A select set of English nouns can head bare-NP adverbs – NPs that can act as adverbs without being preceded by a preposition. These 'BNPA nouns' also can be modified by prepositionless adverbial non-*wh* relative clauses. An analysis is presented in a categorial grammar framework, employing a conjunctive type structure to describe the behavior of BNPA nouns. It is suggested that non-*wh* adverbial relative clauses are selected by BNPA nouns as complements; lexical rules are written to allow such selection. Finally, some remaining issues are surveyed concerning BNPA nouns in particular and conjunctive categories in general.

I. INTRODUCTION

1.1 The facts

Bare-NP adverbs, first discussed in Larson (1983, 1985), are NPs that can act as locative, temporal, or manner adverbs without any kind of morphological marking, as in the following examples:

(1) (a) We visited Mary *last Thursday/one day/this week/that year*.

(b) I lived *every place that I could afford.*

(c) Tom worked the problem *every possible way.*

In short, these phrases have the internal structure of a regular NP, but the external syntax of VP modifiers. Bare-NP adverbials (henceforth BNPAs) also include lexical items like *today, yesterday, tomorrow,* and *then* for the temporal cases, and *there, here* for locative adverbs. However, the BNPAs that interest us here are the phrasal ones, as in (1). Larson notes that nouns that can head BNPAs are a very restricted set. For example, although most nouns denoting periods or instances of time can head a temporal BNPA, not all of them can, as seen in (2a). For BNPAs of location or manner, only the specific words *place* and *way* are eligible, as seen in (2b, c).

(2) (a) *We visited Mary that {occasion, period}.

(b) *I lived every {location, city} that I could afford.

(c) *Tom worked the problem every possible method.

For this reason, Larson favors an explanation in which eligibility to form BNPAs is part of these particular nouns' lexical entries.

Larson discusses a second property that this set of words possesses: they 'can head non-*wh* adverbial relatives without preposition stranding.' (Larson 1985: 616) Examples are shown in (3):

(3) (a) the {day, *occasion} (that) the music died

(b) the {place, *town} (that) I grew up

(c) every {way, *method} (that) Tom worked the problem

This second property is not exclusive to this set of words; it is possible for a word to be modifiable by a relative clause like those seen in (3), but not be eligible to form a BNPA, as shown in (4). The main example, noted by Larson (1983), is *reason.*

(4) (a) the {reason, *cause} (that) Kim fired Robin
(b) Kim fired Robin *(for) this reason.
(c) a shady {place, *area} to sit
(d) Kim sat *(in) that spot.

Nouns that exhibit these properties can exhibit them together, individually, or (when used as ordinary nouns) not at all. Consider the phrases in (5):

(5) (a) Something touched me deep inside the day the music died.
(b) We stayed every place that you recommended.
(c) I remember the day the music died.
(d) I remember the day that we spent on the lake.

In (5a), the noun *day* exhibits both properties of these special nouns: in the upstairs clause, the NP headed by *day* acts as an adverb phrase (Property 1); furthermore, *day* heads the non-*wh* relative adverbial clause *the music died* (Property 2). In (5b, c), a noun exhibits one of the special properties (Property 1 in (5b); Property 2 in (5c)), but acts as an ordinary noun otherwise. In (5b), while *day* acts as an ordinary noun in the upstairs clause, it still exhibits the second property of this select set of nouns by heading the relative adverbial clause *the music died*. In (5c), *place* exhibits the first property of these nouns because the NP headed by it acts as an adverb phrase, but *place* acts as an ordinary noun as it fills the gap in the relative clause *that you recommended.* In (5d), *day* acts as an ordinary noun both upstairs (in the NP complement of *remember*), and downstairs (as the filler of the gap in *that we spent on the lake*). Case (5b) is the only one that Larson specifically considers, using the following example:

(6) (from Larson 1985, (49))
The hours that John spent sleeping that he was supposed to have been on watch nearly cost him his stripes.

Sentence (6) is similar to (5b), since *hours* heads an ordinary subject NP upstairs (and furthermore is heads the ordinary, nonadverbial relative clause *that John spent sleeping*), while heading the adverbial relative clause *that he was supposed to have been on watch* downstairs.

The question to be investigated in this paper, then, is how to formally characterize this select set of words, which I will call BARE-NP ADVERB (BNPA) NOUNS, formally describing both special properties, and allowing for the mixed adverbial and ordinary usages discussed above. In the remainder of this section, I will review previous analyses of BNPA nouns, primarily that presented by Larson, showing that despite its merits syntactically, it falls short with respect to semantics. Section 2 will develop an analysis of the first basic property BNPA nouns, that is, their ability to project an NP that can act as an adverbial phrase. Section 3 will cover the second property of BNPA nouns, their ability to head non-*wh* adverbial relative clauses without preposition stranding. Section 4 will put the analyses of sections 2 and 3 together, showing how sentences like those in (5) and (6) can be derived. Section 5 discusses extensions to the analysis to cover certain constructions with BNPA nouns that are possible for some speakers, but not for all. First, there is the interaction of BNPA nouns with bare plural NPs. Second, there are possibilites for BNPA nouns to participate in coordination of unlikes (also known as neutralization). Remaining issues are brought up in section 6. In presenting my analysis, I will assume a basic knowledge of type-logical grammar and the more common category connectives / and \, but I will specially introduce the less frequently seen connectives that I will be using.

1.2 Previous analyses

1.2.1 Larson (1985)

Larson (1985) proposes that BNPA nouns can assign Case to themselves, instead of having it assigned to them by a verb or preposition. Specifically, they are marked with a feature [+F], which allows them to optionally self-assign a general ‘Oblique’ case. Once

they have Case, they can be assigned a θ-role (specifically TEMP(oral), LOC(ation), DIR(ection)or MAN(ner), depending on the context) by way of a proposed Adverbial θ-Role Assignment (AA) rule. With case thus assigned, a BNPA is allowed to take its place in a sentence. Furthermore, with case assigned, BNPA nouns can participate in adverbial relative clauses in the same way that ordinary words can participate in an relative clauses with NP gaps. The optionality of this case-marking allows for the mixed usages seen in (5) and (6).

Although this theory rules in what it needs to rule in, and rules out what it needs to rule out, there are two reasons for wanting a different one. First of all, the licensing of BNPAs involves two parts: the AA rule, and the optional self-assignment of Case by BNPA nouns. Only the latter is specific to BNPA nouns; the AA rule can assign an adverbial θ-role to any phrase whatsoever. All phrases except those headed by BNPA nouns (which can assign Case to themselves) are then ruled out by the Case Filter. A simpler solution would be one in which the adverbial capability was completely built into the BNPA nouns' lexical entries, instead of vastly overgenerating and then discarding adverbial phrases. Second, it is far from certain that adverbial phrases should occupy θ-roles as arguments to a verb. If θ-roles are removed from the analysis, not only is there nothing to license BNPAs syntactically; there is nothing to give them their adverbial semantics. That is, if an adverbial phrase cannot get its meaning by virtue of occupying some thematic slot in a verb's meaning, then it must supply the meaning itself, a requirement that is not fulfilled simply by having a feature like [+F] percolate up.

1.2.2 Larson (1983)

An earlier proposal in Larson (1983) has BNPAs subordinate to prepositionless PP nodes, a strategy that deserves further comment. There is an intuitive appeal to positing something like an 'understood' preposition in front of a bare-NP adverb, or at the end of a non-*wh* relative adverbial clause. Furthermore, as noted by McCawley (1988), BNPAs have more in common with PPs in particular than with adverb phrases in general. First of all, their distribution is similar, right down to BNPAs' having the ability to modify nouns

(e.g., McCawley's example *your brother's arrival last week*), which PPs can do, but other adverbs cannot. (We will not be dealing with noun-modifying BNPAs, but believe the analysis presented here can easily be extended to allow for them.) Also, McCawley points out, BNPAs have the same semantics as similar phrases with prepositions; thus, *I saw her Tuesday* and *I saw her on Tuesday* have the same meaning.

However, taking such an approach would not really save any work. To mention the lesser problem first, there is the issue of what meaning should be posited for this null preposition. Even if we hypothesize some kind of general spatiotemporal preposition for BNPAs of location and time, the issue gets murkier when manner adverbials are considered. Manner adverbs seem quite different semantically from spatiotemporal ones; whereas adverbs of location and time can be seen as referring to actual areas of the space-time continuum, manner adverbs cannot. Let us assume, though, that there is such a null, spatiotemporal/manner preposition, or perhaps more than one null preposition. The larger problem is to ensure that a null preposition is used only with BNPA nouns, in order to rule out ungrammatical phrases such as **we stayed every location* and **every hotel that we stayed*. So even with a null preposition, some of the work will have to be done by the individual lexical items, and therefore it makes sense to see if they can be made to do all of the work.

1.2.3 Kasper (forthcoming)

Kasper (forthcoming) also addresses BNPAs, in the larger context of how, in general, to modify words and phrases that have a uniform 'internal semantics' but a 'combinatory semantics' that varies according to their syntactic placement. His prime example of such words is attributive vs. predicative adjectives. The problem is not just that predicative and attributive adjectives have different meanings (that is, if a predicative adjective has meaning α, the attributive version of the same adjective will have meaning $\lambda P \lambda x[P(x) \,\&\, \alpha(x)]$); the problem is that modifiers of these adjectives (for instance, *very*) will also have to have different meanings, one suitable for modifying predicatives and one for modifying attributives – a needless proliferation of meanings. Kasper's solution allows

there to be a single lexical entry for an adjective that can be either predicative or attributive, and eliminates the need for creating new categories for modifiers of adjectives.

Having finished with adjectives, Kasper then shows how his approach could be applied to other modifiers, including adverbs and (the relevant part for our purposes) BNPA nouns. Like attributive and predicative adjectives, BNPA nouns have basically the same core meaning wherever they appear, but have radically different combinatorial semantics depending on how they are used. (For instance, *place* always has the same basic meaning of 'place,' even though it functions as a direct object in *Search the place* and as an adverb in *live someplace*.) Furthermore, any modifier of a BNPA noun will have to be able to preserve both its ordinary and its adverbial meaning, which could lead to the same needless proliferation of lexical entries as discussed above for modifiers of adjectives. For details of this analysis, readers are referred to Kasper (forthcoming).

Kasper's characterization of BNPA nouns works in showing how the compositional semantics of a BNPA phrase is built up. Unfortunately, it deals with only the first property of BNPA nouns, i.e. their ability to project an NP that can act as an adverbial phrase. His analysis has nothing to say about their ability to head non-*wh* relative adverbial clauses without preposition stranding.

