

Annual Review of Linguistics

Successive Cyclicity and the Syntax of Long-Distance Dependencies

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Annu. Rev. Linguist. 2020. 6:111–30

First published as a Review in Advance on
November 1, 2019

The *Annual Review of Linguistics* is online at
linguistics.annualreviews.org

<https://doi.org/10.1146/annurev-linguistics-011718-012318>

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Keywords

movement, successive cyclicity, extraction marking, feature percolation, intermediate movement, pronoun copying, stranding, intermediate scope

Abstract

Every major theoretical approach to syntactic structure incorporates a mechanism for generating unbounded dependencies. In this article, I distinguish between some of the most commonly entertained mechanisms by looking in detail at one of the most fundamental discoveries about long-distance dependencies, the fact that they are successive cyclic. Most of the mechanisms posited in order to generate long-distance dependencies capture this property, but make different predictions about what reflexes of successive cyclicity should be attested across languages. In particular, theories of long-distance dependencies can be distinguished according to whether they propose intermediate occurrences of the moving phrases (movement theories) or whether intermediate heads carry features relevant to displacement (featural theories). I show that a full consideration of the typology of successive cyclicity provides clear evidence that both components are part of the syntax of long-distance dependencies. In addition, reflexes of successive cyclicity are equally distributed across the CP and *v*P edge, suggesting that these are parallel domains.

Filler and gap:

long-distance dependencies consist of a filler, the moved phrase, and a gap, the position now empty

Successive cyclicity:

the idea that long-distance dependencies consist of a series of shorter dependencies

1. INTRODUCTION

The pervasiveness of long-distance dependencies in natural language is one of the most significant discoveries to come out of research into syntactic structure. Long-distance dependencies include constituent questions and topicalization and relativization constructions, which are formed by taking a phrase, such as *these books* in example 1a, and potentially moving it across long distances, as in examples 1b–d:¹

Examples of long-distance dependencies

- (1a) Fatima thinks Sam said Harisah likes these books.
- (1b) Which books does Fatima think Sam said Harisah likes ___?
- (1c) These books, Fatima thinks Sam said Harisah likes ___.
- (1d) I grabbed the books that Fatima thinks that Sam said Harisah likes ___.

The position the moved phrase occupies outside the long-distance dependencies is called the gap, and the moved position is called the filler. As first pointed out by Chomsky (1957), such dependencies put natural language in the class of context-free grammars and seem to distinguish human language from many other animal communication systems (Hauser et al. 2002; but see Sonnweber et al. 2015, Reber et al. 2019). As a result, almost every major approach to syntactic structure incorporates a special mechanism that is capable of generating long-distance dependencies.

One of the most fundamental yet surprising properties of long-distance dependencies is that they are successive cyclic. This idea originates from Chomsky (1973, 1977), and a wealth of empirical evidence from a wide variety of languages has since accrued that shows that long-distance dependencies do not occur in one fell swoop, but should in fact be decomposed into a series of more local dependencies, as in examples 2 and 3:

A long-distance dependency in one fell swoop

- (2) Which books does Fatima think [CP Sam said [CP Harisah likes ___]]?

A long-distance dependency as successive cyclic

- (3) Which books does Fatima think [CP ___ Sam said [CP Harisah likes ___]]?

The phenomenon of successive cyclicity is one of the key characteristics that any theory of long-distance displacement should capture. As a consequence, the crosslinguistic profile of successive cyclicity effects is one of the major ways in which we can distinguish between different approaches.

We can broadly distinguish at least three approaches to long-distance dependencies and the property of successive cyclicity. Many syntactic frameworks adopt what I refer to as a percolatory mechanism, in which long-distance dependencies represent the passing of information up a syntactic tree, from node to node, through either feature percolation or semantic operations.

¹Long-distance dependencies are sometimes characterized as potentially unbounded, because these dependencies can cross finite clauses, which can be recursively embedded indefinitely. Since Ross (1967), it has been well known that there are also clause types that restrict dependencies across them, called islands (hence the term potentially unbounded). Long-distance dependencies can be contrasted with dependencies such as passivization and raising in examples 1a and 1b, which cannot cross intervening noun phrases and, at least in English, cannot span finite clauses (but see Halpert 2019):

Passivization and raising

- (ia) These cookies were brought ___ by Pavel.
- (ib) These cookies appear [___ to be tasty].

Such ideas are common in Head-Driven Phrase Structure Grammar (HPSG), Lexical-Functional Grammar (LFG), or Combinatory Categorial Grammar (e.g., Kaplan & Bresnan 1982, Steedman 1987, Pollard & Sag 1994, Bouma et al. 2001; but see Neeleman & Van de Koot 2010). Within a percolatory approach, the effect of successive cyclicity reflects the presence of percolated features along the path of a dependency. This type of theory can be distinguished from frameworks that make use of syntactic movement, so that a sentence like example 3 is generated by taking *which books* from the position of the gap and moving it up the tree (e.g., Chomsky 1973, 1977, 1986). A subset of such theories is “feature free” and attributes all successive cyclicity effects to multiple movement steps, in contrast to a percolation account (Bošković 2002, 2007; Heck & Müller 2003; Chomsky 2013, 2015). The last approach assumes that all movement involves a featural component as well (Chomsky 1995, McCloskey 2002, Abels 2012, Van Urk 2015).

