The substance of the lexicon in a Generative Lexicon

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1.   Introduction

In the prelude of Anderson (1997: 4), the author puts forward the hypothesis that "[…] generally, syntactic properties are projected from notional" and even more explicitly, in Anderson (in Andor, this volume: XX), that "the core of syntax is the lexicon". He also states (in Andor, this volume: XX), that "the […] lexicalism of Pustejovsky […] has not received the attention it warrants".

With this in mind, the present paper presents and assesses some aspects of Pustejovsky's theory. More specifically, the aim of this paper is to establish and discuss what kind of substance is needed in a Generative Lexicon (Pustejovsky 1995), and to show how the (rich) informational content of lexical entries projects to syntax, providing explanatory accounts of syntactic and semantic phenomena.

The Generative Lexicon is both a theory of the lexicon and of the meaning of the composition of lexical units. Over the years, it has been used to provide explicit theoretical accounts of various linguistic phenomena, in various languages, and has also been applied in the field of computational linguistics.[1] Some aspects of this theory, which relies heavily on types, have raised doubts, of which some are expressed in Asher (2011: 86), specifically as regards the construction of types called "dotted types", intuitively defined (see Pustejovsky 1995: 93) as types of words with dual aspect like *book*, which appears to have both an informational aspect (its content) and a physical aspect (an object composed of printed pages and a cover with a given weight, etc.).

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[1] Some of these studies are presented in Pustejovsky et al. (2013), examples of applications to computational linguistics are Gupta and Aha (2003, 2005) or Havasi et al. (2007).

After a presentation of the basic elements of a Generative Lexicon (from now on GL), I show that a classic GL such as developed in Pustejovsky (1995) needs no improvement to account for the syntactic and semantic phenomena related to middle verbs like *sell* (cf. Anderson in Andor, this volume: XX).[2] Their lexical distribution, the necessary presence of an adjunct (*the book sells vs. *the book sells well*) and their generic reading can all be accounted for by the information contained in the lexical entry of the verb.

In the third part of the paper, I discuss the controversial issue of dotted types: in order to do so, I will, in the domain of morphology, look at a class of morphologically derived nouns like *invention* (cf. Anderson 2012: §4), which exhibit ambiguity between an event reading (*a chance invention*) and an object reading (*an exhibition of inventions*). These nominals have been extensively studied, notably by Grimshaw (1990), but here I want to concentrate on copredication facts. Copredication can be simply defined as in Asher (2011: 11): it is "a grammatical construction in which two predicates jointly apply to the same argument." This is exemplified for instance in (1):

(1) a. *The lunch was delicious but took forever.*
     b. ??*The examination is printed in English and lasts 3 hours.*

In (1) above, both words *lunch* and *examination* are dotted types, as each of them has a dual aspect: the former refers both to food and to an event of eating,[3] the latter both to a document and an event. In (1.a), *delicious* predicates over the food aspect of *lunch*, and *took forever* predicates over its event aspect. In (1.b) *printed* refers to the physical aspect of *examination* and *lasts three hours* to its event aspect, but copredication seems to be possible only in (1.a).
I will argue that the elements of a classic GL do not allow a convincing treatment of this problem and will suggest that what is needed, instead of the introduction of dotted types as in a classic GL, is an enrichment of the substance of the lexical entries of the lexicon.

2.   A classic Generative Lexicon: its substance as defined in Pustejovsky (1995)

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[2] I call "classic" a GL such as defined in Pustejovsky (1995) and presented in section 2 below, with no addition to its substance.
[3] In (1), the most obvious interpretation seems to be that it took a long time to eat the lunch. But as suggested by Nigel Vincent (personal communication), in this example *took forever* could also refer to the time it took to prepare the meal.

In a GL, the meaning of a lexical item α is distributed over three levels of representation: A, the Argument Structure, E the Event Structure, and Q the Qualia Structure. The types associated with lexemes are organized in a type hierarchy in which each type inherits information from a higher type in an informational hierarchy (I). The general form of an item α can then be represented as α <A, E, Q, I>.[4]

2.1   *The Argument Structure*

The Argument Structure describes the arguments and their types which are involved in the predicates of the Qualia: they are identified as true arguments (ARGi) if they are denoted by the lexical item, or if they must be syntactically realized (for instance in the case of verbs); they are identified as default arguments (D-ARGi) if they participate in the semantics of the item via the predicates of the QUALIA Structure (cf. infra) without being denoted by this item. This is summed up in (2) below in which τ, τ' and τ'' are the types of the arguments involved in A:

$$(2) \quad \left[\text{ARGST} \begin{bmatrix} \text{ARG}_1 = x : t \\ \text{.......} \\ \text{D-ARG}_1 = y : t' \\ \text{D-ARG}_2 = z : t'' \\ \text{...........} \end{bmatrix} \right]$$

2.2   *The Event Structure*

In the same way as A describes the arguments and their types, the Event Structure, whose origin can be found in Kamp & Reyle (1993: 668), describes the events and their types (following Vendler 1967) which are involved in the predicates of the Qualia (i.e. states, activities, accomplishments, or achievements). Then they are identified as true events (Ei) if they are denoted by the lexical item, or default events (D-Ei) if they are involved in the Qualia, and hence are part of the semantics of the lexical item, without being denoted by this lexical item. They are ordered by a precedence relation that can be a strict precedence relation (<) or an overlap relation (O) as expressed in (3):

(3)   a. $e_1 < e_2 < e_3 < \ldots e_n,$

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[4] For details on the type hierarchy, which is not relevant in this study, see Pustejovsky (1995: 90).