1.2.4 Summary

In short, Larson's analysis covers both properties of BNPA nouns, but is weak semantically; Kasper's analysis deals well with the semantics, but only for one of the two properties of BNPA nouns. In the remainder of this paper, I will attempt to develop an analysis that covers both properties of BNPA nouns, while doing justice to their semantics.

2 PROPERTY 1: PROJECTION OF AN ADVERBIAL NP

2.1 Simple feature passing will not work

At issue is how to endow BNPA nouns with their special adverbial property at the lexical level and allow it to percolate up to the NP level. As discussed in section 1, simply assigning a special feature (perhaps *adv:* +) to BNPA nouns, and letting a feature-passing mechanism do the work is not sufficient. Although we can derive an NP(*adv* +) from a BNPA noun, we now need to know how an NP's having a (+) value for its *adv* feature actually translates into its behaving as an adverb. In order for a feature-passing analysis to work, a nonlogical rule like the following would be needed:

(7) Nonlogical rule converting NP(*adv* +) to VP\VP

$$\frac{\text{NP}(adv+):\ x}{\text{VP\VP}:\ \lambda P\lambda y.\mathbf{prep}(x)P(y)}$$

Linguists working in the Lambek type-logical framework would avoid such a rule, simply because it is nonlogical; i.e., it cannot be derived by any of the rules of inference in a type-logical grammar. Therefore, it has to be stipulated, which defeats the purpose of attempting to describe linguistic phenomena in a logic-based system. Furthermore, even if one is not bound by such a consideration, there is linguistic reason for not wanting a rule like (7). Note that as written above, the adverbial semantic term contains the term **prep**, mnemonic for *preposition*. This term is not intended as a claim that a BNPA noun is preceded by an understood preposition (a proposal we rejected in section 1.2.2); rather, it is an abbreviation for whatever set of lexical entailments are appropriate for a given BNPA noun. For example, *place* would have a number of entailments about *x*, and these entailments would more or less coincide for the entailments in the lexical entry for *on, in,* or *at*. The trouble is that different BNPA nouns can have slightly (or very) different sets of entailments, but the **prep** in (7) can abbreviate only one. In other words, (7) is not sensitive to the adverbial information contributed by the different BNPA nouns.

2.2 Special category for BNPA nouns

The strategy taken in this paper will be to put all relevant information about a BNPA noun's semantics into its lexical entry, and give it all the tools it needs to project its adverbial meaning to the NP level. In (8), a first pass at a category and term for *day* in its adverbial capacity is given. (For now, we will ignore BNPA nouns in their ordinary N capacity.)

(8) Category and term for sample BNPA noun (preliminary)
day: $q((\text{VP}\backslash\text{VP})\Uparrow\text{S}, \text{NP}\Uparrow\text{S}, \text{N})$: $\lambda\mathcal{D}\lambda V_{\text{VP}\backslash\text{VP}\rightarrow\text{S}}\mathcal{D}$ (**day′**)($\lambda z.V$(**on′**(z)))

The q connective is known as the generalized scoping constructor, and the $\Uparrow$ connective as the quantifier scoping constructor. Both were introduced by Moortgat (1991), the latter being a special case of the former. It will be more convenient to discuss the special case first. Given a category B$\Uparrow$A, its type is given by the following definition:

(9) Type map for category B$\Uparrow$A
$\text{Typ}(\text{B}\Uparrow\text{A}) = (\text{Typ}(\text{B}) \rightarrow \text{Typ}(\text{A})) \rightarrow \text{Typ}(\text{A})$

Types of this form were first used to allow for quantifier scoping. Thus, if a quantifier phrase such as *every cat* is assigned category NP$\Uparrow$S, then its type would be (Typ(NP) $\rightarrow$ Typ(S)) $\rightarrow$ Typ(S), or **(Ind**$\rightarrow$**Bool)**$\rightarrow$**Bool**. Notice that this is the very same type as we would have if *every cat* had category S/(NP\S) or (S/NP)\S. The reason for having a different category with this same type is that the deduction scheme for $\Uparrow$ allows for the NP$\Uparrow$S to take scope over an S, whereas the other categories would require in situ scoping. The schema is as follows:

(10) Natural deduction elimination rule for $\Uparrow$ (from Carpenter 1997)

$$\begin{array}{ccc} \vdots & \vdots & \vdots \\ \vdots & \text{B}\Uparrow\text{A}: \alpha & \vdots \\ \vdots & \dfrac{\qquad\qquad}{\text{B}: x}\Uparrow\text{E}^n & \vdots \\ \vdots & \dfrac{\qquad\qquad}{\qquad\qquad} & \vdots \end{array}$$

$$\frac{\begin{array}{ccc} : & : & : \\ & \mathrm{A}: \beta & \end{array}}{\mathrm{A}: \alpha(\lambda x.\beta)}\, n$$

This schema says that a B⇑A with meaning α should be treated as a B, with a variable for a semantic term, until a phrase of category A has been derived. At this point, the variable for the B is abstracted, and the resulting term is given as an argument to the original α term. In this way, a quantified NP acts as a simple variable until an S is derived, at which point the meaning of the S is incorporated into the quantificational meaning of the NP. For example, a quantified NP such as *every cat* would have the category NP⇑S, and meaning $\lambda Q.\mathbf{every'}(\mathbf{cat'})(Q)$. The phrase could act semantically as a referential NP, having simply a variable *x* for its semantics – until an S was derived, say, *Every cat meows,* with semantics $\mathbf{meow'}(x)$. At this point, the original meaning $\lambda Q.\mathbf{every'}(\mathbf{cat'})(Q)$ is applied to $\lambda x.\mathbf{meow'}(x)$, resulting in the meaning $\mathbf{every'}(\mathbf{cat'})(\mathbf{meow'})$.

Introduced by Moortgat (1991) and discussed in Carpenter (1997), the "generalized scoping constructor" *q* works as follows. Something of category *q*(A,B,C) acts as a C until a B is derived, at which point the derived phrase acts as an A. The name "generalized scoping constructor" comes from the fact that this constructor is a generalization of the quantifier scoping constructor ⇑. The category NP⇑S used above could have been written with the generalized *q* constructor as *q*(S,S,NP); it can be seen as a special case where A and B are the same. The *q* constructor has been used for pied-piping (Morrill 1994), and also proposed for reciprocal pronouns (Carpenter 1997). The type map and natural deduction elimination rule for *q* are given below:

(11) Type map for category *q*(A,B,C)

$\mathrm{Typ}(q(\mathrm{A},\mathrm{B},\mathrm{C})) = (\mathrm{Typ}(\mathrm{C}) \rightarrow \mathrm{Typ}(\mathrm{B})) \rightarrow \mathrm{Typ}(\mathrm{A})$

(12) Natural deduction elimination rule for *q* (from Carpenter 1997)

$$\frac{\begin{array}{ccc} : & : & : \\ & \mathrm{A}: \beta & \end{array}}{\mathrm{A}: \alpha(\lambda x.\beta)}\, n$$

$$\dfrac{\dfrac{\dfrac{\vdots \quad q(\mathrm{A,B,C}):\ \alpha \quad \vdots}{\mathrm{C}:\ x}\,q\mathrm{E}^{n} \quad \vdots}{\vdots \quad \vdots}}{\mathrm{B}:\ \beta}\ n$$
$$\mathrm{A}:\ \alpha(\lambda x.\beta)$$

In our case, a BNPA noun will act as an N until an NP⇑S is derived, at which point we will derive a (VP\VP)⇑S.

We are now ready to analyze the semantic term corresponding to the *q*((VP\VP)⇑S, NP⇑S, N) category. For convenience, the category and term are rewritten in (13):

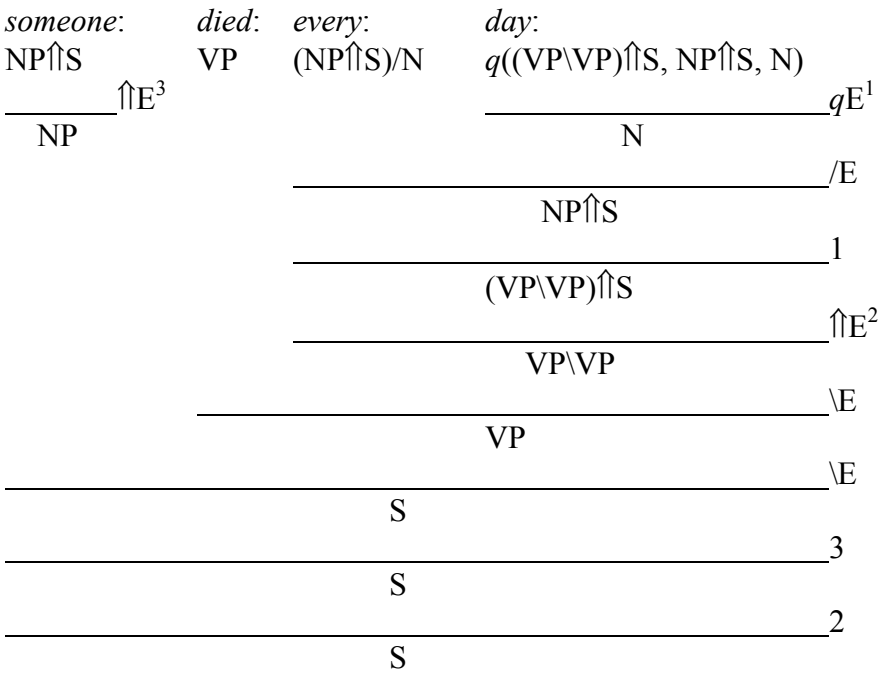
(13) Category and term for sample BNPA noun (final)
day: *q*((VP\VP)⇑S, NP⇑S, N): $\lambda\mathcal{D}\lambda V_{\mathrm{VP\backslash VP}\rightarrow\mathrm{S}}\mathcal{D}\ (\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$

Following (11), the first argument taken by *day* is something of type (Typ(N) → Typ(NP⇑S)), i.e. a generalized determiner. This corresponds to the variable $\mathcal{D}$. After this argument is taken, the resulting type will be Typ((VP\VP)⇑S), which is equivalent to (Typ(VP\VP) → Typ(S)) → Typ(S). In other words, a second argument, having type (Typ(VP\VP) → Typ(S)), will need to be taken in order to end up with an S. This second argument corresponds to the variable *V* in (13). The meaning for the ultimate S will be obtained by providing the generalized determiner $\mathcal{D}$ with arguments for its restriction and scope. For the restriction, **day′**is used. For the scope argument, we need something of type (Typ(NP) → Typ(S)), which is provided by $\lambda z.V(\mathbf{on'}(z))$.

