

# The dual nature of Deverbal Nominal Constructions: Evidence from acceptability ratings and corpus analysis

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## *Abstract*

*The Deverbal Nominal Construction of modern Italian belongs to a class of phenomena that present interesting theoretical challenges given their ambiguous status between morphological compounding and syntax. In this paper, we combine evidence from corpora and a systematic elicitation experiment to propose that Deverbal Nominal Constructions are actually a spurious class, including both true compounds and constructions that belong to the impoverished syntax of telegraphic language, signs and headlines. Besides providing results that allow us to maintain a stronger view of the separation of morpho-lexical and syntactic phenomena, the study also serves as a general illustration of how empirical methods from corpus analysis and psycholinguistics can be brought to bear on issues of interest to the general theory of language.*

*Keywords: Italian deverbal constructions; compounding; headlines; corpora; acceptability judgments.*

## **1. Introduction**

The Deverbal Nominal Construction (henceforth DNC) is a relatively unexplored phenomenon of modern Italian that presents interesting challenges for the theory of lexical heads, given its ambiguous status between compounding and syntax. In brief, DNCs look like perfect NN compounds headed by a deverbal noun, whose constituents may be separated by the insertion of an adjectival modifier (a clear violation of Lexical Integrity, cf., among many others, Di Sciullo and Williams 1987; Lieber and Scalise 2006).

Italian DNCs, thus, belong to the class of borderline phenomena that has mostly entertained morphologists in recent years. The issue at stake is of crucial relevance for the architecture of the grammar: it concerns the dis-

inction between words and phrases and the separation between Morphology and Syntax as different grammatical modules. A great deal of attention has been dedicated to such borderline phenomena, to the point that most recent theories of morphology are based on the interaction between word-formation and phrasal syntax (e.g. Ackema and Neeleman 2004; Booij 2005).

After briefly introducing the details of the Italian DNC (cf. Section 2), our study starts by reviewing two previous analyses (Section 3), which give different views on their nature: Bisetto and Scalise (1999) see these constructions as cases at the boundary between morphology and syntax, while Delfitto and Paradisi (2007) argue for their purely syntactic nature. We show that both these approaches fail to fully explain the data: the reason for this failure lies in the fact that neither of them considers DNCs in full (real-use) contexts.

We provide an alternative analysis of DNCs which takes advantage of corpus-based data (Section 4): an important subset of DNCs (including at least those that show a puzzling “syntax-like” behavior) represent a case of specialized linguistic use, typical of telegraphic language or headlines, and as such display a set of particular morphosyntactic and semantic properties (e.g., absence of determiners, absence of case assigners) that make them stand out from other syntactic phenomena. The predictions of our analysis are then tested against corpus-based distributional data (Section 5) and acceptability judgments elicited in a large Web experiment (Section 6).

Our results have a twofold implication. In the first place, the DNC phenomenon in Italian receives a better account. In the second place, we show that a seemingly problematic case for the theory of language, if analyzed with an adequate empirical basis (both quantitatively and qualitatively), can be reconciled with the natural expectations of the theory. This data-driven cleansing of “special cases” in linguistic theory is, in our opinion, one of the most desirable areas of collaboration between corpus linguistics, experimental techniques and purely theoretical approaches to language.

## 2. The Italian Deverbal Nominal Construction

The DNC is a productive phenomenon in Italian grammar that forms sequences of two nouns sharing the properties of both NN compounding and syntactic NPs. The head in a DNC is an event noun (or process nominal) derived from a transitive or unaccusative-intransitive verb. The noun after the head (an element which we will hereafter call, in theory-neutral terms, the *modifier*) can in turn be the (*direct or indirect*) *object of a (di)transitive verb* or the *subject of an unaccusative verb*:

- (1) a. *raccolta rifiuti*  
 collection waste  
 ‘waste collection’  
 b. *caduta massi*  
 falling<sub>N</sub> stone  
 ‘stone falling’

Italian DNCs have received very little attention in the literature (Bisetto and Scalise 1999; Delfitto and Paradisi 2007): the pattern is a recent innovation of Italian grammar,<sup>1</sup> and is totally productive and transparent. The DNC does not occur systematically in other Romance languages (see [16] and [17] below).

From a purely theoretical point of view, Italian DNCs follow the general structural trends that are present in more commonly studied NN compound patterns: left-headedness and endocentricity (see, e.g., Bisetto and Scalise 1999). At first sight, cases such as those in (1) seem to be perfectly mirrored by their equivalent compounds in English, the only difference being the position of the head constituent. However, the most salient exceptional feature of Italian DNCs is their tolerance to adjectives embedded in the NN structure, qualifying either the head on the left (schematically: [NA]N cases, e.g., [2-a]) or the modifier on the right (N[AN] and N[NA] cases, e.g., [2-b], [2-c]). Both are a clear violation of the Lexical Integrity Hypothesis.<sup>2</sup>

- (2) a. *raccolta differenziata rifiuti*  
 collection selective waste  
 ‘selective waste collection’  
 b. *approvazione nuovi parametri*  
 approval new<sub>pl</sub> parameters  
 ‘approval of new parameters’  
 c. *approvazione piano triennale*  
 approval plan triennial  
 ‘approval of triennial plan’

Notice that (2-a) ([NA]N) is quite different from (2-b) and (2-c) (N[AN], N[NA]), since in the former case we have a sort of semantic-syntactic mismatch, with the adjective syntactically embedded within NN, but semantically taking scope over the whole nominal construct (what is *selective* is the operation of *waste collection*), whereas no such mismatch is present in the other types. We will see reflections of this difference in the acceptability experiment below. Notice also that in (2-c) the A is not linearly in-between the Ns, but, depending on the modifier, it is hierarchically embedded inside the NN structure.

In addition, and unlike other NN compounds in the Romance languages, DNCs are easily extended by recursion (3). Furthermore, the Ns can be coordinated (4) and the non-head can be the antecedent of a pronoun (5).

- (3) a. *raccolta privata rifiuti tossici*  
collection private waste toxic  
'private collection of toxic waste'
- b. *delibera comunale raccolta privata rifiuti tossici*  
deliberation municipal collection private waste toxic  
'municipal deliberation on the private collection of toxic waste'
- (4) *trattamento plastiche e multimateriale da raccolta differenziata*  
treatment plastics and multi-material from collection  
selective  
'treatment of plastic materials and diverse materials (derived) from selective (waste) collection'
- (5) *trattamento [materie plastiche]<sub>i</sub> e [smaltimento loro<sub>i</sub> derivati]*  
treatment [materials plastic]<sub>i</sub> and [disposal their<sub>i</sub>  
by-products]  
'treatment of plastic materials and disposal of their by-products'

Note that the English compound equivalents of complex cases such as (5), involving pronominal reference, are ill-formed (*\*plastic material(s) treatment and their/its by-product(s) collection*), while the equivalents of (3) or (4) are tolerated if the adjectives do not interrupt the NN sequence (cf. *private [toxic waste] collection* vs. *\*[toxic waste] private collection*).<sup>3</sup>

The position of adjectives in Italian DNCs also raises a problem of a more theoretical nature. Within Government and Binding Theory, an influential analysis of attributive adjectives (presented in Cinque 1994 and developed in Bernstein 1993, Cinque 2005, Laenzinger 2005 and others) accounts for the different placement of adjectives in Romance and Germanic (see [6]) with the idea that the two language families start out with the same order: [Det Adj N PP<sub>compl</sub>]. However, in Romance, N moves to the left of the adjective, deriving the final order [Det N<sub>i</sub> Adj t<sub>i</sub> PP<sub>compl</sub>].

- (6) a. *The American invasion of Panama*  
b. *La invasione americana di Panama*  
the invasion American of Panama

If this analysis is to be maintained for the adjectives that qualify head and modifier in, e.g., (3), we would be forced to allow multiple word-internal movements, an idea that goes against the well-established fact that word-internal constituents cannot be displaced by syntactic operations (a consequence of the Lexical Integrity Hypothesis, cf. Lieber and Scalise 2006 for a recent overview).

We conclude that DNCs are extremely problematic if analyzed as complex nominal heads. The obvious alternative, however – to treat DNCs as complex

syntactic phrases – must explain why DNCs can omit all functional elements, and in particular Case assigners (prepositions), articles or numerals.

### 3. Previous analyses

The ambiguous status of DNCs between morphology and syntax is made explicit by Bisetto and Scalise (1999), who give them the label *compound-like phrases*. A purely syntactic analysis is advanced in Delfitto and Paradisi (2007), who link these constructions to juxtapositional genitives. Since this remains the only attempt at a compositional analysis of these forms we are aware of, we can take it as our starting point.

