Abstract

This paper considers the role of nonlocal amalgamation in a system of analyses for typologically diverse languages. Nonlocal amalgamation (Bouma et al., 2001a) was suggested in particular to get rid of extraction rules in Pollard & Sag's (1994) analysis of long-distance dependencies. However, in implemented projects like the English Resource Grammar (Flickinger, 2000, 2011) and the Grammar Matrix (Bender et al., 2002, 2010), the extraction rules have been maintained, while nonlocal amalgamation is used for the analysis of phenomena like the *easy*-adjectives. Zamaraeva & Emerson (2020) argue that, if extraction rules are kept, then supporting the English *easy*-adjectives may be an insufficient reason to maintain nonlocal amalgamation in a cross-linguistic system like the Grammar Matrix, as it complicates the analysis of multiple question word fronting with flexible word order (in languages such as Russian [rus]). However, I present here a case of morphological marking of questions (in languages like Makah [myh]) which further motivates nonlocal amalgamation, as the analysis is remarkably more simple with it than it is without it. An analysis of morphological marking of questions needs to be part of a cross-linguistic system such as the Grammar Matrix as well as an analysis of multiple fronting, which adds a new tension at the level of the Matrix "core" and provides concrete material for discussion of issues ranging from empirical implementation of theoretical ideas like nonlocal amalgamation to the big question of how much of typological space a single system of grammar is expected to cover.

1 Introduction

This paper is about interrogative constructions (questions), specifically constituent questions often referred to in the western literature as *wh*-questions (*Who did what to whom?*).[1] Such interrogative constructions take various forms but in most cases there are the question words (like *who*), and in many languages there is also something special going on at the syntactic level, such as obligatory fronting of one or more question words or special morphological marking on the verb that has a *wh* argument. There is rich syntactic literature, in all theoretic traditions including HPSG, dedicated to the syntax of constituent questions in English (Ross, 1967; Ginzburg & Sag, 2000, among many others), containing many focused analyses of *long-distance dependencies*, constructions where a verb and its argument are separated by a clause boundary (1).

(1) *Who* do you think Kim said Sandy believes *did* what to whom? [eng]

This paper considers the role of *nonlocal amalgamation* (aka "lexical threading" of nonlocal features) in a cross-linguistic system of analyses which supports typologically diverse languages. Nonlocal amalgamation (Bouma et al., 2001a) is a theoretical concept in HPSG having to do with propagating the information

[1] Parts of this paper are from the unpublished portions of my dissertation (Zamaraeva, 2021).

about long-distance dependencies in the derivation. It is intended to make analyses more elegant, in particular by getting rid of *extraction lexical rules*, an HPSG device which takes a verb's argument off of its valence list and places it elsewhere, such that it can appear at a dislocated position. This theoretical concept was implemented and tested as part of DELPH-IN grammar engineering projects such as the English Resource Grammar (ERG; Flickinger, 2000, 2011) and the Grammar Matrix (Bender et al., 2002, 2010). One of the research goals of such projects is to test theoretical concepts, particularly in interaction with each other and in the context of prolonged application to large datasets. The Grammar Matrix contains a large system of analyses which, in different customized combinations, cover data (grammatical and ungrammatical sentences) from hundreds of different language types, at least to the extent of test suites which are stored along with the system.

Below, I discuss how such testing of a theoretical idea leads to discovering tensions in cross-linguistic systems of analyses. This paper builds directly on previous work of similar kind. In Zamaraeva & Emerson 2020, we discuss how using nonlocal amalgamation not just theoretically but as implemented in the DELPH-IN version of the HPSG formalism, complicates the analysis of multiple fronting in languages with flexible word order (using Russian as the example). In the context of the Grammar Matrix, that discussion led to actually abandoning nonlocal amalgamation.[2] Here, however, I present a case *for* nonlocal amalgamation which I developed in the process of my work on a cross-linguistic analysis of interrogatives for the Grammar Matrix which followed Zamaraeva & Emerson 2020 (Zamaraeva, 2021). The case is of languages that mark interrogatives morphologically, and in particular the ones which have distinct paradigms for polar and constituent questions (in addition to a separate paradigm for declarative forms).

The paper is structured as follows. Section §2 presents illustrative data from languages which mark interrogatives morphologically, showing how some have a paradigm for constituent questions which is distinct from the set of inflections verbs use in polar questions. Section §3 gives the necessary background on the version of the HPSG formalism that the Grammar Matrix uses, presents the Grammar Matrix project, and provides a summary of how nonlocal features work generally and what nonlocal amalgamation is. The analysis (§4) is given in two parts, each presenting an alternative: morphological marking of interrogatives with (§4.1) and without (§4.2) nonlocal amalgamation, showing that the former is much simpler than the latter. The paper concludes with brief notes regarding future work (§5) and a detailed discussion of how the revealed tension in the system of analyses may help guide future inquiry into linguistic theory (§6).

[2] I omit any detailed exposition of the issue in this paper and refer the reader to Zamaraeva & Emerson 2020 and to Zamaraeva 2021, §6.5.

2 Data

In some languages, questions (polar and constituent) involve special morphological marking on the verb, as illustrated by examples from Negidal ([neg]; Tungusik), where the subject agreement marker on the verb in a declarative sentence (2) is different from that in an interrogative sentence (3)–(4).[3]

(2) oǯa-va iche-ǯee-**v**
track-ACC see-FUT-**1SG**
'I will see the tracks.' [neg] (Hölzl, 2018, p. 295)

(3) ii-ǰə-**m**=i?
enter-FUT.Q-**1SG.Q**=Q
'Shall I come in?' [neg] (Hölzl, 2018, p. 295)

(4) eeva iche-ǯa-**m**?
what see-FUT.Q-**1SG.Q**
'What will I see?' (Hölzl, 2018, p. 295)

This type of morphological marking is also found in Yukaghir ([yux]; isolate) and is generally not typologically uncommon. Negidal and Yukaghir will be used in this paper just as two examples of a fairly common phenomenon, in particular because Negidal has non-zero marking and thus is very illustrative, while Yukaghir is in practice part of the Grammar Matrix set of test suites and supported languages (see §3.1 below and Zamaraeva 2021 §§5.2-5.6). The zero marking special for the interrogative paradigm in Yukaghir is illustrated in (5)-(6).[4]

(5) kin ejre-**0**?
who.NOM walk-**ITRG.3SG**
'Who is coming?' [yux] (Constructed by me based on Maslova (2003).)