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b. e_iOe_{i+1}

One of the sub-events involved in the Event Structure is also headed: this event headedness is a way of indicating the relative prominence of sub-events and the focus of the interpretation. It is relevant in the representation of the aspectual properties of predicates:[5] events typed as accomplishments are left-headed events (the initial process sub-event is the head of the Event Structure) and their structure is then $E_{:accomp}[*e_1,e_2])$, achievements are right-headed (the final resulting state sub-event is the head) and their structure is then $E_{:achiev.}[e_1,*e_2])$.[6]

States are analyzed as a unique event in which no sub-event is included and hence the structure of states is $E_{:s}[e]$. Consequently they are not headed. Processes are not headed either and they are made of n sub-events e_i such that $\forall e_i,\ e_i=e_{i+1}$. The structure of process types is then $E_{:process}[e_1,e_2,\ldots e_i..e_n]$.

More formally, an Event Structure is then a tuple $\{E, <, O, *\}$, where E is the set of events, R is either a precedence or an overlap relation and * marks the headed event.

The general representation of an Event Structure is then as indicated in figure (4) below, in which ε and ε' are the types of the sub-events:

$$(4)\quad \text{EVESTR}\begin{bmatrix} \begin{bmatrix} E_I = e_I : \varepsilon \\ \ldots\ldots \\ D\text{-}E_I = e_I : \varepsilon' \\ \ldots \\ \text{RESTRICTION} = e_IRe_2 \\ \text{HEAD} = *e \end{bmatrix} \end{bmatrix}$$

2.3 *The Qualia Structure*

The basic intuition here is that word meaning is organized over Qualia roles whose function is to provide the basic behaviour of lexical items in their

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[5] From now a different font will be used to refer to types.

[6] Although in the context of GL "headedness" is based on the notions of salience and foregrounding, and thus not entirely unrelated conceptually to the notion of "headhood" in Anderson's dependency grammar framework, it is not to be understood in the sense of a syntactic construction 'having a syntactic head'.

linguistic context.[7] The information contained in a word is represented by a set of predicates encoded in four roles: the FORMAL role, (which distinguishes an object from a larger domain, e.g. orientation, magnitude, shape, colour, ..., a taxonomic relation "is a kind of"), the CONSTITUTIVE role (internal constituency of the object, e.g. material, weight, ...), the AGENTIVE role, (which indicates the factors involved in the creation of the object) and the TELIC role (which defines the function or purpose of the object). The lexical representation of any item *a* is then as in (5) below:

$$
(5) \quad
\begin{bmatrix}
a \\[4pt]
ARGSTR = \begin{bmatrix} Arg_1 = x \\ ... \end{bmatrix} \\[10pt]
EVENTSTR = \begin{bmatrix} E_1 = e_1 \\ D\_E_i = e_i \\ ... \end{bmatrix} \\[14pt]
QUALIA = \begin{bmatrix} Constitutive = \text{what } x \text{ is made of} \\ Formal = \text{what } x \text{ is} \\ Telic = \text{function of } x \\ Agentive = \text{how } x \text{ came into being} \end{bmatrix}
\end{bmatrix}
$$

It must be added that the predicates encoded in the agentive and the telic role differ as regards their quantificational force. The sub-event encoded in the agentive is by definition existentially quantified, whereas the sub-event that is encoded in the telic receives a modal interpretation. This interpretation is also generic as the property encoded in the telic also expresses a general truth, for instance for a knife, to cut.

As the elements of the Qualia are typed, a GL can be viewed as a typed decomposition formalism: in this formalism, each predication is distributed into as many sub-predicates as there are sub-events in the Qualia Structure.[8]

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[7] This view of word meaning goes back to Aristotle's four modes of explanation or "causes".

[8] Davidson (1967: 83) introduced an event variable argument *e* for all action predicates, so that the interpretation of an *n*-ary action predicate φ is no longer $\lambda x_n....\lambda x_1\ (\varphi)$ but $\lambda e \lambda x_n....\lambda x_1\ (\varphi)$. In a GL, the interpretation of all predicates (not only action predicates) is only partially Davidsonian as in a GL Davidson's event variable is decomposed into as many sub-events e_i as required by the semantics of a predicate.

Its interpretation is then like the expression given below in (6), in which F, A, T, and C are the FORMAL, AGENTIVE, TELIC, and CONSTITUTIVE roles respectively:

(6) *Argument Structure*   *Event Structure*   *Qualia Structure*

$$(\lambda x_n \, \lambda x_{n-1}... \, \lambda x_1) \quad (\lambda e_m \, \lambda e_{m-1}... \, \lambda e_1) \quad (Q_F \wedge Q_A \wedge Q_T \wedge Q_C)$$

We now show how this representational language can account for the syntax and semantics of middle verbs, and that for this class of verbs, Anderson's claim quoted above that "syntactic properties are projected from notional" is fully justified.

3.   Middle verbs

3.1   *Definition and properties*

The transitive/middle alternation is exemplified in (6a, b) (Anderson in Andor, this volume: XX):

(7) a. *I sold these books.*
     b. *They sold well.*

As the examples above show, the middle variant of the alternation exhibits the following three basic characteristics: the presence of an adverbial is needed,[9] the agent 'theta-role' is not syntactically projected, and semantically it is a generic statement, whatever the genericity of the surface structure subject – either generic as in (8.a), or specific as in (8.b):[10]

(8) a. *This kind of novel sells well.*
     b. *My laptop stores easily in the drawer.*

Consequently, the genericity of a statement such as that in (8.a) cannot result from the genericity of the surface subject.

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[9] The presence of other elements which provide contrastive information (e.g. negation, modal verb) may also license middles. Roger Böhm (personal communication) points out that middle variants of the alternation lacking such elements are odd for discourse pragmatic reasons, as argued in Fagan (1992), Goldberg and Ackerman (2001).

[10] What is meant here by "genericity" is various instantiations by multiple agents of a unique property of the object, here a novel.

An important property of the adverbial modifier in the middle form of the alternation is that it cannot be agent-oriented as shown by (9):

(9)   a.   *This shirt washes *carefully/*patiently/*professionally*.
       b.   *This shirt washes completely/easily/well*.