A syntactic derivation of *Someone died every day*, with *every day* taking wide scope, is given in (14) to illustrate how the preceding analysis works syntactically. A derivation of this sentence with semantics included can be found in the Appendix to

illustrate how the category and term in (13) actually produce the desired meaning. Also in the Appendix is a derivation of *every rainy day*, showing how the *q* category for BNPA nouns allows for modification.

(14) Syntactic derivation of *Someone died every day* (wide scope *every*)



A final comment about *q* should be noted. In (12), only the elimination rule for *q*(A,B,C) is given; the introduction rule is absent. The reason for this is that such a rule can be formulated only for the case in which A = B. Recall that the type for *q*(A,B,C) is (Typ(C) → Typ(B)) → Typ(A); thus, proof of *q*(A,B,C) can be considered a proof of A/(C\B). Now whereas A/(C\A) is derivable from an A (in a move known as Lifting), A/(C\B) is not; it would involve proving that B ⇒ A. There is a solution for this incompleteness, which involves reformulating *q* by way of a wrapping modality (Morrill 1994). However, since we will never need to introduce a *q* type in a derivation (all of them being lexically assigned), we will continue to use the *q* notation here.

2.3 An overgeneration problem

Though the preceding analysis gets the semantics right for BNPAs with regard to the adverbial meaning at the NP projection, there is an overgeneration problem. The deduction schema for q(A,B,C) in (12) allows an A to be derived after successful derivation of a B; however, this B might not be the first one that is derived after the qE step. This indeterminacy is deliberate, as it is what allows for different scopings in cases of multiple quantifiers. For BNPA nouns, though, we want the conversion to $(VP\backslash VP)\Uparrow S$ to occur at the first opportunity. Otherwise, it would be predicted that an $NP\Uparrow S$ such as *the fact that Kim cherishes each day* could act as an adverb. Similar difficulties are encountered in preventing quantifiers from scoping outside relative clauses, and to overcome them, Carpenter (1997) mentions using a unary modal operator (p. 240). This is the solution that will be pursued here.

We first introduce a sorted typing, along the lines of Moortgat and Oehrle (1994), in which any category A will have a sortal decoration *ordinary* or *special*. Next, we introduce the inclusion postulate in (15):

(15) Inclusion postulate
$A_{special} \rightarrow A_{ordinary}$

The final component of the analysis is to assign new categories to nominal modifiers and determiners, and a revision of the q category for BNPA nouns:

(16) Revised categories for nominal modifiers, determiners, and BNPA nouns, where i is either *ordinary* or *special*
- (a) Nominal modifiers: N_i/N_i, $N_i\backslash N_i$
- (b) Determiners: $(NP_i\Uparrow S)/N_i$
- (c) BNPA nouns: $q((VP\backslash VP)\Uparrow S, NP_{special}\Uparrow S, N_{special})$

With these categories in place, *the fact that Kim cherishes each day* would be ruled out as an adverb as follows. First, all other categories with N or NP as an input category are now understood to have $N_{ordinary}$ or $NP_{ordinary}$, respectively. The phrase *each day* would

have (after the ⇑E step) category $NP_{special}$, but in order to be parsed as part of *Kim cherishes each day*, this category would first have to become $NP_{ordinary}$ via the inclusion postulate in (15). Once this happens, the conversion to (VP\VP)⇑S can never take place. Having introduced this solution, though, for better readability we will omit the *ordinary* and *special* subscripts henceforward.

At this point, it may seem that we have gone to a lot of trouble, only to propose in the end that BNPA nouns be marked as special, and that this mark be propagated through category assignments to modifiers and determiners – much like the feature-passing analyses rejected earlier. The difference here is in the *q* category for BNPA nouns, which makes explicit how a BNPA noun will contribute its adverbial semantics to a sentence.

2.4 BNPA nouns in *wh*-NPs

Before concluding this section, one more fact needs to be addressed. Up until now, the behavior of BNPA nouns in *wh*-NPs has been ignored (except for the example in (xb)), but in fact, BNPA nouns can project adverbial *wh*-NPs, too. Examples are provided in (17):

(17) (a) What time did the plane arrive?
(b) What places in Russia have you lived?
(c) What way did Tom work the problem?

To cover these cases, the same approach will be used as above: the determiner (in this case, a *wh* determiner) will be taken as a complement, and the result will be a *wh* adverb phrase. That is, just as BNPA nouns as used in section 2 had the type ((Typ(N) → Typ(NP⇑S)) → Typ((VP\VP)⇑S)), or more simply, Typ(Det) → Typ(Adv⇑S), BNPA nouns as used in this section will have type Typ(Wh-Det) → Typ(Wh-Adv), where Wh-Det stands for whatever category we assign to the determiners *what, which* and *whose*, and Wh-Adv stands for whatever category we assign to *wh*-adverbs such as *where* and *when*.

The categories we will assign to the *wh* words are modified from those in Carpenter (1997), and are presented in (18) and (19):

(18) Categories and terms for *wh* words for direct questions

(a) *what, which*: $(S_w/(S_{inv}/NP))/N$: $\lambda P\lambda Q\lambda p.\exists x[P(x) \wedge p = {\wedge}Q(x)]$

(b) *whose*: $(S_w/(S_{inv}/NP))/N$: $\lambda P\lambda Q\lambda p.\exists xy[P(x) \wedge \mathbf{POSS}(x)(y) \wedge p = {\wedge}Q(x)]$

(19) Categories and terms for *wh* words for indirect questions

(a) *what, which*: $(S_{wc}/(S/NP))/N$: $\lambda P\lambda Q\lambda p.\exists x[P(x) \wedge p = {\wedge}Q(x)]$

(b) *whose*: $(S_{wc}/(S/NP))/N$: $\lambda P\lambda Q\lambda p.\exists xy[P(x) \wedge \mathbf{POSS}(x)(y) \wedge p = {\wedge}Q(x)]$

S_w is the category for direct *wh* questions, with type **Prop**→**Bool**, i.e., a set of propositions. **Prop** is the type for propositions, functions from world/time pairs to boolean values. S_{inv}/NP is the category assigned to inverted interrogatives that combine with a *wh*-NP to form a *wh*-interrogative, and has the same type as S/NP[1]. (For yes/no questions, the type will be S_y; though interrogatives with category S_{inv} are syntactically identical to those with S_y, the latter category maps to **Prop** → **Bool**.) The category S_{wc} is for embedded interrogatives, but maps to the type **Prop** → **Bool**, just as S_w does.

At this point, we can give a categorization for BNPA nouns appropriate for use with *wh* determiners. As before, we will use *day* as our sample BNPA noun:

(20) Category and term for sample BNPA noun *day*, for use in *wh*-NPs

(a) (nonembedded interrogatives)

day: $q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N)$:

$$\lambda\mathcal{D}_{WH}\lambda V_{VP\backslash VP\rightarrow S}\mathcal{D}_{WH}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$$

(b) (embedded interrogatives)

day: $q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N)$:

$$\lambda\mathcal{D}_{WH}\lambda V_{VP\backslash VP\rightarrow S}\mathcal{D}_{WH}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$$

The *q* categorization indicates that the BNPA noun acts as a normal noun until a *wh*-NP is projected, that is, until a $S_w/(S_{inv}/NP)$ or $S_{wc}/(S/NP)$ is projected. At this point, the $S_w/(S_{inv}/NP)$ or $S_{wc}/(S/NP)$ is replaced by a $S_w/(S_{inv}/(VP\backslash VP))$ or a $S_{wc}/(S/(VP\backslash VP))$. In other words, *what day* is no longer looking for a sentence with an NP gap, but a (possibly inverted) sentence with an adverbial gap, in order to form a *wh* question. The semantic terms are just as they were for the other categorization of the BNPA noun, except that the $\mathcal{D}$ variable now stands for a *wh* determiner instead of an ordinary determiner. A syntactic derivation of *what day they arrived* is shown in (21); the semantic derivation can be found in the Appendix.

(21) Syntactic derivation of *what day they arrived*

what:	*day*:		*they arrived*:
$(S_{wc}/(S/NP))/N$	$q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N)$		$S/(VP\backslash VP)$
	$\underline{\qquad\qquad\qquad\qquad\qquad\qquad}\,qE^1$		
	N		
$\underline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}$/E			
$S_{wc}/(S/NP)$			
$\underline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}$1			
$S_w/(S/(VP\backslash VP))$			
$\underline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}$/E			
S_{wc}			

This concludes the analysis of the first property of BNPA nouns, allowing them to act as ordinary nouns up to their NP (or more precisely, NP⇑S or $S_{wc}/(S/NP)$) projection, and then access the adverbial semantics wired into their lexical entry. The next step is to allow BNPA nouns to head non-*wh* adverbial relative clauses without preposition stranding.

3 PROPERTY 2: MODIFICATION BY NON-*WH* ADVERBIAL RELATIVE CLAUSES

3.1 The problem

As mentioned in the introduction, phrases like those in (22) (repeated from (3)) contain a BNPA noun that is modified by an adverbial relative clause (RC) introduced by *that* or ∅, without a stranded preposition at the end.

(22) (a) the {day, *occasion} (that) the music died
(b) the {place, *town} (that) I grew up
(c) every {way, *method} (that) Tom worked the problem

In these RCs, *that* cannot simply be treated as a relative pronoun like *who*, with category and term along the lines of $(N_i\backslash N_i)/(S/NP)$: $\lambda P\lambda Q\lambda x[P(x)\ \&\ Q(x)]$. First of all, we would need a different category: $(N_i\backslash N_i)/(S/(VP\backslash VP))$. That is, *that* combines with a sentence containing an adverbial gap[2] to form a postnominal modifier. However, if we were to write such an entry for *that*, we would need to include prepositional information in the semantic term: **in′** for locative and temporal adverbials; something else for manner adverbials. In other words, we would actually have to write several more entries for *that*, thus duplicating the information supplied by individual BNPA nouns and missing the generalization that we have been trying to capture all along. Moreover, we would be recreating the same problem seen in the null preposition analysis of section 1: nothing would prevent ordinary nouns from being modified by adverbial RCs headed by a *that* enriched with prepositional meaning.

Another problem is what to do with non-*wh* RCs introduced by ∅, since in these cases, there is no word upon which to pin any kind of combinatory semantic term. Of course, this is a general problem for both adverbial and nonadverbial non-*wh* RCs. The analysis that will be developed in this section covers both kinds of non-*wh* adverbial RCs, those introduced by *that* and those introduced by ∅, and thus suggests some interesting possibilities for the analysis of non-*wh* RCs in general.