(6) touke-lek ejre-**0**?
dog-PRED walk-**ITRG.3SG**
'Is the dog coming?' [yux] (Constructed by me based on Maslova (2003).)

Furthermore, in some languages, e.g. in Makah ([myh], Wakashan), the paradigms for constituent and polar questions are distinct. The marker occurring in constituent interrogatives is shown in (7)–(8); note that the question word here is actually analyzed as the main predicate (Davidson, 2002, p. 285).

(7) ʔačaq=**qaːɬ** dudu'k
who=**CONTENT.3SG** sing
'Who is singing?' [myh] (Davidson, 2002, p.285)

[3]The future tense markers differ as well, and there is an additional question marker *=i*, but it is sufficient to look at just the person and number marker.

[4]Native speakers of Yukaghir are not available, so some examples have to be constructed.

(8) baqiq=**qa:ɬ** ti^{l}
what = **CONTENT.3SG** DEM
'What is this?' [myh] (Davidson, 2002, p.285)

Polar question marking is exemplified in (9).

(9) dudu^{l}k = 'aχ$_{\sim}$=**qa:k** = s
sing = TEMP = **POLAR** = 1SG
'Am I singing?' [myh] (Davidson, 2002, p.100)

The goal of this paper is to model separate paradigms as in Makah (7)–(9). Furthermore, the analysis is intended for the Grammar Matrix framework, which means it must fit into a broader system of analyses for different types of languages, including not only the ones like Negidal or Yukaghir but also languages like Russian, among others.

3 Background

The goal of §3 is two-fold: (i) to orient the reader in questions of empirical HPSG implementation and explain the specific form in which the analysis issues are presented later in §4; and (ii) aggregate several pieces of analyses scattered around several classic HPSG works such as Pollard & Sag 1994, Ginzburg & Sag 2000, and Bouma et al. 2001a. First, in §3.1 I give a brief overview of the DELPH-IN version of the HPSG formalism and of the Grammar Matrix meta-grammar engineering project. Then I give a summary of what nonlocal features are and how they are traditionally used in HPSG analyses of nonlocal dependencies (§3.2), and how the idea of nonlocal amalgamation fits in (§3.3). I illustrate the theoretical concepts here in the DELPH-IN formalism, because this is what §4 is situated in.

3.1 DELPH-IN and the Grammar Matrix

DELPH-IN (DEep Linguistic Processing with HPSG INitiative)[5] is an international consortium of researchers who are interested in engineering grammars using HPSG. DELPH-IN members pursue an integrated research-engineering goal of advancing linguistic theory (particularly syntactic and semantic) through modeling it rigorously on the computer and in the context of real-life applications.[6] DELPH-IN Joint Reference Formalism (JRF; Copestake, 2000) is an HPSG formalism restricted to rely on only unification as a native operation, without relational constraints such as list reordering or counting. This feature of DELPH-IN JRF allows for relatively fast parsing and makes it possible to deploy DELPH-IN

[5] www.delph-in.net; https://github.com/delph-in/

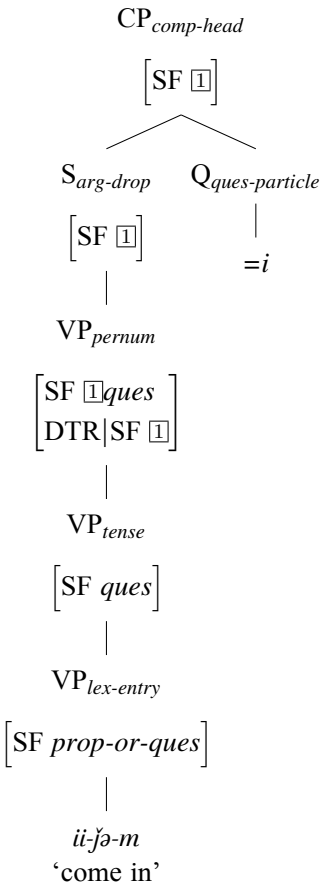
[6] There are other HPSG-based formalisms with varying properties but with similar goals, including ALE (Penn, 2000), LIGHT (Ciortuz, 2002; Ciortuz & Saveluc, 2012), Alpino (Bouma et al., 2001b; Van Noord et al., 2006, focusing on Dutch), and Enju (Miyao & Tsujii, 2008, focusing on probabilistic disambiguation). CoreGram (Müller, 2015) is a grammar engineering project similar to the Grammar Matrix but couched within ALE rather than the DELPH-IN formalism.

grammars for practical applications such as grammar coaching (e.g. Morgado da Costa et al., 2020). Other features of DELPH-IN relevant to this paper's material include the use of lists instead of sets for nonlocal features (see Zamaraeva & Emerson 2020 for details). Constraint unification in DELPH-IN is defined in the context of the "closed world" hierarchy assumption. This means that, in order for any two types to unify, there must be a single (unique) type in the hierarchy which represents their combination (Copestake, 2002, p.42). This is helpful to know to understand the parameterized list hierarchy in §4.2. DELPH-IN JRF incorporates the Minimal Recursion Semantics formalism (MRS; Copestake et al., 2005). Major DELPH-IN projects include the English Resource Grammar (ERG, Flickinger, 2000, 2011); Jacy (a grammar of Japanese, Siegel et al., 2016); Zhong (a grammar of Chinese, Fan, 2018); the LKB grammar engineering environment (Copestake, 2002); the ACE parser (Crysmann & Packard, 2012); and the Grammar Matrix (Bender et al., 2002, 2010), among many others.