This review demonstrates that the crosslinguistic profile of successive cyclicity can be used to adjudicate between different theories of long-distance dependencies. A full consideration of the reflexes of successive cyclicity that are attested implicates a model with both a featural component and the involvement of movement steps (as in Chomsky 1973, 1977, 1995; McCloskey 2002; Abels 2012). This article also serves as a comprehensive overview of evidence for the notion of successive cyclicity.

2. APPROACHES TO SUCCESSIVE CYCLICITY

Most theoretical approaches to syntax acknowledge that long-distance dependencies display successive cyclicity effects, but there is a great deal of variation as to how these are implemented exactly. In this section, I provide an overview of the three basic types of theories of successive cyclicity discussed in this article: feature percolation, feature-driven movement, and what I refer to as featureless movement.

2.1. Feature Percolation

One of the most common approaches to long-distance dependencies across syntactic frameworks is to assume percolation of information up the syntactic tree. In a percolatory approach of this sort, long-distance dependencies do not involve literal movement steps but rather are established by a mechanism of information transmission that links the gap to the filler. This type of perspective is usually adopted in syntactic frameworks that do not make use of a notion of syntactic movement, such as HPSG or LFG (e.g., Pollard & Sag 1994, Bouma et al. 2001, Dalrymple 2001). Neeleman & Van de Koot (2010) present a minimalist version.

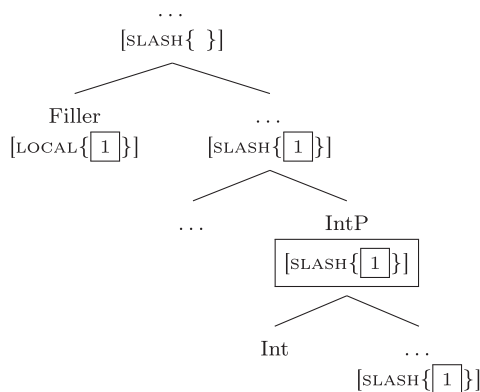
In HPSG, for example, long-distance dependencies are usually modeled with the feature `SLASH`, which can carry information up a tree (e.g., Pollard & Sag 1994, Bouma et al. 2001). A `SLASH` feature is appended to a node and represents the information that the tree contains a gap. I refer to such features as extraction features, and I show below that they play an important role in long-distance dependencies. Information is stored in a `SLASH` feature when a gap is introduced, and combinatorial rules ensure that this feature is carried up the tree from node to node. In this way, information about the missing phrase can be connected to the filler, as represented in example 4.² In this tree, information about the gap (represented with the index 1) is stored in a `SLASH` feature and passed up the tree. The `SLASH` feature becomes empty only when the content of the feature can be identified with the local information of a filler:

²I do not discuss the many different implementations of feature percolation in detail, since the crucial point here is only that such approaches predict that successive cyclicity effects should be limited to the realization of extraction features on intermediate heads.

(Syntactic) movement:

the idea that filler–gap dependencies reflect a syntactic operation that moves a phrase from the gap to the filler

(4) Feature percolation using slash



Extraction feature: a feature that appears in the context of a long-distance dependency

Intermediate movement: movement to an intermediate position in a long-distance dependency

This model means that long-distance dependencies are necessarily successive cyclic. A long-distance dependency consists of many successive operations of percolation of an extraction feature. As a result, feature percolation makes the prediction that, across languages, any intermediate node in a long-distance dependency, such as IntP in example 4 (here and below, Int stands for intermediate), may show morphological evidence of these extraction features, in the same way that other morphosyntactic features can affect realization.³ Since such an approach denies the existence of syntactic movement, however, there should be no evidence of the syntactic presence of the moved phrase in the gap position or any other location.⁴

2.2. Feature-Driven Intermediate Movement

Feature percolation is often contrasted with approaches to long-distance dependencies that assume movement (Chomsky 1957, 1977, 1981, 1995). In movement theories, long-distance dependencies arise because a phrase is first generated at the position of the gap and subsequently moved within the tree to the filler position. Within such an approach, successive cyclic effects are usually taken to arise because of additional movement steps (Chomsky 1973, 1977, 1986), which I refer to as intermediate movement. Within movement-based approaches, we can distinguish at least two theories of intermediate movement, depending on whether extraction features are involved.

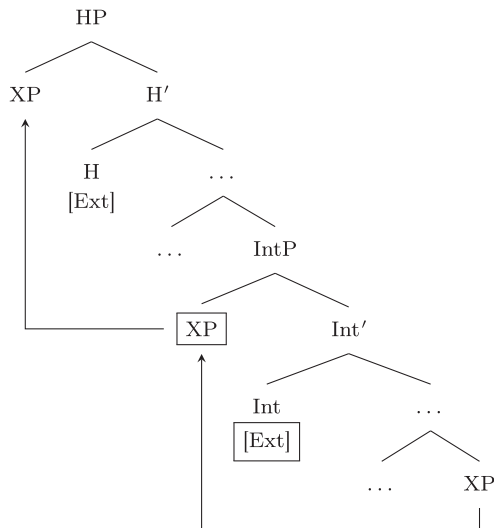
Many movement-based approaches also assume the presence of extraction features. However, the role of these features is not to carry information but rather to act as an instruction for movement to occur. In the first movement-based approach, all movement, including intermediate movement, is assumed to involve an extraction feature akin to SLASH (e.g., Chomsky 1995; see also McCloskey 2002, Abels 2012, Georgi 2014, Van Urk 2015). The representation of a long-distance dependency, then, is analogous to example 5. The filler is the sister of the head, H, bearing the

³Note that, technically speaking, classic feature percolation proceeds from daughter to mother, leaving Int itself unaffected (as in Pollard & Sag 1984). But many implementations of percolation allow IntP to dictate the shape of the head Int (for HPSG, see, e.g., Bouma et al. 2001, Vaillette 2002), so I abstract away from this issue.