3.2 Non-*wh* adverbial RCs as complements

Rather than try to include any prepositional meaning in *that,* I will take adverbial RCs introduced by *that* to be ordinary complementized sentences (with adverbial gaps). Similarly, I will take adverbial RCs introduced by ∅ to be ordinary sentences (again, with adverbial gaps). Thus, non-*wh* RCs will be of category S_c/(VP\VP) or S/(VP\VP)), where S_c is the category to be given to complementized sentences, and Typ(S_c) = Typ(S) = **Bool**.

The question now is how these RCs will be connected with the nouns they modify. The answer is that they will be selected as complements. In this way, the BNPA nouns have access to the semantics of these clauses, and can turn them into (what we have been calling) adverbial RCs. The category and term for the BNPA noun *day* taking this kind of complement is shown in (23):

(23) Category and term for sample BNPA noun with non-adverbial RC complement

day: $q((\mathrm{VP}\backslash\mathrm{VP})\Uparrow\mathrm{S}, \mathrm{NP}\Uparrow\mathrm{S}, \mathrm{N})/((\mathrm{S}_c\vee\mathrm{S})/(\mathrm{VP}\backslash\mathrm{VP}))$:

$$\lambda U\lambda\mathcal{D}\lambda V.\mathcal{D}\ (\lambda z.[\mathbf{day'}(z)\ \&\ U(\mathbf{on'}(z))])(\lambda z.V(\mathbf{on'}(z)))$$

Semantically, there are only two changes from (13): another variable U is abstracted; and the determiner's restriction argument is no longer just **day′**, but $(\lambda z.[\mathbf{day'}(z)\ \&\ U(\mathbf{on'}(z))])$. The variable U corresponds to the $(\mathrm{S}_c\vee\mathrm{S})/(\mathrm{VP}\backslash\mathrm{VP})$ argument, which is a (possibly complementized) sentence with an adverbial gap. The ∨ constructor is known as the disjunction constructor, introduced by Lambek (1961). Its interpretation and rules of introduction are given in (24) and (25). (The rule of elimination is omitted, since it is messy to present in natural deduction style, and is not needed for this analysis.)

(24) Interpretation of A∧B

$v(\mathrm{A}\vee\mathrm{B}) = \{\ x \mid x \in v(\mathrm{A}) \vee x \in v(\mathrm{B})\ \} = v(\mathrm{A}) \cup v(\mathrm{B})$

(25) Introduction rules for ∨

(semantically inactive; adapted from Morrill 1994: p. 166)

$$\frac{A:\ \alpha}{A \vee B:\ \alpha}\vee_1 I \qquad \frac{B:\ \alpha}{A \vee B:\ \alpha}\vee_2 I$$

The semantics of these rules is actually simplified from the general case, which is more complex than is necessary for our purposes. In the general case, A and B will be associated with different types and semantic terms. In our case, however, since $Typ(S_c) = Typ(S)$, and since there will be no semantic difference between a sentence and the same sentence introduced by *that*, we can use Morrill's "semantically inactive" version of the rules seen in (25), where the term α is unchanged, even when the category A or B is weakened to $A \vee B$.

For some speakers, similar categorizations will be needed for BNPA nouns in *wh*-NPs, to allow for interrogatives such as:

(26) What day that it rained did we cancel the picnic?

3.3 Objections to a complement analysis of non-*wh* adverbial RCs

One argument (brought up by an anonymous reviewer) against having RCs of any kind as complements is the prediction that they will always be adjacent to their head noun. This, of course, is not borne out, as seen in the examples below and in many instances of extraposed RCs:

(27) (a) a place in Paris that we stayed during our vacation
(b) the day in March that the visitor arrived
(c) no way in hell to succeed

Larson's sentence (6), repeated here as (28), is another example: the RC *that John spent sleeping* (which we are still assuming to be a modifier, with category N\N) intervenes between *hours* and the supposed complement *that he was supposed to have been on watch.*

(28) The hours that John spent sleeping that he was supposed to have been on watch nearly cost him his stripes.

However, there are other cases of complement extraposition; to give just one example, there are sentences like (29):

(29) She said loudly that she had to go to the bathroom.

An analysis for nonadjacent complements is developed in Moortgat and Oehrle (1994). Thus, this objection is not fatal for a complement analysis of non-*wh* adverbial RCs.

Another argument against having RCs as complements is their iterability (also brought up by an anonymous reviewer). In our case, if these adverbial RCs are indeed complements, we should expect them not to be iterable. This expectation is not met, as (30) illustrates:

(30) that place we stayed that we had so much fun

This issue will be addressed in section 4.

In this and the preceding section, the necessary categories for the various usages of BNPA nouns have been described. The task now is to relate these categories to each other, and capture the generalization that any noun with Property 1 also has Property 2.

4 PUTTING THE PROPERTIES TOGETHER

4.1 Category overview

Ignoring for the moment BNPA nouns in *wh*-NPs, we have so far three categories for any BNPA noun. First, of course, there is the plain N category. With this category, a BNPA noun can do all the things an ordinary noun can do. Thus, sentences such as (5d),

repeated here as (31d), are licensed. Second, there is the *q*((VP\VP)⇑S, NP⇑S, N) category, which allows a BNPA noun to project an NP⇑S that can convert to an adverbial phrase of category (VP\VP)⇑S (Property 1). This category would license sentences such as (31b), the mixed case where *place* is modified by an ordinary RC, but where the NP *every place that you recommended* acts as an adverb. Third, we have the *q*((VP\VP)⇑S, NP⇑S, N)/((S$_c$∨S)/(VP\VP)) category, which allows for modification by non-*wh* adverbial RCs (Property 2). This category would license sentence (31a), where *day* is modified by such an adverbial RC, and where the projected phrase *the day the music died* acts as an adverbial phrase.

(31) (a) Something touched me deep inside the day the music died.
(b) We stayed every place that you recommended.
(c) I remember the day the music died.
(d) I remember the day that we spent on the lake.

However, we still have no way of generating (31b), where *day* is modified by a non-*wh* adverbial RC, but is used as an ordinary noun in the matrix clause. Therefore, we need one final category for BNPA nouns: N/((S$_c$∨S)/(VP\VP)). The noun *day* is given as an example in (32), summarizing the four categorizations and terms needed for it:

(32) Four categories and terms needed for sample BNPA noun *day*
(a) N: **day′**
(b) N/((S$_c$∨S)/(VP\VP)): $\lambda U \lambda z.[\mathbf{day'}(z) \,\&\, U(\mathbf{on'}(z))]$
(c) *q*((VP\VP)⇑S, NP⇑S, N): $\lambda \mathcal{D} \lambda V.\mathcal{D}\ (\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$
(d) *q*((VP\VP)⇑S, NP⇑S, N)/((S$_c$∨S)/(VP\VP)):
$\lambda U \lambda \mathcal{D} \lambda V.\mathcal{D}\ (\lambda z.[\mathbf{day'}(z) \,\&\, U(\mathbf{on'}(z))])(\lambda z.V(\mathbf{on'}(z)))$

In addition to the categories in (32), we will also need corresponding categories for BNPA nouns in *wh*-NPs.

(33) Additional categories and terms needed for use in *wh*-NPs

(a) (nonembedded interrogative)

$q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N)$:

$$\lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$$

(b) (nonembedded interrogative)

$q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N)/((S_c\vee S)/(VP\backslash VP))$:

$$\lambda U\lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\lambda z.[\mathbf{day'}(z) \,\&\, U(\mathbf{on'}(z))])(\lambda z.V(\mathbf{on'}(z)))$$

(c) (embedded interrogative)

$q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N)$:

$$\lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$$

(d) (embedded interrogative)

$q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N)/((S_c\vee S)/(VP\backslash VP))$:

$$\lambda U\lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\lambda z.[\mathbf{day'}(z) \,\&\, U(\mathbf{on'}(z))])(\lambda z.V(\mathbf{on'}(z)))$$

4.2 Lexical rules

At this point, we need to formalize the relationship between these categorizations of a BNPA noun. This will be done via lexical rules. We will begin by considering only the categories in (32), ignoring BNPA nouns in *wh*-NPs. Our starting point will be the category $q((VP\backslash VP)\hat{\uparrow}S, NP\hat{\uparrow}S, N)$. The generalization that we want to capture is that any word with this category will also have the categories shown in (32b, d); that is, it can take an adverbial RC complement. Thus, we might write two lexical rules, as in (34):

(34) Adverbial RC addition lexical rules for BNPA nouns (preliminary)

(a) $q((VP\backslash VP)\hat{\uparrow}S, NP\hat{\uparrow}S, N) \Rightarrow q((VP\backslash VP)\hat{\uparrow}S, NP\hat{\uparrow}S, N)/((S_c\vee S)/(VP\backslash VP))$

(b) $q((VP\backslash VP)\hat{\uparrow}S, NP\hat{\uparrow}S, N) \Rightarrow N/((S_c\vee S)/(VP\backslash VP))$

There is a problem, however, when we try to spell out the semantic portion of these rules. As can be seen by comparing the terms in (32c) and (32d), the main difference between them is the extra information in the restriction argument for $\mathcal{D}$. The

problem is that the lambda calculus does not allow us to reach into the term in (32c) and pull out this restriction argument in order to assemble the semantic term in (32d). The term we want is easily accessible in (32a), of course, but we cannot write a lexical rule with a simple N as input; this would allow any noun to become a BNPA noun.

The solution proposed here is to have the N and $q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N)$ categories in a single lexical entry for *day*, with both associated terms listed and accessible. There is a category constructor that allows us to do just this: the conjunction connective $\wedge$, the dual of $\vee$. The interpretation and rules of inference for $\wedge$ are given in (35) and (36).

(35) Interpretation of $A \wedge B$

$v(A \wedge B) = \{ x \mid x \in v(A) \,\&\, x \in v(B) \} = v(A) \cap v(B)$

(36) Rules of inference for $\wedge$
(adapted from Carpenter 1997: p. 191)

$$\frac{\begin{array}{c}\vdots\\ A \wedge B:\ \alpha\end{array}}{A:\ \pi_1(\alpha)}\wedge_1 E \qquad \frac{\begin{array}{c}\vdots\\ A \wedge B:\ \alpha\end{array}}{B:\ \pi_2(\alpha)}\wedge_2 E \qquad \frac{\begin{array}{cc}\Gamma & [\Gamma]^n\\ \vdots & \vdots\\ A:\ \alpha & B:\ \beta\end{array}}{\langle\alpha,\beta\rangle:\ A \wedge B}\wedge I^n$$

As defined in (35), expressions of category $A \wedge B$ are in the intersection of the sets of expressions of type A and expressions of type B. The rules of elimination ($\wedge_1 E$ and $\wedge_2 E$) state that a given element with category $A \wedge B$ and semantics α can be considered an A or a B. α will be an ordered pair of semantic terms, the first element of which, $\pi_1(\alpha)$, corresponds to the A, and the second element of which, $\pi_2(\alpha)$ corresponds to the B. The rule of introduction states that if the categories A and B can each be derived from the same sequence Γ, then Γ can be given category $A \wedge B$, and its semantic term will be the ordered pair comprising the semantic terms for the A and the B. (The notation is confusing, since brackets ordinarily indicate a hypothesized expression in a particular

location in a string, but here [Γ] indicates an entire sequence of expressions, and in the presentation, it is arbitrarily placed to the right of Γ.)