As noted in Anderson (1968: 13), an agent oriented reading forces the active reading as shown by the pair in (10) below:

(10)   a.   *He cuts easily*.
        b.   *He cuts dexterously*.

Obviously, (10.a) receives a middle reading, but in (10.b) only the active reading is possible.

Interestingly, this class of verb was under scrutiny right from the start in case grammar studies as it provides good support for the tenets of Anderson's case grammar: the relevance of semantic relations in the syntactic construction, the irrelevance of deep structure and the derivative status of linearity as underlined in Anderson (2004: 3).

Syntactic analyses in the 'mainstream' generative tradition must resort to the solution consisting in positing an empty category to account for the absence of the object NP in the middle form of the alternation: an example of this is the treatment suggested by Stroik (1992) who proposed that PRO is the argument of the verb in the middle form of the alternation.[11] Analyses along these lines are ruled out right from the start in Anderson's notionally grounded grammar, in which, following the "lexical projection condition" (Anderson 1997: 10), every syntactic node is projected from a category associated with a lexical item.[12] This claim is compatible with the GL analysis of the phenomenon that is presented now, as it is the projection from the Event Structure of the verb that accounts for the properties of the middle alternation.

3.2   *An explanatory account: the relevance of the Event Structure*

3.2.1   Event Structure and lexical distribution

It has long been noticed that states and processes are not good candidates for the middle alternation as shown by (11) and (12) respectively:

(11)   **Latin knows easily/well*.
(12)   **This pen uses easily*.

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[11] An outline of analyses of the middle construction in various frameworks is presented in Stalmaszczyk (1997).

[12] Although there is nothing in principle to exclude them, empty categories in other non-derivational frameworks such as HPSG or LFG, are replaced by constraints. This also is the way empty categories are dealt with in Culicover and Jackendoff (2005).

The best candidates for the middle alternation are accomplishments. Their Event Structure (cf. supra) includes two sub-events in which e_1 precedes e_2, e_1 is of type process, e_2 is of type result, and e_1 is headed. The event structure of an accomplishment is then represented in (13) below:

$$(13) \qquad E:_{accomp}[*e_1:process, e_2:resultative\_state]$$

Conversely, the reason why states and processes aspectual types are infelicitous in the middle alternation is that they do not have a complex event structure with a final resultative state: states as there is only one event typed state and processes as all *n* sub-events of the process are of the same type process.

Now, as indicated above, achievements display a resultative final state, and consequently should be good candidates for the middle variant of the alternation.[13] In English though, they usually do not display the middle form of the alternation, and as indicated by (14.a) below, and the generic reading must be expressed by other means, for instance a *tough*-'movement' construction as in (14.b):

(14)   a.   *This race wins easily*.
        b.   *This race is easy to win*.

However, this seems to be a quirk of English as the equivalent (15) of (14.a) in French is possible:

(15)   *Cette course se gagne facilement*.

It can be considered, as in Bassac and Bouillon (2002: 45), that it is the presence of the clitic *se,* which here has no equivalent in English, which licenses (15) in French.[14]

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[13] Whatever their aspectual type, other factors seem to be relevant in the lexical distribution of middle verbs, such as the degree of lexical specialization (*this car uses well* vs. *this car handles well*) or the degree of involvement of the agent in the event identified by the verb *(*lemon curd eats easily* vs. *lemon curd digests easily*).

[14] The interpretation of the French clitic *se* as an aspectual marker of the genericity of the event expressed by the verb, which follows Nishida's (1991) proposal for Spanish, is unlikely to generalize to the presence in typologically distinct languages of a non-referential reflexive in various types of derived intransitives such as anticausatives, middles, absolute actional intransitives, antipassives, and verbal reflexives.

In Anderson's substance-based grammar the predicator's argument structure of derived intransitive constructions, including middles, is parasitic on the argument structure of actional transitive predicators which subcategorize for distinct { {source}} (roughly, 'agent') and { {absolutive}} ('neutral' or 'theme') functors.

3.2.2 The Event Structure and projection to syntax

In the transitive form of the alternation, the salient initial process sub-event (the sub-event head) and the types associated with it are projected and no adverbial is needed. This is represented in (16):

$$
(16)\quad
\begin{bmatrix}
\text{they sell this book} \\[4pt]
ARGSTR \begin{bmatrix} Arg_1 = x : human \\[4pt] Arg_2 = y : artefact \end{bmatrix} \\[20pt]
EVENTSTR \begin{bmatrix} E_1 = e_1 : process \\[4pt] E_2 = e_2 : state \\[4pt] RESTR = < \\[4pt] Head = e_1 \end{bmatrix} \\[28pt]
QUALIA \begin{bmatrix} Agentive = sell\_process(e_1, x, y) \\[4pt] Telic = sell\_result(e_2, y) \end{bmatrix}
\end{bmatrix}
$$

In this form of the alternation both agent-subject (x) and theme-object (y) encoded in the agentive quale are syntactically realized.

The middle form of the alternation is derived when the focus of the interpretation is on the resultative state sub-event. This sub-event is projected from the telic quale and as only one argument (y, the theme) is present in this quale, it is this argument that is syntactically expressed. The role of adverbial modifiers in the middle form of the alternation is to shift the head of the Event Structure from the initial sub-event to the final sub-event, here a resultative state. The initial sub-event is encoded in the agentive quale and the final resultative state is encoded in the telic. For the

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The argument structure of derived intransitives combines the functor features {source} and {abs} into a single featurally complex { {source,abs}} functor and allows for asymmetrical combinations in which either the {source} or the {abs} feature governs or is preponderant over (';') the other: { {source;abs}} (as in absolute actional intransitives, antipassives) vs. { {abs;source}} (as in anticausatives, antitransitives and middles). Looked at in these terms, it is in response to the complex { {source,abs}} functor in their argument structure that derived intransitives or specific subsets thereof may show the presence of a non-referential reflexive (cf. further Anderson 2011: §3.5; Anderson in Andor, this volume; Böhm 1993: §§5.2ff., 1994).