The Grammar Matrix (Bender et al., 2002, 2010) is a DELPH-IN-based meta-grammar engineering project that includes a web questionnaire, a core HPSG grammar, a grammar customization system, and a set of language test suites illustrating the supported typological space. Given a typological specification (e.g. "the language uses special morphological marking in questions"), it automatically outputs an HPSG grammar fragment which covers data from the language to the extent specified. The grammar consists of lexical entries as well as phrasal and lexical rules. The types are customized according to the specification but each grammar is based on the same "core". For example, there is a core type for lexical rule, *lex-rule*, from which all customized lexical rules inherit. The core types were originally distilled from the ERG (Flickinger, 2000), as part of Bender et al. 2002. Only few core types are intended as rules for actual licensing of strings in the grammar though, and most of the types in an actual grammar that the Matrix outputs will be customized versions of the core types.

Morphological rules in the Matrix are lexical rules which apply to terminal nodes in the derivation (O'Hara, 2008; Goodman & Bender, 2010). For example, the Negidal example (3) would be analyzed as illustrated in (10). The affixes attach in order. I assume here that the final *=i* is a clause-final question particle which in the Grammar Matrix is analyzed as a complementizer (Bender & Flickinger, 2005). The tense as well as the person and number affixes, being specific to the interrogative paradigm, constrain the clause to have question semantics via the Sentential Force feature ([SF *ques*]), and all other affixes have to unify with that, so an affix from an indicative paradigm would not appear.

(10)



The analyses presented in §4 were developed as part of my work on the constituent questions library for the Matrix. Adding libraries to the Matrix has a fairly established methodology (Bender et al., 2010). The goal of creating a new library is adding testable support for a new syntactic phenomenon. For example, adding support for constituent questions means the user should as a result be able to automatically obtain a grammar which can pair sentences containing constituent questions with syntactic and semantic representations, for a range of languages. In particular, the semantic representations should be well-formed and standard for the Minimal Recursion Semantics formalism. Testing for these criteria can be made automatic, reducing human error to "bugs" that can be made fully explicit and fixed systematically.

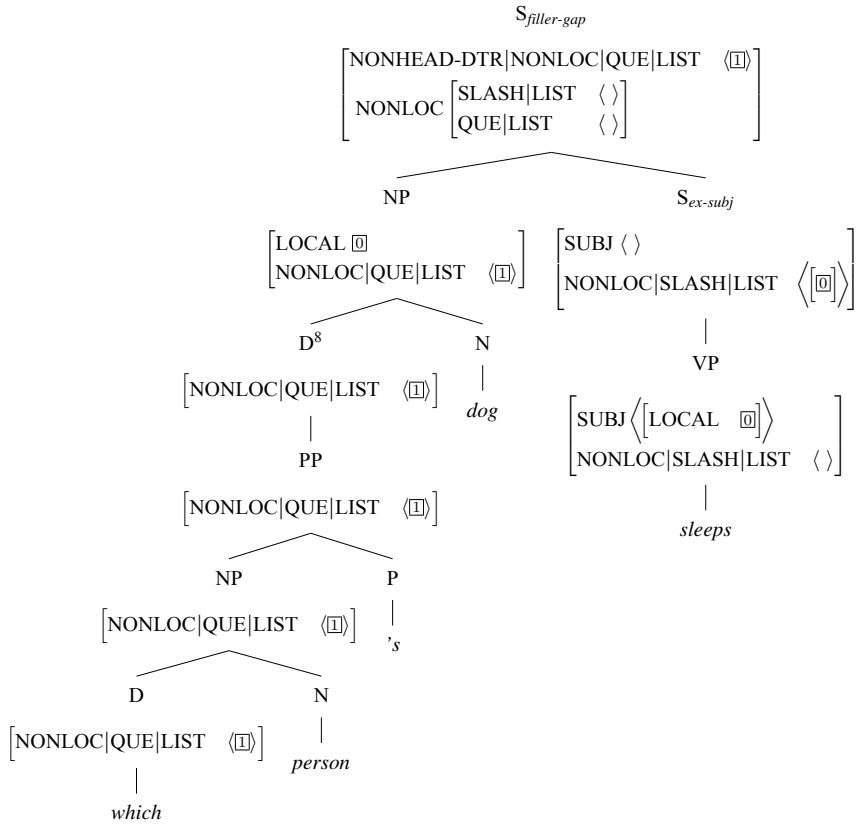
3.2 Nonlocal features and long-distance dependencies

At the core of Pollard & Sag's (1994) HPSG analysis of long-distance dependencies there are three concepts: (i) nonlocal features; (ii) the Nonlocal Feature Principle (NFP), which is related to nonlocal amalgamation, the focus of this paper; and (iii) the filler-gap construction, aka the head-filler schema. These three con-

cepts can be mapped to three tiers of the analysis: (i) introducing the dependency (the "bottom" tier; nonlocal features); (ii) propagating the dependency ("middle"; the NFP or later nonlocal amalgamation); and (iii) filling the dependency ("top"; filler-gap).

An example illustrating all three tires in a derivation is given in (11).[7]

(11)



Example (11) shows two nonlocal features, SLASH and QUE. That SLASH is "housed" under the nonlocal feature path along with QUE means, if there is any principle which affects all nonlocal features, it will affect both SLASH and QUE. In particular, nonlocal amalgamation (§3.3) was originally developed for SLASH (Bouma et al., 2001a) but Ginzburg & Sag (2000) later suggested a unified nonlocal amalgamation principle applying to all nonlocal features.