⁴It is worth noting that the implementation of long-distance dependencies in LFG is quite different, such that it may even be somewhat misleading to label it feature percolation. In LFG, the relationship between the antecedent and the gap site is handled through functional equations and not through percolated features. However, the way successive cyclic effects are handled is ultimately the same, as LFG handles effects like the Irish complementizer alternations by placing constraints on intermediate nodes. As a result, these approaches appear to make the same predictions for the typology of reflexes of successive cyclicality.

extraction feature [Ext].⁵ Movement to an intermediate position, Int, is associated with the same extraction feature [Ext].⁶

(5) Feature-driven intermediate movement



As in a feature percolation approach, this type of theory predicts that there are successive cyclicity effects which reflect the realization of an extraction feature on an intermediate head, Int. But a movement-based approach also predicts another class of successive cyclicity effects. Such a view posits intermediate copies of the moved phrase throughout the tree, so the effects of these should be detectable. For example, we expect to find cases of multiple realization or stranding of material inside XP in intermediate positions, as well as other syntactic effects associated with the intermediate phrase.

2.3. Featureless Intermediate Movement

An issue that arises within a theory that makes use of feature-driven intermediate movement concerns how to regulate the distribution of extraction features. As a consequence, a variety of movement-based approaches to successive cyclicity that eliminate the need for intermediate extraction features have been developed (e.g., Heck & Müller 2000, 2003; Bošković 2002, 2007; Chomsky 2013). I refer to these as featureless intermediate movement theories.

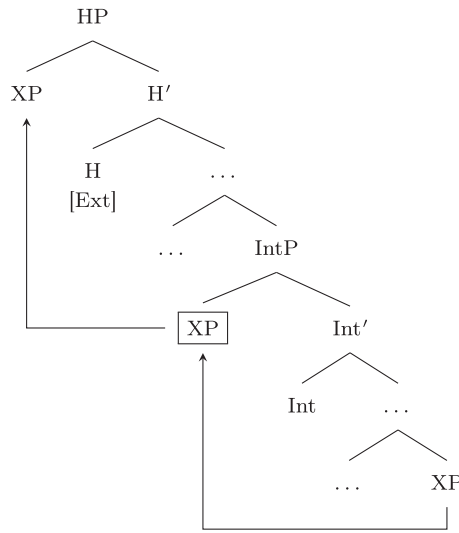
There are various featureless approaches to intermediate movement. In Heck & Müller's (2000, 2003) optimality-theoretic approach, the constraint PHASEBALANCE prevents phrases with extraction features from remaining in situ. In this type of approach, intermediate movement is not accompanied by any special features on intermediate heads, while movement to the filler position may still be associated with an extraction feature,⁷ as represented in example 6:

⁵The moving phrase is usually assumed to carry a special feature associated with long-distance dependencies, too, possibly the same feature as [Ext], but I omit it here for simplicity.

⁶Or a version of [Ext]. In a feature-driven theory, it is conceivable that the extraction feature associated with intermediate movement is not identical to the feature associated with final movement, for example, in whether it is interpretable/uninterpretable or in whether it is flat or articulated, if probing features are part of a feature geometry (Rizzi 1990, Abels 2012; see, in particular, Georgi 2014).

⁷It is conceivable in a free Merge approach that no movement is ever accompanied by an extraction feature (in Chomsky's free Merge theory, however, the requirements of labeling still force feature sharing in the filler

(6) Featureless intermediate movement



Other featureless approaches result in the same configuration. Chomsky's (2013, 2015) recent research on successive cyclicity also assumes that long-distance dependencies have the structure in example 6, although the distribution of intermediate movement is regulated only by well-formedness constraints resulting from labeling requirements (see also Bošković 2002, 2007).

Again, this approach to successive cyclicity makes different predictions about what the reflexes of successive cyclicity should look like crosslinguistically. Like a feature-driven intermediate movement approach, this perspective on successive cyclicity predicts intermediate copies along the path of movement. In contrast to the other two approaches, however, featureless approaches do not predict morphological realizations of extraction features on intermediate heads.

An important caveat to this picture is that there is a type of morphological effect that a featureless approach could predict. As Preminger (2011) notes, an intermediate copy could act as a trigger for allomorphy of *Int*, if allomorphy can be triggered in such a configuration (contra Bobaljik 2012, Bobaljik & Harley 2017). In Section 4, I discuss in more detail how such allomorphy could be distinguished from a genuine morphological effect.

Thus, there are at least three broad categories of approaches to successive cyclicity, which can be distinguished according to their typological predictions of what type of successive cyclicity effects we expect to find. These predictions are summarized in **Table 1**.

