (41d–f) worsens their acceptability, by contrast to (39b–e), a matter we interpret at the end of this section.[18]

(41) a. to break the ice: ?the breaking/breaker of the ice; ice-breaker
     b. to catch the eye: ?the catching/??catcher of the eye; eye-catcher

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[15] Our data are based on a questionnaire with four native speakers who rated the examples on a scale from 1 (bad) to 5 (perfect). We labeled these examples and the ones in (41), (43)–(45) as follows: * stands for 1 to 2; ?? for 2 to 3, ? for 3 to 4; no mark for 4 to 5. The ratings of the different speakers were also in these cases highly convergent.

[16] Interestingly, the SynCs in (39c) have also led to a back-formed N-V compound *to whistelblow*. A similar example is available for *to shoot trouble* and *to trouble-shoot* (cf. *trouble-shooter/shooting*).

[17] The Corpus of Global Web-based English (GloWbE) is available here: https://www.english-corpora.org/glowbe/ and the Corpus of News on the Web (NOW) is here: https://www.english-corpora.org/now/. We thank Ingo Plag for drawing our attention to data as in (40) and (46).

[18] The ArgStrNs in (41d–f) received about 0.5 points less than those in (41a–c), which did not always change their overall mark as in (41e). We did not test (41d, e, f) with a *by*-phrase because in some other tests we noticed that the Saxon genitive is generally more flexible than *by*-phrases, which is also found in Alexiadou et al.'s (2013: 93) data.

    c.   to pull one's leg: ?the pulling/??puller of his leg; ?leg-puller/pulling

    d. ??**John's breaking of the ice** at the party

    e. ?**Mary's catching of my eye** at the party

    f. ??**My pulling of his leg** had a special purpose.

    g.   The wisdom was in **the breaking of the ice**. DeOrio knew he could force them to settle the smaller claims.

Given the picture in (39)–(41), it seems implausible to invoke a structural difference between ArgStrNs and SynCs to account for the idiom contrast, since the two constructions are either similarly (un)acceptable as idioms (see (39a, b), (40), (41c)) or exhibit slight differences and variations that are not predictable from a strong structural contrast. This only confirms that idiom formation is not dependent on structure alone, but also on pragmatics and use.

At the same time, all these idioms involve an internal argument, which is compatible with our analysis of SynCs in (33), (35), and (36). A question arises on the presence of Voice in SynCs and correlate ArgStrNs. If they have the same structure (with or without Voice), they should be just as (un)acceptable, but this prediction is challenged by some of the data in (41). Two observations are in order, before we analyze each idiom in turn.

First, we argued in §4.2 that the only difference between SynCs with Voice and the corresponding ArgStrNs lies in the structural complexity of their non-heads: simple nPs in the former and more complex DPs in the latter. All idioms in (39) and (41) involve DP objects, which, however, have no referential properties. Previous literature has shown that such definite objects in idioms qualify as weak definites, and they have been analyzed either as kind-denoting or incorporated nominals (see Aguilar-Guevara & Zwarts 2010; Carlson et al. 2013; Gehrke & McNally 2019). In this respect these DPs are semantically closer to the nP non-heads of compounds, which have no referential properties either (see Iordăchioaia et al. 2017). This is one factor that possibly makes the compound more natural as an idiom than the ArgStrN, which usually involves referential DP objects, but further study is necessary to understand the division of labor between SynCs and ArgStrNs in their realization of referential and non-referential DP arguments (cf. the literature above on idioms). While ArgStrNs should be possible both with referential and generic objects, we expect SynCs to appear with the latter but not with the former.

Second, we saw in (39) that the eventive ArgStrN perfectly works as an idiom when it realizes the external argument. It has been argued that VoiceP is obligatory in ArgStrNs based on *-ing*, which always project an external argument, by contrast to derived nominals (based on *ion, ment* etc), which optionally involve Voice (Alexiadou et al. 2013; cf. van Hout & Roeper 1998; Borer 2013; Alexiadou 2017a, and Wood 2021 on Icelandic nominalizations, which lack Voice). In support of this, a stative reading (required by *persist* and incompatible with Voice) is available with *-ion* but not with *ing* in (42a), and a non-agentive reading such as 'the play that Bill attended' is possible in (42b), as Embick (2021: 79) argues:

(42)   a.   The humiliat**ion**/*humiliat**ing** of the audience persisted for a while.

           b.   Bill's perform**ance** of the play

The implication is that ArgStrNs based on *-ing* should only be possible with idioms that include Voice and external arguments, which leads us to further investigate the behavior of the corresponding verbal idioms below.