In (11), a feature structure labeled 0 contains the local features of the noun phrase *which person's dog*, and those are also the local features of the subject of *sleeps*. In order for *which person's dog* to appear in its fronted position,[9] the

[7]This example is in the DELPH-IN formalism (§3.1); the feature paths are abbreviated, though the LIST feature of SLASH and QUE is given explicitly, because this is an important detail for technical implementation of list append (see Zamaraeva & Emerson 2020). For a detailed explanation of how nonlocal features work theoretically in Pollard & Sag (1994) and Ginzburg & Sag (2000), see Zamaraeva 2021, pp. 57-74.

[9]It may not be obvious that the position is fronted but consider (i), and see also Zamaraeva 2021,

subject is essentially taken off of the SUBJ list and put on the nonlocal SLASH list by the *subject extraction* phrase structure rule. This is the "bottom" tier. That the SLASH values are propagated through the tree is the "middle" tier, and this is happening due to what Pollard & Sag (1994) call the NFP and what Bouma et al. (2001a) and Ginzburg & Sag (2000) later developed into "nonlocal amalgamation" (§3.3). Finally, at the "top", the filler-gap phrase structure rule "discharges" the dependency; now all nonlocal lists are empty, which is consistent with the definition of a successful parse. The top filler-gap phrase must also be a subtype of the interrogative clause (12), in particular in order for the semantics (e.g. the CONT features) to be correct.

(12)
$$\begin{bmatrix} \textit{interrogative-clause} & \\ \text{SYNSEM}|\text{LOCAL}|\text{CONT}|\text{HOOK} & \boxed{1}\begin{bmatrix}\text{INDEX}|\text{SF} & \textit{ques}\end{bmatrix} \\ \text{HEAD-DTR}|\text{SYNSEM}|\text{LOCAL}|\text{CONT}|\text{HOOK} & \boxed{1} \\ \text{C-CONT}|\text{HOOK} & \boxed{1} \end{bmatrix}$$

Note that the non-head daughter of the filler-gap rule in (11) must have a nonempty QUE value. According to Ginzburg & Sag (2000), the lexical types for some words (such as most question words) will have a nonempty QUE value, while other words will have an empty one. This means only phrases containing a *wh*-word are suitable as filler daughters in this filler-gap construction. Note also that in addition to the SLASH dependency, example (11) shows also the QUE dependency, which is an unbounded dependency between the top of the construction and the bottom of the filler daughter ("pied piping"; Ross, 1967). In other words, QUE helps characterize what types of constituents can occur in the initial position in constituent questions and supports modeling of pied piping.

3.3 Nonlocal amalgamation

Bouma et al. 2001a suggested improvements to the analysis in Pollard & Sag 1994, which were later incorporated into Ginzburg & Sag's (2000) account of English interrogatives. In particular, Bouma et al. (2001a) further motivate and simplify the "middle" tier of the analysis. At the core of the classic analysis of that tier is the observation that (i) the information about the long-distance dependency is encoded locally throughout the derivation path (the "middle" part of the long-distance dependency mechanism needs access to the local features of the extracted element at every step); and that (ii) extraction is furthermore registered lexically as selection for a "slashed" argument. Building on the critique of Pollard &

p. 63 for a summary of Ginzburg & Sag's (2000) and Bouma et al.'s (2001a) argument for why the position can be considered fronted even when there is only a single clause in the sentence. At any rate, (11) is intended to just generally illustrate how long-distance dependencies are analyzed.

(i) Which person's dog do you think sleeps? [eng]

Sag 1994 by Hukari & Levine (1996), Bouma et al. (2001a) further motivate the need to register nonlocal information at every step of the derivation by data from languages like Chamorro ([cha], Austronesian), in which verbs exhibit agreement with extracted arguments (13)–(14).

(13) Hayi f-um-a'gasi i kareta
who WH.SU-wash the car
'Who washed the car?' [cha] (Bouma et al., 2001a, p.4)

(14) Hayi si Juan ha-sangan-i hao [f-um-a'gasi i kareta]
who UNM Juan E3S-say-DAT you WH.SU-wash the car
'Who did Juan tell you washed the car?' [cha] (Bouma et al., 2001a, p.5)

Following Chung (1982, 1994), Bouma et al. (2001a) analyze the verb morphology in Chamorro as registering agreement with arguments that contain extracted elements, uniformly in main (13) and embedded (14) clauses. They note that in such a case, a subject extraction rule is not desirable; instead, there can be a unified account of fronted subjects, complements, and adjuncts which (at least for English) does not require extraction lexical rules at all, because they can be replaced by the principle of nonlocal amalgamation. The nonlocal amalgamation principle constrains a head's nonlocal features to be the union of its arguments' nonlocal feature sets, which then allows phrases to simply inherit the nonlocal values of the head daughter, instead of explicitly gathering all the values of all daughters via the extraction lexical rules. In DELPH-IN, this principle is implemented with supertypes like (15), from which all relevant heads (such as verbs) inherit.

(15)
$$\left[\begin{array}{ll} \textit{basic-two-arg-lex-item} & \\ \text{ARG-ST} & \left\langle \left[\text{NON-LOCAL} \left[\begin{array}{ll}\text{SLASH} & \boxed{1}\\ \text{REL} & \boxed{2}\\ \text{QUE} & \boxed{3}\end{array}\right]\right], \left[\text{NON-LOCAL} \left[\begin{array}{ll}\text{SLASH} & \boxed{4}\\ \text{REL} & \boxed{5}\\ \text{QUE} & \boxed{6}\end{array}\right]\right]\right\rangle \\ \text{SYNSEM|NON-LOCAL} & \left[\begin{array}{ll}\text{SLASH|APPEND} & \langle \boxed{1}, \boxed{4} \rangle\\ \text{REL|APPEND} & \langle \boxed{2}, \boxed{5} \rangle\\ \text{QUE|APPEND} & \langle \boxed{3}, \boxed{6} \rangle\end{array}\right] \end{array}\right]$$