verb *sell*, the representation of the middle variant of the alternation is (17) below:

$$
(17) \quad
\begin{bmatrix}
\text{this book sells well} \\[4pt]
ARGSTR \begin{bmatrix} Arg_1 = x : human \\ Arg_2 = y : artefact \end{bmatrix} \\[14pt]
EVENTSTR \begin{bmatrix} E_1 = e_1 : process \\ E_2 = e_2 : state \\ RESTR = < \\ Head = e_2 \end{bmatrix} \\[20pt]
QUALIA \begin{bmatrix} Formal = well([1]) \\ Agentive = sell\_process(e_1, x, y) \\ Telic = [1] = sell\_result(e_2, y) \end{bmatrix}
\end{bmatrix}
$$

As it is the resultative state sub-event that is headed, it is this sub-event that is projected from the telic. This explains why its interpretation is modal and generic,[15] whatever the genericity of the theme, as noted in (8) above, and consequently why result-oriented adverbials are preferred in the middle variant of the alternation.[16]

What this ultimately shows is that, like in a Dependency Grammar as presented in Anderson (2011), a predication is a projection of some property of the predicator and that the lexicon can no longer be considered as a static list without structure, or as Anderson has it, a mere "repository of idiosyncrasies" (Anderson 2006: 385), as it was in the first versions of generative analyses.

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[15] This follows from the different quantificational force of the predicates encoded in the Agentive (existentially quantified) and the Telic (modal cf. supra 1.3).

[16] The adverbials in middles are "result-oriented" in so far as they have scope over the result sub-event, in a framework that decomposes events into sub-events. But as pointed out by Roger Böhm (personal communication), in another sense they could also be considered as "dispositional", see e.g. Kahrel (1985). In Anderson's framework the dispositional interpretation emerges as a consequence of the association of the { {abs;source}} argument of the detransitive predicator with the { {loc,abs}} functor introduced by the adjective/adverbial. The { {abs;source}} argument of the middle is thereby also presented as the location or site of the property jointly described by the adjective/adverbial and the detransitive verb; cf. in this connection Anderson (2006: §12.2.1) on *tough*-'movement' constructions, and see also Böhm (1993: 70ff.; 1994).

A number of other syntactic phenomena can, and have been accounted for, without adding anything to the substance of a classic GL. In the domain of derivational morphology, Bassac and Çiçek (2013) show that the properties of some deverbal nominals in Turkish can be accounted for without any addition or enrichment whatsoever to a classic GL. However, other derived nominals are much more difficult to account for without any changes in the theory, for instance deverbal event nominals. It is some of the problems raised by these nominals and their consequences for the theory of a GL that are discussed now.

4.   Derived complex event nominals

Research has long recognized, at least as early as Quine (1960: 117), the existence of a class of deverbal nominals that can both receive an event and a result reading.[17] Anderson (2012: 16f.) gives the canonical example of the nominal *invention*: it can receive both an event reading, for instance in *a chance invention*, and a result reading as in *an exhibition of inventions*. He adds that these nominals can also be count nouns (for instance *collections*) or non-count (for instance *condensation*).

This class of ambiguous deverbal nouns has been on the agenda of research for quite a few years now and has received most scrutiny from Grimshaw (1990), who has shed light on important properties of these nominals.

4.1   *Outline of previous studies*

In her study Grimshaw presents the relevant features that characterize the ambiguity between the process and the resultative meanings. These include properties of the subject (the process reading is impossible with possessive subjects), of pluralisation (only result nominals can be pluralized) and modification (modifiers like *frequent* or *constant* are licit with singular deverbal nominals in their process meaning, or with plural resultative nominals). This is exemplified by (18), (19) and (20), respectively:

(18)   a.   *John's examination*
       b.   *??John's examination of the students*[18]
(19)   a.   *John's collections*
       b.   **The destructions of the city took several days.*
(20)   a.   *This facilitates the frequent construction of cheap houses.*
       b.   *Students prefer frequent examinations.*[19]

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[17] Quine calls this class of deverbal "verbal nouns". He notes that they exhibit "process-product" ambiguity and gives the example of the noun "assignment".
[18] As Nigel Vincent (personal communication) points out, (18.b) seems to be acceptable if John is a doctor and the students are his patients.
[19] Grimshaw (2004) notes the counterexample of *a frequent sight*.

Grimshaw adds that the process reading is allowed only if the internal argument of the base verb is present, as indicated by (21) and (22) below:

(21)   *The instructor's assignment of difficult problems drives the students crazy*.

(22)   **The instructor's assignment drives the students crazy*.

In his analysis of this phenomenon, Anderson (2012: 17) seems to share this claim. He too states that in (23):

(23)   *Bill's invention of the puzzle*

the *of*-phrase is present in the event interpretation and is absent in the result interpretation.

However, counterexamples to this generalization do exist, as shown for instance by Asher (2011: 287). In (24) below, the internal argument of the base verb *translate* is not expressed, and yet the derived nominal receives an event interpretation:

(24)   *The translation lasted for years*.

Conversely, Anderson (2012: 16) also gives the example of *an exhibition of inventions*; this example shows that, on the other hand, the presence of an argument is compatible with the result reading of the nominal, here the noun *exhibition*.

