Lexical idiosyncrasies—constructions or inferences?:
A case study on English auxiliaries

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1. Introduction The notion of constructions plays a prominent role in recent HPSG analyses of various phenomena (see, e.g., Boas and Sag 2012; Sag et al. 2020; Kim and Michaelis 2020). For example, a detailed analysis of the English auxiliary system by Sag et al. (2020) extensively exploits the hierarchical network of constructional templates in Sign-Based Construction Grammar (SBCxG) in accounting for some of the familiar and recalcitrant facts in the syntax of auxiliary verbs in English. In particular, one of the claims made by Sag et al. (2020) is that the idiosyncratic patterns exhibited by some of the specific lexical items (such as the auxiliary use of *better* and first person singular inverted *aren't*) pose significant challenges to transformational approaches (such as Pollock 1989) that attempt to derive the core properties of the auxiliary system from abstract general principles.

Categorial grammar (CG) offers an interesting perspective in this theory comparison. While sharing with traditional HPSG the spirit of strong lexicalism, the type-logical variant of CG recognizes abstract operations in syntax similar to transformational operations which seem somewhat alien to the surface-oriented perspective embodied in much HPSG research (see Kubota 2021). In fact, in a recent paper, Kubota and Levine (2022) make extensive use of transformation-like operations in accounting for the NI(C)E properties and the *do* support pattern in Hybrid Type-Logical Grammar (Hybrid TLG; Kubota and Levine 2020). One major omission in Kubota and Levine's (2022) proposal is the idiosyncratic patterns that Sag et al. (2020) take to be problematic for transformational approaches. Since there is currently no direct analogue of the notion of constructions in CG (but see Steedman and Baldridge (2011) for an interesting suggestion for lexicalizing some of the constructional templates in Goldberg (1995)), such facts may initially seem equally challenging for CG-based approaches. The goal of the present paper is to take up this challenge, and work out some of the beginnings of an account of 'constructional patterns' within a CG-based architecture of grammar. To state the conclusion first, we essentially argue for an approach which entertains an extended notion of the lexicon, in which both regular patterns of lexical organization and lexical idiosyncrasies are recognized, much along the lines of inheritance hierarchy-based organization of the lexicon that is usually assumed in HPSG/SBCxG work. In this respect, our approach largely follows the footsteps of the HPSG/SBCxG research. But there is also a difference: unlike the 'constructions-as-templates' type of perspective dominant in current SBCxG work, our approach emphasizes the role that the notion of (logical) inference plays within grammar, both in syntax and in the lexicon. In our approach, lexical organization is governed by the same underlying logic that governs syntactic composition (in which operations such as function composition are theorems). As we discuss below, this has certain interesting consequences with respect to broader issues pertaining to the grammar of auxiliary verbs such as historical change and child language learning.

2. English auxiliaries in Type-Logical Grammar Our point of departure is the higher-order treatment of auxiliaries in Kubota and Levine (2016, 2020, 2022), in which the lexical entries of the sort in (1) play a key role in accounting for the anomalous scope possibilities exhibited by modals in examples such as (2).

(1) $\lambda\sigma.\sigma(\mathsf{can't})$; $\lambda\mathscr{F}.\neg\Diamond\mathscr{F}(\mathsf{id}_{et})$; $\mathrm{S}_\alpha{\upharpoonright}(\mathrm{S}_\alpha{\upharpoonright}(\mathrm{VP}_f/\mathrm{VP}_b))$ (where $\alpha \in \{\mathit{fin}, \mathit{inv}\}$)

(2) John can't eat lobster for dinner every night and Mary just pizza.

In a nutshell, the modal in (1) takes a sentence with a preverbal gap of type $\mathrm{VP}_f/\mathrm{VP}_b$ as an argument, and fills in that gap position with the string $\mathsf{can't}$. The semantic scope reflects this 'quantifying in'-like syntax of the auxiliaries (where the modal essentially takes scope at the clausal level), and this immediately predicts that when two Gapping clauses are conjoined as in (2), the modal can scope over the whole conjunction to yield the $\neg\Diamond > \wedge$ reading (see Park et al. (2019) for an alternative HPSG analysis for data such as (2) which heavily relies on the technique of underspecification).

A perhaps unexpected consequence of this approach is that it provides the basis for an explanation of auxiliary distributions with respect to the NI(C)E properties, while retaining the descriptive coverage of the lexicalist approach. Specifically, Kubota and Levine (2022) posit the three operators in (3) for the analysis of negation, inversion and ellipsis (here, $\neg_{et\to et} = \lambda\mathscr{F}\lambda P\lambda x.\neg\mathscr{F}(P)(x)$).