In the English Resource Grammar (Flickinger, 2000, 2011) and subsequently in the Grammar Matrix (Bender et al., 2002, 2010), nonlocal amalgamation was implemented mainly to support an elegant analysis of e.g. English *easy*-adjectives. However, extraction lexical rules were maintained, in particular to avoid positing additional lexical entries for all heads which can have their arguments extracted.[10] In Zamaraeva & Emerson (2020), we argue that while for the English Resource Grammar implementing nonlocal amalgamation may be convenient, maintaining nonlocal amalgamation in a cross-linguistic system (the Grammar Matrix) complicates the analysis of multiple question fronting such as is found in Russian. We show that, in the context where extraction rules are present anyway, maintaining

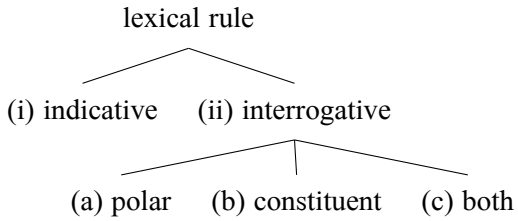
[10]Having to explicitly implement the entire lexicon is one of the things which make empirical approaches to grammar principally different from purely theoretical approaches.

nonlocal amalgamation necessitates adding even more extraction rules, to model languages with flexible order of fronting, where an extracted adjunct may appear between two extracted arguments as well as before or after them. Here in §4, I present a counterpoint to this and show that nonlocal amalgamation greatly simplifies the analysis of morphological marking of questions, thus making explicit a tension in a cross-linguistic system of analyses.

4 Analysis

In the context of question marking, a lexical rule can be (i) indicative or (ii) interrogative; and if it is interrogative, it can serve (a) polar, (b) constituent questions, or (c) both:

(16)

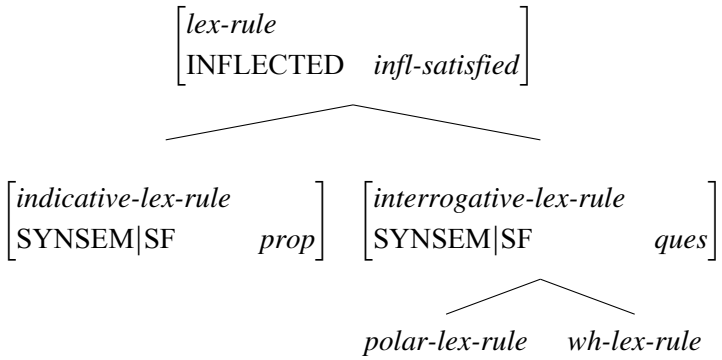


Makah is an example of a language which makes the (a)-(b) distinction, while Negidal and Yukaghir are of the (c) type.

Morphological marking of constituent questions is an example of where nonlocal amalgamation allows for a particularly elegant analysis, especially when it comes to modeling the distinction between options (a), (b), and (c) above, while modeling the difference between (i) and (ii) is straightforward with or without nonlocal amalgamation.

To see why modeling the difference between (i) and (ii) is straightforward either way, consider an HPSG hierarchy of lexical rules (17).[11]

(17)

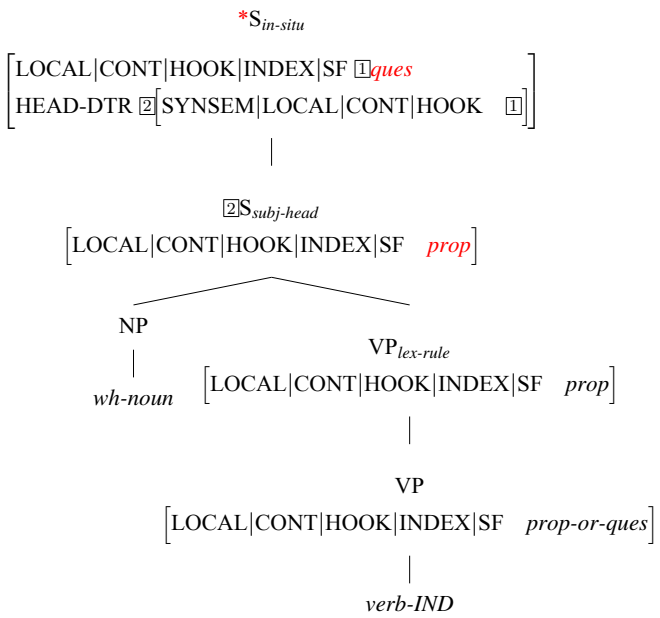


An *indicative-lex-rule* simply says its SF value is *prop*. This ensures the correct semantics. As for blocking an application of any subtype of the *interrogative clause*,

[11] Feature structures are abbreviated, here and throughout.

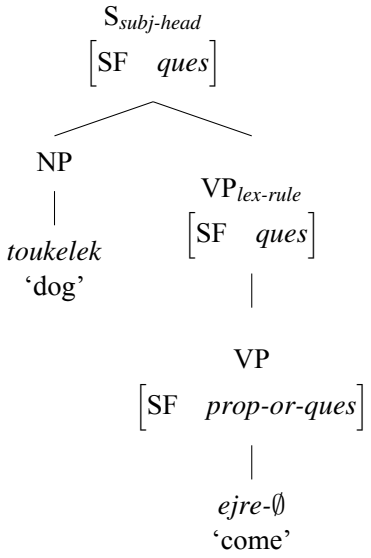
it will be ruled out even without saying anything about the nonlocal features of the verb or of its argument, due to the identity between the mother and the daughter's semantic HOOK values which comes from the definition of all head-compositional phrases in the Grammar Matrix, including *interrogative-clause* (12). This somewhat subtle mechanism is illustrated in (18). Red indicates unification failure.

(18)



An *interrogative-lex-rule* will say that its SF value is *ques*, allowing verbs marked with such rule to go through a question-forming phrase structure rule, or, if it is a polar question, to make the semantics of the clause interrogative without an additional phrase structure rule, like in (19) for the Yukaghir sentence (6).