In terms of Anderson's (1992, 1997) system of syntactic categories, verb-derived nouns are associated with a mixed or 'second-order' categorization: {{N;P};{P;N}} (cf. Anderson 1997: 83, 102f., 133). Their categorization involves the categorial representation of a verb, {P;N}, which in turn is governed by (';') the representation of a noun, {N;P}.[20] Given that nouns, as prototypically taking neither complements nor adjuncts, are non-relational, the governing or dominant {N;P} component of the categorial {{N;P};{P;N}} complex has a 'blocking effect' on the argument structure associated with the verbal {P;N} subcomponent: it prevents the argument structure for which the {P;N} component in the complex {{N;P};{P;N}} category is subcategorized from being syntactically projected. Rather, the verbal subcomponent of a nominalization is said to have its complements

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[20] The second-order categorization of a nominalizations (deverbal nouns), {{N;P};{P;N}}, is opposed to those of verbal nouns ({{P;N}:{N;P}}) and gerunds ({{P;N};{N;P}}) by the type of dependency of the {N;P} (noun) and {P;N} (verb) component categorizations: in a verbal noun, there is mutual dependency between {P;N} and {N;P}, in a gerund, {P;N} unilaterally preponderates over {N;P} (cf. Anderson 1997: 102f., and see further Anderson 1997: 103f. on the recategorization of gerunds as {{P;N};{(P;N);(N;P)}}).

incorporated. Any overtly present optional modifiers of the derived noun, as in the example in (25),

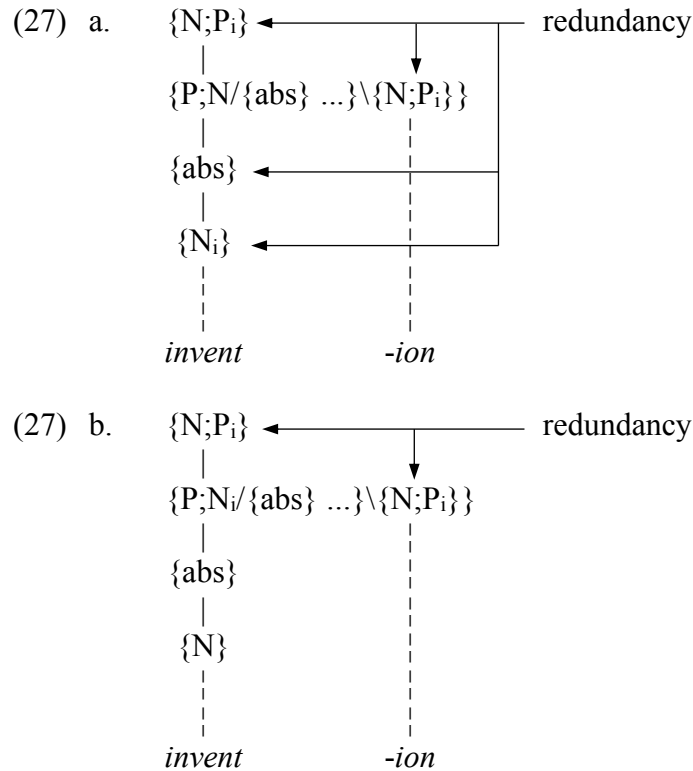(25)   *the coronation (of the queen) (by the archbishop)*

are optional circumstantial elements that are appositionally related to and coreferential with the absolutive and source ('agent') complements which the {P;N} component incorporates (cf. Anderson 2006: §§9.2.4, 10.3.1; 2011: §§2.4, 5.4.2). Anderson (2012: §§3-4, 7) offers some refinement of the second-order categorization of nominalizations and interprets the governing noun part of their complex categorization as an "upward", i.e. modifying, expansion of the verbal {P;N} base which is provided for by a lexical redundancy. This is shown in (26) below, where the arrows point at the elements provided by the lexical redundancy. The '\{N;P}' subpart in (26), which the redundancy adds to the categorization of the {P;N} base, serves as an 'instruction' for the {P;N} base to seek a nominal {N;P} categorization for the {P;N} base to "absorb", i.e. to take as a superjoined head category.

(26)   {N;P} ⟵——————— redundancy
              | ↓
          {P;N\{N;P}}

Anderson (2012: 13) calls the relation between the two contentive categories {P;N} and {N;P} in (26) "appositional" in the sense that "the verb-headed [sub]configuration provides an identificatory description of the otherwise minimally contentful noun".
Appositional "absorptions" are, moreover, "mediated by a coreferentiality link" and may be "valency-respecting" or not, depending on whether coreferentiality holds between an incorporated argument of the {P;N} base and the absorbed {N;P} head component of the derived categorial complex or between the {P;N} base category and the {N;P} head it absorbs. Respect or otherwise for the valency of the base distinguishes between result and event (readings of deverbal) nouns. Thus, the result reading of, for example, *invention* in *an exhibition of inventions*, where the derived noun *invention* denotes the entity that is brought into existence by the process described by the base *invent*, links the incorporated absolutive argument of the base verb and the {N;P} head of the derived category by coreferentiality. On the event reading of *a chance invention* appositional coreferentiality, as signalled by co-indexation, rather holds between the {N;P} head component and the {P;N} category of the base; compare the lexical structures in (27.a) and (27.b) (adapted from Anderson 2012: 16), respectively:[21]

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[21] For the sake of graphical simplicity, the representations in (27) ignore that the base verb *invent* is an existential(-causative) verb. On the localist interpretation

(27) a.   {N;P$_i$} ◄─────────┬──────── redundancy
            │   ▼
           {P;N/{abs} ...}\{N;P$_i$}}
            │   ┊
           {abs} ◄─────────┊────────┘
            │   ┊
           {N$_i$} ◄───────┊────────┘
            ┊   ┊
           invent   *-ion*

(27) b.   {N;P$_i$} ◄────────────── redundancy
            │   ▼
           {P;N$_i$/{abs} ...}\{N;P$_i$}}
            │   ┊
           {abs}   ┊
            │   ┊
           {N}   ┊
            ┊   ┊
           invent   *-ion*

To return to Grimshaw's proposal and other syntactic analyses of event nominals, it may be noted that these face a second problem.
Syntactic analyses, whether they consider that what is relevant in their derivation is the argument structure of the base verb, for instance Borer (1998), or the event structure of the DP that they head, as in Alexiadou and Grimshaw (2008), all suggest that the event meaning of the nominals and their result meaning are derived via two different processes.
Borer (1998: 183) postulates two levels of insertion, one for event nouns, the other for artefact or resultative nouns. The derivational affix is in a head position and the base verb heads a node in a lower position. This derivation of event nouns is represented in (28) below:

(28) NP[[Spec] [N' [N[-ion]] [VP[spec][V'[V[collect]][XP[complmt.]]]]]]