The remainder of this review tests these predictions. I argue that the attested reflexes of successive cyclicity suggest syntactic movement (Section 3), as well as the presence of extraction features (Section 4), lending support to a feature-driven intermediate movement approach (e.g., Chomsky 1995; McCloskey 2002; Abels 2003, 2012). Section 5 reveals a strong degree of parallelism

Table 1 Expectations about reflexes of successive cyclicity

	Feature on intermediate head?	Intermediate copy?
Feature percolation	Yes	No
Feature-driven movement	Yes	Yes
Featureless movement	No (except allomorphy)	Yes

position). The same empirical problems that I identify for featureless intermediate movement would arise for such a proposal.

between the clausal and verb phrase domains, two syntactic domains typically associated with intermediate movement. Specifically, I show that each reflex attested at one edge is attested at the other, providing evidence that both phrases constitute locality domains (Chomsky 1986, 1995, 2001).

3. EVIDENCE FOR INTERMEDIATE MOVEMENT

I begin this section by arguing that evidence from successive cyclicity suggests that long-distance dependencies involve intermediate movement, and do not solely reflect a percolatory mechanism. Instead, across languages, we find evidence for occurrences of the moved phrase in intermediate positions, as in movement theories (Chomsky 1973, 1977, 1986).

The first and most obvious argument for intermediate movement comes from constructions in which intermediate copies are overtly realized. It has frequently been observed that, in addition to full *wh*-movement and *wh*-in situ, some languages allow a third option, partial *wh*-movement, in which a moving phrase seems to surface in an intermediate position. Examples 7a–c illustrate for Malay (Cole & Hermon 2000), a language which permits ordinary *wh*-movement and *wh*-in situ but also partial *wh*-movement to the front of an intermediate clause:

Wh-in situ and full and partial *wh*-movement in Malay

- (7a) *Siapa* Bill harap [CP ___ akan membeli baju untuknya]?
 who Bill hopes will buy clothes for.him
 ‘Who does Bill hope will buy clothes for him?’
- (7b) Ali memberitahu kamu tadi [CP *apa* Fatimah baca ___]?
 Ali told you just.now what Fatimah read
 ‘What did Ali tell you just now that Fatimah was reading?’
- (7c) Ali memberitahu kamu tadi [CP Fatimah baca *apa*]?
 Ali told you just.now Fatimah read what
 ‘What did Ali tell you just now that Fatimah was reading?’
 (Cole & Hermon 1998, pp. 224–25)

Importantly, in Malay, partial *wh*-movement is sensitive to islands both above and below the intermediate position, just like full *wh*-movement, as in examples 8a and 8b:

Partial *wh*-movement is sensitive to higher and lower islands

- (8a) *Ali memberitahu kamu [CP *apa* Mary fikir [CP dia suka [DP perempuan yang
 Ali told you what Mary think he likes woman that
 beli ___]]]?
 buy
 ‘What did Ali tell you that Mary thinks that he likes a woman who bought?’
- (8b) *Kamu sayang [DP perempuan yang Ali fikir [CP *apa* telah makan ___]]]?
 you love woman that Ali thinks what already eat
 ‘Who do you love the woman who Ali thinks ate what?’
 (Cole & Hermon 2000, pp. 91–92)

Cole & Hermon (2000) point out that this pattern is evidence that a partially moved *wh*-phrase does undergo full movement covertly, so constructions like example 7b are best analyzed as realization of an intermediate copy.⁸ If this analysis is correct, then partial *wh*-movement reveals

⁸Establishing this is important, because there seem to be constructions that look like partial *wh*-movement in which there is no island sensitivity above the partially moved *wh*-phrase (see, e.g., Zentz 2016 on Shona). In

Pied-piping:

movement of a larger phrase containing a focused or topicalized phrase

intermediate movement in the embedded clause (see Fanselow 2006 for an overview of other languages that may allow similar partial *wh*-movement constructions).

As also noted by Fanselow (2006) and Abels (2012, sections 3.3 and 3.4), another configuration in which intermediate phrases are realized is found when intermediate movement interacts with pied-piping (Ross 1967). In particular, if a domain targeted by intermediate movement can be pied-piped, then we expect the moving phrase to be realized in its intermediate position rather than in the gap position. Languages that have been identified as clausal pied-piping languages include Imbabura Quechua and Basque (e.g., Hermon 1985, Ortiz de Urbina 1989, Arregi 2003). As evident in examples 9a and 9b, these languages reveal that a *wh*-phrase occupies an intermediate position within a pied-piped clause and is not in the position of the gap:

Clausal pied-piping in Quechua and Basque

- (9a) [CP Ima-ta wawa __ miku-chun-taj] Maria muna-n?
 what-ACC child.NOM eat-SUBJ-Q Maria want-PR.3
 ‘What does Maria want that the child eat?’
 (Hermon 1985, p. 151)
- (9b) [CP Se idatzi rabela Jonek] pentzate su?
 what written has Jon.ERG you-think
 ‘What do you think Jon wrote?’
 (Arregi 2003, p. 118)

Another piece of evidence for intermediate movement comes from multiple realization. In *wh*-copying, a copy of a moved *wh*-phrase is realized at the edge of a clause on the path of a long-distance dependency. Examples 10a–c illustrate for a variety of languages:

Examples of *wh*-copying in German, Frisian, and Passamaquoddy

- (10a) Wen glaubst du [CP wen sie getroffen hat]?
 who believe you who she met has
 ‘Who do you believe she has met?’
 (Felser 2004)
- (10b) Wêr tinke jo [CP wêr’t Jan wennet]?
 where think you where-c Jan lives
 ‘Where do you think that Jan lives?’
 (Hiemstra 1986, p. 99)
- (10c) Tayuwe kt-itom-ups [CP tayuwe apc k-tol-i malsanikuwam-ok]?
 when 2-say-DUB when again 2-there-go store-LOC
 ‘When did you say you’re going to go to the store?’
 (Bruening 2006, p. 26)

See Felser (2004) and Bruening (2006) for detailed arguments that such constructions arise from movement and should be distinguished in particular from *wh*-scope marking. *Wh*-copying is usually limited to constituent questions and relative clauses (see, e.g., Pankau 2013), but there are also cases that affect all long-distance dependencies, as in Seereer (Baier 2014; see also the Dinka pattern in Section 5).

such languages, partial *wh*-movement should more likely be analyzed as *wh*-in situ plus independent focalization/topicalization.

Multiple realization seems to reveal intermediate copies directly. An important caveat about these patterns, however, is that copies of the filler spelled out in intermediate positions always take the form of pronouns, as discussed extensively by Nunes (1995, 2004) and Van Urk (2018). Any theory of long-distance dependencies, then, must be able to account for this restriction on multiple realization (see Nunes 2004 and Van Urk 2018 for proposals within a movement framework).⁹

Another well-known argument for intermediate movement comes from instances of stranding (DuPlessis 1977, McCloskey 2000, Barbiers 2002). McCloskey (2000) describes a pattern of *all*-stranding in West Ulster English. He points out that *wb*-phrases modified by *all* can leave *all* behind in the gap site but also in an intermediate position, at the edge of an embedded clause, as shown in examples 11a–c:

All-stranding in West Ulster English

- (11a) *What all* did he say [_{CP} he wanted ___]?
 (11b) *What* did he say [_{CP} he wanted *all*]?
 (11c) *What* did he say [_{CP} *all* he wanted ___]?
 (McCloskey 2000, p. 61)

Such facts provide evidence that the moved phrase once occupied this intermediate position, since it can leave material there (see also Wiland 2010 and Davis 2018 for other instances of stranding at the clause edge).

A fourth argument for intermediate occurrences of the filler phrase comes from verb-second (V2) satisfaction (Thiersch 1978, Van Urk & Richards 2015). In Dinka (Van Urk & Richards 2015), all clauses come with a V2 requirement. In long-distance dependencies, the moving phrase satisfies the V2 property of all intervening clauses, as in *wb*-cleft examples 12a and 12b. No other phrase can satisfy V2 in such clauses, as examples 12c and 12d demonstrate:¹⁰

Long-distance movement satisfies V2 in Dinka

- (12a) Yè ñà yùùkù luèeel [_{CP} ñà cé cuïin câam]?
 be who HAB.1PL say.NF PRF food eat.NF
 ‘Who do we say [_{CP} __ has eaten food]?’
 (12b) Yè ñó yùùkù luèeel [_{CP} ñé cí Ból câam]?
 be what HAB.1PL say.NF PRF.OV Bol.GEN eat.NF
 ‘What do we say [_{CP} Bol has eaten __]?’
 (12c) *Yè ñó yùùkù luèeel [_{CP} Ból àcé câam]?
 be what HAB.1PL say.NF Bol PRF eat.NF
 ‘What do we say [_{CP} Bol has eaten __]?’
 (12d) *Yè ñà yùùkù luèeel [_{CP} cuïin àcí câam]?
 be who HAB.1PL say.NF food PRF.OV eat.NF
 ‘Who do we say [_{CP} __ has eaten food]?’

On the assumption that the V2 requirement necessitates an overt phrase before the second position verb/auxiliary, the patterns in examples 12a–d make sense if a copy of the moving phrase

Verb-second (V2) satisfaction: the requirement that the highest verb/auxiliary come second in a clause

⁹I do not know of accounts within a percolatory approach, and it is not necessarily obvious how such theories would handle these patterns. A movement-free account might hope to treat the pronoun copying patterns as a novel type of iterated resumption, but see Van Urk (2018) for syntactic differences between resumption and pronoun copying.

¹⁰The same patterns are found in topicalization and relativization structures.

Extraction marking:
a morphological reflex
that appears only
along the path of a
long-distance
dependency

occupies the edge of the embedded clause. At the relevant level of representation, the clause is V2, like all other Dinka clauses (see Thiersch 1978 for a similar effect in German).

In this section, I have shown that intermediate copies can be detected in a variety of ways, providing evidence that long-distance dependencies involve syntactic movement and that successive cyclicity reflects the presence of intermediate movement. These observations argue against a purely percolatory approach.

4. MORPHOLOGICAL EFFECTS OF LONG-DISTANCE DEPENDENCIES

The second question I examine in this review is whether there is crosslinguistic evidence for a featural component to successive cyclicity, as in percolation theories or movement theories in which all movement is feature driven. As this section demonstrates, there is a wealth of typological evidence that long-distance dependencies affect the featural content of intermediate heads.