(19)



While the distinction between (i) and (ii), and by extension (c),[12] is straightforwardly modeled with just the SF feature with or without nonlocal amalgamation (assuming semantic compositionality which ensures the semantic HOOK identities in the phrasal rules), modeling the distinction between (a) and (b) is much easier with nonlocal amalgamation than without it.

4.1 Analysis 1: With nonlocal amalgamation

Under the nonlocal amalgamation assumption and in the context of DELPH-IN JRF, a verb's QUE value will be the append of its subject's and objects' (20).

(20)
$$\begin{bmatrix} \textit{verb} & & \\ \text{SYNSEM} & \begin{bmatrix} \text{NON-LOCAL}|\text{QUE}|\text{APPEND} & \langle \boxed{1}, \boxed{2} \rangle \\ \text{LOCAL}|\text{CAT}|\text{VAL} & \begin{bmatrix} \text{SUBJ} & \left\langle \left[\text{NON-LOCAL}|\text{QUE } \boxed{1} \right] \right\rangle \\ \text{COMPS} & \left\langle \left[\text{NON-LOCAL}|\text{QUE } \boxed{2} \right] \right\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

In other words, if one or more of the verb's arguments are *wh*-words, the verb's own QUE list will be non-empty; otherwise it will be empty. Given this, modeling the distinction between (i) and (ii) and furthermore between (a) and (b) is straightforward. Markers which are to be used exclusively in polar questions constrain the daughter of the rule (the verb) to be QUE-empty (21).

(21)
$$\begin{bmatrix} \textit{polar-lex-rule} & \\ \text{SYNSEM}|\text{SF} & \textit{ques} \\ \text{DTR}|\text{SYNSEM}|\text{NON-LOCAL}|\text{QUE}|\text{LIST} & \langle\,\rangle \end{bmatrix}$$

Under the nonlocal amalgamation assumption, this is the same as to say that neither of the arguments is a *wh*-word. Conversely, the ones which are to be used exclusively for *wh*-questions are customized to take QUE-nonempty daughters (22).

(22)
$$\begin{bmatrix} \textit{wh-lex-rule} & \\ \text{SYNSEM}|\text{SF} & \textit{ques} \\ \text{DTR}|\text{SYNSEM}|\text{NON-LOCAL}|\text{QUE}|\text{LIST} & \textit{cons} \end{bmatrix}$$

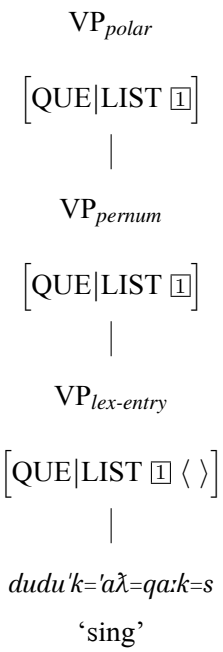
This means one or more of the arguments is a *wh*-word.[13] I illustrate the situation with subtrees for (9) and (7) presented side by side in (23).

[12] Option (c) is essentially a statement that only the distinction between (i) and (ii) is relevant.

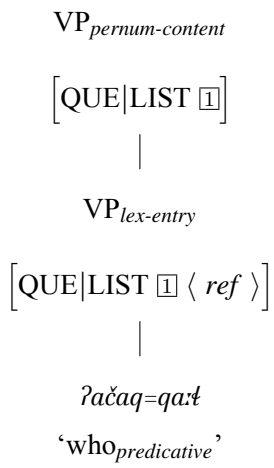
[13] *Cons* in (22) is a type for non-empty list.

(23)

a.



b.



In the analysis on the left (23a), because the verb has no *wh*-argument, it has an empty QUE value. In the analysis on the right (23b), the verb has a *wh*-subject, and so its own QUE value is not empty. The correct morphological behavior follows, with only the appropriate affix licensed in each case. Note that there is no need to worry about how many arguments the verb has and how many of them are *wh*, and which positions they occupy on the argument list. If the same marker is used for both polar and constituent questions (c), the QUE value on the daughter is underspecified. The analysis is thus simple and elegant.

4.2 Analysis 2: Without nonlocal amalgamation

In Zamaraeva 2021, nonlocal amalgamation is not used for reasons addressed in Zamaraeva & Emerson (2020) (namely, to simplify the analysis of multiple fronting and also to make the large system easier to reason about). Nonlocal amalgamation was an integral part of the Matrix core, and after it was removed, no grammars could use it. Therefore, since Zamaraeva 2021 is a cross-linguistic account of multiple types of question-forming strategies, I was forced to develop an account of morphological marking for languages like Makah (making the (a)-(b) distinction in (16)) without nonlocal amalgamation as well. I present it below.

Without nonlocal amalgamation, option (c) (languages which just use one marker for all types of questions) still does not pose complications; the analysis is the same as with nonlocal amalgamation: the QUE value of the lexical rule's sole

daughter is underspecified on the rule. However, neither (21) nor (22) will lead to the desired analysis of (a) and (b).

Recall from §3.2 that lexical entries that are not *wh*-words have empty QUE-lists, and the way the QUE values are propagated up the tree is an explicit inheritance in unary and an explicit append in binary rules. Verbs' own QUE lists are empty. This means that most verbs will unify with the daughter of (21) regardless of what their arguments are. An explicit constraint must be put on the verb's arguments instead, but this means an explicit constraint is required for the subject and yet another for the complement.

For the analysis of options (a) and (b), I use a constructed pseudolanguage for an exposition because sufficient data from Makah is not available to me at this time. This pseudolanguage is similar to Makah in the sense that it has two distinct paradigms for polar and constituent questions (24)–(32).

(24) noun tverb-PQ noun?

(25) *noun tverb-WHQ noun?

(26) who iverb-WHQ?