Using the conjunction connective, the category and term for our sample BNPA noun would be as in (37):

(37) Conjunctive category and term for sample BNPA noun *day*

N ∧ *q*((VP\VP)⇑S, NP⇑S, N): ⟨ **day′**, λ𝒟λ*V*.𝒟 (**day′**)(λ*z*.*V*(**on′**(*z*))) ⟩

With this category, everything that was derivable with the unconjoined N or *q*((VP\VP)⇑S, NP⇑S, N) categories is still derivable; the only difference in the derivations will be the presence of a ∧E step to discard one or the other categories as appropriate. And now it is possible to express the desired semantics, in a single lexical rule. The lexical rule in (38) will add an argument slot for a non-*wh* adverbial RC, and the output can be used either as an N or as a *q*((VP\VP)⇑S, NP⇑S, N).

(38) Adverbial RC addition lexical rule for BNPA nouns (final)

N ∧ *q*((VP\VP)⇑S, NP⇑S, N): α ⇒

(N ∧ *q*((VP\VP)⇑S, NP⇑S, N))/((S$_c$∨S)/(VP\VP)):

λ*U*⟨ λ*z*.[π1α(*z*) & *U*(**prep**(*z*))],

λ𝒟λ*V*.𝒟 (λ*z*.[π1α(*z*) & *U*(**prep**(*z*))])(λ*z*.*V*(**prep**(*z*))) ⟩

To illustrate, α for *day* would be the term in (37), and π1α would be **day′**. Thus, lexical rule (38) would generate the following category and term for *day*, for when non-*wh* adverbial RCs modify it:

(39) Conjunctive category and term for sample BNPA noun *day*,

with argument slot for non-*wh* adverbial RC

(N ∧ *q*((VP\VP)⇑S, NP⇑S, N))/((S$_c$∨S)/(VP\VP)):

λ*U*⟨ λ*z*.[**day′**(*z*) & *U*(**prep**(*z*))],

$\lambda\mathcal{D}\lambda V.\mathcal{D}\ (\lambda z.[\mathbf{day'}(z)\ \&\ U(\mathbf{prep}(z))])(\lambda z.V(\mathbf{prep}(z)))\rangle$

One loose end needs to be tied up here: the abbreviation **prep**. It has been used instead of **on′** or **in′** or some other preposition for sake of generality. An immediate objection to this formulation is that it suffers from the same problem seen in the rejected "null preposition" analyses discussed earlier. However, the problem is alleviated by the fact that this is a LEXICAL rule. It is a well known fact about lexical rules that they do not always completely determine the meanings of their outputs. Words generated by lexical rule often accrue elements of meaning that are not predictable from the rule; an often cited case is the word *readable*, which does not mean simply 'capable of being read,' but something more like, 'easy to read.' In this case, it is reasonable to imagine that a lexical rule would generate a BNPA noun taking an adverbial RC complement with an as-yet-unspecified prepositional meaning, and that a speaker would supply the most logical prepositional meaning – i.e., the one present in the input semantics.

Lexical rules parallel to (38) could add argument slots for non-*wh* adverbial RCs to BNPA nouns in *wh*-NPs; the categorial portions of these rules are shown in (40).

(40) Adverbial RC addition lexical rules for BNPA nouns in *wh*-NPs

(a) (nonembedded interrogative)

$N \wedge q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N) \Rightarrow$

$(N \wedge q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N))/((S_c\vee S)/(VP\backslash VP))$

(b) (embedded interrogative)

$N \wedge q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N) \Rightarrow$

$(N \wedge q(S_{wc}/(S/(VP\backslash VP)), S_{wc}/(S/NP), N))/((S_c\vee S)/(VP\backslash VP))$

To generalize the lexical rules in (38) and (40), we could write a lexical rule schema as in (41):

(41) Generalized adverbial RC addition lexical rule schema for BNPA nouns

$N \wedge q(X,Y,N) \Rightarrow (N \wedge q(X,Y,N))/((S_c\vee S)/(VP\backslash VP))$,

where $Typ(X) = ((Typ(VP\backslash VP) \rightarrow Typ(S)) \rightarrow Typ(S_i)$,

$$\text{Typ(Y)} = ((\text{Typ(NP)} \rightarrow \text{Typ(S)}) \rightarrow \text{Typ}(S_i),$$
$$\text{and } S_i \in \{S, S_w, S_{wc}\}$$

Thus, in the category $q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N)$, $X = (VP\backslash VP)\Uparrow S$, which clearly meets the description in (39); likewise, $Y = NP\Uparrow S$, satisfying the description. In the category $q(S_w/(S_{inv}/(VP\backslash VP)), S_w/(S_{inv}/NP), N)$, $X = S_w/(S_{inv}/(VP\backslash VP))$, and since $\text{Typ}(S_{inv}) = \text{Typ(S)}$ and $S_w \in \{S, S_w, S_{wc}\}$the requirement of (39) for X is met. Here, $Y = S_w/(S_{inv}/NP)$, which satisfies the requirement of (39) for Y. Finally, for the category $q(S_{wc}/(S_{inv}/(VP\backslash VP)), S_{wc}/(S/NP), N)$, $X = S_{wc}/(S_{inv}/(VP\backslash VP))$; since $S_{wc} \in \{S, S_w, S_{wc}\}$, the requirement for X is met. In this category $Y = S_{wc}/(S/NP)$, meeting the requirement for Y.

A syntactic derivation of *place (that) we stayed* is shown in (42), using the category from (39); the semantic derivation can be found in the Appendix. Also, the line labeled $\vee$I would be more specifically labeled $\vee_1$I or $\vee_2$I, depending on whether $S_c \vee S$ is being derived from a S_c or an S. The step labeled with an asterisk would be omitted if *that* did not appear. Finally, *we stayed* is derived as having an adverbial gap by making use of the hypothetical reasoning available in (Lambek-style) categorial grammars, hypothesizing a VP\VP and withdrawing the assumption at the step labeled $/I^1$.

(42) Derivation of *place (that) we stayed*

place	*(that)*	*we*	*stayed*	[VP\VP]^1	
$(N \wedge q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N))/((S_c \vee S)/(VP\backslash VP))$	S_c/S	NP	VP		
			VP		\E
		S			\E
	S_c				/E*
	$S_c \vee S$				$\vee$I
	$(S_c \vee S)/(VP\backslash VP)$				$/I^1$
$N \wedge q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N)$					/E

A temptation offered by this unified treatment of adverbial RCs introduced by *that* and by ∅ is to attempt to cover all non-*wh* RCs this way, adverbial and nonadverbial alike. That is, they are all optionally complementized sentences containing some kind of gap, and are complements, not modifiers. In fact, this is not a new proposal. In a survey of a century's worth of literature on this hypothesis, Van der Auwera (1985) credits Jespersen with first expressing it, in an 1885 grammar textbook. However, there are enough obstacles to a complement analysis of non-*wh* nonadverbial RCs that I will not promote such an analysis here, and will maintain only the claim stated above: that non-*wh* adverbial RCs are taken as complements.

4.3 Extension of the analysis to infinitival adverbial relative clauses

Although we have not discussed this point until now, the second property of BNPA nouns is true for infinitival as well as finite adverbial RCs, as exemplified in (43):

(43) (a) a place (for Kim) to stay
(b) a good day (for me) to die
(c) no way (for anyone) to treat a lady
(d) every reason (for them) to believe that Robin is a spy

The analysis in the previous section easily extends to these infinitival adverbial RCs. Rather than attempt to give infinitives with adverbial gaps category N\N, we will take them as complements. Here we will assume that *for* is a complementizer, with meaning $\lambda X.X$, and that *to* is of category VP_{inf}/VP, with meaning $\lambda P \lambda x[\Diamond P(x)]$. The $\Diamond$ is the modal operator for possibility, indicating that the action in an infinitive does not necessarily take place. The lexical entries are summarized in (44):

(44) Lexical entries for *for* and *to* for infinitives
for: $S_{c\text{-}inf}/S_{inf}$: $\lambda X.X$
to: VP_{inf}/VP: $\lambda P \lambda x[\Diamond P(x)]$

To add the appropriate arguments, a lexical rule parallel to that in (38) is given in (45); however, it is divided into two rules, one for complementized infinitives, and one for uncomplementized ones.

(45) Adverbial infinitival RC addition lexical rules for BNPA nouns

(a) With infinitival subject

$N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N): \alpha \Rightarrow$

$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/(S_{c\text{-}inf}/(VP\backslash VP))$:

$\lambda U\langle \lambda z.[\pi 1\alpha(z) \,\&\, U(\mathbf{prep}(z))],$

$\lambda\mathcal{D}\lambda V.\mathcal{D}\,(\lambda z.[\pi 1\alpha(z) \,\&\, U(\mathbf{prep}(z))])(\lambda z.V(\mathbf{prep}(z)))\rangle$

(b) Without infinitival subject

$N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N): \alpha \Rightarrow$

$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/(VP_{inf}/(VP\backslash VP))$:

$\lambda U\langle \lambda z.[\pi 1\alpha(z) \,\&\, \exists y.U(\mathbf{prep}(z))(y)],$

$\lambda\mathcal{D}\lambda V.\mathcal{D}\,(\lambda z.[\pi 1\alpha(z) \,\&\, \exists y.U(\mathbf{prep}(z))])(\lambda z.V(\mathbf{prep}(z))(y))\rangle$

As with the finite non-*wh* RCs, there is a temptation to extend this analysis to cover all infinitival non-*wh* RCs, but as before, I will leave open the question of non-*wh* nonadverbial RCs as complements.