One of the most well-known examples of an extraction marking effect is the pattern of Irish complementizer alternations in long-distance dependencies (McCloskey 1979, 2001, 2002). Irish has a declarative complementizer *go* as well as a complementizer *aL* that surfaces in the context of a long-distance dependency, as the contrast between examples 13a and 13b shows:¹¹

Two different complementizers in Irish

(13a) Creidim [CP *gu-r* inis sé bréag].
believe.1SG c.DCL-PAST tell he lie
'I believe that he told a lie.'

(13b) an fhilíocht [CP *a* chum sí ___]
the poetry c.EXT composed she
'the poetry that she composed'
(McCloskey 2002, pp. 185–86)

In a long-distance dependency, as in example 14, every complementizer on the path of movement must be *aL*, and not *go*, revealing the presence of successive-cyclic dependencies:

Extraction complementizer in intermediate clauses:

(14) an t-ainm [CP *a* hinnseadh dúinn [CP *a* bhí ___ ar an áit]]
the name c.EXT was.told to.us c.EXT was on the place
'the name that we were told was on the place'
(McCloskey 2002, p. 185)

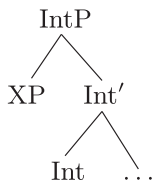
In this way, the Irish pattern provides support for the idea that there are extraction features on intervening heads. In addition, such effects turn out to be widespread. Similar patterns are attested, for example, in Asante Twi (Korsah & Murphy 2019), Chamorro (Chung 1982), Defaka (Bennett et al. 2012), Dinka (Van Urk 2015), Kikuyu (Clements et al. 1983, Clements 1984) Kĩtharaka (Abels & Muriungi 2008), Seereer (Baier 2014), and Wolof (Torrence 2005).

As Preminger (2011, p. 188) notes, there is a way in which an apparent extraction marking effect could be generated without proposing an extraction feature. In particular, we could imagine an approach in which the form of a head is sensitive to whether its specifier is occupied. In a

¹¹This complementizer is often represented as *aL*, because it triggers lenition on the following verb. It can be distinguished from the complementizer *aN*, which triggers nasalization and accompanies resumption (see McCloskey 2002).

configuration like example 15, an intermediate head *Int* could have a special allomorph that appears only in the context of a filled specifier, with the realization rules shown in example 16:

(15) Allomorphy configuration



Realization rules for *Int*

- (16) $\text{Int}_A \rightarrow A$
 $\text{Int}_B \rightarrow B / \text{XP} _$

There are conceptual reasons to worry about this type of account, since some recent research on the locality of allomorphy explicitly rules out allomorphy in a configuration such as example 15 (e.g., Bobaljik 2012, Bobaljik & Harley 2017). Bobaljik & Harley (2017), for instance, observe that, in a number of languages, root suppletion triggered by number is sensitive only to the plurality of an unaccusative subject or transitive object, and they account for this restriction by ruling out allomorphy in a specifier–head configuration. Even if possible, such allomorphy effects should at least be rare.

But, if we set such concerns aside, the system described by these rules could in principle create an apparent extraction marking effect without a feature on *Int*. There are extraction marking systems, however, that allow us to rule out this possibility. In Dinka, long-distance dependencies are also accompanied by extraction marking, as evident in examples 17a and 17b. In these examples, any V2 verb or auxiliary on the path of the dependency appears with an extraction prefix (the nonextraction forms are *áa-* and *áa-kè*, respectively):

Extraction prefix in Dinka

- (17a) $\text{Yè } k\acute{o}c-k\acute{o}; \quad \emptyset-y\grave{u}k\grave{u} \quad k\acute{e} \quad t\grave{a}ak \quad [_{CP} \quad k\grave{e} \quad \emptyset-c\acute{i} \quad \acute{A}y\grave{e}n$
 be people-which EXT.3-HAB.1P 3PL think.NF C EXT.3-PRE.OV Ayen.GEN
 (ké) cà̀m k\grave{e}̀n\grave{e} k\acute{e}k;] ?
 3PL eat.NF with 3PL
 ‘Which people do we think Ayen has eaten with?’

- (17b) $\text{Ye } k\acute{o}c-k\acute{o} \quad \acute{e}-k\grave{e}-y\acute{a} \quad k\acute{e} \quad t\grave{a}ak \quad [_{CP}$
 be people.cs-which.pl EXT.PST-3P-HAB.2SG 3PL think.NF
 $\acute{e}-k\grave{e}-c\acute{i} \quad \acute{A}y\grave{e}n \quad k\acute{e} \quad g\grave{a}am \quad g\grave{a}l\grave{a}m] ?$
 EXT.PST-3P-PRE.OV Ayen.GEN 3PL give.NF pen
 ‘Which people did (s)he think that Ayen had given a pen to?’

In Dinka, this extraction prefix cannot be the result of allomorphy triggered by a filled specifier, because this specifier is ordinarily occupied as well, as a result of Dinka’s V2 system, described above.¹² An alternative might be to adopt realization rules similar to those in example 16 that care about the featural content of the phrase that precedes the V2 position, so that the allomorph of *Int* appears only when preceded by a phrase with a particular extraction feature, like *wh*. For *wh*-movement and relativization, this account is attractive, because the same extraction prefix appears

¹²In Irish too, distinguishing between the movement complementizer *aL* and the resumptive *aN* poses challenges for an allomorphy approach (see McCloskey 2002 for a featural proposal).