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offered by Anderson, *invent* describes the 'existential journey' (from non-existence to existence) of the entity referred to by its absolutive argument. In addition to what is shown in (27) and ignoring its causative component, *invent* thus also subcategorizes for/incorporates two directional functors for an existential locative { {loc{source}}} and { {loc{goal}}} argument, respectively; cf. Anderson (2012: 17). For a lexical-semantic delineation of the class of verbs whose nominalizations are (potentially) ambiguous between an event and result interpretation which also builds on the 'effective' (i.e. causative-existential) character of the verbal base see Bisetto & Melloni (2007), Melloni (2010).

Event nouns are then built by head movement of the verb head, here *collect*, to the affix head *-ion*.

As for resultative nouns, they are morphologically (pre-syntactically) constructed and enter the syntactic process as nouns as indicated in (29):

(29) $_N[[_V[collect]] [_N[-ion]]]$

Alexiadou & Grimshaw (2008) is in the same vein as the previous analysis: they also suggest, following Grimshaw (2004), that the opposition between the two nominals is accounted for by two different derivations. First, a derivation that preserves event structure builds complex event nominals with event meaning. It consists in the affixation of *-ion* to the verb as in (30) and preserves argument structure:

(30) $_N[[V]-ion]$

In the derivation of result nominals, a second step of zero-affixation transforms the previous N into another N. This is represented in (31) below:

(31) $_N[_N[[V]-ion] \varnothing]$

The result of the affixation of the zero-affix to the deverbal noun $_N[[V]-ion]$ is that this noun loses its argument structure.

The main problem with syntactic analyses, in addition to the fact that Grimshaw and Alexiadou's analyses rely heavily on a zero derivation, is that, as they crucially hinge on the argument structure of the base verb, they cannot account for cases in which the derived noun is not an argument of the verb, as in (24) above, where $_N[translation]$ is not an argument of $_V[translate]$.[22]

Even more crucially, none of these analyses account for the copredication facts exemplified in (32):

(32)   *The translation took ages but is fairly accurate.*

In (32) a *unique* nominal (*translation*) is the subject of a predication both on its event aspect (*took ages*) and its result reading (*is fairly accurate*): since each meaning of this type of nominal is derived by a distinct derivation, examples like (32) cannot be accounted for by any of these syntactic analyses.

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[22] It must be added that zero affixation in itself can appear suspect, but it is all the more so in Alexiadou and Grimshaw's analysis, as the zero derivation suggested there does not even change the lexical category of the base it is attached to.

In a classic GL, this copredication problem receives a solution that is presented now.

4.2 *The classic GL analysis*

A basic assumption in the conception of a GL is that meaning is compositional: informally, this means that the meaning of a complex expression is derived via operations on the meaning of its constituent parts. More formally, compositional operations apply following the usual type theory as shown in (33):

(33) a. *The stone fell.*

   b. $_S[_{NP}[\text{the stone}]_{VP}[\text{fell}]]$
          $\downarrow$ $\downarrow$

   c.   e:n   (e:n)$\rightarrow$t

   d. $_t[[e{:}n][(e{:}n)\rightarrow t]]$

   e. $\lambda x{:}n[fall(x)]$

In (b) the syntactic structure of (a) is given, (c) shows the type assignment to each syntactic constituent, *stone* being an entity (*e*) of natural type (n) and *fall* being of type (e:n) $\rightarrow$t. In (d) the composition of these types yields the right type *t* (true) for the sentence, as *stone* satisfies the requirement of the predicate *fall*. The interpretation of (a) is eventually given in (e).

However, a number of syntactic phenomena of natural languages seem non-compositional, and an important aim of a GL is to save the compositional model of meaning construction via several mechanisms. Some of these mechanisms are presented now. [23]

4.2.1 GL: dynamic operations

If the type of an argument is not the type expected by the predicate that applies to this argument, a type mismatch yields a type error and the sentence is declared illicit. But in two cases, a coercion operation is possible that forces the right type of the argument.

First, if there is a hyponymy link between the type of the argument and the type expected by the predicate: here a subtyping coercion operation allows the application of the predicate to this argument (cf. Pustejovsky 1995: 113). For instance, the predicate *drive* expects an argument of type

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[23] The meaning of a sentence like (34) below seems to be an example of non-compositional meaning as $_V[\text{start}]$ selects an event complement, and $_N[\text{book}]$ obviously does not satisfy this type requirement.

vehicle, but as Honda is one of its subtypes, the noun *Honda* is accepted by the predicate as a licit argument, so that the composition between the verb *drive* and its complement is possible.

Second, if the type required by the predicate is present in the Qualia Structure of the argument, this type can be selected by the predicate and the application is possible. This is the case for instance in (34) where the argument expected by the verb *start* should be of type event:

(34)   *John started a new book.*

As *book* is not of type event, (34) should be impossible. But as shown in (35), in the qualia of *book,* two event types are present, *write* and *read*, in the agentive and telic quale respectively:

$$(35) \begin{bmatrix} book \\ \\ QUALIA \begin{bmatrix} FORM = book \\ AGENT = write(e_1, x, y) \\ TELIC = read(e_2, z, y) \end{bmatrix} \end{bmatrix}$$

Consequently, these two event types are good candidates for selection by the predicate *start* in (34). If *write* is selected, the meaning of (34) is that John is an author and that he is writing a new book, if *read* is selected then its meaning is that John started reading a new book.[24] From this point of view, the qualia structure can be considered as a reserve of types for a predicate in the compositional process.

Another operation on types is postulated in a classic GL: an operation that combines two different types to form a new type called a *dotted type*. It is this dotted type that is supposed to account for the properties of event nouns.