4.4 Summary and evaluation

The categorial portions of the lexical rules that have been introduced are summarized below:

(46) Non-*wh* adverbial RC addition lexical rules for BNPA nouns

(a) Finite adverbial RCs

$N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N) \Rightarrow$

$$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/((S_c\vee S)/(VP\backslash VP))$$

(b) Infinitival adverbial RCs (with *for*)

$$N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N) \Rightarrow$$
$$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/(S_{c\text{-}inf}/(VP\backslash VP))$$

(c) Infinitival adverbial RCs (without *for*)

$$N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N) \Rightarrow$$
$$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/(VP_{inf}/(VP\backslash VP))$$

A question brought up in section 3 was the false prediction that these adverbial RCs could not iterate. To allow multiple non-*wh* adverbial RCs, we need for (46a) to be allowed to apply to its own output, so that more than one complement can be added. (The other rules cause no problem, since infinitivial adverbial RCs do not seem to iterate.) Put differently, we want the eligible input to be any lexical item whose result category after taking any number of complements is $N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N)$. Such a lexical rule is quite easily written in a system such as HPSG, where the input specification is just a description that must subsume the description of any actual input. For the rules in (46), however, the category specification for the input is the exact category that the input must have.

Carpenter (1995) uses a $-notation taken from Ades and Steedman (1982) to get the effect we want; using this notation, we could write (46a) as (47):

(47) Lexical rule to allow iteration of finite adverbial RCs (preliminary)

$$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))\$ \Rightarrow$$
$$(N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))\$/((S_c\vee S)/(VP\backslash VP))$$

A category A$ abbreviates an infinite disjunction of all the categories whose ultimate result category is A. Formally, then, (47) is not a single lexical rule, but something more like a schema for lexical rules. Keeping this distinction in mind, however, such a solution could work. It requires a final adjustment, though: only RCs introduced by *that* are iterable; those introduced by are ∅ not, as discussed in Sag (1997). Assuming that

this fact is not simply extragrammatical (a possibility that Sag mentions), it could be described by keeping (46a) as it is, and writing a rule schema like (47), which adds argument slots for *that* adverbial RCs to BNPA nouns that already have at least one argument slot for a *that*- or ∅-adverbial RC:

(48) Lexical rule to allow iteration of finite adverbial RCs (final)

$((N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/((S_c\vee S)/(VP\backslash VP)))\$ \Rightarrow$

$((N \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N))/((S_c\vee S)/(VP\backslash VP)))/(S_c/(VP\backslash VP))$

4.5 The case of *reason*

As mentioned earlier, the set of BNPA nouns and the set of nouns that can head non-*wh* adverbial RCs without preposition stranding are not entirely the same. The data in (4), showed *reason* to be in the latter set, but not the former. For unique cases like these, the solution is simply to assign the appropriate category and semantics directly. There is no need for the kind of lexical rule seen in the previous sections, since it is not a whole class of words that exhibits this pattern. Thus, for *reason* we would have an ordinary lexical entry with category N, and an entry with category $N/((S_c\vee S)/(VP\backslash VP))$ to allow for *the reason (that) Kim fired Robin*. We would also have entries with categories $N/(S_{c\text{-}inf}/(VP\backslash VP))$ and $N/(VP_{inf}/(VP\backslash VP))$, to allow for *reason (for Kim) to fire Robin.*

Another example of a word with Property 2 but not Property 1 is *spot*, as illustrated in (49):

(49) (a) Kim found a spot to sit

(b) *Kim sat every spot in the room.

Interestingly, *spot* is even more discriminating than *reason*, in that it allows only infinitival adverbial RCs to follow it. However, full Property 2 possibilities may be in some speakers' grammars, as evidenced in the following attestation:

(50) … trying to triangulate the exact spot that Mary stood.
(National Public Radio commentator, spring 2001)

5 OTHER EXTENSIONS TO THE ANALYSIS

5.1 Plural BNPA nouns

Plural forms are often described by means of a pluralization lexical rule, whose categorial portion would be something like:

(51) Noun pluralization lexical rule (phonological portion omitted)
$N_{sing} \Rightarrow N_{pl}$

However, now that we have a category other than N_{sing} for BNPA nouns (specifically $N \wedge q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N)$), the claim would seem to be that BNPA nouns cannot undergo this rule. Certainly, plural forms such as *places, days, ways* exist, but the analysis as currently articulated would have these forms listed in the lexicon without being related to the corresponding singular forms by the rule in (51).

To overcome this counterintuitive state of affairs, one might rethink the formalization of lexical rules, so that if the input category is specified as A, any word with category B such that $v(B) \subseteq v(A)$ could undergo the rule. Thus, since $v(A \wedge B) \subseteq v(A)$, a word with category $A \wedge B$ can undergo a lexical rule requiring an A, and in particular, a word with category $N_{sing} \wedge q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N_{sing})$ can undergo the pluralization lexical rule. However, the output category would still be a problem. If a BNPA noun undergoes the pluralization rule, the prediction is that as a plural, the noun will not have its ability to project an adverbial NP. It will simply be an N_{pl}. Therefore, this solution will not work, given sentences such as (52):

(52) We don't go out much these days.

Instead, we will just introduce another lexical rule for pluralization of BNPA nouns, as in (53):

(53) BNPA noun pluralization lexical rule (phonological portion omitted)

$N_{sing} \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N_{sing}) \Rightarrow N_{pl} \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N_{pl})$

A similar rule will be needed for plural BNPA nouns in *wh* phrases.

Having settled on a means of allowing plural BNPA nouns, we now address the issue of whether plural BNPA nouns can serve as bare-plural NPs. Here we have a terminology conflict, with 'bare' meaning 'sans preposition' for bare-NP adverbials, and 'sans determiner' for bare-plural NPs. The basic question, though, is whether sentences like (54) should be licensed:

(54) We go to church Sundays.

Carpenter (1995) proposes the following lexical rule for bare-plural NPs:

(55) Bare-plural NP lexical rule (adapted from Carpenter 1995, (116))

$N_{pl}\$ \Rightarrow NP_{pl}\$$

As before, if we allow (plural) BNPA nouns to undergo this rule, we would predict that the output will not be able to serve as an adverbial phrase, but will be merely an NP_{pl}. For speakers who find (55) ungrammatical, nothing further need be said. For speakers who find (55) grammatical, we will need a separate bare-plural NP rule for BNPA nouns:

(56) Bare-plural NP lexical rule for BNPA nouns

$N_{pl} \wedge q((VP\backslash VP)\hat{\Uparrow}S, NP\hat{\Uparrow}S, N_{pl}) \Rightarrow NP_{pl} \wedge q((VP\backslash VP), N_{pl}, N_{pl})$

This rule states that given a plural BNPA noun (for example, *Sundays*), the lexicon will also contain a homophonous form which can be either an ordinary bare plural NP, or something of category $q((VP\backslash VP), N_{pl}, N_{pl})$. This category indicates that the word can act as a plural N, and when a plural N phrase is derived (perhaps by modification, perhaps trivially), the phrase can be converted to an adverbial phrase. Note that the $ is not needed here. To derive a phrase such as *rainy days* as a bare-plural BNPA, *rainy* would undergo the bare-plural NP rule in (55), while *days* would need only its $q((VP\backslash VP)\Uparrow S, NP\Uparrow S, N_{pl})$ category.

There seems to be more variation among speakers in judgments for bare-plural BNPA nouns, as well as more variation in exactly which words are acceptable, and in which positions. For example, (54) is not grammatical for everyone, and even those who find it grammatical might not like a similar sentence with a different BNPA noun, such as (57):

(57) *We have recess in the cafeteria rainy days.

But if the BNPA is fronted, the sentence becomes much better:

(58) ?Rainy days, we have recess in the cafeteria.

This, though, might be usage as a BNPA noun at all, but just something like the topic-comment constructions seen in sentences like:

(59) Every flight I take, they lose my luggage!

For these speakers, BNPA nouns that are acceptable as bare plurals should perhaps be listed separately, and not summed up by a lexical rule.

5.2 Neutralization possibilities

Neutrality, or *neutralization,* is the term used when an expression is required to be parsed in two different ways simultaneously (without the effect of zeugma). Much has been written recently about neutralization involving morphosyntactic features, such as case, number or gender. The best known examples of this kind of neutralization were first collected in Pullum and Zwicky (1986), and involve coordination of unlikes, as in the following sentence from German:

(60) (from Pullum and Zwicky 1986, (40))

Er	*findet*	*und*	*hilft*	*Frauen*.
He	finds	and	helps	women (acc/dat)

In this example, *findet* governs the accusative case, while *hilft* governs the dative. Consequently, a coordination like this one usually is not grammatical. Here, though, *Frauen* coincidentally has the same form for the accusative and dative plural, and the sentence is grammatical. In other words, the accusative and dative plural forms for this word are *neutralized*.

Johnson & Bayer (1995) propose an analysis employing the conjunction connective handle these cases of neutralization. Their analysis simply treats features (in the German example, case) at the same level as syntactic category, and allows conflicting feature values to be assigned to a single expression. Thus, *Frauen* would be categorized as NP$\wedge$*acc*$\wedge$*dat*. In most situations where it is used, an $\wedge$E step will eliminate either *acc* or *dat* as appropriate. In (60), however, the conjoined VP *findet und hilft* is looking for an argument of category NP$\wedge$*acc*$\wedge$*dat*, and the conflicting case values never need to be resolved.

With a few modifications, our analysis of BNPA nouns can be extended to allow for neutralization at the category level, in the same way that Johnson and Bayer propose to handle neutralization at the morphosyntactic level. We will examine the possibilities for neutralization with respect to Property 1 and Property 2 in turn.

5.2.1 Property 1

A neutralization involving Property 1 would require an NP to be parsed as both NP and VP\VP simultaneously, as in (61) (due to Nathan Vaillette):

(61) *Kim liked and lived every place.

In an earlier version of our analysis, (61) was derivable, with *place* assigned the category N∧(NP/N)\(VP\VP), as shown in (62):

(62) Derivation of **like and live every place*; X = VP/(NP∧(VP\VP))

PART A:

like	[NP∧(VP\VP)]^1		*and*	*live*	[NP∧(VP\VP)]^2		
VP/NP	——————∧E		(X\X)/X	VP	——————∧E		
	NP				VP\VP		
——————————/E				——————\E			
VP				VP			
——————————/I^1				——————/I^2			
VP/(NP∧(VP\VP))				VP/(NP∧(VP\VP))			
			——————————/E				
			X\X				
——————————————————————————\E							
VP/(NP∧(VP\VP))							

PART B:

every	*place*			[NP/N	N ∧ (NP/N)\(VP\VP)]^3		
NP/N	N ∧ (NP/N)\(VP\VP)				——————∧E		
	——————∧E				(NP/N)\(VP\VP)		
	N						
——————————/E				——————————\E			
NP				VP\VP			
——————————————————————————∧I^3							
NP ∧ (VP\VP)							

PART C:

like and live	*every place*
VP/(NP ∧ VP\VP)	NP ∧ (VP\VP)
——————————/E	
VP	

In the current analysis, however, (61) is not generated. **Review proof search to make sure this is true.** At first, this seems desirable, but for some speakers, sentences such as those in (63) are at least marginally acceptable:

(63) (a) I've lived and visited many places in this great state of Ohio.
(b) What places in Ohio have you spent time in or lived?