(3) a. $\textbf{Inv} = \lambda\sigma\lambda\varphi.\varphi \bullet \sigma(\epsilon)$; $\lambda\mathscr{F}.\mathscr{F}$; $(\mathrm{S}_{inv}\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\upharpoonright(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))$

b. $\textbf{Neg} = \lambda\sigma\lambda\varphi.\sigma(\varphi \bullet \mathsf{not})$; $\lambda\mathscr{F}\lambda g.\mathscr{F}(\neg_{et\to et}\, g)$; $(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\upharpoonright(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))$

c. $\textbf{Ell} = \lambda\sigma\lambda\varphi.\sigma(\varphi)$; $\lambda\mathscr{G}\lambda f.\mathscr{G}(f(P))$; $(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\upharpoonright(\mathrm{S}_b\upharpoonright\mathrm{VP}_b)$

These operators have in common the property that they all apply to 'gapped' sentences before the gap is filled in by a lexical auxiliary. For example, as the sample derivation in (12) makes clear, the inversion operator (3a) is semantically an identity function and all it does is to move the preverbal gap (φ) to the sentence initial position.[1] The syntactic type S_{inv} records the fact that inversion has taken place, following the lexicalist analysis of auxiliaries in the G/HPSG literature. Similarly, the negation operator (3b) places the negation morpheme right after the auxiliary gap position, and applies the (appropriately typed) sentential negation operator to its input. The ellipsis operator (3c) takes a sentence with a VP type gap and converts it to a sentence containing a VP/VP type gap, by supplying the property type meaning corresponding to the 'missing' VP via anaphoric reference to contextual information (via the free variable P).

Sentences with negation, inversion and ellipsis are thus derived by applying these operators before the VP/VP type gap is filled in by the higher-order auxiliary of the form in (1). Another way to think about the process by which such sentences are derived (which is provably equivalent to the successive function application along the above lines) is that the grammar makes available *composed* operators such as **Can** ∘ **Inv**, **Can** ∘ **Ell** and **Can** ∘ **Neg**, listed in (4b–d). These composed operators are instances of function composition ($f \circ g \equiv \lambda x.f(g(x))$), that is, they are all theorems in the type logic underlying Hybrid TLG. Further immediate consequences that follow in this setup is that the familiar interactions of the NIE operators that are accounted for via the interactions of lexical operations or constructional templates in HPSG/SBCxG approaches (Kim and Sag 2002; Sag et al. 2020) all fall out as similar theorems in the type logic. The relevant composed operators, together with example sentences they license, are given in (4e–h) (see Kubota and Levine (2022) for proofs).

(4)
a. John can leave.	**Can**	e. Can John?	**Can** ∘ **Inv** ∘ **Ell**
b. Can John leave?	**Can** ∘ **Inv**	f. Can John not leave?	**Can** ∘ **Inv** ∘ **Neg**
c. John can ∅ .	**Can** ∘ **Ell**	g. John can not ∅ .	**Can** ∘ **Neg** ∘ **Ell**
d. John can not leave.	**Can** ∘ **Neg**	h. Can John not ∅ ?	**Can** ∘ **Inv** ∘ **Neg** ∘ **Ell**

While the higher-order analysis involving the 'quantifying in'-like operation embodied in (1) may initially look abstract and alien to the surface-oriented perspective on syntax underlying much HPSG/SBCxG work, it should be clear at this point that there are clear connections between the type-logical analysis and the more familiar surface-oriented approach originating from Gazdar et al.'s (1982) work in the PSG tradition, whose key components are inherited in the more recent, construction-based recasting by Sag et al. (2020).

Connections to familiar ideas extend even further. For example, one of the notable properties of the nontransformational analysis of auxiliaries in the lexicalist tradition is the use of lexically-controlled feature specifications to govern the morphosyntactic dependency in the governing and governed verbs in the chain of auxiliary verbs (i.e. the 'Affix Hopping' effect). Kubota and Levine's (2022) type-logical analysis essentially follows the lexicalist tradition fully in accounting for this aspect of English auxiliary syntax. The two theorems in (5) make this point clear (see (13) and (14) for proofs).