4.2.2   Dotted types in a classic GL

For event nouns such as *translation* or *invention*, the dotted type formed by two types process and result is created by a type constructor called the

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[24] Obviously, these are not the only possible interpretations of a coerced argument. If uttered by a bookbinder, *I started a new book* may also mean that what was started is the process of binding a book. Contextual information is crucially relevant here, see also 4 infra.

"lexical conceptual paradigm", following the dot introduction rule expressed in (36):[25]

$$(36) \qquad \frac{\alpha\text{:}process,\ \alpha\text{:}result}{lcp(\alpha)\text{:}process \bullet result} \bullet i$$

The representation of the generic entry for an event noun resulting from the nominalization of a verb V is then (37):

$$(37) \quad \begin{bmatrix} V - ion \\[4pt] EVENTSTR = \begin{bmatrix} E_1 = e_1 : process \\ E_2 = e_2 : state \\ Rest = e_1 < e_2 \\ Head = e_i \end{bmatrix} \\[20pt] ARGSTR = \begin{bmatrix} D\_Arg_1 : x : human \\ Arg_2 : y : result\,/\,artefact \\ D\_arg_3 : z : material \end{bmatrix} \\[16pt] QUALIA = \begin{bmatrix} lcp\_process \cdot result \\ Formal = V_2\_result(e2,y) \\ Agentive = V_1\_process(e_1,x,y) \end{bmatrix} \end{bmatrix}$$

The type of this event noun is the dotted type process.result, but each individual type remains available so that each sense of polysemous event nouns can be accounted for.

4.2.3 Problems: copredication and formalization

Copredication (see definition supra) is not possible with all polysemous words. For instance, Asher (2011: 63) gives the example of (38):

(38)   *#The bank specializes in IPOs and is steep and muddy and thus slippery.*

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[25] Other polysemous lexical items such as *lamb* (count and mass), *bottle* (container and containee) or *city* (place and people) are examples of dotted types (cf. Pustejovsky 1995: 92).

The obvious reason why (38) is infelicitous is that *bank* is an instance of accidental polysemy, here a case of homography and homophony.

Conversely in (39), as the two senses of *lunch* (event and food) are logically connected, copredication on both senses is possible:

(39)   *The lunch was delicious but took forever.*

In the case of *bank* in (38), there are two senses with no relation between the two and the identity of form of spelling and pronunciation is purely accidental and in this case of accidental polysemy, no sense enumeration is necessary as this is not a case of two senses for a single word but two different words. But if the solution of a sense enumeration lexicon was applied to words like *lunch* in (39), in which there are two distinct but logically connected meanings, the logical connection between the two senses would be lost.[26]

Consequently, in (39) it seems intuitively correct to consider that copredication is possible because of this logical connection between the two senses, and (40) below seems to confirm that when the two senses are logically connected (in this example an event and artefact that is the result of this event), copredication is possible:

(40)   *The translation took ages but is accurate.*

However, the problem is not as simple as that, as (41) below is infelicitous:

(41)   ??*The examination is printed in English and lasts 3 hours.*

It seems obvious that in (41), *examination* is more like *lunch* in (39) or *translation* in (40) than *bank* in (38), with two senses logically connected, (an event and a printed matter), and yet copredication in (41) is infelicitous.

The fact that in (40) (felicitous) and (41) (infelicitous) there are two derived morphologically complex words with two related types (event and result) shows that no unique treatment can be applied to both examples. What this also reveals is the high degree of idiosyncrasy involved in examples of copredication. Furthermore, even two words belonging to the same simple type may display different environment constraints: for instance, *soldier* and *serviceman* are two words that belong to the same type (member_of_armed_forces), but the compound *a tin soldier* is possible whereas *a tin service man* seems fairly improbable.

Not only can words belong to the same type and yet display different syntactic constraints, but, as shown by (42) (from Asher 2011: 63),

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[26] Other authors in different frameworks have tackled this problem, among them Cruse (1999) in his analysis of "facets" or Croft and Cruse (2004).

linearization is also relevant and attests to the fact that copredication is also discourse sensitive:

(42) a.   *The city has 500000 inhabitants and outlawed smoking in bars last year.*
      b.   *?The city outlawed smoking in bars last year and has 500000 inhabitants.*

And this holds too for derived nominals of type process and result in (43):

(43) a.   *The construction that stands on the corner of Princess Street took ages.*
      b.   *?The construction that took ages stands in the corner of Princess Street.*

The adequate level of treatment of the copredication problem is not types like in a classic GL, but words. An example like (43) shows too that the order of the distribution of predicates applying to types is relevant too. Consequently, an analysis that is on the right track must deal with words, not with types. This is the reason why our solution, which is presented now, is based on an enrichment of lexical entries of words, not on operations on types.[27]

4.3   *A solution: a GL enriched with functions associated with each lexical entry*

One of the most interesting properties of a GL is that it is based on a rich typing system and as was seen above, the qualia can be considered as a reserve of types that can be selected whenever required by contextual factors. The only difference with a Montague typing then is that words have types that are not restricted to types *e* and *t* (and all the possible combination of types constructed from these base types) like in a Montagovian typing. Hence, we can introduce a type variable τ for any variable *x* such that $x{:}\tau$ is a term. For instance, a noun of type event ε will be represented as $x{:}\varepsilon$.

The number of types can be increased by construction of two types, so that if τ and τ' are types then $\tau \rightarrow \tau'$ is a type. In this case, there exists a function *f* such that $\lambda x{:}\tau\,(f\tau \rightarrow \tau'(x))$.

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[27] The interested reader will find another proposal to solve the copredication problem in Asher (2011: 97), in the framework of Type Compositional Logic. However, this proposal meets the same problems as the dotted type solution, as this proposal too is based on types rather than words.