For speakers who allow sentences like those in (63), we need a slightly altered categorization for BNPA nouns; one possibility is shown in (64):

(64) *day*: $q((\text{NP}\wedge(\text{VP}\backslash\text{VP}))\Uparrow\text{S}, \text{NP}\Uparrow\text{S}, \text{N})$:
$\lambda\mathcal{D}\lambda V_{(\text{NP}\times\text{VP}\backslash\text{VP})\rightarrow\text{S}}\mathcal{D}\ (\mathbf{day'})(\lambda z.V\langle z, \mathbf{on'}(z)\rangle)$

An analogous category would also be needed in order to allow for the *wh* phrase *what places*. A syntactic derivation of *live and visit many places* is shown in (65); the semantic derivation can be found in the Appendix.

(65) Derivation of *live and visit many places*; X = VP/(NP∧(VP\VP))

$$\dfrac{\dfrac{\text{live and visit:}\ \text{VP}/(\text{NP}\wedge\text{VP}\backslash\text{VP}) \qquad \dfrac{\dfrac{\dfrac{\text{many}\ (\text{NP}\Uparrow\text{S})/\text{N} \qquad \dfrac{\text{places}\ q((\text{NP}\wedge(\text{VP}\backslash\text{VP}))\Uparrow\text{S}, \text{NP}\Uparrow\text{S}, \text{N})}{\text{N}}\,q\text{E}^1}{\text{NP}\Uparrow\text{S}}/\text{E}}{(\text{NP}\wedge(\text{VP}\backslash\text{VP}))\Uparrow\text{S}}\,3}{\text{NP}\wedge(\text{VP}\backslash\text{VP})}\,\Uparrow\text{E}}{\text{VP}}/\text{E}$$

This revised category would have to be in addition to the (N $\wedge$ *q*((VP\VP)⇑S, NP⇑S, N)) category, though, since the latter is still needed for the adverbial RC addition lexical rules.

5.2.2 Property 2

With respect to the second property, consider the following attestation, in which *place* heads a coordinated nonadverbial and adverbial relative clause (*he loved and felt comfortable*):

(66) He decided to remain because it was a place he loved and felt comfortable.
(Warren, Rich. Ghost stories: an old friend drops in for a séance. *Columbus (Ohio) Alive*, 4 Nov. 1999, p. 10)

As pointed out by an anonymous reviewer, the analysis presented in the earlier sections will not license this sentence. For (66) to be grammatical under the assumptions made about adverbial RCs earlier, *he loved and felt comfortable* would be a complement to *place*. However, our lexical rule for adding adverbial RC complements adds an argument of category S/(VP\VP), and therefore, *place* would have category (N $\wedge$ *q*((VP\VP)⇑S, NP⇑S, N))/(S/(VP\VP)) here. But *he loved and felt comfortable* will have category S/(NP$\wedge$(VP\VP)), just as *like and live* did in Part A of derivation (62). Therefore, in order for *place* and *he loved and felt comfortable* to combine, we need to be able to derive *place* as having category *q*((VP\VP)⇑S, NP⇑S, N))/(S/(NP$\wedge$(VP\VP))). To see the problem more clearly, let us think of *q*((VP\VP)⇑S, NP⇑S, N) as A; S as B; NP as C; and VP\VP as D. What we are trying to prove is that A/(B/(C$\wedge$D)) is derivable from A/(B/D). This is not a theorem in the Lambek calculus. The failed proof in (67), while not a complete proof search, indicates the basic problem that all proof attempts encounter: at some point C$\wedge$D must be derived from D, which is not allowed since *v*(D) is not a subset of *v*(C$\wedge$D).

(67) Attempted proof that A/(B/D) $\Rightarrow$ A/(B/(C$\wedge$D))

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{B \Rightarrow B}\,Ax \quad \dfrac{\dfrac{\text{FAIL}}{D \Rightarrow C}}{D \Rightarrow C \wedge D}\,\wedge R}{B/(C \wedge D),\ D \Rightarrow B}\,/L}{B/(C \wedge D) \Rightarrow B/D}\,/R \quad \dfrac{}{A \Rightarrow A}\,Ax}{A/(B/D),\ B/(C \wedge D) \Rightarrow A}\,/L}{A/(B/D) \Rightarrow A/(B/(C \wedge D))}\,/R$$

On the one hand, this is a desirable result, since Rich Warren is the only one who seems to have this kind of neutralization, assuming the sentence is not just an editing error. On the other hand, if this sentence is truly grammatical in Warren's dialect, how would it be licensed? The simplest amendment to the analysis as presented would be to change the adverbial RC addition lexical rule to add an argument of category S/(NP∧(VP\VP)), instead of S/(VP\VP):

(68) Non-*wh* adverbial RC addition lexical rule for BNPA nouns,
for dialects that allow (66)

$$N \wedge q((VP\backslash VP)\Uparrow S,\ NP\Uparrow S,\ N) \Rightarrow$$
$$(N \wedge q((VP\backslash VP)\Uparrow S,\ NP\Uparrow S,\ N))/((S_c \vee S)/(NP \wedge (VP\backslash VP)))$$

Depending on one's analysis of parasitic gaps, this lexical rule might also be in the grammar of speakers who accept phrases such as the following (suggested by an anonymous reviewer):

(69) ?the place that the spies met without bothering to properly secure

Here, the RC containing a parasitic gap would presumably have category $S_c/(NP \wedge (VP\backslash VP))$.

The rule in (68) would still work for noncoordinated RCs; for example, if we were just deriving *place that he felt comfortable*, the phrase *that he felt comfortable* would have category S_c/(VP\VP), but could easily be strengthened to S_c/(NP∧(VP\VP)): Although we cannot derive A/(B/(C∧D)) from A/(B/D), we can certainly derive B/(C∧D) from B/D. Likewise, this lexical rule would work for nonadverbial RCs, too. If we were just deriving *place that he loved*, the S_c/NP for *that he loved* could be strengthened to S_c/(NP∧(VP\VP)). So in this speaker's grammar, the RCs-as-complements approach extends to nonadverbial RCs, but only for BNPA nouns. Once again, the question arises about whether (in this speaker's grammar, at least) all non-*wh* RCs could be taken as complements, since it is easy to imagine a lexical rule parallel to (68) existing for ordinary nouns. Nevertheless, I will leave this an open question.

5.2.3 Significance

The sentences in (63) and (66) are especially interesting in light of recent debate concerning neutralization. It has been claimed (Bayer 1996, Heylen 1996, 1999) that neutralization does not happen when there is a semantic difference between the two (or more) senses of a word, in other words, that neutralization is always *semantically inactive*. The best known example of where *semantically active* neutralization might be argued to happen is in sentences such as (70):

(70) (Sag et al. 1988, (2b))
Pat is a Republican and proud of it.

Here, the copula seems to be simultaneously parsed with the categories and terms indicated in (71):

(71) Different categories and terms for *is*
(a) VP/NP: $\lambda x \lambda y.x=y$
(b) VP/AP: $\lambda P \lambda y.P(y)$

Bayer (1996) manages to explain away sentences like (70) by invoking the well-known type-shifting of NPs (discussed in detail by Parteee (1987)), but sentences such as those in (63) and (66), which do seem to be acceptable to at least some speakers, do not offer such an easy escape. Thus, they challenge the claim that neutralization is never semantically active.

6 CONCLUSION

I have presented an analysis of BNPA nouns that accounts for their two characteristic properties: the ability to form adverb phrases without use of prepositions, and the ability to head non-*wh* adverbial RCs without preposition stranding. I have also shown how the analysis might be modified to account for BNPA usages that are acceptable only to some speakers, including cases of neutralization/coordination of unlikes.

Two other BNPA-related issues have not been mentioned here, but are discussed in Whitman (1998). The first concerns determiners. All the examples with determiners presented here have used *every* with the idea that the same approach could be used with any determiner. However, not all determiners are equally good with BNPA nouns, a fact also noted by Stroik (1992). For example, *the* is usually bad; consider **We stayed the place, *We did it the way,* etc. It is tempting to say that what determiners are allowed is a pragmatic matter when examples like those mentioned and **We did it a way* are considered, but one conclusion Whitman draws is that pragmatics alone will not explain all the data. The other issue concerns prepositions. Although BNPA nouns have been assumed to be able to function as ordinary nouns, there are some cases where an ordinary noun can be modified by an RC with a stranded preposition, while a BNPA noun cannot. To illustrate, consider first *a place to eat*. This is grammatical by virtue of the N-*bnpa* part of the type for *place,* but *a place to eat at* is also good, since *place* is after all, an N as well as an N-*bnpa*. But with temporal BNPA nouns, the preposition is not so acceptable: *?the day the music died on.* And for manner BNPA nouns, it is definitely bad: **the way they did it in.* For a detailed discussion of both issues, the reader is referred to Whitman (1998).

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FOOTNOTES

[1]These categories allow only for (right-)peripheral extraction; to allow for medial extraction, a more elaborate category or a special modality would need to be introduced. For ease of presentation, I ignore this issue here.

[2]I choose this category instead of the simpler $(N_i\backslash N_i)/S$ for two reasons. First, for verbs that subcategorize for an adverbial complement (such as *put* or *behave*), *that* would need to have this category in order to license *the place that we put it* and *the way that he behaved*. Second, Hukari and Levine (1995) argue convincingly for the common nature of adjunct and complement extraction.