5.1 Verbal idioms

There is a long discussion in the syntactic literature about how complex a verbal structure can become an idiom. An old idea defended by Marantz (1984; 1997) is that an idiomatic reading certainly includes internal arguments and may include Voice (i.e. $DP_{Agent} + [V + DP_{Theme}]_{idiom}$) but never the agent that Voice realizes: that is, idioms do not include fixed agents. Harley & Stone (2013) carefully investigate apparent challenges and provide further support for this generalization. Our idioms also conform to this generalization, but we will see that we find some important contrasts as to whether Voice (without the agent) is part of the idiomatic reading or not, which bear on the available idiomatic SynCs.

To the extent that agent-oriented modifiers such as *carefully* and *intentionally* diagnose a Voice projection, only the idiom *to kick the bucket* is incompatible with Voice in (43). *To break the ice* in (43c) allows both adverbs, while the other idioms are fine with *intentionally* and less so with *carefully*. This contrast must be aspectual: unlike *intentionally*, *carefully* imposes an accomplishment reading, which the idioms in (43b, d–f) do not allow out of context.

(43)   a.   Peter (*intentionally/*carefully) kicked the bucket.

           b.   Greg (intentionally/??carefully) blew the whistle on his colleague.

           c.   Mary (intentionally/carefully) broke the ice and started chatting with another guest.

           d.   John (intentionally/?carefully) caught my eye yesterday in the coffee shop.

           e.   I (intentionally/??carefully) pulled his leg to see how he would react.

           f.   Mary (intentionally/??carefully) spilled the beans.

All the idioms in (43b–f) present evidence for a possible Voice projection,[19] although some may be ambiguous. For instance, *to catch the eye* has two idiomatic readings: a non-agentive one 'to become apparent', in which both adverbs are excluded, and a possibly agentive one 'to meet the glance of another'. (43d) illustrates the latter, which involves Voice.

In view of the structural variation that idioms present (Fraser 1970; Nunberg et al. 1994; Punske & Stone 2014; Stone 2016) and the availability of Voice in (43b–f), we must distinguish between different types of idioms depending on whether they include/exclude Voice. Voice has

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[19] These results were confirmed by tests with comitatives and instruments, which also test Voice (Bruening 2013).

been proposed to be part of idioms in Folli & Harley (2007), who argue that some idioms do not allow passivization because they project their own Voice, which conflicts with passive Voice. Punske & Stone (2014) and Stone (2016) use this proposal to argue that, in English, idioms like *kick the bucket* also project Voice and block passivization. Yet, (43a) indicates that this idiom does not project Voice – at least, not agentive Voice. In addition, the passive should not be blocked by the presence of Voice since it applies to agentive constructions. It seems more plausible to state that *kick the bucket* is an idiom that excludes Voice, because its interpretation is unaccusative ('to die'): see Burzio's (1986) generalization.[20,21]

The fact that all the other idioms are compatible with Voice-modifiers suggests that their idiomatic reading either requires the projection of agentive Voice, whose external argument is not part of the idiom (see Marantz 1984), or it does not require Voice but does not conflict with Voice either, yielding two possible readings. In view of our discussion of *-er* SynCs in §4.4, idiomatic SynCs can help us to determine which verbal idioms belong to which category, as we expect those based on idioms that require Voice to yield only person readings and those based on idioms that do not require Voice to yield instrument readings but possibly also person readings when Voice is included.

5.2 Idiomatic *-er* synthetic compounds

We saw in §4 that SynCs include a vP with an internal argument and may also realize VoiceP. If a verbal idiom forms an *-er* SynC, this means that the idiom could be a vP or a VoiceP as the compound would be compatible with both. However, in view of §4.4, the instrument reading of *-er* SynCs comes about only in the absence of Voice. Thus, an idiom that obligatorily projects Voice should not derive instrument *-er* SynCs. In other words, if an idiomatic *-er* SynC has no instrument reading, this indicates that the verbal idiom includes Voice, which imposes a person/agent reading on the compound. Another implication is that idiomatic *-er* SynCs with an

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[20] To the extent that one posits Voice in unaccusatives, this Voice would have to be non-agentive (cf. Schäfer 2008b; Kastner 2016). One could follow Folli & Harley (2007) and Stone (2016) to argue that such idioms project Voice, yet of a special non-agentive type, although Stone (2016: 208–210) specifically argues that *to kick the bucket* projects agentive Voice (contra (43a)). In the absence of evidence for agentive (or another type of) Voice, we stick here to our idea that Voice is not present at all in this idiom.