The intuition behind our solution of the problem of copredication on nominals with event and result readings is to consider that one of the two predications is a kind of type mismatch. For instance in (44):

(44)   ??*The examination is printed in English and lasts 3 hours.*

the first predication (*is printed*) applies to the first aspect of the noun (*result*), and once this result aspect is selected, the other predication (*lasts 3 hours*), which needs an event type to satisfy its selectional requirement, applies to a wrong type. This problem then is a particular case of type conflict: *lasts 3 hours* should apply to an event (of type ε) and not to a result object (of type ρ). This case of type conflict can be represented generically in (45):

(45) $\lambda x : \tau\,(P\tau \rightarrow \tau'x)\,z : \tau''$

A possible solution to this type conflict is to introduce a function that changes the wrong type to the required type. The function f below in (46) is such a function, which when applied to type τ'' yields the right type τ for its argument z:

(46) $f\tau'' \rightarrow \tau\,(z : \tau'')$

This is in essence the solution suggested in Bassac et al. (2009) and applied to deverbal nouns in Portuguese in Réal and Rétoré (2011).[28]

In the particular case of the class of derived nouns studied here, the function is a function of type event ε to object result of type ρ defined in (47) below:

(47) $f\varepsilon \rightarrow \rho$ that is $\lambda x : \varepsilon\,(f\varepsilon \rightarrow \rho\,(x))$

So, in a sentence such as (40) repeated here as (48):

(48)   *The translation took ages but is accurate.*

assuming that the main term is of type event, the copredication expressed in sentence (48) will receive the interpretation in (49) below, in which function f transforms the event type to a result type:[29]

(49) $\lambda x : \varepsilon : (\text{translation}(x)) \wedge (\text{took\_ages}(x)) \wedge (\text{accurate}(fx))$

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[28] In these papers, the reader will find the details of second order quantification on types allowed by Girard's system F, developed in Girard (1989).
[29] The choice of a main term of type event in the lexical entry of event nominals is arbitrary. The other type could be selected as well.

Thus, instead of a dotted type event.result assigned to an event noun as in a classic GL, each lexical entry of the class of deverbal event nouns will now come with the main λ-term and a function f that changes type ε to result ρ. The interpretation of the lexical entry of an ambiguous event noun is then given in (50), in which V is the base verb, and *-ion* or *-ment* is the deverbal suffix.[30]

$$(50) \qquad [\text{V-}ion/\text{-}ment: \varepsilon \dots \quad \lambda x{:}\varepsilon.x$$
$$\lambda x{:}\varepsilon\,(f\varepsilon \nrightarrow \rho\,(x))]$$

Each lexical entry of ambiguous event nouns comes with the right types and two λ-terms, one typed event, the second typed result via a type shifting function, so that both composition with the lexical environment and copredication are now possible. Copredication applies according to the selectional requirements of the predicate, the application of f being controlled by the nature of each lexical item and licensed by the discourse context. Therefore, it is the lexical content of each lexical entry that allows both to compose with its lexical environment, which is a primary aim of a GL, and to distinguish between licit and infelicitous copredications, which was impossible in a classic GL.

5.   Final remarks

This paper has showed that the rich informational content of a classic GL allows a neat account of the properties of the middle/transitive alternation: these properties result from the projection of the Event Structure of the verb. Thus, no addition to the contents of the lexical entry of such a verb is needed, and a classic GL can account for the basic properties of the middle form of the alternation: the lexical distribution of verbs candidates to the alternation, the syntactic restrictions such as the impossibility of projection of the agent role, the necessary presence of a particular class of non agent-oriented modifiers, and the generic meaning, whatever the genericity of the subject.

As regards the morphological derivation of deverbal event nouns, we argued that the lexical puzzle of copredication shows that copredication is word-dependent rather than type-dependent. Consequently, as in a classical GL the burden of explanation of the phenomenon lies on types via an

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[30] As they seem to have only two readings, only one function is needed for event nominals, but a lexical entry can contain more than one function if need be, in order to change the main type to a third type. This would be needed for instance in the case of *newspaper* which is both of type object and information, but also of type institution (see Pustejovsky 1995: 95).

operation of dot type introduction, it is impossible to account for copredication on event nouns in a systematic way. Our solution to this problem was to transfer the burden of the explanation from types to words, via a function that is part and parcel of a lexical entry. Thus, the price to pay for an adequate explanation of copredication facts is an increase of the contents of lexical entries. And immediately here two obvious questions arise, first about the nature of the contents of a lexical entry and how much information is needed in it, and second about the relation between lexical knowledge and world knowledge. We have shown that basically, a GL is a typed structured lexical decomposition, but semantic primitives à la Wierzbicka (see for instance Wierzbicka 1996) have been ruled out as a way to capture the core semantic content of a word for at least two reasons. First, although the definition of primitives is possible and their use is relevant in the domain of phonology (but see van der Hulst & van de Weijer, this volume, for the debate about their grounding), it is much more difficult to define primes in the domain of semantics and second, decomposition via primitives is probably more adequate in the definition of concepts than that of words. As regards linguistic knowledge and its relation with world knowledge it certainly is a relevant question too. Although this is a complex problem, suffice it to say here that linguistic knowledge is only part of world knowledge: for instance, *read* is the predicate encoded in the telic in the qualia structure of *book* in (31) as the function of the artefact *book* is to be read. This is both linguistic knowledge and world knowledge, but there are lots of other possible uses of the object *book*: it can also be thrown at someone, it can be burnt in an auto-da-fé, etc. These are idiosyncratic uses, they are not part of the semantic content of the word and consequently are not part of linguistic knowledge encoded in the semantics of a word.

The reason why it was possible to increase the contents of the lexicon in order to provide an explanatory account of copredication facts is that a GL is more of a method of analysis of lexical composition in context than a theory. Most importantly, the major conclusion of this paper is that the overall approach adopted allows a lexically-guided account of syntactic and morphological phenomena, thus bearing out Anderson's claim that "the core of syntax" and morphology "is the lexicon".

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