The two main problems for a phrasal analysis of DNCs, schematically shown in (7), are the absence of determiners, which are obligatory in singular count verb complements (cf. the English \**I repealed administrative act*), and the absence of the Case-assigning preposition *di* ‘of’.<sup>4</sup>

- (7) a. [DP *l’* [NP *annullamento di* [DP *un* [NP *atto*  
[DP the [NP *repeal* of [DP a [NP act  
*amministrativo*]]]]]  
administrative]]]]  
b. ... [NP *annullamento* [NP *atto amministrativo*]]

Delfitto and Paradisi note the similarity of (7-b) with structures in Old French, Old Italian and some Italian dialects (cf. [8], from 14th century Tuscan), which they interpret as cases in which the modifier receives Case from a phonologically empty preposition, under strict adjacency with a deverbal noun. Note that (8-b) retains a determiner, and (8-a) is based on the noun *nodo*, which is not deverbal. Both of these features are not acceptable in modern DNCs.

- (8) a. *il nodo Salamone*  
the knot Salomon  
‘Salomon’s knot’  
b. *reghatura una chassa*  
transportation a box  
‘transportation of a box’

Later stages of the language would have assigned the Case-marking function to an empty determiner/agreement head (D/Agr<sup>e</sup>), but only when the DP-internal NP in need of Case moves to the specifier of the empty determiner, making it in a sense “visible”.

- (9) N<sub>deverbal</sub> [D/AgrP [NP *atto amministrativo*]<sub>i</sub> [D/Agr’ D/Agr<sup>e</sup> *t<sub>i</sub>*]]

Delfitto and Paradisi claim that the modifier of DNCs always receives a generic interpretation (a claim often made about compounds at large, see Krifka et al. 1995). To this effect, they adopt Longobardi's (1996) idea that movement of the NP to [Spec,DP] is responsible for the 'kind' interpretation that we see in English in determinerless plural nouns (e.g., *dinosaurs* in [10]). While in their model the movement of NP to DP in Italian is only triggered by the presence of (Genitive) Case features in D, its effect at the syntax-semantics interface is the 'kind' meaning the DNCs receive.

(10) *Dinosaurs are extinct.*

Setting aside various technical differences, the analysis just sketched resembles a proposal put forth in Heycock and Zamparelli (2003) to explain the possibility for coordinated nouns to appear without determiners in cases such as:

- (11) a. *At the company meeting, **president and vice-president** gave an optimistic speech.*  
 b. *The novel (or so I hope) signals a separation between **author and narrator** with its very first sentence.*

Coordinations of this sort, which can be found in virtually all Romance and Germanic languages that normally require articles, can contain plural or singular nouns. When the nouns are singular, they take a definite or a kind-denoting meaning; when plural, they can also be indefinites. Heycock and Zamparelli give the structure in (12), where the conjunction of two NPs under a single empty D position (written  $D^e$ ) has moved to the [Spec,DP], licensing the empty D.

(12)  $[DP [_{CoordP} [_{NP} \textit{president}] \textit{and} [_{NP} \textit{vice-president}]]_i [D^e D^e \dots t_i]]$

In both analyses an empty functional category (D/Agr in Delfitto and Paradisi 2007,  $D_{+DEF}$  in Heycock and Zamparelli 2003) is licensed by having its NP complement move into its Spec.

The main problem we see in Delfitto and Paradisi's analysis of DNCs is a serious risk of overgeneration. If NPs could routinely license empty determiners by moving to [Spec,DP], it is not clear why we would ever need Case-assigning prepositions, or indeed, non-empty definite determiners. From the syntax-semantics interface perspective, many studies have stressed the fact that Italian (and Romance languages in general) requires definite articles for kind-denoting noun phrases (13), while English does not (Chierchia 1998).

- (13) *I dinosauri sono estinti.*  
 the dinosaurs are extinct  
 'Dinosaurs are extinct'

Thus, it remains unclear why Italian nominals should end up acquiring a kind-meaning the way English does in just one construction, the DNC, which in English is not equally productive and anyway disallows bare plurals (*\*taxes collection*); why Spanish or French, which also adopt the structure in (13) for kind-meanings and also allow for coordinated bare nouns like (11), should have no DNC (cf. [16]); and more generally, what the nature of the connection between genitive assignment from deverbal nouns and the (phonological) absence of overt P and Det is. Last but not least, further examples shed doubt on the idea that the non-head in these forms is always interpreted generically. Our intuitions on (7-b), for instance, suggest that this nominal can naturally refer to a *specific/definite* administrative act. Qualitative analyses of DNCs in large corpora (cf. Section 5) produce many cases which can plausibly refer to specific events or where the modifier can easily be specific or definite, both with singulars (14) and plurals (15):

- (14) a. *abrogazione legge regionale*  
 repeal law regional  
*can mean*: ‘repeal of the/a (specific) regional law’
- b. *approvazione definitiva regolamento edilizio*  
 approval final regulation building  
*can mean*: ‘final approval of the/a (specific) building regulation’
- (15) a. *accertamento posti disponibili*  
 checking<sub>N</sub> seats available  
*can mean*: ‘checking for the/some available seats’
- b. *approvazione nuove tabelle parametriche*  
 approval new tables parametric  
*can mean*: ‘approval of (the/some) new parametric tables’
- c. *abrogazione precedenti decreti*  
 repeal previous decrees  
*can mean*: ‘repeal of (the/some) previous decrees’

Another potential analysis, pointed out to us by an anonymous reviewer, reduces DNCs to cases of phonological omission of functionally less prominent material. Under the pressure for brevity, speakers would drop the semantically empty preposition *di* ‘of’ and the articles, leaving only content words. Undoubtedly, the functional drive for omitting “less contentful” material appears to fit our final conclusions – that complex DNCs are essentially used in headers or headlines. Still, we believe that regardless of the role one is willing to assign to function in language design and production, this simple proposal cannot be maintained. One reason is that, within a certain *genre* (say, newspaper headlines), the pressure for brevity is presumably constant across languages. Yet, according to various informants, DNCs are impossible in other Romance languages (in contrast to the bare coordination construc-

tion seen in [11]), including close relatives of Italian such as Spanish (16) or Portuguese (17).<sup>5</sup>

- (16) ?\**recolección basura*  
collection waste  
'waste collection'
- (17) a. \**Coleta municipal lixo reciclável*  
collection municipal garbage recyclable  
vs. Italian *raccolta municipale rifiuti riciclabili*,  
'municipal collection of recyclable garbage'
- b. \**Alargamento area de/para pedestres*  
widening<sub>N</sub> area of/for pedestrians  
vs. Italian *allargamento area pedonale*,  
'widening of pedestrian area'

A second reason is that many of our examples do not come from newspaper headlines, but from section headers or list items. The nature of the deverbals we used (see Appendix A) favors bureaucratic documents (laws, regulations, contracts, official meeting reports, etc). While brevity might be at a premium in news headers, it is dubious that bureaucratic documents display a drive for brevity anywhere.

A third reason to believe that the phenomenon has grammatical and not purely functional roots is that the pattern [N1 Det N2] is virtually absent from the corpus, where N1 is one of the deverbal nouns used in the corpus search, Det is any determiner and N2 any noun except temporal units (*times/days/months/years*). The absence of these structures can easily be captured by any descriptively adequate grammatical characterization of this construction, but it is entirely unexpected in a purely functional model in which semantically empty Ps are omitted. Why should the omission only happen when the deverbal is followed by a bare nominal? In a case like *costruzione di tre edifici* 'construction of three buildings', it would seem to make perfect sense to preserve the informative numeral *tre* but to omit the empty P. Yet, this never happens. Even the idea that P is removed when meaningless is dubious, since in DNCs such as *autorizzazione rilascio* 'authorization release' the missing P is a 'to', not *di* 'of'.

To sum up: the morphological analysis of DNCs is extremely problematic, but syntactic analyses run a serious risk of overgeneration, while a functional approach does not capture the inter- and intra-linguistic distribution of the DNC construction.

#### 4. Proposed analysis

The puzzling status of complex DNCs with embedded adjectives can be explained, we propose, if we abandon the rigidity of the morphology/syntax dualism, and – broadening the view from DNCs to the contexts in which they occur – recognize the possibility for these cases to appear in more than one syntactic register. Complex DNCs, we claim, are syntactic objects, but they are *not* part of normal syntax, taken here to be that set of principles governing, together with morphology, the structure of DPs like *the puzzling status of DNCs* or *the morphology/syntax dualism*.