Inversion: the reversal of subject and auxiliary in the context of a long-distance dependency

at the filler, as in examples 17a and 17b. However, this idea runs into trouble when we examine long-distance topicalization. Topicalized phrases are accompanied by the declarative prefix *à-*. But, in a construction like example 18, the extraction prefix appears in the intermediate landing site:

- Extraction prefix in intermediate position with topicalization
- (18) Cuñin à-yàa tàak [CP kẹ̀ Ø-céem Áyèn].
 food DECL.3SG-HAB.1SG think.NF C EXT.3-eat.OV Ayen.GEN
 ‘The food, I think Ayen is eating.’

It cannot be the case, then, that the extraction prefix is an allomorph conditioned by the features of the moving phrase, because the two prefixes should be identical in form. In contrast, a featural approach can explain example 18 by allowing the features involved in intermediate movement to be different (see Georgi 2014).¹³

Evidence for extraction features can also be found in the presence of other morphosyntactic effects associated with a long-distance dependency. For instance, in some languages in which movement can be accompanied by inversion, inversion can happen in an intermediate clause as well (e.g., Kayne & Pollock 1978, Torrego 1984, Henry 1995). Examples 19a and 19b from Belfast English illustrate (Henry 1995):

- Inversion in Belfast English
- (19a) Who did John hope [CP would he see ___]?
 (19b) What did Mary claim [CP did they steal ___]?
 (Henry 1995, p. 109)

Finally, in a number of languages, the path of long-distance movement is tracked by agreement with the filler. In Dinka, for example, intermediate movement to the clause edge results in number agreement. In examples 20a and 20b, relativization or topicalization of a plural DP is signaled by a plural agreement prefix at all intermediate clause boundaries:¹⁴

- Intermediate movement in Dinka triggers φ -agreement
- (20a) Yè kòɔc-kó [CP Op é-kè-yá ké tàak [CP è ___
 be people.cs1-which EXT.PST-PL-HAB.2SG 3PL think.NF C
 é-kè-cíi Áyèn ké gâam gâlám]]?
 EXT.PST-PL-PRF.OV Ayen.GEN 3PL give.NF pen
 ‘Which people did (s)he think that Ayen had given a pen to?’
- (20b) Wòɔk yíi Ból ké luéel [CP è ___ é-kè-léet Áyèn ké].
 we HAB.OV Bol.GEN 3PL say.NF C EXT.PST-PL-insult.OV Ayen.GEN 3PL
 ‘Us, Bol says Ayen was insulting.’

As Van Urk (2015) argues, we can account for this effect using the notion of “parasitic” agreement. In particular, we can understand the fact that agreement in these intermediate positions seems to

¹³We also cannot resort to the idea that the extraction prefix surfaces when nothing overtly occupies the clause-initial position. This position can be occupied by other silent material without the extraction prefix, as in the following *pro*-drop example:

- No extraction prefix with *pro*-drop in Dinka
- (ii) *pro* à-cé cuñin câam.
 DECL.3SG-PRF food eat.NF
 ‘S/he has eaten food.’

¹⁴See Van Urk (2015) for a detailed analysis of Dinka clause structure that places this agreement at C.

favor a moving phrase over a more local target if the satisfaction of an extraction feature may value number features on the intervening head as a free rider. Another pattern of agreement at C is found in Wolof, as described by Torrence (2005, 2012).

In summary, there is clear evidence that the property of successive cyclicity affects the featural content of intervening material. These effects are straightforwardly derived in any approach built on a mechanism of feature percolation. A theory based on syntactic movement must incorporate the assumption that intermediate movements are accompanied by extraction features as well (Chomsky 1995, McCloskey 2002, Abels 2012, Georgi 2014, Van Urk 2015). This conclusion presents a problem for approaches to intermediate movement that do away with such features, such as those presented by Heck & Müller (2000, 2003), Bošković (2002, 2007), and Chomsky (2013, 2015).¹⁵

5. SUCCESSIVE CYCLICITY AT THE VERB PHRASE EDGE

An important question that arises within an approach that makes use of intermediate movement is exactly what positions are targeted. Chomsky (1973, 1977) proposes that intermediate movement stops at the edge of each clause, and so far I have presented only effects found in this position. However, movement theories differ in whether they posit intermediate movement to the verb phrase edge (Chomsky 1986, 1995, 2001). In this section, I demonstrate that almost every effect attested at the clause edge is attested in the verb phrase as well.

5.1. Evidence of Intermediate Movement in the Verb Phrase

I begin by looking at the realization of intermediate copies. Just as at the clause edge, we can detect intermediate movement by looking at pied-piping. Ewe has an operation of VP-fronting, in which a verb fronts with its object (Buell 2012), as in example 21a. Strikingly, it is also possible for an intermediate verb in a long-distance dependency to be pied-piped by a *wh*-phrase, as demonstrated in example 21b.¹⁶ Note that the *wh*-phrase originates in the embedded clause and so is not an object of the fronting verb. As a result, its position inside the fronting VP does not reflect the gap site, which is in the embedded clause, and can be explained only through an operation of intermediate movement:

Ewe fronted VP pied-pipes *wh*-phrase at edge

- (21a) [VP Mólì dù gé] m̀è-l̀è.
 rice eat PROSP 1SG-be.at
 ‘I’m about to eat some rice.’