(27) who tverb-WHQ what?

(28) who tverb-WHQ noun?

(29) noun tverb-WHQ what?

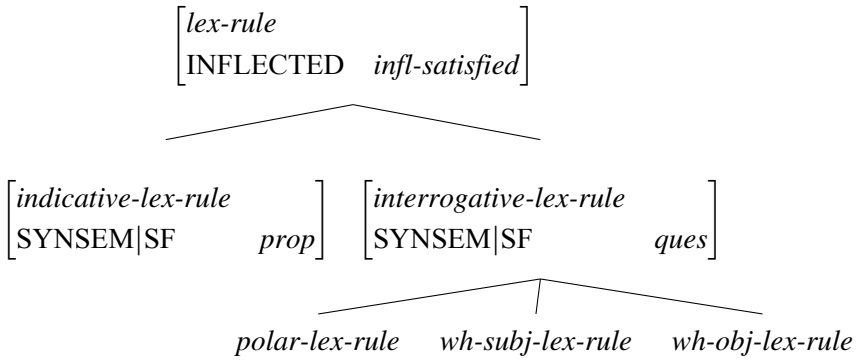
(30) *who tverb-PQ what?

(31) *who tverb-PQ noun?

(32) *noun tverb-PQ what?

For a grammar to behave correctly with respect to (24)–(32), the *interrogative-lex-rule* type should in fact be expanded not into just two but into three further subtypes (33).

(33)



The complication here compared to the analysis with nonlocal amalgamation has to do with the number of the arguments of different verbs. Now that the QUE constraints have to be placed directly on the arguments, covering both (26) and

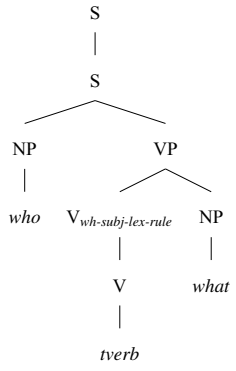
(27) as well as (29) cannot be done that easily. It can be done by having two rules, as suggested in (33), but note that the rules as presented in (34) and (35), without additional constraints, will both apply in e.g. (27), leading to spurious ambiguity (36a)–(36b).

(34)
$$\begin{bmatrix} \textit{wh-subj-lex-rule} \\ \text{SYNSEM|LOCAL|CAT|VAL|SUBJ} \quad \left\langle \left[\text{NON-LOCAL|QUE|LIST} \quad \text{cons} \right] \right\rangle \end{bmatrix}$$

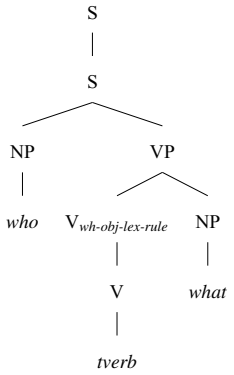
(35)
$$\begin{bmatrix} \textit{wh-obj-lex-rule} \\ \text{SYNSEM|LOCAL|CAT|VAL|COMPS} \quad \left\langle \left[\text{NON-LOCAL|QUE|LIST} \quad \text{cons} \right] \right\rangle \end{bmatrix}$$

(36)

a.



b.



I would like the *wh-subj-lex-rule* to only apply where *wh-obj-lex-rule* cannot. I cannot however constrain the SUBJ list of the *wh-obj-lex-rule* to be empty, because I still need to license sentences with non-*wh* subjects (29) and also because constraining the SUBJ list of the *wh-obj-lex-rule* to be empty would violate a constraint on the lexical rule supertype. By the lexicalist assumption, lexical rules apply before phrase structure rules, and so the subject list of a verbs is necessarily nonempty, since the head-subject rule has not applied yet.

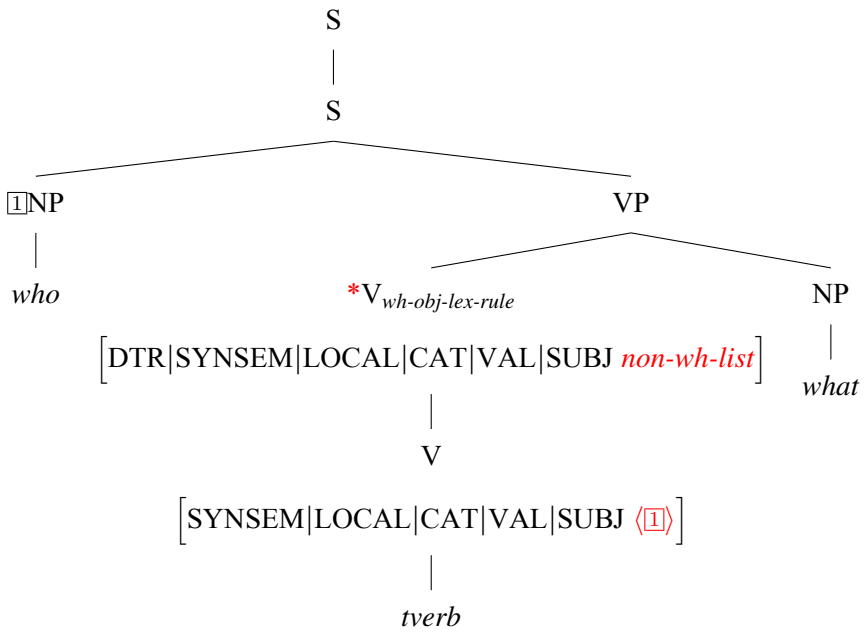
This can be addressed by using a *parameterized list* which here I call *non-wh-list* (37). Simply put, it is a list which stipulates that all elements on it, of which there is zero or more, are not *wh*-words.[14]

(37)
$$\begin{bmatrix} \textit{non-wh-cons} & \\ \text{FIRST} & \begin{bmatrix} \textit{synsem} \\ \text{NON-LOCAL|QUE|LIST} \quad \langle\,\rangle \end{bmatrix} \\ \text{REST} & \textit{non-wh-list} \end{bmatrix}$$

[14]For a full hierarchy needed for this parameterized list to work, see Zamaraeva 2021, p. 202.