Using the itWaC corpus of Italian (Baroni and Ueyama 2006; see Section 5.1 for details), we can now extract the natural contexts in which complex and problematic DNC cases are actually found. Qualitative examination of the results yields cases such as:

- (18) a. *Punto 6: lettura e approvazione bilancio consuntivo*  
 item 6: reading and approval budget final  
*anno 2000*  
 year 2000  
 ‘Reading and approval of the year 2000 final budget’
- b. *Richiesta autorizzazione iscrizione ipotecaria su*  
 request authorization inscription mortgage on  
*immobile sito nel Comune di Siena:*  
 building situated in\_the municipality of Siena:  
*Presenti 24 – favorevoli 24*  
 voters 24 – in-favor 24  
 ‘Mortgage authorization request for a building in the Siena municipality: 24 voters, 24 in favor’
- c. *Centro recupero fauna selvatica di Fimon*  
 center recovery fauna wild of Fimon  
 ‘Fimon wild fauna recovery center’
- d. *I servizi individuati sono: pulizia edifici*  
 the services singled\_out are: cleaning<sub>N</sub> buildings  
*comunali, manutenzione ordinaria edifici comunali*  
 municipal, maintenance ordinary buildings municipal  
*e plessi scolastici, manutenzione impianti*  
 and structures scholastic, maintenance facilities  
*sportivi*  
 sportive  
 ‘The services singled out are: municipal building cleaning, ordinary maintenance of municipal buildings and school facilities, maintenance of sport facilities’

In all of these examples, the DNC is part of a *headline*:<sup>6</sup> a title in a list, a vote record, the complex proper name of a center, or a list of services provided by some contract, all in bureaucratic style.

Like other cases of specialized language uses (e.g. *recipes, newscasts*, cf. Bell 1991), headlines have special syntactic and semantic features. In an analysis of English newspaper headlines, Stowell (1999) lists the omission of determiners among the features that are typical of many headline registers, and certainly common to Italian headlines, along with many other differences in the use of auxiliaries, tenses and pronouns which do not apply to the case of nominals, but which clearly show how headlines follow quite a different syntax from, say, that of the texts they precede.

Suppose, then, that the DNCs with the most complex status (in particular, those where the adjective violates the Lexical Integrity Hypothesis) are *not* morphological objects, but phrases, probably whole DPs built according to the rules of “headline syntax”, not those of “general syntax”. We will refer to these as *Headlines DNCs* (HDNCs) from now on. Of course, headline syntax could also accommodate simple, non-adjectival DNCs (i.e., NN cases, possibly with an adjective taking scope over the whole DNC, as in the A[NN] and [NN]A structures). Note however that these DNCs do not violate Lexical Integrity and present no problems for a purely morphological derivation, which cannot thus be excluded.

For the syntactic cases, an analysis along the lines of Delfitto and Paradisi (2007), or even some modification of Heycock and Zamparelli’s (2003) analysis for coordinated nouns, might be applied successfully, *within the boundaries of headline syntax*. In this paper, we remain completely non-committal as to which syntactic analysis should be adopted. It should be clear, however, how the proposal to remove (complex) DNCs from normal syntax solves the serious problem of overgeneration associated with syntactic analyses: we no longer need to postulate a general NP-to-[Spec,DP] licensing rule. In addition, the idea gives us a better handle to address the cross-linguistic variability: English, Spanish or French might have NP-to-[Spec,DP] raising in the special case of coordinated NPs, but very different rules for headline language(s). At the same time, we can adhere, in morphology, to a strong version of Lexical Integrity, since HDNCs are *not* morphological units.

How to validate the hypothesis that DNCs, and in particular complex DNCs, are portions of headline language? Interestingly, this possibility has never been brought up in the previous literature on this topic, and for a reason: as pointed out before, judgment forms were always presented in strict isolation, leaving the subject free to imagine a “headline context” or a “normal context”, without realizing that these contexts would not be directly comparable.

To remedy this, we ran a corpus-based study and a large-scale acceptability experiment, focusing on the most typical feature of headline uses of nouns, namely the absence of determiners. In other terms, we start from the assump-

tion that the use of DNCs as parts of headlines will be statistically correlated with the absence of Det *before* *NI*, while their use as complex Ns built in morphology should correlate with the presence of Det, in a proportion similar to that of other noun classes.

A second aspect of our hypothesis that we intended to test is that if DNCs without Det are indeed those created in syntax, the modifier should have the number variability that we expect from syntactic constructions, and not from morphological composition. In contrast with English, the modifier in Italian NN compounds in general (e.g., *angolo bambini*, lit. ‘corner children’) tends to be non-singular (see Table 5 below). What happens with number in HDNCs?

## 5. Corpus analysis

### 5.1. Data preparation

We seed our search for potential DNCs in the corpus with a list of 57 deverbal nouns, made of heads of deverbal compounds sampled from a corpus in unrelated work as well as deverbals we found in online glossaries of administrative terms. The list, presented in Appendix A, represents only a small portion of all Italian deverbal nouns, but we have no reason to think that the items in it are atypical with respect to the larger deverbal set.

We look for all occurrences of potential DNCs containing one of the target deverbals in a very large POS-tagged corpus (itWaC, about 2 billion of tokens from a random crawl of the Italian Web, Baroni and Ueyama 2006). In order to identify DNCs, we extract all sequences matching the pattern ADJ? DEVERBAL ADJ{0,2} NOUN ADJ?, where DEVERBAL is one of the deverbals in our list. In this way, we obtain a list of 5,654 distinct candidate DNCs. The list is then checked by hand in three passes by the authors, in order to filter out sequences that are not plausible DNCs. Besides filtering out obvious false hits, such as tagging errors, named entities and meaningless fragments, we only keep cases in which there is a true verb/internal-argument relation between the deverbal and the modifier, i.e., the modifier would be the direct/indirect object or unaccusative subject of the source verb. For example, we keep *promozione musei* ‘museum promotion’, but we discard *promozione miracolo* ‘miracle promotion’, since in the latter case the miracle is not what is promoted. Manual filtering reduces the list to 2,782 DNCs. While performing the manual filtering, we also code the number of the modifier as *singular* or *other* (including ambiguous forms, plurals, mass and other singular-only nouns).<sup>7</sup>

Next, for each of the DNCs, we count how many times they occur in the determiner and no-determiner contexts. The first is operationalized as the one where the DNC is immediately preceded by an article or a determiner

(such as *questo* ‘this’ or *due* ‘two’). DNCs occurring in the complementary contexts are categorized as no-determiner, unless they are preceded by a verb optionally followed by one or more adverbs or a preposition, in which case they are discarded (since these contexts allow both readings). Finally, any DNC with a cumulative frequency across contexts of more than five occurrences is removed and not submitted to further analysis, in order to focus on the productive end of the DNC spectrum. The resulting data set includes 2,570 distinct DNCs occurring in a total of 3,717 contexts.

Some examples of corpus-extracted sentences containing DNCs in determiner (19-a,b) and no-determiner context (19-c,d) follow (determiners and target DNCs in bold):

- (19) a. *Abbiamo ridotto l' impatto **dell' abbattimento***  
 we\_have reduced the impact of\_the lowering  
***costi** da 1.100 a 430 lavoratori*  
 costs from 1,100 to 430 workers  
 ‘we have reduced those impacted by the effects of lowering costs from 1,100 to 430 workers’
- b. *L' autorizzazione alla cremazione può essere*  
 the authorization to\_the cremation can be  
*contestuale **all' autorizzazione affidamento** ceneri*  
 contextual to\_the authorization custody ashes  
 ‘Permission to cremate can be granted together with permission to entrust the ashes’
- c. *Approvazione spesa **piccolo manutenzione palestre***  
 approval expense small maintenance gyms  
 ‘Small gym maintenance expense approval’
- d. *Task 2: **Trasferimento esperienze** a scala territoriale*  
 task 2: transfer experiences on scale territorial  
 ‘Task 2: experience transfer on territorial scale’

These fairly typical examples of what we find in the corpus bring support to our intuition that no-determiner contexts are typical of sections in a telegraphic/headlines style.