(5) a. **Should** $\vdash$ should; $\lambda y\lambda P.\Box P(y)$; $\mathrm{VP}_f/\mathrm{VP}_b$

b. **Should** ∘ **Inv** $\vdash$ should; $\lambda y\lambda P.\Box P(y)$; $\mathrm{S}_{inv}/\mathrm{VP}_b/\mathrm{NP}$

As one can easily confirm, these are essentially direct analogues of the uninverted and inverted versions of the lexical entries for modal auxiliaries that are standardly assumed in lexicalist syntactic

[1] Note that this analysis of inversion immediately predicts the availability of the wide-scope reading for the modal in Gapping examples such as *Should John eat lobster for dinner every night and Mary just pizza?*

approaches. For example, *should* is specified as VP_f/VP_b in (5a), which means that it takes a base form VP to return a finite VP. Other auxiliaries have similar feature specifications in their lower-order entries (for example, VP_f/VP_{prog} for *be*).

3. Accounting for idiosyncrasies A question that immediately arises in connection with the approach sketched in the previous section is how to treat (apparent) auxiliaries with idiosyncratic distributions. For example, Gazdar et al. (1985) observe that inverted *shall*, as in (6a), has a deontic force lacking in its uninverted counterpart, and that *aren't*, though unacceptable with a first person singular subject in the uninverted environment, becomes acceptable when cooccuring with such subject in inverted position.

(6) a. Shall I inform John of our decision?
b. I shall inform John of our decision.

(7) a. Aren't I clever?!
b. *I aren't clever.

Such examples can be handled in a way which is strictly parallel to their treatment in previous lexicalist phrase structure approaches (a constructional recasting of which can be found in Sag et al. (2020)). To account for (6a), we posit an additional entry for *shall* whose type is $S_{inv}\upharpoonleft(S_f\upharpoonleft(VP_f/VP_b))$, as in (8).

(8) $\lambda\sigma.\mathsf{shall} \bullet \sigma(\epsilon);\ \lambda\mathscr{F}.\Box\mathscr{F}(\mathsf{id}_{et});\ S_{inv}\upharpoonleft(S_f\upharpoonleft(VP_f/VP_b))$

Note that this is identical—except for semantics—to **Shall** ∘ **Inv**, where **Shall** is the lexical entry for non-deontic *shall* of the form in (1). That is, (8) is essentially an inversion-specific lexical entry which already incorporates the effect of **Inv**. Similarly, we posit a second entry for *aren't*, typed $S_{inv}\upharpoonleft(S_f\upharpoonleft(VP_f/VP_b))$, which again restricts its distribution to the inverted position.

The form *better* in (9) is another case in point, displaying a somewhat different distribution which arguably is the result of historical change.

(9) a. You better (not)(say that).
b. *Better you (not)(say that)?

Negation, ellipsis and their composition are all possible, but inversion is ill-formed. The distributional restriction on *better* here is essentially a mirror image of the restriction on deontic *shall* and the first person singular *aren't*. Just as the distribution of the latter is controlled by imposing a restriction on the feature value of the S that the auxiliary verb sign takes as its argument, here, the distribution can be regulated by means of a feature restriction. This can be done by making **Better** specifically target S_f-rooted clauses.

(10) $\textbf{Better} = \lambda\sigma.\sigma(\mathsf{better});\ \lambda\mathscr{F}.\Box_{\mathbf{better}}\mathscr{F}(\mathsf{id}_{et});\ S_f\upharpoonleft(S_f\upharpoonleft(VP_f/VP_b))$

From this, it immediately follows that **Better** ∘ **Neg** and **Better** ∘ **Ell** are well-formed, but ***Better** ∘ **Inv** isn't, the latter being blocked via feature conflict (**Better** is looking for $S_f\upharpoonleft X$, but **Inv** returns $S_{inv}\upharpoonleft X$).

We suggest that the best way to make sense of the distribution of *better* in present-day English is to consider its historical development, along lines we sketch below. The origin of *better* as used in (9) seems most likely to lie in the complex auxiliary *had better*, which, as noted in the *Cambridge Dictionary* (`https://dictionary.cambridge.org/`), almost invariably takes the form *'d better* in informal speech. *Had* inversion (*Had I better go?*) shows clearly that with complex auxiliaries such as *had better* and *would rather*, there is an authentic auxiliary and some sort of associated qualifier that combine quasi-idiomatically to form a separate lexical item.[2] But this *had* exhibits the same contraction possibilities as the perfective aspect auxiliary (*'ve*), as in (11).

(11) You'd better (not)(say that).

[2]Note, for example, that **She has/We have better do that* are blocked; the collocation demands a dedicated past tense form of *had*.