APPENDIX

Derivations

(A1) Derivation of *Someone died every day* (wide scope *every*)

PART A:

every: (NP⇑S)/N: $\lambda P\lambda Q.\mathbf{every'}(P)(Q)$

day: *q*((VP\VP)⇑S, NP⇑S, N): $\lambda\mathcal{D}\lambda v_{VP\backslash VP\rightarrow S}\mathcal{D}\ (\mathbf{day'})(\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))$

N: *P* — *q*E[1]

NP⇑S: $\lambda Q.\mathbf{every'}(P')(Q)$ — /E

(VP\VP)⇑S: $\lambda\mathcal{D}\lambda v_{VP\backslash VP\rightarrow S}\mathcal{D}\ (\mathbf{day'})(\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))\ [\lambda P'\lambda Q.\mathbf{every'}(P')(Q)]$
$\Rightarrow \lambda v_{VP\backslash VP\rightarrow S}[\lambda P'\lambda Q.\mathbf{every'}(P')(Q)](\mathbf{day'})(\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))$
$\Rightarrow \lambda v_{VP\backslash VP\rightarrow S}[\lambda Q.\mathbf{every'}(\mathbf{day'})(Q)](\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))$
$\Rightarrow \lambda v_{VP\backslash VP\rightarrow S}.\mathbf{every'}(\mathbf{day'})(\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))$ — 1

PART B:

someone: NP⇑S: $\lambda Q.\mathbf{some'}(\mathbf{person'})(Q)$ — ⇑ E[2]

NP: *x*

died: VP: $\mathbf{die'}$

every day: (VP\VP)⇑S: $\lambda v_{VP\backslash VP\rightarrow S}.\mathbf{every'}(\mathbf{day'})(\lambda z.v(\lambda Q\lambda y.\mathbf{on'}(z)Q(y)))$ — ⇑ E[3]

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{VP\textbackslash VP: } V}{\text{VP: } V(\textbf{die}')}\backslash\text{E}}{\text{S: } V(\textbf{die}')(x)}\backslash\text{E}}{\text{S: } \lambda Q.\textbf{some}'(\textbf{person}')(Q)\ [\lambda x.V(\textbf{die}')(x)] \Rightarrow \textbf{some}'(\textbf{person}')(\lambda x.V(\textbf{die}')(x)) \Rightarrow \textbf{some}'(\textbf{person}')(V(\textbf{die}'))}\ 2}{\text{S: } \lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}.\textbf{every}'(\textbf{day}')(\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))\ [\lambda V.\textbf{some}'(\textbf{person}')(V(\textbf{die}'))]}\ 3$$

$\Rightarrow \textbf{every}'(\textbf{day}')(\lambda z.[\lambda V.\textbf{some}'(\textbf{person}')(V(\textbf{die}'))](\lambda Q\lambda y.\textbf{on}'(z)Q(y)))$
$\Rightarrow \textbf{every}'(\textbf{day}')(\lambda z.[\textbf{some}'(\textbf{person}')((\lambda Q\lambda y.\textbf{on}'(z)Q(y))\ (\textbf{die}'))])$
$\Rightarrow \textbf{every}'(\textbf{day}')(\lambda z.[\textbf{some}'(\textbf{person}')(\lambda y.\textbf{on}'(z)\textbf{die}'(y))\ ])$
$\Rightarrow \textbf{every}'(\textbf{day}')(\lambda z.\textbf{some}'(\textbf{person}')(\textbf{on}'(z)\textbf{die}'))$

(A2) Derivation of *every rainy day*

every:	*rainy*:	*day*:
(NP⇑S)/N:	N/N:	q((VP\VP)⇑S, NP⇑S, N):
$\lambda P\lambda Q.\textbf{every}'(P)(Q)$	$\lambda P\lambda x[P(x)\ \&\ \textbf{rainy}'(x)]$	$\lambda\mathcal{D}\lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}\mathcal{D}$ $(\textbf{day}')(\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))$

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{day}'}{\text{N: } P}\ q\text{E}^1 \qquad \text{rainy}'}{\text{N: } \lambda x[P(x)\ \&\ \textbf{rainy}'(x)]}/\text{E}}{\text{NP⇑S: } \lambda Q.\textbf{every}'(\lambda x[P(x)\ \&\ \textbf{rainy}'(x)])(Q)}/\text{E}}{\text{(VP\textbackslash VP)⇑S: } \lambda\mathcal{D}\lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}\mathcal{D}\ (\textbf{day}')(\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))[\lambda P\lambda Q.\textbf{every}'(\lambda x[P(x)\ \&\ \textbf{rainy}'(x)])(Q)]}\ 1$$

$\Rightarrow \lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}[\lambda P\lambda Q.\textbf{every}'(\lambda x[P(x)\ \&\ \textbf{rainy}'(x)])(Q)]\ (\textbf{day}')(\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))$
$\Rightarrow \lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}[\lambda Q.\textbf{every}'(\lambda x[\textbf{day}'(x)\ \&\ \textbf{rainy}'(x)])(Q)]\ (\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))$
$\Rightarrow \lambda v_{\text{VP\textbackslash VP}\rightarrow\text{S}}.\textbf{every}'(\lambda x[\textbf{day}'(x)\ \&\ \textbf{rainy}'(x)])(\lambda z.v(\lambda Q\lambda y.\textbf{on}'(z)Q(y)))$

(A3) Derivation of *what day they arrived*

what:	*day*:	*they arrived*:
(S_{wc}/(S/NP))/N:	q(S_{wc}/(S/(VP\VP)), S_{wc}/(S/NP), N):	S/(VP\VP)
$\lambda P\lambda Q.\textbf{what}'(P)(Q)$	$\lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\textbf{day}')(\lambda z.V(\textbf{on}'(z)))$	$\lambda U.U(\textbf{arrive}')(\textbf{they}')$

$$\dfrac{\dfrac{\text{day}' \qquad \text{N: } P}{\text{N: } \lambda x[\textbf{day}'(x)\ \&\ \textbf{rainy}'(x)]}/\text{E}}{\text{(S}_{wc}\text{/(S/NP))/N: } \lambda P\lambda Q.\textbf{what}'(P)(Q)\ \ \lambda\mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\textbf{day}')(\lambda z.V(\textbf{on}'(z)))\ \ \lambda U.U(\textbf{arrive}')(\textbf{they}')}\ q\text{E}^1$$

S_{wc}/(S/NP): $\lambda Q.\mathbf{what'}(P)(Q)$

_____1

S_w/(S/(VP\VP)):
$\lambda \mathcal{D}_{WH}\lambda V.\mathcal{D}_{WH}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))\ (\lambda P\lambda Q.\mathbf{what'}(P)(Q)) \Rightarrow$
$\lambda V.(\lambda P\lambda Q.\mathbf{what'}(P)(Q))\ (\mathbf{day'})(\lambda z.V(\mathbf{on'}(z))) \Rightarrow$
$\lambda V.\mathbf{what'}(\mathbf{day'})(\lambda z.V(\mathbf{on'}(z)))$

_____/E

S_{wc}: $\mathbf{what'}(\mathbf{day'})(\lambda z.\mathbf{on'}(z)(\mathbf{arrive'})(\mathbf{they'}))$

(A4) Derivation of *place (that) we stayed*

place	*(that)*	*we*	*stayed*	[VP\VP: V]^1
(N ∧ q((VP\VP)⇑S, NP⇑S, N))/	S_c/S:	NP:	VP:	
((S_c ∨ S)/(VP\VP)):	$\lambda X.X$	**we′**	**stay′**	
$\lambda U\langle\ \lambda z.[\mathbf{place'}(z)\ \&\ U(\mathbf{in'}(z))]$,			_____\E	
$\lambda \mathcal{D}\lambda V.\mathcal{D}\ (\lambda z.[\mathbf{place'}(z)\ \&\ U(\mathbf{in'}(z))])$			VP: V(**stay′**)	
$(\lambda z.V(\mathbf{in'}(z)))\ \rangle$			_____\E	
			S: V(**stay′**)(**we′**)	
		_____/E*		
		S_c: V(**stay′**)(**we′**)		
		_____∨I		
		S_c ∨ S: V(**stay′**)(**we′**)		
		_____/I1		
		((S_c ∨ S)/(VP\VP): $\lambda V.V$(**stay′**)(**we′**)		
_____/E				

N ∧ q((VP\VP)⇑S, NP⇑S, N):
$\langle\ \lambda z.[\mathbf{place'}(z)\ \&\ \mathbf{in'}(z)(\mathbf{stay'})(\mathbf{we'})]$,
$\lambda \mathcal{D}\lambda V.\mathcal{D}\ (\lambda z.[\mathbf{place'}(z)\ \&\ \mathbf{in'}(z)(\mathbf{stay'})(\mathbf{we'})])(\lambda z.V(\mathbf{in'}(z)))\ \rangle$

(A5) Derivation of *we live and visit many places*; X = VP/(NP ∧ VP\VP)

we live and visit:	*many*	*places*
S/(NP ∧ VP\VP):	(NP⇑S)/N:	q((NP∧(VP\VP))⇑S, NP⇑S, N):
$\lambda V.[\pi_2 V(\mathbf{live'})(\mathbf{we'})\ \&$	$\lambda P\lambda Q.\mathbf{many'}(P)(Q)$	$\lambda \mathcal{D}\lambda V_{(NP\times VP\backslash VP)\rightarrow S}\mathcal{D}$ (**place′**)
$\mathbf{visit'}(\pi_2 V)(\ \mathbf{we'})]$		$(\lambda z.V\langle z,\ \mathbf{on'}(z)\rangle)$
		_____qE^1
		N: P
	_____/E	
	NP⇑S: $\lambda Q.\mathbf{many'}(P)(Q)$	
	_____1	
	(NP∧(VP\VP))⇑S:	
	$\lambda V_{VP\backslash VP\rightarrow S}.\mathbf{many'}(\mathbf{place'})(\lambda z.V\langle z,\ \mathbf{on'}(z)\rangle)$	
	_____⇑E^2	

$$\frac{\text{NP}\wedge(\text{VP}\backslash\text{VP}):\ U \qquad \text{S}:\ \pi_2 U(\mathbf{live'})(\mathbf{we'})\ \&\ \mathbf{visit'}(\pi_2 U)(\mathbf{we'})}{\text{S}:\ \lambda V.\mathbf{many'}(\mathbf{place'})(\lambda z.V\langle z,\ \mathbf{on'}(z)\rangle)\ (\lambda U.[\pi_2 U(\mathbf{live'})(\mathbf{we'})\ \&\ \mathbf{visit'}(\pi_2 U)(\mathbf{we'})]) \Rightarrow \mathbf{many'}(\mathbf{place'})(\lambda z\lambda U.[\pi_2 U(\mathbf{live'})(\mathbf{we'})\ \&\ \mathbf{visit'}(\pi_2 U)(\mathbf{we'})]\ \langle z,\ \mathbf{on'}(z)\rangle) \Rightarrow \mathbf{many'}(\mathbf{place'})(\lambda z[\mathbf{on'}(z)(\mathbf{live'})(\mathbf{we'})\ \&\ \mathbf{visit'}(z)(\mathbf{we'})])}\ 2$$

/E