The overall distribution of DNC types in the sample is reported in Table 1, with examples for each DNC type (the specific examples are not all attested in the corpus).<sup>8</sup>

Table 1. DNC types in the corpus: occurrence counts and examples

DNC type	No. of occurrences	Example
NN	2,103	<i>raccolta rifiuti</i> 'waste collection'
N[NA]	1,027	<i>raccolta rifiuti tossici</i> 'toxic waste collection'
[NA]N	139	<i>raccolta diurna rifiuti</i> 'day-time waste collection'
A[NN]	117	<i>difficile raccolta rifiuti</i> 'difficult waste collection'
N[AN]	104	<i>raccolta nuovi rifiuti</i> 'collection of new waste'
[NA][NA]	99	<i>raccolta diurna nuovi rifiuti</i> 'day-time collection of new waste'
[NN]A	61	<i>raccolta rifiuti efficiente</i> 'efficient waste collection'
N[ANA]	24	<i>raccolta nuovi rifiuti tossici</i> 'collection of new toxic waste'
A[N[NA]]	23	<i>difficile raccolta rifiuti tossici</i> 'difficult collection of toxic waste'
[NA][AN]	8	<i>raccolta efficiente nuovi rifiuti</i> 'efficient collection of new waste'
N[AAN]	7	<i>raccolta nuovi pericolosi rifiuti</i> 'collection of new dangerous waste'
[ANA][NA]	2	<i>difficile raccolta efficiente rifiuti tossici</i> 'difficult efficient toxic waste collection'
[NAA]N	2	<i>raccolta speciale efficiente rifiuti</i> 'special efficient toxic waste collection'
A[NN]A	1	<i>difficile raccolta rifiuti efficiente</i> 'difficult efficient waste collection'

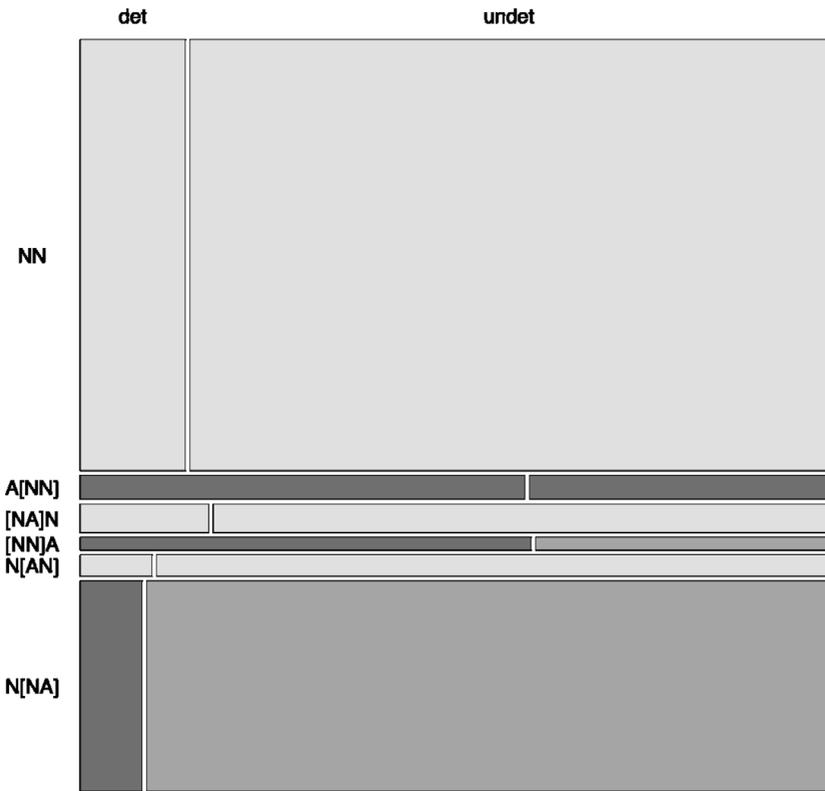
### 5.2. Determinacy

Table 2 reports the absolute and proportional distribution of DET vs. UNDET contexts for DNCs with different internal structures (excluding, for simplicity, the relatively unusual DNCs with more than one adjective). As a term of comparison, the table also reports the distribution of DET and UNDET contexts for all nouns in itWaC.

Figure 1 visualizes the DET vs. UNDET distribution, perhaps more conspicuously, as a *mosaic* plot, through rectangles whose areas are proportional to the observed frequencies. Grey shadings are used to highlight strongly over- or under-represented cells (Zeileis et al. 2005); in particular, cells with absolute Pearson residuals (quantifying the contribution of a single cell to the  $X^2$  statistic) between 2 and 4 are light grey, and cells with Pearson residuals above 4 are dark grey (roughly corresponding to 0.05 and 0.0001 significance levels).

Table 2. *Distribution of determinacy across DNC structures*

	DET	UNDET
NN	297 (14%)	1,806 (86%)
A[NN]	70 (60%)	47 (40%)
[NA]N	24 (17%)	115 (83%)
[NN]A	37 (61%)	24 (39%)
N[AN]	10 (10%)	94 (90%)
N[NA]	85 (8%)	942 (92%)
Total	538 (14%)	3,179 (86%)
all N	247M (70%)	104M (30%)

Figure 1. *Mosaic plot of the distribution of determinacy across DNC structures*

The first striking observation here is how skewed the distribution of plain DNCs is towards the no-determiner context (UNDET): 86% NNs occur in this context vs. 30% in the overall itWaC noun population. This confirms our hunch that there should be an interesting relation between determiners and

DNCs. Under our hypothesis, plain deverbal NNs could be true compounds (which should mostly occur in DET contexts) as well as HDNCs (which should occur in UNDET contexts). The current results are thus not problematic, although they seem to indicate that, among deverbal NNs in our corpus, HDNCs are much more common than true compounds.

In any case, when the DNC features a modifier-dependent adjective (and thus, according to our approach, it *cannot* be a true compound) the distribution is even more skewed than with plain NNs (the difference is large enough to make the underestimation of DET highly significant for the more populated N[NA] class, despite the already very skewed baseline determined by the NNs). The same anti-DET tendency is present in the [NA]N category, but it is considerably less pronounced.

Finally, and importantly, the two cases in which the adjective is both linearly and hierarchically outside the NN, i.e. A[NN] and [NN]A, occur more often in DET than UNDET contexts, with a distribution not far from the one we find with general nouns. Given that we saw that plain NNs in general tend to be HDNCs, the fact that these classes of NNs with external adjectives have such a high proportion of DET occurrences makes us suspect that a further constraint on HDNCs is that they cannot be modified by an adjective as a whole.

Our main prediction, namely that DNCs with an embedded adjective have special status with respect to determinacy (as they repel it), is strongly confirmed by the data. However, in order to include the DNCs with more than one adjective in the analysis and, more importantly, to take effects linked to specific deverbals and modifiers into account, we decided to model the probability that a DNC occurs in a no-determiner context using logistic regression with fixed and random effects.

The fixed effects are indicator variables marking the presence of an adjective in five possible slots: pre-DNC/head-dependent (PRE-H); middle-DNC/head-dependent (MID-H); middle-DNC/modifier-dependent (MID-M); post-DNC/head-dependent (POST-H); post-DNC/modifier-dependent (POST-M). The value that each of the attested DNC types in our data set takes for each of these variables is presented in Table 3 (refer back to Table 1 for examples of the constructions).

Our model predicts that the presence of an adjective that depends on the modifier (MID-M or POST-M) or on the head but occurring in the middle of the DNC (MID-H) should increase the probability that the DNC occurs in a no-determiner (UNDET) context. Moreover, we model heads and modifiers as *random effects* on the intercept.<sup>9</sup> We explore increasingly more complex models by testing whether the addition of each factor provides a significant improvement in goodness of fit with respect to a model missing the factor.

The final model emerging from these experiments (Table 4) has two (highly) significant fixed effects (the model has an excellent fit: Somers'  $D_{xy} = 0.96$ ;

Table 3. Classification of DNC types in terms of adjective slots

DNC type	PRE-H	MID-H	MID-M	POST-H	POST-M
NN	–	–	–	–	–
N[NA]	–	–	–	–	+
[NA]N	–	+	–	–	–
A[NN]	+	–	–	–	–
N[AN]	–	–	+	–	–
[NA][NA]	–	+	–	–	+
[NN]A	–	–	–	+	–
N[ANA]	–	–	+	–	+
A[N[NA]]	+	–	–	–	+
[NA][AN]	–	+	+	–	–
N[AAN]	–	–	+	–	–
[ANA][NA]	+	+	–	–	+
[NAA]N	–	+	–	–	–
A[NN]A	+	–	–	+	–

Table 4. Fixed effects in logistic regression modeling the probability of occurring in no-determiner context; all effects significant at  $p < .001$  according to a z-test

Factor	Coefficient (std. err)
intercept	2.36 (0.19)
PRE-H	–0.79 (0.29)
POST-M	0.54 (0.16)

see Baayen 2008: 204). PRE-H, i.e., the presence of an adjective before the head (*difficile raccolta rifiuti* ‘difficult waste collection’), significantly *lowers* the probability of the no-determiner context, whereas POST-M, an adjective after the modifier and depending on it (*raccolta rifiuti tossici* ‘toxic waste collection’), significantly *raises* such probability.