[21] The resistance to Voice-modifiers in (43a) cannot be due to the full opacity of *kick the bucket*, since *shoot the breeze*, cited by Nunberg et al. (1994) in the same category, allows such modifiers, precisely because it has an activity interpretation – 'to chat', which is compatible with Voice (see (ia)). Moreover, the behavior of *kick* in (43a) also defies the expectation for this verb to preserve the lexical properties of its literal meaning, if we follow Everaert's (2010) observation that the Dutch correspondent of *kick the bucket* behaves like an unergative verb (and not unaccusative as in the idiom) with respect to auxiliary selection. As (ib) shows, the literal meaning of *kick* can be agentive, which is not preserved by the idiom in (43a):

(i) a. John was intentionally/?carefully shooting the breeze instead of working.
     b. John intentionally/carefully kicked the ball.

instrument-only reading will point to a verbal idiom without Voice. Turning now to the verbal idioms in (43b–f), they form the following idiomatic *-er* SynCs:

(44)   a.   whistleblower   i.   person   ii.   *instrument
        b.   ice-breaker   i.   ??person   ii.   instrument
        c.   eye-catcher   i.   person   ii.   ?instrument
        d.   leg-puller   i.   ?person   ii.   ??instrument
        e.   bean-spiller   i.   ?person   ii.   ??instrument

According to (44a), *whistleblower* allows only the person reading as an idiom, which indicates that the verbal idiom *to blow the whistle* must include (agentive) Voice; the idiomatic reading disappears in the absence of Voice on an instrument reading of the SynC. *Ice-breaker* offers the opposite pattern: as an idiom it has an instrument reading, i.e. 'a game people play to get to know each other' or 'a line used to start a conversation'. This idiom must be formed below VoiceP: enforcing a person denotation with Voice on *ice-breaker* triggers a literal interpretation. This contrast between *to blow the whistle* and *to break the ice* is supported by the use of non-agentive causers. Causers exclude Voice and are incompatible with *to blow the whistle* (e.g. **This will blow the whistle*) but felicitous with *to break the ice* (**This will break the ice**).

Another argument for the two SynC idioms *whistleblower* and *ice-breaker* as exhibiting opposite patterns that obligatorily include, respectively, exclude VoiceP comes from their use with adjectival Voice-modifiers, as in (45). *Whistleblower* is compatible with them on an action-modifier reading (cf. (37)), as predicted by the obligatory Voice and a derivation as in (35). *Ice-breaker* marginally allows them, whereby the ratings in (45b) require a person denotation, which is not readily available (cf. (44b)). This SynC would have to be derived by means of the structure in (36) as instrument-denoting.

(45)   a.   an intentional/careful whistleblower
        b.   an (?intentional/??careful) ice-breaker

By comparison to the verbal idiom in (43b), we observe that *careful* is much improved in (45a). This means that the aspectual restriction of the verbal idiom *to blow the whistle* is lost in the SynC, which is explained by the simple fact that the SynC does not inherit the aspectual value of the verb (see §4.4). In addition, the verb in (43c) fares much better with Voice-modifiers than the SynC in (45b). For us, this means that the SynC has become lexicalized as an idiom without Voice, while the verbal idiom *to break the ice* is also formed below Voice but is compatible with Voice, projected above the idiom domain.

The corresponding idiomatic event ArgStrNs also support this contrast between *to blow the whistle* and *to break the ice*. As we saw in (39e), an ArgStrN with an overt external argument is rated better than one with a covert external argument as in (39c) for the idiom *to blow the*

whistle: that is, Voice is required by both the ArgStrN and the verbal idiom, and the overt external argument improves the idiomatic ArgStrN. By contrast, the ArgStrN of *to break the ice* worsens with an overt external argument ((41a), (41g) vs. (41d)). Here, Voice is not a necessary part of the idiom and enforcing its realization in the ArgStrN yields a literal interpretation, just like in the case of person-denoting *-er* SynC in (44b).

Having discussed these two opposite patterns of SynCs in terms of presence/absence of Voice, let us turn to the SynCs in (44c–e), whose behavior indicates a less clear status. Our consultants prefer *eye-catcher* as a person (see (44c)), but this SynC also allows an instrument reading attested in corpora (see (46a, b)). This means that *eye-catcher* can be used as an idiom both with and without Voice, yielding person and instrument readings, respectively (cf. the ambiguous verbal idiom in (43d)). (39b) and (41c) show that our consultants find *bean-spiller* and *leg-puller* less natural than the other idiom compounds and, if at all, they receive a person reading in (44d–e). This preference is confirmed by the few corpus attestations for *bean-spiller* in (40d) and for *leg-puller* in (46c). The corresponding verb idioms realize Voice (cf. (43e–f)), and the instrument reading is marginal in SynCs in (44d–e) and unattested in corpora. These facts indicate that, to the extent that *bean-spiller* and *leg-puller* become more established, they would join the pattern of *whistleblower* in (44a), including Voice and referring only to persons.