I can use *non-wh-list* to constrain lexical rules so that they allow both empty lists and lists which do not contain *wh*-words. This way, *wh-obj-lex-rule* can insist that the subject is not a *wh*-word — that case would be for the *wh-subj-lex-rule* to take care of — but does not have to be empty. The unwanted second tree (36b) is then ruled out (38).

(38)



The complete set of interrogative lexical rules for a grammar of a language presented as data in (24)–(32) then looks like this (39)–(40).[15]

(39)
$$\begin{bmatrix} \textit{polar-lex-rule} \\ \text{SYNSEM|LOCAL|CAT|VAL} \begin{bmatrix} \text{SUBJ} & \left\langle \left[\text{NON-LOCAL|QUE|LIST} \ \langle\,\rangle \right] \right\rangle \\ \text{COMPS} & \textit{non-wh-list} \end{bmatrix} \end{bmatrix}$$

(40)
$$\begin{bmatrix} \textit{wh-subj-lex-rule} \\ \text{SYNSEM|LOCAL|CAT|VAL|SUBJ} \left\langle \left[\text{NON-LOCAL|QUE|LIST} \ \text{cons} \right] \right\rangle \end{bmatrix}$$

(41)
$$\begin{bmatrix} \textit{wh-obj-lex-rule} \\ \text{SYNSEM|LOCAL|CAT|VAL} \begin{bmatrix} \text{SUBJ} & \textit{non-wh-list} \\ \text{COMPS} & \left\langle \left[\text{NON-LOCAL|QUE|LIST} \ \text{cons} \right] \right\rangle \end{bmatrix} \end{bmatrix}$$

It requires three lexical rules and a separate hierarchy of parameterized list types.[14]

[15] All these rules are subtypes of the interrogative rule (33) and so their sentential force value is *ques*.

5 Future work

The argument presented above appeals primarily to elegance. In future work, the interaction of morphological rules with adjunct extraction can be explored with relevant data, and may provide further testing for the nonlocal amalgamation approach. Additionally, while the parameterized list helps get rid of spurious derivations in Analysis 2, considering a larger natural language test suite may reveal other spurious derivations or undesirable behavior in either analysis.

6 Conclusion

As shown in Zamaraeva & Emerson 2020 and Zamaraeva 2021, nonlocal amalgamation significantly complicates a system of cross-linguistic analyses such as the Grammar Matrix (Bender et al., 2002, 2010), particularly when it comes to the analyses of long-distance dependencies in languages with flexible word orders. However, in this work I show that at the same time, nonlocal amalgamation significantly simplifies the analysis of constituent questions in languages with morphological marking of questions, particularly those where there exist separate paradigms for polar and constituent questions (in addition to a paradigm for declarative forms of the verb).

What does this tension between two typologically different systems of analyses mean? There are different possibilities to consider.

The first one is that the tension illustrates some issues with the DELPH-IN formalism (particularly, its treatment of nonlocal features as lists with fixed length and order; see Zamaraeva & Emerson 2020 for details). In other words, the argument may be that nonlocal amalgamation should not pose any complications in theory, and that it poses them in practice is not a problem with the idea but with its implementation. While this conclusion is a possible one and it may well be that the DELPH-IN formalism could be improved in the future, it is important to consider the years of empirical success of the DELPH-IN formalism, particularly in the form of the English Resource Grammar (Flickinger, 2000, 2011) and its applications in research (e.g. Buys & Blunsom, 2017) and industry (e.g. Morgado da Costa et al., 2020). The Grammar Matrix (Bender et al., 2002, 2010) is a similar empirical success story, as its analyses are serving 517 typological profiles, as a system.[16] In other words, there is no reason to immediately conclude that the core elements of the formalism such as nonlocal lists should just be abandoned.

The second possible conclusion is that perhaps there is no need for a system of analyses which supports such different typological profiles as Russian and Makah. Here, we are approaching a rather big theoretical debate about whether there is any core set of elements which all languages absolutely must share, or if such a set does not necessarily exist. Reflecting on this debate goes beyond the goals

[16] Some of the profiles are similar to each other but the range is wide, due to the methodology of Matrix development (see Bender et al. 2010 and Zamaraeva 2021, Chapter 5).

of this paper but the evidence shown here could in principle be considered to serve the latter point of view. A weak version of this conclusion is that nonlocal amalgamation itself should not be part of the core but can be added as part of the customization system. This means a rather complex, nontrivial conpcept of customization though.

The third possible conclusion, which perhaps is also a weak version of the second one, is that the typological profiles involved (Russian with its multiple fronting, as discussed in Zamaraeva & Emerson 2020, and Makah with its distinct paradigms, as discussed here) are rare. This in turn can mean two things: First, perhaps rare typological profiles warrant more complexity. On the other hand, it could mean that such languages are not yet well analyzed, and trying to accommodate both of them in the same system requires first refining our understanding of such languages.

Yet another version of this conclusion is that the role of long-distance dependencies is only so prominent in syntactic analysis because English happens to have them. In other words, the elements of analysis that long-distance dependencies seem to require may not be as important for all grammars as we are used to think. This is not to say that a comprehensive theory of grammar should not support them, but rather that our attachment to the existing analyses may be overly influenced by the dominance of English as the test language. Put another way, while it seems obvious that it is the analysis of Makah (and languages like Makah) that we don't yet understand well enough and that should be improved, it may also be that revisiting the analysis of Indo-European languages in the context of a cross-linguistic system may be beneficial.

All the conclusions presented above confirm that systems of analyses such as the Grammar Matrix, which, with computational aid, force syntacticians to consider complex interactions between phenomena intra- and cross-linguistically, are serving their purpose by exposing tensions such as described here.

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