Given the fact that the reduction of *had* to *'d* in ordinary discourse is almost universal, it should not be surprising that a further phonological reduction eliminated the contracted form entirely, yielding surface forms such as those in (9a). Note crucially that when the reduction of *'d* happens, *better* sits in a place where an auxiliary verb is expected, so, it takes on the role of a lexical auxiliary by itself, with the meaning of *had better*, at least in the simple affirmative, negation and contraction forms. At this point the language has **Better**, **Better** ∘ **Ell** and **Better** ∘ **Neg**. But crucially, **Better** does not yet have a status of a full-fledged auxiliary since ***Better** ∘ **Inv** is ill-formed/unattested (note that there is no route for this surface form via inversion of *had* and contraction: *Had I better go* ⇒ **'d I better go* ⇒ ??). Thus, *better* comes with the idiosyncratic restriction $\alpha = \mathit{fin}$ for the more general template for auxiliaries in English in (1). It is conceivable that with time, due to a pressure for regularity this idiosyncrasy may be removed from the language by eliminating this restriction. At that point (which is a possible future direction that English may undergo), forms such as *Better you say that?* will be fully grammatical. However, for the time being, we of course can't predict the future course of language change.

4. Conclusion: Rethinking constructions as operators The foregoing proposal hinges on the reinterpretation of the NIE properties as interacting higher-order operators whose distributions are constrained by their syntactic types to specifically combine with auxiliaries, and not with lexical verbs. The status of this restriction as a literal logical consequence of the type system suggests that there is a major difference between HPSG's constructional approach and the proof-theoretic framework assumed in Hybrid TLG: in the latter, the NIE properties are reinterpreted as *axioms* (just like individual lexical entries are axioms) which interact with each other and with the auxiliaries according to the same deductive calculus as any other axioms that are posited in the grammar to drive 'syntactic inference'. The prosody and semantics of the result of their combination is completely determined as a consequence of the specific properties encoded in such axioms (some being idiosyncratic and specific to particular forms of lexical items) and the general rules of the calculus.

As noted above, the machinery of lexicalist PSG that has for forty years been taken to be responsible for morphosyntactic dependency relations in the auxiliary system can be readily embodied in the higher-order lexical entries we posit for auxiliaries. This ready translatability should not be too surprising, in view of the fact that, as pointed out in Pollard and Sag (1994), the valence satisfaction mechanisms that are central to HPSG's account of the auxiliary dependency pattern was deliberately modeled on categorial grammar's encoding of argument structure in the specification of category types. Perhaps more surprisingly, our account of auxiliary syntax has no difficulty accommodating idiosyncratic lexical behavior of the sort that Sag et al. (2020) take to constitute a major challenge to reductionist approaches in the transformational tradition. Moreover, our reinterpretation of the constructional analysis is compatible with certain plausible assumptions about language acquisition and the diachrony of the auxiliary system (for further arguments along these lines, see Kubota and Levine's (2022) analysis of the *do* support pattern).

If our approach is on the right track, it can be understood as a defense of a radical lexicalism in the face of even quite eccentric behavior on the part of individual lexica. We believe that the logic-based perspective we have advocated above is equally illuminating as the construction-based perspective that is more familiar in the HPSG literature at least for the restricted empirical domain we have focused on in this paper. In view of the larger set of empirical issues that have been addressed under the umbrella of constructional approaches, it goes without saying that further work is needed to evaluate carefully the pros and cons of the sort of approach we have advocated above. This task is left for future work. We simply list below what we take to be outstanding issues at this point:

- How to implement inheritance hierarchy. – Can this be done by logical inference rules alone? Perhaps yes, by recognizing both general and specific axioms (e.g., **MatrixPolarq** ≡ **Question** ∘ **Inv**), but the details need to be worked out.
- The treatment of defaults. – While default specifications are extensively utilized in SBCxG, whether to admit them in the grammar at all is itself an open question.
- The treatment of larger constructional/idiomatic chunks (e.g., *take advantage of X*).