The baseline (which, given the factors that are preserved in the final analysis, groups all DNCs that do not begin with an adjective and do not end with a modifier-dependent adjective) has already a very high probability (.91) of occurring in the no-determiner context. Thus, the fact that POST-M comes up as significantly positive indicates that, for DNCs with a post-NN modifier-dependent adjective, the probability of occurring in the UNDET context is *extremely* high. The lack of effect for DNCs with internal modifier-dependent adjectives – which have a similar distribution to the post-modifier class just discussed – is probably due to the lower absolute count in the class. We will focus on these DNCs in the elicitation experiment.

The statistical analysis also confirms that DNCs with adjectives outside the NN, and in particular pre-modified DNCs, tend to be true compounds, and not HDNCs. Our approach was agnostic on this front. Further analyses

of headlines should find out why HDNCs cannot be modified as a whole (possibly, this has something to do with their verb-phrase-like nature, and problems with adjectival modification of a VP-like unit).

On the other hand, given that they have a distribution that is quite similar to that of plain NNs, the statistical model does not have a significant term for DNCs with a head-dependent, NN-medial compound (*raccolta diurna rifiuti* ‘day-time waste collection’). This class will also be explored in the elicitation experiment.

### 5.3. Number of modifier

Recall our hypothesis that HDNCs, being syntactic in nature, should have a more syntax-like distribution of singular and non-singular modifiers, i.e., be less skewed towards the latter type than regular Italian compounds. Table 5 and Figure 2 report the distribution of “other” vs. singular modifiers for DNCs with different internal structures (please refer back to Table 1 for illustrations of the various structures, and recall that the “other” category includes ambiguous forms, plurals, mass and other singular-only nouns). For comparison purposes, the table also reports the distribution in the frequent (non-deverbal) compounds discussed by Baroni et al. (2007)<sup>10</sup> and, as an approximation to the distribution in comparable syntax-like contexts, the distribution of singular and non-singular nouns in a random sample of 100 phrases in which they are preceded by a deverbal and *di* (‘of’).<sup>11</sup>

Table 5. Distribution of modifier number across DNC structures

	Other	Singular
NN	1,150 (55%)	953 (45%)
A[NN]	92 (79%)	25 (21%)
[NA]N	71 (51%)	68 (48%)
[NN]A	55 (90%)	6 (10%)
N[AN]	51 (49%)	53 (51%)
N[NA]	514 (50%)	513 (50%)
Total	2,030 (55%)	1,687 (45%)
Frequent COMP	64 (65%)	35 (35%)
N <i>di</i> N	50 (50%)	50 (50%)

Despite the different nature of the phenomenon analyzed here, we see the same trends we observed with determiner distribution. All hypothesized HDNC classes have a stronger tolerance towards the singular than classes that should also include compound DNCs. Interestingly, the distribution of number in the HDNC classes is very similar to the one we find in the “explicit” *N di N* syntactic context. Again, we notice that plain NNs tend to behave like HDNCs.

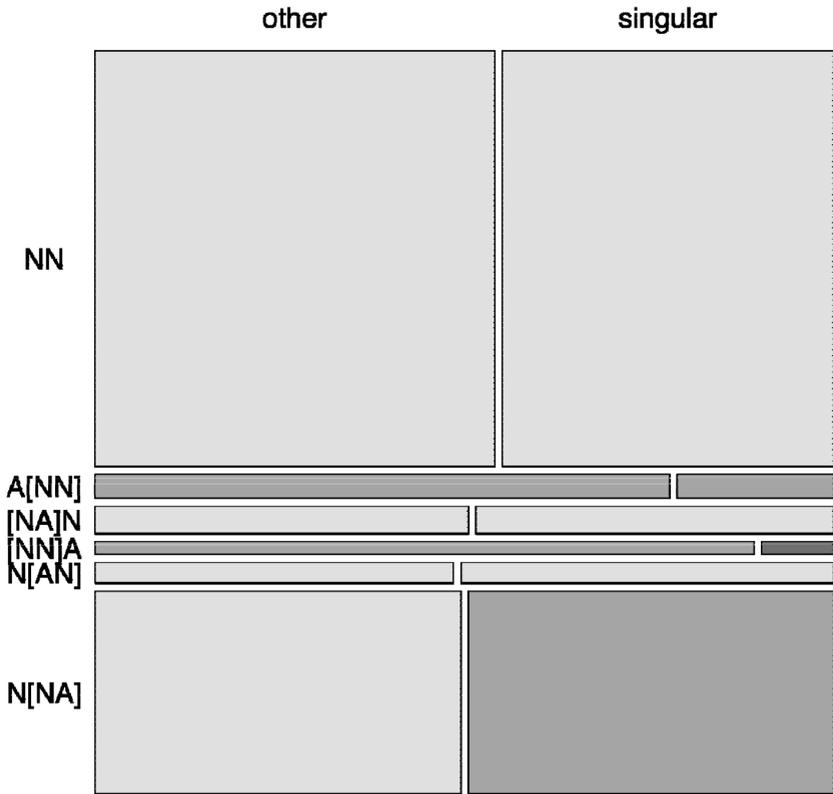


Figure 2. Mosaic plot of the distribution of modifier number across DNC structures

We ran a logistic regression to predict the probability of a singular modifier considering the same adjective slot variables as in the determinacy analysis, and entering heads as random effects (since here modifier number is the dependent variable, we did not enter modifiers as random effects).

The final model (Table 6, Somers'  $D_{xy} = 0.72$ ) has two (highly) significant negative fixed effects: PRE-H marks items with a pre-head adjective, e.g., *rapida rimozione auto* 'quick car removal' (lit. 'quick removal car'); and POST-H items, with a post-modifier DNC that is attached to the head, e.g. *rimozione auto rapida* (lit. 'removal car quick'). Taken together, the effects roughly single out the cases in which the DNC features an adjective, but this adjective takes scope over the whole DNC and does not occur between head and modifier. Again, with the plain NNs covering most of the distribution and being skewed towards a higher proportion of singular modifiers than other

Table 6. Fixed effects in logistic regression modeling the probability of having a singular modifier; all effects significant at  $p < .01$  according to a z-test

Factor	Coefficient (std. err)
intercept	-0.57 (0.13)
PRE-H	-0.79 (0.23)
POST-H	-1.48 (0.45)

DNCs, what emerges here are the cases with a *lower* probability of singular modifiers.

A final issue we briefly consider is the relation between determinacy and singular modifiers. Since we claimed that both are cues of headlines, we do not only predict that the same DNC classes will show an above-average proportion of both, but also that they should co-vary when looking at the very same specific DNCs (occurring in no-determiner context should make it relatively more likely that a DNC has a singular modifier, etc). This prediction is borne out by the data, as shown in Table 7 ( $X^2 = 32.3$ ,  $df = 1$ ,  $p < .001$ ). This correlation, together with the data above, confirms our hunch that both distributional cues studied here are symptoms of headlines.

The distribution of modifier number in DET contexts is almost identical to the one we recorded in frequent non-deverbal compounds (see Table 5), and the distribution in UNDET contexts is very close to the one of nouns depending on a deverbal in normal syntactic constructions with *di* (same table), strongly suggesting that DNCs that occur with a determiner are, as we suspected, true compounds, and not HDNCs, whereas the latter have, indeed, a syntax-like distributional behavior.

Table 7. Distribution of determinacy by modifier number

	Other	Singular
DET	355 (66%)	183 (34%)
UNDET	1,675 (52%)	1,504 (47%)

#### 5.4. Summary of corpus-based results

We predicted that, since complex DNCs with an embedded adjective are HDNCs, and not regular compounds, their distribution should be marked by two simple cues of headlines, namely tendency to occur in the no-determiner context and stronger tendency to display a singular modifier (with respect to the non-HDNCs).

The corpus data confirmed our predictions, in particular as far as DNCs with adjectives attached to the modifier are concerned. Evidence for the special status of DNCs with a post-nominal head-dependent adjective is less

clear, in part because plain NNs, contrary to our expectations (but with no consequence for our predictions), showed a behavior strongly skewed towards headline, thus leading to statistical analyses where the baseline is tilted towards the headline side of the distributions. The status of DNCs with a post-nominal head-dependent adjective will be one of our foci in the elicitation experiment we are about to present.

## 6. Eliciting acceptability judgments

There are several reasons to follow up the corpus analysis with experimental elicitation of acceptability judgments. Obviously, convergence between the corpus analysis and experimental evidence will make our claim stronger. Showing that we can reproduce the patterns we found in the corpus in an experimental setting will confirm that these patterns are truly the product of synchronic linguistic constraints, and not, e.g., due to unforeseen biases in the documents collected in a Web-derived corpus.

More specifically, we want to clarify the following issue. Our hypothesis predicts that plain DNCs (NNs) are acceptable as compounds as well as HD-NCs. The corpus data showed that, at least in the documents in our corpus, plain DNCs have a strong preference for headline. This does not counter our hypothesis, but it makes it hard to see a contrast between plain NNs and the complex DNCs with embedded adjectives, for which we do predict occurrence in headline contexts only. In an elicitation study, we can directly ask subjects about the acceptability of plain and complex DNCs with determiners (and thus in a non-headline context). Furthermore, we predict that in non-headline contexts (i.e. contexts with determiners) plain DNCs are significantly *more* acceptable than complex DNCs, despite the fact that in actual usage plain DNCs are also more likely to occur in headline contexts. In other words, we need to deal with the general problem that negative evidence (or weak positive evidence) in a corpus can be an indicator of unacceptability, as well as the product of “external” (pragmatic, stylistic, register-related) biases.

Finally, in the experiment we can focus on the two classes of complex DNCs that showed weaker effects in the corpus analysis, possibly because they are less frequent than other constructions, i.e., the cases in which the adjective occurs between the two nouns, attached to the head ([NA]N) or to the modifier (N[AN]).

### 6.1. Materials

We extracted DNCs of the two types ([NA]N and N[AN]) from our corpus-derived list, respecting the constraint that a head should not be repeated within stimuli of one type. The maximum number of N[AN] sequences we

could extract following this criterion was 9, and thus we also (randomly) selected 9 [NA]N sequences. For each DNC, we generated 4 versions, by removing/keeping the adjective and adding/not adding an article. For example, starting with *promozione pari opportunità* ‘equal opportunities promotion’ (lit. ‘promotion equal opportunities’), we generated:

- (20) a. no determiner, no adjective:  
*promozione opportunità*  
‘opportunities promotion’
- b. determiner, no adjective:  
*la promozione opportunità*  
‘the opportunities promotion’
- c. no determiner, adjective:  
*promozione pari opportunità*  
‘equal opportunities promotion’
- d. determiner, adjective:  
*la promozione pari opportunità*  
‘the equal opportunities promotion’

In this way, we obtained 72 experimental stimuli, cross-classified on the variables DETERMINACY (*no-determiner*, *determiner*) and ADJ-POSITION (*no-adj*, *head-adj*, *mod-adj*). The full list of stimuli can be found in Appendix B.

Foils were chosen to mask the purpose of the experiment, and to encourage subjects to use the full acceptability scale. They feature a mixture of well-formed phrases (also including deverbal nouns in syntactically explicit constructions, e.g. *la preparazione della festa* ‘the preparation of the party’), as well as phrases or word strings with semantic and syntactic violations. Both well-formed and problematic foils include noun phrases with and without determiners, as well as verb phrases. In total, we used 141 foils.

## 6.2. *Experimental procedure*

Following a recent and promising trend (cf., among others, Joinson et al. 2007), we developed a Web-based experiment, implemented as a set of server-based scripts written in PHP and JavaScript, accessible by means of a standard Web-browser.

Recent studies (Murphy 2007; Weskott and Fanselow 2008) suggest that a simple Likert task in which subjects are asked to rate stimuli on an acceptability scale produces results that are as good as those obtained with more sophisticated (and somewhat less intuitive) techniques such as magnitude estimation. Thus, we decided to stick to rating on a Likert scale, which we implemented with a slide-bar returning integer values from 00 to 99 (sub-

jects controlled location of a vertical line on the rectangular slide, but were not aware of the numerical values they would return). The range of possible values should be large enough to justify treating the results as continuous and applying standard linear multiple regression, as we do below, although we realize that the issue of how to analyze data of this sort is an open one.

141 adult university students, ex-students and staff voluntarily participated in an acceptability-rating test of Italian DNCs. The experiment was carried out in two different modalities. A first group of 25 students took part in a controlled experimental session at the University of Bologna. The rest of the subjects received an invitation e-mail letter, and completed the experiment remotely. The students and ex-students were enrolled either at the faculty of Foreign Languages and Literature or at the faculty of Letters and Philosophy (U. of Bologna) and none of them had an advanced background in linguistics.

Participants had to log onto a dedicated Website (a *captcha* security system was implemented to prevent automatic agents from entering the experiment). The Website was structured in four different areas: login, subject data input, warm-up and experiment. An introductory description of the experiment materials and modality was given during the warm-up phase. The experimental phase comprised two data sets. First, all participants were presented with an (implicit) training set containing the same 10 foils. The real experimental set involved 100 test items presented in random order. These included 30 randomly selected stimuli and 70 randomly selected foils.

Each test item was displayed in a browser window. At the top of the page, the experimental task/question was displayed: *Trovi ben formata questa costruzione?* ('Do you find this construction well-formed?'). Underneath each test item there was a large clickable Likert scale, displayed as a horizontal rectangle colored red and green. When the mouse pointer hovered over the scale, a thin yellow line was highlighted below the pointer. As soon as subjects clicked on the scale, the data were sent to the server and a new item was presented (cf. Figure 3).

As with any Web-based experiment, we experienced some problems with client-side software and Internet connection, which made data of some subjects unusable. After removing these problematic data, we were left with analyzable responses from 107 different subjects. On average, each stimulus was rated by 42 different subjects (min. 27, max. 54).

As a sanity check, we compared the ratings assigned by each of the remaining subjects to 32 foils that were clearly syntactically and semantically well formed and 28 foils that were obviously problematic (with basic agreement or word order violations). For all subjects, the average rating to the items in the first class was (very strongly) significantly higher than the average rating to the items in the second class. This suggests that the subjects understood the task they were asked to perform.



Figure 3. Screenshot of a test item being displayed while the mouse pointer hovers over the rectangular Likert scale

### 6.3. Results

The average ratings given to items in the various conditions are presented in Table 8 (to reduce variation, ratings are first averaged across subjects on a per item basis).

Table 8. Mean ratings (and standard deviations) in the experimental conditions (data pre-averaged by item)

Determinacy	ADJ-position	Mean rating (s.d.)
no-determiner	no-adj (NN)	65.8 (14.4)
	head-adj ([NA]N)	57.8 (13.8)
	mod-adj (N[AN])	65.4 (16.0)
determiner	no-adj (NN)	45.7 (16.6)
	head-adj ([NA]N)	41.9 (14.6)
	mod-adj (N[AN])	41.7 (14.4)

We first take note, as a caveat on what we are about to discuss, of the large standard deviations, suggesting that, besides the inter-subject variability that we tried to reduce by pre-averaging, there is also large by-item variation. We

will enter both subjects and items as random effects in the regression model presented below.

The results very clearly show the overall negative effect of adding a determiner. We already saw in the corpus data that DNCs in all relevant classes have a preference for headlines contexts, and thus this does not come as a surprise.

What is more remarkable is that DNCs with an internal adjective modifying the head (the [NA]N case) are less acceptable than the other DNCs even in the no-determiner condition. The syntactic/semantic mismatch present in these constructions (as discussed in 2) might have some unforeseen effect on acceptability. For example, it could be that these constructions require specific contexts that we did not include in our stimuli.

The most important datum for our research is that, while NN and N[AN] are almost equally acceptable in the no-determiner context, the decrease in acceptability when the determiner is added is much stronger for N[AN] than for NN (about 18% stronger). This confirms our prediction of an asymmetry, since complex DNCs are only acceptable as HDNCs, whereas plain NNs should also be acceptable (although possibly dispreferred) as true compounds.

In absolute terms, the mean acceptability of [NA]N in the determiner context is similar to the one of N[AN]. The *drop* in acceptability, however, is not as marked, since these DNCs were already less acceptable in the no-determiner condition. It is plausible, although impossible to prove using our data, that the less marked drop is due to a “floor” effect that flattens the results – [NA]N are already mildly bad in isolation, and they can only get so much worse with a determiner. The results for this class are, at least, not in contradiction with our hypothesis

One general concern with the interpretation of the results is that the two conditions with the lowest acceptability are also those with the longer stimuli (4 words: determiner, noun, adjective, noun). Length cannot of course be the whole story, or else we would not expect the strong contrast among 3-word stimuli (cf. the better no-determiner N[AN] cases vs. the worse determiner NN case). Moreover, the mean rating (computed as in Table 8) for the 14 well-formed foils that are as long as our longest stimuli or longer (4 words or more) is extremely high: 94.9 (s.d.: 2.6). Again, this shows that length by itself is not leading to low acceptability ratings. We recognize, however, that in future experiments we should avoid having length systematically covarying with the conditions of interest, as was the case in this first study.

In order to take possible familiarization/fatigue effects and subject- and DNC-specific variability into account, as well as to evaluate the statistical significance of the trends, we modeled the ratings using linear regression with fixed and random effects. The fixed effects we explored were trial number (to take familiarization/fatigue into account), determinacy, adjective position

and the determinacy-by-adjective-position interactions. Random effects on the intercept were introduced for subjects and items (items are the specific NN pairs used in the DNCs); a subject random effect was also inserted to model variation in the trial coefficient across subjects (to account for different adaptation rates). An incremental model-building strategy confirmed that all fixed and random effects (main and interactions) should be kept. The fixed effect coefficients in the resulting model ( $R^2 = .51$ ) are reported in Table 9 (the trial coefficient might look surprisingly low, but keep in mind that we are modeling subject-specific trial slopes with a random effect).

Table 9. Fixed effects in linear regression modeling acceptability ratings; significance measured by Markov chain Monte Carlo (MCMC) simulation, with significance levels ++ :  $p < .01$ ; +:  $p < .05$

Factor	Coefficient (std. err)	<i>p</i>
intercept	58.4 (3.9)	++
trial	0.1 (0.02)	++
determiner	-19.4 (1.4)	++
head-adj	-9.2 (1.8)	++
mod-adj	4.0 (1.8)	+
determiner * head-adj	4.3 (2.3)	+
determiner * mod-adj	-5.6 (2.4)	

Focusing on the linguistically interesting part of the model, the strong disruptive effect of the presence of a determiner is confirmed by the large negative coefficient of the determiner factor. We also see, in accordance with what we observed above, that the presence of a head-dependent adjective has a clear negative impact on acceptability. Somewhat surprisingly, there is a small positive effect for the presence of the modifier-dependent adjective. One possible explanation is that, for some N[AN] DNCs, removing the adjective in order to create an NN stimulus might worsen the interpretation of the compound – e.g., it could be that *agevolazioni piccole imprese* ‘small company aids’ makes more sense out of context than *agevolazioni imprese*, corresponding to unspecified ‘company aids’.

More importantly, despite this unexpected positive effect, the interaction between presence of the determiner and presence of the modifier-dependent adjective is significantly negative (with a coefficient that stays negative even after subtracting the positive coefficient for mod-adj). Thus, our prediction that adding a determiner should have a stronger negative effect on N[AN] than on NN is confirmed by a statistical model that takes many other potentially confounding factors into account. On the other hand, the interaction between presence of the determiner and presence of a head-dependent adjective is not significant, which, as discussed above, could be due to the presence of a floor effect.

#### 6.4. Summary of elicitation results

The elicitation study confirms that, despite the tendency for plain NN DNCs to occur in headlines in actual usage, there is a difference between them and complex DNCs with a modifier-dependent adjective in terms of acceptability in a non-headline context, which results in complex DNCs being significantly less acceptable in combination with a determiner (a context that forces a non-headline reading). The effect occurs with the N[AN] class of complex DNCs, i.e., the one for which we did not get a significant effect in the corpus analysis (probably, we can hypothesize now, due to the rare occurrence of the relevant constructions in the corpus).

At the same time, the elicitation study produced an unexpected result pertaining to the other type of complex DNC we investigated, the one with a head-dependent adjective occurring between the nouns ([NA]N). The ratings suggest that this construction as a whole, when presented out of context with or without determiner, is less acceptable than the other constructions we studied. While this is not problematic for our approach (complex DNCs of this sort are as bad as the others in the determiner context), it does suggest a more nuanced view of DNCs, which should be the object of further studies. For now, we just note that the peculiar behavior of this class would not have emerged had we only looked at corpus data – an example of why the two methodologies should be combined when tackling a linguistic problem.

## 7. Concluding remarks

The conclusions that we can draw from the study described above concern at least three different areas in the study of language.

In the first place, we proposed a new analysis of Italian Deverbal Nominal Constructions that conceives them as a spurious class including true compounds (hence their similarity to regular compounds in some aspects) and instances of headline phrases (HDNCs), syntactic in nature, although subject to the constraints of telegraphic syntax, rather than to the general rules of Italian syntax. Exactly the cases that are problematic for the Lexical Integrity Hypothesis (if they were to be analyzed as compounds) turn out to be the ones for which the evidence of a correlation with headline contexts is the strongest. At the same time, syntactic accounts of HDNCs can be limited to headline syntax, thus avoiding an over-generation of NPs with similar argument licensing properties elsewhere in Italian. It would be very difficult to test principled predictions about the distribution of DNCs in the headline register using qualitative intuition. However, we could support our hypothesis with quantitative patterns emerging from corpus analysis and large-scale elicitation of acceptability judgments.

Phenomena such as the DNC, standing at the boundary of syntax and morphology, and thus calling the putative separation into question, have been the object of much recent theoretical debate (see, e.g., Ackema and Neeleman 2004). It is tempting to look at such cases from our perspective, to find out whether they all genuinely represent interface paradoxes, or whether at least some of them could be explained away by looking at their distribution in different registers and styles.

More work is evidently necessary to study the properties of headlines, but some general considerations can be offered here. First, in this register determiners are not just absent in the modifier, but also in the head (see e.g. [18-a] above). Thus, if NP-to-[Spec,DP] movement plays a role in licensing these bare nouns, it does not seem to require lexical selection or Case-marking. Second, the increasing presence of singulars in HDNCs, compared to real NN compounds, suggests that these singulars might indeed be bare definite/specific Ns, as we have proposed for (14-a), and that this possibility might be excluded for genuine compounds.

As we have seen, the presence of an adjective taking scope over the whole [NN] is correlated with genuine compound status. While this fact is compatible with a variety of explanations, which we hope to evaluate in future work, we should note that in a theory that regards the Romance NA-order as the result of leftward movement of the N head over A, we expect this movement to be possible if the moved element is a genuine NN compound, but impossible if it is a complex [N(A)N] syntactic phrase. Interestingly, our data do not contain any example of the pattern [NAN]A, exemplified in (21).

- (21) ??*approvazione nuovi documenti immediata*  
 approval new documents immediate  
 ‘immediate approval of new documents’

Thus, our results can be seen an indirect confirmation of the N-movement analysis.

In the second part of this article we decided to combine a corpus-based analysis with behavioral investigation, in the form of an acceptability elicitation experiment (following a recent trend in theoretical linguistics, e.g. Gries et al. 2005; Hoffmann 2006; Arppe and Järvikivi 2007). The results from the latter study confirm that the patterns encountered in the corpus reflect, in some way, the speakers’ knowledge of language, and that they are not artifacts, e.g., of the way in which the corpus was constructed. Moreover, the behavioral experiment allowed us to zero in on the variables of interest with a level of control that is not possible in a corpus-based observational study, and to distinguish degrees of acceptability among constructions that are rarely attested in the corpus. Besides confirming our basic predictions, the elicitation experiment brought a pattern to light (lower overall acceptability of [NA]N constructions) that did not emerge from the corpus data.

More directly, after analyzing the elicited data, we decided to ask five professional linguists (all Italian native speakers) for their intuitions about the following pair: *autorizzazione spesa* ‘expense authorization’ and *autorizzazione ulteriore spesa* ‘further expense authorization’ (lit. ‘authorization further expense’). In our elicitation experiment, these forms showed a strong acceptability asymmetry in the determiner context (mean acceptability with determiner around 40% for plain NN, around 23% for N[AN]). To the linguists, we asked 1) whether they found both constructions acceptable, 2) whether they found them *equally* acceptable, and 3) whether they could think of factors that could make them more or less acceptable. All linguists provided interesting insights, and most mentioned that these constructions belong to headline. However, there was high discordance in the judgments (two found the constructions equally well-formed, two preferred plain NN, one preferred N[AN]) and, crucially, nobody mentioned that the complex DNC is less acceptable in non-headline contexts (e.g., with a determiner) than the plain one.

The third and final aspect of our concluding remarks concerns the implications of our methodological approach to the Italian DNCs. Our study, first and foremost, confirms the dangers of relying on introspection alone. We have presented a case where different constructions seem equally acceptable when assessed out of context but, when looked at from the viewpoint of actual usage data and systematic elicitation, turn out to be quite distinct. That solely relying on the researchers’ own intuitions is not safe is demonstrated by the fact that the important distinction between true deverbal compounds and HDNCs has gone unnoticed in previous studies of Italian DNCs (see Section 3).

Interestingly, using extended empirical evidence instead of relying on researchers’ out-of-context intuitions led us to a *simpler* analysis of the data, and thus allowed us to maintain a stronger theoretical view of the separation of morphology and syntax and a more restrictive approach to grammar overall (preserving the Lexical Integrity Hypothesis in morphology, and attributing the special status of HDNCs to headline). This runs against the belief, sometimes held in corpus linguistics circles (see, e.g., Sampson 2007), that corpus analyses inevitably lead to abandoning strong, categorical views of grammar.

As a related point, it was natural for us to bring corpus-based and experimental evidence to bear on issues that are relevant to current debate within the “minimalist” framework (stemming from or related to Chomsky 1995), what one could call mainstream “Chomskyan linguistics”. While a quick look at the earlier issues of CLLT and a query to the *Corpora* list suggest that theoretical linguists using corpora usually come from other theoretical traditions (in particular, so-called “cognitive” linguistics and related approaches, and, to a lesser extent, other generative theories such as LFG), we see no reason why

corpora should not constitute a precious source of evidence for minimalist grammarians as well, as they were for us here.

Evidence from corpora and behavioral experiments is statistical in nature, in the sense that our hypothesis is supported by distributions that are heavily skewed in the predicted direction, rather than by “100% vs. 0%” patterns. For example, we took the fact that N[NA] constructions only occur in DET positions 8% of the times (vs. 70% for nouns in general) as strong support for our hypothesis that these constructions are not regular nouns (refer to Table 2). However, what should we do of that 8% of cases (85 instances in absolute terms) in which they *do* occur preceded by Det? One possibility is that we can stick to a categorical version of our theory, and that the exceptions are just “noise” inherent in our data collection procedure: some of the cases might be the product of annotation errors, other might pertain to lexicalized constructions, etc. A more radical alternative, if further analysis revealed that the previous approach is not tenable, would be to add a probabilistic component to our grammar, in order to account for the gradient results (see, e.g., Keller 2000). This is of course a very interesting and central issue, but one that deserves one or more papers in its own right.

## Appendix A: Deverbal heads

NB: English translations do not always fully capture the range of senses and usage options/restrictions of the Italian nouns.

Deverbal	Translation	Deverbal	Translation
abbattimento	fall	abilitazione	qualification
abrogazione	repeal	accertamento	check
adempimento	fulfillment	aereazione	ventilation
affissione	posting	agevolazione	facilitation
aggiudicazione	adjudication	ammodernamento	modernization
annullamento	cancellation	approvazione	approval
autocertificazione	self-declaration	autorizzazione	authorization
calcificazione	calcification	cessazione	cessation
cessione	handover	collaudo	test
concessione	concession	conduzione	conduction
confisca	confiscation	depenalizzazione	depenalization
destituzione	destitution	dichiarazione	declaration
disdetta	cancellation	elaborazione	processing
erogazione	supply	immatricolazione	registration
legittimazione	licensing	limitazione	limitation
manipolazione	manipulation	manutenzione	maintenance
mappatura	mapping	massimizzazione	maximization
potatura	pruning	progettazione	design
promozione	promotion	promulgazione	dissemination
raggruppamento	grouping	ratifica	approval
recupero	recovery	requisizione	requisition
revoca	revocation	riempimento	filling

Deverbal	Translation	Deverbal	Translation
rimborso	reimbursement	rinvio	postponing
risarcimento	compensation	sequestro	confiscation
smaltimento	disposal	sospensione	suspension
spedizione	shipment	spostamento	displacement
subappalto	subcontract	svuotamento	emptying
taratura	calibration	trascrizione	transcription
trasferimento	transfer		

## Appendix B: Experimental stimuli

NB: each line in the table below was used to generate four different stimuli by combining N1 and N2 alternatively with a Determiner and an intervening Adjective.

Schematically, for each line the following stimuli were generated: N1-N2, Det-N1-N2, N1-Adj-N2, Det-N1-Adj-N2.

DET	N1	ADJ	N2
(l')	approvazione	(nuovo)	statuto
(la)	progettazione	(nuove)	attività
(l')	autorizzazione	(ulteriore)	spesa
(le)	concessioni	(singole)	modifiche
(l')	ammodernamento	(vecchi)	impianti
(le)	agevolazioni	(piccole)	imprese
(l')	erogazione	(terza)	tranche
(la)	promozione	(pari)	opportunità
(il)	recupero	(maggiori)	oneri
(gli)	adempimenti	(formali)	iscrizione
(l')	aggiudicazione	(definitiva)	lavori
(la)	concessione	(gratuita)	beni
(la)	conduzione	(mista)	ospedale
(il)	raggruppamento	(addestrativo)	cavalleria
(i)	trasferimenti	(diretti)	aeroporto
(il)	recupero	(urbanistico)	area
(l')	elaborazione	(informatica)	dati
(l')	abrogazione	(parziale)	referendum

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## Notes

1. However, the DNC may have originated from a similar construction in Old Italian, the *juxtapositional genitive*, cf. the examples and the discussion in Delfitto and Paradisi (2007).
2. The Lexical Integrity Hypothesis (LIH) expresses the well-known observation that complex words are syntactically opaque. There exist a number of different formulations, but the version that is most frequently cited is probably the “strong lexicalist hypothesis” by Lapointe (1980: 8): “No syntactic rule can refer to elements of morphological structure”. The corollary of the LIH is that if a linguistic element is subject to at least one syntactic rule (movement, extraction, binding, etc), then its nature must be phrasal and not lexical. Cf. Ackema and Neeleman (2004: 17–47); Lieber and Scalise (2006).
3. The English example is just for illustration purposes. We have not systematically searched for violations of Lexical Integrity in English compounding. However, an extensive corpus-based distributional analysis such as the one we describe in Section 5 for Italian would be mandatory in order to clarify whether English has a construction with the properties of the Italian DNC.
4. We will assume a generic DP structure for noun phrases (Abney 1987), where NP is the complement of D that contains the noun proper and its adjectives.
5. Note that Brazilian Portuguese, from which the data in (17) are taken, can normally omit articles with singular nouns in argumental position. Yet, P cannot be omitted even in these cases.
6. Other ways to refer to this or similar uses of language are *titles*, *telegraphic language*, *shortened language*, etc. For simplicity, we will here use the term ‘headlines’ (and ‘headline’, following Stowell 1999), without trying to analyze the difference between these partially overlapping terminologies and/or registers, or the relation between ‘headline register’ and ‘bureaucratic register’. We also do not mean to imply that what we call ‘headlines’ in this article are newspaper headlines, as the examples in (18) illustrate.
7. Deciding whether a modifier is a “true” singular while looking at out-of-context DNCs is very difficult. For this reason, we focus on the more easily operationalizable determiner alternation as our main cue to headline.
8. Bracketings in this table and below are meant to give an intuitive idea of the structure of the DNC, and in particular to indicate whether adjectives are attached to the head – left constituent – (thus taking scope over the whole DNC) or to the modifier – right constituent.

- The suggested structures are only illustrative and do not represent a commitment to a specific theoretical analysis of DNCs.
9. These random effects can be seen as adjustments to the intercept that are linked to each head and modifier to provide a better fit by taking item-specific differences into account. See, e.g., Baayen (2008).
  10. These are the 99 attributive and non-deverbal subordinative compounds that occur 1,000 times or more in the itWaC corpus.
  11. More precisely, we extracted nouns in contexts having the following shape: DEVERBAL DI/DEL ART? NOUN, where DEVERBAL is one of the deverbal heads in our list. Some examples are: *manutenzione di imbarcazioni* ‘maintenance of ships’, *ammodernamento dei musei* ‘modernization of+the museums’, *spostamento di una virgola* ‘displacement of a comma’.

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