(46) a. I am a firm believer about book titles being **the eye-catcher**. (GloWbE)
   b. The lights, the chrome, the shape, all conspire to make it **an eye-catcher**. (GloWbE)
   c. He was, as Mr. Christopher Hollis says in his excellent study, "an incorrigible **leg-puller**." (GloWbE)

To summarize the picture on the interaction between verbal idioms and their corresponding SynCs, we can identify three categories of verbal idioms in terms of presence/absence of Voice:

  I. Idioms that reject Voice, because their meaning conflicts with Voice: e.g. unaccusative *to kick the bucket* (see (43a)) and non-agentive *to catch the eye* (see the instrument SynC in (44c));

 II. Idioms that obligatorily include Voice, since the lack of Voice brings about a literal meaning in SynCs: e.g. *to blow the whistle* (see (43b), (44a), (45a)) and quite likely also *to pull one's leg* (see (43e)/(44d)) and *to spill the beans* (see (43f)/(44e));

III. Idioms that are formed below VoiceP but whose interpretation is mostly compatible with Voice: see agentive *to catch the eye* in (43d)/(44c) and *to break the ice* in (43c)/(44b).

The corresponding idiom *-er* SynCs behave similarly to their base verbs and are split accordingly in the three classes above. The exception is *ice-breaker*, which seems to have become lexicalized on an instrumental reading and, despite its verbal idiom's belonging to class (iii), with optional

Voice, it rejects Voice and belongs to the first class, like the instrumental *eye-catcher*. These SynCs are derived by our structure in (36) only. Class (ii) SynCs are derived by means of (35), and class (iii) SynCs (e.g. *eye-catcher*) are ambiguous between (35) and (36), like the non-idiomatic *-er* SynCs in §4.4.

The unavailability of the SynC *bucket-kicker* may receive at least two explanations. First, the apparent direct object of *to kick the bucket* is not an internal argument (the subject is), which, in our approach, conflicts with the structure of argumental SynCs (whether agentive or instrumental). However, this would leave the option of a root compound open, which is not available either. A second reason may be the implausibility of the idiom as a one-time event to be conceptualized as a generic activity (as compounds usually are). In conclusion, besides the structure of the idiom, semantic-pragmatic conditions may also play an important role in preventing the formation of the idiomatic compound *bucket-kicker*.

In this section we also saw that the contrast between idiomatic SynCs and ArgStrNs is not as strong as presented in Borer (2013). At least following the judgments of our consultants and corpus evidence, we showed that both SynCs and ArgStrNs are similarly (un)acceptable for verbal idioms, beyond the semantic-pragmatic differences triggered by the full DP vs. nP status of their internal argument. One difference we noticed in (39) vs. (41) is that the presence of an agent improves eventive ArgStrNs built on an idiom that requires Voice (see *the blowing of the whistle* in (39c, e)), but worsens those built on an idiom that does not require Voice (see *the breaking of the ice* in (41a, d)). This can be explained by the fact that ArgStrNs based on *-ing* must include Voice and, if Voice is not necessary for the idiom, the idiomatic reading will not be preserved in the corresponding ArgStrN. *-er* SynCs, however, may receive instrumental readings in the absence of Voice and are available for such idioms as for *ice-breaker* in (44b).

6 Conclusions

In this paper we defended an analysis of English SynCs as built on compositional event structure from the base verb of their deverbal nominal head, just like ArgStrNs. We addressed several challenges to this approach and argued for a contrast between true argumental SynCs headed by ArgStrNs, whose non-heads can only be interpreted as internal (object) arguments, and root compounds headed by deverbal nouns on a ResN or SEvN reading, whose non-heads may receive non-argumental subject-like readings, among others.

We accounted for true SynCs as including at least a vP with an internal argument, but possibly also VoiceP or even AspectP, just like ArgStrNs. We closely analyzed SynCs built on *-er* nominals and accounted for their instrument vs. person/agent readings by means of the absence, respectively, presence of Voice, which introduces an agent. We showed that properties associated with Voice also account for the lack of event implication in the former, in contrast with the latter.

A further challenge to the thesis of SynCs sharing structure with ArgStrN that we addressed is the alleged presence of idiomatic readings in SynCs and their absence in ArgStrNs. While corpus evidence is limited for both constructions and native speaker intuitions do converge but are not clear-cut, we could collect some evidence that both SynCs and ArgStrNs are possible to a similar extent for underlying verbal idioms. We further showed how Voice-related properties in idiom formation correlate with the observations we made for *-er* SynCs. In particular, verbal idioms that require the presence of Voice form person-denoting SynC idioms, while those that do not include Voice yield instrumental SynCs.

Given that idiomatic readings are not very well established for either SynCs or ArgStrNs, as the speaker intuitions and the corpus data in our study show, carrying a large-scale experimental investigation in the future would be useful to test the hypothesis promoted here. At the same time, it would be worth pursuing similar studies in other languages to understand in how far the properties we have highlighted here for English may hold of synthetic compounds crosslinguistically.

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