Figures

(12)

$$\dfrac{\begin{array}{l}\lambda\sigma.\sigma(\mathsf{should});\\ \lambda\mathscr{F}.\Box\mathscr{F}(\mathsf{id}_{et});\\ \mathrm{S}_\alpha\upharpoonright(\mathrm{S}_\alpha\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\end{array} \quad \dfrac{\begin{array}{l}\lambda\sigma\lambda\varphi.\varphi\bullet\sigma(\epsilon);\\ \lambda\mathscr{F}.\mathscr{F};\\ (\mathrm{S}_{inv}\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\upharpoonright(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\end{array} \quad \begin{array}{l}\vdots\\ \lambda\varphi.\mathsf{john}\bullet\varphi\bullet\mathsf{come};\\ \lambda f.f(\mathbf{come})(\mathbf{j}); \mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b)\end{array}}{\lambda\varphi.\varphi\bullet\mathsf{john}\bullet\mathsf{come};\ \lambda f.f(\mathbf{come})(\mathbf{j});\ \mathrm{S}_{inv}\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b)}}{\mathsf{should}\bullet\mathsf{john}\bullet\mathsf{come};\ \Box\mathbf{come}(\mathbf{j});\ \mathrm{S}_{inv}}$$

(13)

$$\dfrac{\dfrac{\dfrac{\begin{array}{l}\lambda\sigma.\sigma(\mathsf{should});\\ \lambda\mathscr{F}.\Box\mathscr{F}(\mathsf{id}_{et});\\ \mathrm{S}_\alpha\upharpoonright(\mathrm{S}_\alpha\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\end{array} \quad \dfrac{\dfrac{[\varphi_1; x; \mathrm{NP}]^1 \quad \dfrac{[\varphi_2; g; \mathrm{VP}_f/\mathrm{VP}_b]^2 \quad [\varphi_3; f; \mathrm{VP}_b]^3}{\varphi_2\bullet\varphi_3;\ g(f);\ \mathrm{VP}_f}/\mathrm{E}}{\varphi_1\bullet\varphi_2\bullet\varphi_3;\ g(f)(x);\ \mathrm{S}_f}\backslash\mathrm{E}}{\lambda\varphi_2.\varphi_1\bullet\varphi_2\bullet\varphi_3;\ \lambda g.g(f)(x);\ \mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b)}{\upharpoonright}\mathrm{I}^2}{\varphi_1\bullet\mathsf{should}\bullet\varphi_3;\ \Box f(x);\ \mathrm{S}_f}{\upharpoonright}\mathrm{E}}{\mathsf{should}\bullet\varphi_3;\ \lambda x.\Box f(x);\ \mathrm{VP}_f}\backslash\mathrm{I}^1}{\mathsf{should};\ \lambda f\lambda x.\Box f(x);\ \mathrm{VP}_f/\mathrm{VP}_b}/\mathrm{I}^3$$

(14)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\begin{array}{l}\lambda\sigma_1\lambda\varphi_1.\varphi_1\bullet\sigma_1(\epsilon);\\ \lambda\mathscr{F}.\mathscr{F};\\ (\mathrm{S}_{inv}\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\upharpoonright(\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\end{array} \quad \dfrac{\dfrac{\dfrac{[\varphi_2; P; \mathrm{VP}_b]^2 \quad [\varphi_3; f; \mathrm{VP}_f/\mathrm{VP}_b]^3}{\varphi_3\bullet\varphi_2;\ f(P);\ \mathrm{VP}_f} \quad [\varphi_4; y; \mathrm{NP}]^4}{\varphi_4\bullet\varphi_3\bullet\varphi_2;\ f(P)(y);\ \mathrm{S}_f}}{\begin{array}{l}\lambda\varphi_3.\bullet\varphi_4\bullet\varphi_3\bullet\varphi_2;\\ \lambda f.f(P)(y);\mathrm{S}_f\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b)\end{array}}}{\lambda\varphi_1.\varphi_1\bullet\varphi_4\bullet\epsilon\bullet\varphi_2;\ \lambda f.f(P)(y);\ \mathrm{S}_{inv}\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b)} \quad \begin{array}{l}\lambda\sigma_2.\sigma_2(\mathsf{should});\\ \lambda\mathscr{G}.\Box\mathscr{G}(\mathsf{id}_{et});\\ \mathrm{S}_\alpha\upharpoonright(\mathrm{S}_\alpha\upharpoonright(\mathrm{VP}_f/\mathrm{VP}_b))\end{array}}{\mathsf{should}\bullet\varphi_4\bullet\epsilon\bullet\varphi_2;\ \Box f(P)(y);\ \mathrm{S}_{inv}}}{\mathsf{should}\bullet\varphi_4\bullet\epsilon;\ \lambda P.\Box P(y);\ \mathrm{S}_{inv}/\mathrm{VP}_b}}{\mathsf{should}\bullet\varphi_4;\ \lambda P.\Box P(y);\ \mathrm{S}_{inv}/\mathrm{VP}_b}}{\mathsf{should};\ \lambda y\lambda P.\Box P(y);\ \mathrm{S}_{inv}/\mathrm{VP}_b/\mathrm{NP}}$$

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