- (21b) [VP Nùkà dí-r̀m̀] ǹè-l̀è [CP bé má-dà ___]?
 what want-PROG 2SG-be.at that 1SG.FUT-prepare
 ‘What do you want me to make?’

(Buell 2012, pp. 4, 19)

¹⁵Note that it is possible to augment these approaches with a mechanism of operator agreement, analogous to person and number agreement, with no semantic or syntactic consequences. As far as I can tell, adding such an assumption makes the predictions of feature-free accounts almost identical to those of theories with a featural component.

¹⁶Note that the embedded clause must obligatorily extrapose out of the fronting VP, presumably because of an independent left edge restriction on such fronted VPs (see Buell 2012).

We also find effects analogous to *wb*-copying. In Dinka, all long-distance dependencies leave a trail of plural pronouns, realizing intermediate occurrences of the moved phrase at the verb phrase edge, as evident in examples 22a and 22b (Van Urk 2018):

Plural pronoun copying in Dinka verb phrase

- (22a) Ké(ek) áa-cíí Áyèn [_{vP} ké tíiŋ].
 3PL 3P-PRF.OV Ayen.GEN 3PL see.NF
 ‘Them, Ayen has seen.’
- (22b) Yè kòɔc-kò [_{CP} yíí Ból [_{vP} ké luêeel [_{CP} è cíí Áyèn
 be.3SG people-which be.OV Bol.GEN 3PL say.NF C PRF.OV Ayen.GEN
 [_{vP} ké tíiŋ]]]]?
 3PL see.NF
 ‘Which people does Bol say Ayen has seen?’

Whether there is evidence for partial movement, analogous to Malay, is less clear. Manetta (2010) argues that Kashmiri and Hindi allow long-distance movement to stop at an intermediate *vP* (but see Dayal 2017 for some critical discussion).¹⁷

Stranding effects are also found in the verb phrase. Henry (2012) demonstrates that a range of *all*-stranding patterns are found in varieties of West Ulster English, not only the pattern described by McCloskey (2000). Some speakers permit stranding only at the edge of the verb phrase, as illustrated in examples 23a–c, while others permit stranding at the edge of the verb phrase and the clause, as in examples 24a–c.¹⁸

All-stranding only at verb phrase

- (23a) What did he [_{vP} all do __ on holiday]?
 (23b) What did he [_{vP} all say [_{CP} that he did __ on holiday]]?
 (23c) *What did he [_{vP} say [_{CP} all that he did __ on holiday]]?

(Henry 2012, p. 28)

All-stranding at *vP* and CP

- (24a) What did he [_{vP} all do __ in Derry]?
 (24b) What did he say [_{CP} all that he did __ in Derry]?
 (24c) What did he [_{vP} all say [_{CP} that he did __ in Derry]]?

(Henry 2012, p. 31)

See Barbiers (2002), Koopman (2010), and Davis (2018) for other patterns of stranding in the verb phrase.

Van Urk & Richards (2015) (see also Van Urk 2015) demonstrate that we can also find V2 satisfaction in the verb phrase. The Dinka verb phrase has a V2 effect, so that the highest object must always appear initially, preceding the base position of the main verb, as in the ditransitive examples 25a–c:

Dinka *vP* has V2 effect

- (25a) Yíin cè [_{vP} Áyén gàam cáa].
 you PRF.SV Ayen give.NF milk
 ‘You have given Ayen milk.’

¹⁷There are a number of convincing cases of *wb*-movement that seem to stop at a low verb phrase position, but it is hard to demonstrate that this is the realization of an intermediate copy.

¹⁸Henry (2012) identifies these patterns with South and East Derry, respectively, but she suggests that these grammars more likely instantiate individual-level variation (A. Henry, personal communication).

(25b) Ȳĩn cẹ́ [vP cáa gàam Àyén].
 you PRF.SV milk give.NF Ayen
 ‘You have given milk to Ayen.’

(25c) *Ȳĩn cẹ́ [vP __ gàam cáa Àyén].
 you PRF.SV give.NF milk Ayen
 ‘You have given Ayen milk.’

When the object is moved from inside the verb phrase, however, the same effect as at the CP edge is observed. Intermediate movement satisfies verb phrase V2, as demonstrated in examples 26a–d:

Object extraction satisfies V2 in Dinka

(26a) Yè ŋ́ó [CP cíi môc [vP __ yiǰǰɛn Bòl]]?
 be what PRF.OV man.GEN give.NF Bol
 ‘What has the man given Bol?’

(26b) *Yè ŋ́ó [CP cíi môc [vP Bòl yiǰǰɛn]]?
 be what PRF.OV man.GEN Bol give.NF
 ‘What has the man given Bol?’

(26c) Yè ŋ́à [CP cíi môc [vP __ yiǰǰɛn kítàap]]?
 be who PRF.OV man.GEN give.NF book
 ‘Who has the man given the book to?’

(26d) *Yè ŋ́à [CP cíi môc [vP kítàap yiