English NPN Constructions: A Constraint-Based Analysis

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1. Introduction

English Noun-Preposition-Noun Constructions (hereafter NPNs) consist of two identical nouns and a preposition, with one noun preceding and the other following the preposition, forming a constituent. Typical examples are given in (1).

(1) a. **Day after day,** the weather remained gloomy.
b. The snow fell, **layer upon layer**, covering the entire village in white.
c. The police searched the neighborhood, **house by house**.
d. **Line for line**, the two articles are equally remarkable.
e. The leaders of G20 met **face to face**.

NPNs have long posed challenges in theoretical analyses, particularly in three respects. First, in addition to requiring identical nouns, NPNs constrain these nouns to be bare singular count nouns, as shown in (1) and (2). Second, the meaning of NPNs appears to be "constructional," as it cannot be fully predicted from the lexical items. For instance, in (1a), the NPN conveys not only the ordering relation between the two nouns, corresponding to the lexical meaning of *after*, but also a sense of succession (i.e., 'multiple days in succession'). Third, certain NPNs can function as either arguments or adjuncts within a sentence (e.g., (3)), making it challenging to determine their internal structure and the head.

(2) a. *men for men, *books after books, *weeks by weeks
b. *water after water, *dusk for dusk
c. *the man for the man, *a day after a day, *some inch by some inch (Jackendoff, 2008, p. 9)

(3) a. **Day after day** brings new challenges to overcome. (argument NPN)
b. **Day after day,** the weather remained gloomy. (adjunct NPN)

Due to these properties, NPNs are often regarded as idiomatic, non-headed constructions whose syntax and semantics are not fully determined by their daughters but are, to some extent, independently specified by the constructions themselves (e.g., Bargmann, 2019; Poss, 2010). Alternatively, in analyses that treat NPNs as headed (e.g., Haïk, 2013; Huddleston & Pullum, 2002; Jackendoff, 2008), two distinct internal structures and heads are proposed for NPNs, given their dual functionality.

In this paper, I argue that these seemingly idiomatic properties of NPNs can, in fact, be accounted for through an ordinary headed structure. Thus, a unified, headed structure suffices, and the need for a non-headed structure or two distinct structures is avoided. To support this, I propose new lexical and constructional constraints for NPNs, demonstrating that NPNs are not entirely idiosyncratic but exhibit regular and compositional aspects to a substantial extent.

2. Phenomena

Jackendoff (2008) identifies five prepositions as productive in NPNs: *after*, *upon*, *by*, *for*, and *to*. However, while these prepositions are commonly used, numerous NPN examples feature other prepositions (e.g., *hand in hand*, *year over year*, *box within box*). Given the flexibility and expandability of NPN usage, there appears to be no constraint on the types of prepositions that can occur in NPNs.

Based on Jackendoff (2008), the meanings conveyed by NPNs can be broadly categorized into three types: succession, matching, and juxtaposition. Each meaning is instantiated by different prepositions—for instance, succession by *after*, *upon*, and *by*; matching by *for*; and juxtaposition by *to* and *in*. Thus, the preposition serves as the locus of NPN meaning.

All NPNs invariably function as adjuncts; however, *N after N* and *N upon N* can also function

as arguments, exhibiting dual functionality (e.g., (3)). Specifically, adjunct NPNs modify the VP with which they combine, whereas argument NPNs serve solely as arguments of the verb without modifying the VP.

In addition, NPNs display several phenomena that complicate the analysis. First, a syntax-semantics mismatch is observed. For example, as shown in (4), the NPN, which is semantically plural (i.e., 'multiple students in succession'), yet agrees with a singular verb.

(4) Student after student {was / *were} actively participating in the mock U.N.

Second, when the two nouns in NPNs are premodified by adjectives, the modifiers for each noun must be identical (e.g., (5a)). Furthermore, modification on the first noun is optional, whereas on the second noun it is obligatory (e.g., (5b)). In other words, the first noun cannot be modified unless the second noun is as well. Crucially, regardless of the distribution of modifiers, both NPs convey the same meaning. This means that in (5b), even when the first NP lacks an adjective, it is still interpreted as *stormy day*.

(5) a. Stormy day after {stormy / *snowy} day has ended at last.
b. (Stormy) day after *(stormy) day has ended at last.

Third, NPNs that convey a sense of succession, in particular, can iterate their PN sequence (e.g., (6)), a phenomenon that Sommerer (2022) refers to as "multiplication."

(6) a. **Day after day after day,** the weather remained gloomy.
b. The snow fell, **layer upon layer upon layer**, covering the entire village in white.
c. The police searched the neighborhood, **house by house by house**.

3. Previous Analyses

Previous analyses of NPNs can be categorized into three approaches: minimalist approaches (e.g., Haïk, 2013; Travis, 2001), construction-based approaches (e.g., Bargmann, 2019; Jackendoff, 2008; Poss, 2010), and semantic approaches (e.g., Beck & von Stechow, 2007; Kinn, 2022; Matsuyama, 2004). Each approach addresses fragmentary aspects of NPNs, with a key limitation being the absence of a comprehensive syntactic and semantic analysis that encompasses all prepositions found in NPNs and their dual functionality.

Minimalist approaches propose generative mechanisms and corresponding internal structures for NPNs but fail to account for the full range of their meanings. For example, Travis (2001) suggests that NPNs are an instantiation of "reduplication," where a reduplicative head Q copies an element from its sister NP and places it in [Spec,QP]. However, this analysis remains unclear regarding the syntactic and semantic properties of QP, particularly in terms of how QPs can capture the various meanings of NPNs and function both as adverbials and nominals. Haïk (2013) discusses the syntactic and semantic differences between argument NPNs and adjunct NPNs but does not address the full spectrum of NPN meanings. Moreover, her analysis assumes noncanonical structures, such as a ternary, headed structure and treating NPNs as lexical units.

Construction-based approaches provide a more detailed discussion of the meaning of NPNs but still lack a comprehensive explanation. Specifically, Jackendoff (2008) examines an extensive range of data and identifies various meanings of NPNs; however, his theoretical account primarily addresses the case of *after* and does not account for other prepositions or the dual functionality of NPNs. Similarly, Bargmann (2019) provides a formalization of the meaning of *N after N*, but does not offer an analysis for other prepositions and assumes an unconventional (non-headed) ternary structure to account for the syntactic and semantic properties of the construction.

In semantic approaches, the analysis of NPN meaning is the most detailed, but the syntactic argumentation is notably less developed in comparison to other approaches. Beck and von Stechow (2007) offer a compositional analysis of NPN meanings, but the syntactic structure within which this composition proceeds is left undiscussed. Similarly, Kinn (2022) proposes an internal structure for NPNs based on crosslinguistic data, but it falls short of how the proposed structure can account for the syntactic properties of NPNs.

4. Proposed Analysis

To begin by determining the internal structure of NPNs, consider the three possible structures below. Note that although the nouns are defective, lacking overt determiners, they are nonetheless licensed as noun phrases in NPNs; thus, I treat them as NPs.

(7) a. [PP [NP1 student] [P' [P after] [NP2 student]]] (canonical PP structure)
b. [NPN [NP1 student] [P after] [NP2 student]] (non-headed ternary structure)
c. [NP [NP1 student] [PP [P after] [NP2 student]]] ("PP as the modifier" structure)

Among the structures in (7), I adopt (7c), which corresponds to Kinn's (2022) structure, for my analysis. This choice is based on two considerations. First, this structure provides a foundation for explaining multiplication. For example, the entire NPN can serve as a complement of another preposition, which leads to structural iteration. Second and more importantly, (7c) is the most appropriate for capturing how, as we shall see, the syntax and semantics of the construction are determined by its daughters.

To license the structure in (7c) and capture the syntactic and semantic properties of NPNs, I introduce a new lexemic type, *npn-p(reposition)-lxm(leme)*. I assume that *npn-p-lxm* is the output of a lexical rule, the input of which is *predicational-preposition-lxm* from Sag et al. (2003).

(8) $npn-p-lxm \Rightarrow$
$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD|MOD} & \langle \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{SPR} & \langle det \rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{RESTR} & \langle \begin{bmatrix} \text{RELN} & \boxed{2} \\ \text{INST} & i \end{bmatrix} \rangle \oplus \boxed{\text{B}} \end{bmatrix} \end{bmatrix} \rangle \\ \text{SPR} & \langle\,\rangle \\ \text{COMPS} & \langle \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1}\begin{bmatrix} \text{AGR} & 3sing \\ \text{COUNT} & + \end{bmatrix} \\ \text{SPR} & \langle det \rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{RESTR} & \boxed{\text{A}} \langle \begin{bmatrix} \text{RELN} & \boxed{2}\, N \\ \text{INST} & j \end{bmatrix} \rangle \oplus \boxed{\text{B}} \oplus \boxed{\text{C}} \end{bmatrix} \end{bmatrix} \rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{MODE} & prop \vee ref \\ \text{RESTR} & \boxed{\text{A}} \oplus \boxed{\text{B}} \oplus \boxed{\text{C}} \oplus \langle [\text{RELN} \quad npn-p-rel], \ldots \rangle \end{bmatrix} \end{bmatrix}$$

The lexical constraint in (8) specifies the following information. First, it constrains the COMPS and MOD elements of the preposition such that they are bare (SPR ⟨*det*⟩), third-person singular (AGR *3sing*) count (COUNT +) nouns. This captures the restrictions on NPN nouns shown in (2). Second, since two nouns share the same nominal relation (RELN *N*) in their RESTR list, this accounts for the identity requirement of the two nouns, assuming that each noun represents its own unique relation.

The RESTR values of the two nouns also explain the distributional and interpretive properties of modifiers of NPN nouns discussed in (5). Specifically, since *npn-p-lxm* essentially requires the two nouns to have identical semantic information while allowing the second noun to specify additional information, *stormy day after stormy day* and *day after stormy day* are licensed, whereas **stormy day after day*, where the first noun carries more semantic information, is ruled out. Importantly, since the RESTR value of the second noun is reflected in the RESTR list of the preposition, as shown in (9) below, and the construction inherits the meaning of the preposition in my analysis, the second noun (phrase) determines the semantic contribution of NPN nouns to the construction.

Next, I turn to the CONT value of the preposition. As noted earlier, each NPN meaning is instantiated by different prepositions, whose meanings in NPNs are construction-specific rather than canonical. In (8), *npn-p-rel(ation)* in the RESTR list of the preposition reflects this meaning. It is categorized into three specific relations: *in-succession-rel*, *in-matching-rel*, and *in-juxtaposition-rel*, and these are specified in the lexical entries of the prepositions associated with them.

(9) The lexical entry of Succession preposition(s) (e.g., *after*, *upon*, *by* in (1a-c))

$$\begin{bmatrix} npn-p-lxm \\ \text{CAT} \quad \left[\text{COMPS} \quad \langle\left[\text{CONT|RESTR} \quad \boxed{\text{A}}\langle\begin{bmatrix}\text{RELN} & N\\ \text{INST} & j\end{bmatrix}\rangle\right]\rangle\right] \\ \text{CONT} \quad \left[\text{RESTR} \quad \boxed{\text{A}} \oplus \langle\begin{bmatrix}\text{RELN} & group\\ \text{INST} & i\end{bmatrix}, \begin{bmatrix}\text{RELN} & member\\ \text{SET} & i\\ \text{ELEMENT} & j_{n\geq 2}\end{bmatrix}, \begin{bmatrix}\text{RELN} & in-succession\\ \text{SIT} & s\\ \text{PREDECESSOR} & j_n\\ \text{SUCCESSOR} & j_{n+1}\end{bmatrix}\rangle\right] \end{bmatrix}$$

In (9), I adopt Bargmann's (2019) insight, which formalizes the meaning of *N after N* in terms of a set and the ordering relation between its elements. The meaning of the preposition involves a group (i.e., a plural entity). This group is a set, and the elements of the set are multiple *j*s, all of which share the property of being an *N*, which is determined by the complement noun. Crucially, the *j*s participate in the "in-succession" relation, where one follows another. In this way, the meaning of 'multiple *N*s in succession' is effectively captured.

Matching and Juxtaposition also share the same property in that the meaning of the complement noun is reflected in the meaning of the preposition, with the only difference being the inherent meaning of the preposition itself. In the case of Matching (e.g., (10)), two sets are involved, and the *n*-th elements of each set are matched. In contrast, in Juxtaposition (e.g., (11)), no set is involved, and the meaning of the noun is specified as corresponding to a part of an individual (e.g., *face to face*, *hand in hand*, *arm in arm*, *bumper to bumper*).

(10) The lexical entry of Matching preposition(s) (e.g., *for* in (1d))

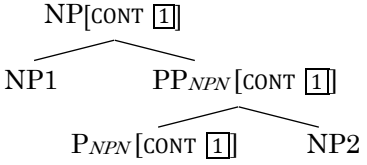
$$\begin{bmatrix} npn-p-lxm \\ \text{CAT} \quad \left[\text{COMPS} \quad \langle\left[\text{CONT|RESTR} \quad \boxed{\text{A}}\langle\begin{bmatrix}\text{RELN} & N\\ \text{INST} & k\end{bmatrix}\rangle\right]\rangle\right] \\ \text{CONT} \quad \left[\text{RESTR} \quad \boxed{\text{A}} \oplus \langle \begin{bmatrix}\text{RELN} & group\\ \text{INST} & i\end{bmatrix}, \begin{bmatrix}\text{RELN} & group\\ \text{INST} & j\end{bmatrix}, \begin{bmatrix}\text{RELN} & member\\ \text{SET} & i\\ \text{ELEMENT} & k_{i_n}\end{bmatrix}, \begin{bmatrix}\text{RELN} & member\\ \text{SET} & j\\ \text{ELEMENT} & k_{j_n}\end{bmatrix}, \begin{bmatrix}\text{RELN} & in-matching\\ \text{SIT} & s\\ \text{ARG1} & k_{i_n}\\ \text{ARG2} & k_{j_n}\end{bmatrix}\rangle\right] \end{bmatrix}$$

(11) The lexical entry of Juxtaposition preposition(s) (e.g., *to* in (1e))

$$\begin{bmatrix} npn-p-lxm \\ \text{CAT} \quad \left[\text{COMPS} \quad \langle\left[\text{CONT|RESTR} \quad \boxed{\text{A}}\langle\begin{bmatrix}\text{RELN} & N\\ \text{INST} & j\end{bmatrix}\rangle\right]\rangle\right] \\ \text{CONT} \quad \left[\text{RESTR} \quad \boxed{\text{A}} \oplus \langle \begin{bmatrix}\text{RELN} & part-whole\\ \text{PART} & j_n\\ \text{WHOLE} & k_n\end{bmatrix}, \begin{bmatrix}\text{RELN} & individual\\ \text{INST} & k_{n\geq 2}\end{bmatrix}, \begin{bmatrix}\text{RELN} & in-juxtaposition\\ \text{SIT} & s\\ \text{ARGS} & \{j_1, j_2, \ldots, j_n\}\end{bmatrix}\rangle\right] \end{bmatrix}$$

The NPN meaning specified in the lexical entry of the preposition is propagated to the construction, in accordance with the concept of semantic head and the Content Principle (Pollard & Sag, 1994). According to these principles, in a head-adjunct structure, the adjunct daughter is the semantic head, and the CONT values of the semantic head daughter and the mother must be token-identical. In (7c), where PP functions as the modifier of NP1, PP serves as the semantic head of the construction, and its CONT value is thus propagated to the construction. This process of semantic inheritance is schematized as in (12).

(12)



Through this, it can be argued that the meanings of NPNs, often regarded as constructional, actually derive from the meaning of the preposition, suggesting that NPNs are neither entirely noncompositional nor idiomatic. Additionally, the syntax-semantics mismatch shown in (4) is accounted for, as the syntactic information is still inherited from NP1, which is a singular noun.

In this analysis, there are two possible internal structures for a multiplicated NPN. In (13a), the PP *after student* recursively combines with the entire NPN as a modifier, whereas in (13b), the entire NPN serves as the complement of another NPN preposition.

(13) a. [NP [NP [NP1 student] [PP [P after] [NP2 student]]] [PP after student]]
b. [NP [NP1 student] [PP [P after] [NP [NP student] [PP [P after] [NP student]]]]]

Although both structures are syntactically well-formed, only (13b) conforms to the constraints proposed in this paper. For example, in (13a), the first NP (i.e., the entire NPN) carries more semantic information than the second NP, thereby violating the constraint of *npn-p-lxm*, which disallows the first NP from specifying more semantic information than the second NP. In contrast, in (13b), no such violation occurs. Thus, (13b) is adopted as the internal structure in the present analysis.

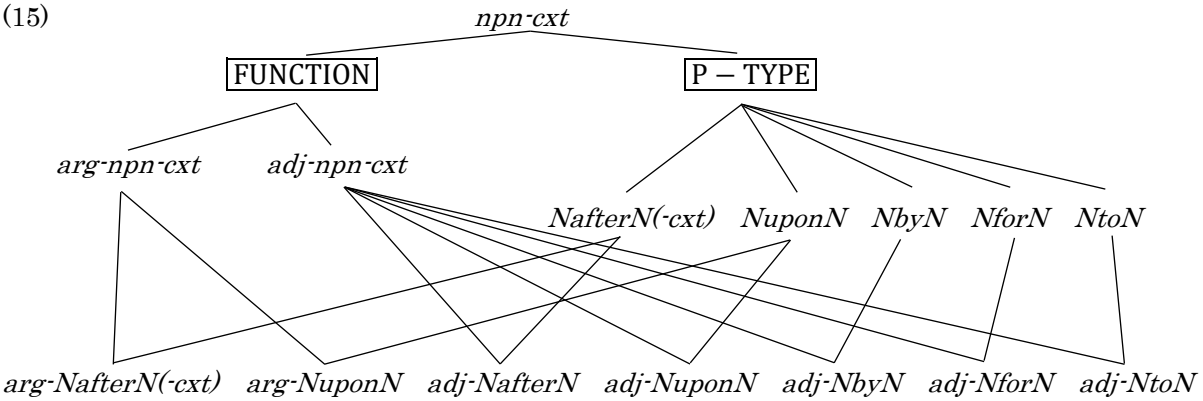
The final property of NPNs to analyze is their dual functionality. Previous studies have primarily sought to explain the differences in functionality through semantic distinctions (e.g., Haïk, 2013; Kinn, 2022). However, this explanation fails to account for why *by*, which shares the meaning of Succession with *after* and *upon*, cannot be used as an argument NPN. Given this, I do not attribute the dual functionality of NPNs to their semantics. Instead, I use multiple inheritance in HPSG to accurately capture how these patterns differ by preposition.

First, I introduce the construction formed according to *npn-p-lxm* as the constructional type: *npn-cxt(construction)*, which is a subtype of *h(ea)d-adj(unct)-ph(rase)*.

(14) $npn-cxt \Rightarrow \begin{bmatrix} hd-adj-ph & \\ \text{CAT|SPR} & \langle\,\rangle \\ \text{DTRS} & \langle \text{X}, \text{PP}_{NPN} \rangle \end{bmatrix}$

I then introduce two dimensions of *npn-cxt*, FUNCTION and P(REPOSITION)-TYPE, to cross-classify NPNs based on their function and the type of preposition.

(15)



In the FUNCTION dimension, *npn-cxt* is subtyped into *arg(ument)-npn-cxt* and *adj(unct)-npn-cxt*. As shown in (16a), when an NPN is used as an argument, the MODE and INDEX values are set to *ref* and *i*, respectively, where *i* represents the INST of the "group" relation in the meaning of the preposition. In contrast, as shown in (16b), when an NPN is used as an adjunct, the situation represented by *npn-p-rel* is structured in such a way that it connects to the eventuality expressed by the element the NPN modifies, thereby functioning as a manner adverbial. This allows the syntactic and semantic differences in the modification function of argument NPNs and adjunct NPNs to be captured as constraints.

(16) a. $arg-npn-cxt \Rightarrow \begin{bmatrix} \text{CAT|HEAD|MOD} & \langle\,\rangle \\ \text{CONT} & \boxed{1}\begin{bmatrix}\text{MODE} & ref \\ \text{INDEX} & i\end{bmatrix} \\ \text{DTRS} & \langle \text{X}, \left[\text{CONT} \quad \boxed{1}\left[\text{RESTR} \quad \langle \begin{bmatrix}\text{RELN} & group \\ \text{INST} & i\end{bmatrix}, \ldots \rangle\right]\right]\rangle \end{bmatrix}$

b. $adj-npn-cxt \Rightarrow \begin{bmatrix} \text{CAT|HEAD|MOD} & \langle \text{VP} \vee \text{N}' : \begin{bmatrix}\text{INDEX} & \boxed{2} \\ \text{RESTR} & \boxed{E}\end{bmatrix}\rangle \\ \text{CONT} & \begin{bmatrix}\text{MODE} & prop \\ \text{INDEX} & s_2 \\ \text{RESTR} & \boxed{D} \oplus \boxed{E} \oplus \langle \begin{bmatrix}\text{RELN} & in-the-manner-of \\ \text{SIT} & s_2 \\ \text{EVENTUALITY} & \boxed{2} \\ \text{MANNER} & s_1\end{bmatrix}\rangle\end{bmatrix} \\ \text{DTRS} & \langle \text{X}, \left[\text{CONT|RESTR} \quad \boxed{D}\langle \begin{bmatrix}\text{RELN} & npn-p-rel \\ \text{SIT} & s_1\end{bmatrix}, \ldots \rangle\right]\rangle \end{bmatrix}$

In the P-TYPE dimension, *npn-cxt* is subtyped into constructions such as *NafterN-cxt*, *NuponN-cxt*, *NbyN-cxt*, *NforN-cxt*, and *NtoN-cxt*, based on the type of preposition used. Each subtype is distinguished by its corresponding PFORM values. As a result, the leaf types in the hierarchy clearly capture that only *N after N* and *N upon N* can function as both arguments and adjuncts, while other NPNs cannot.

This paper demonstrates that NPNs, often considered idiomatic or non-headed, can be explained within a unified headed structure, facilitated by the inheritance mechanism in HPSG. By introducing specific lexical and constructional constraints, I suggest that NPNs are largely regular, with their meaning primarily determined by the preposition rather than being entirely idiosyncratic. The proposed analysis accounts for the syntactic and semantic properties of NPNs, including the peculiarities of their nouns, their dual functionality, the syntax-semantics mismatch, modification patterns, and multiplication, thus providing a comprehensive picture for understanding these complex constructions.

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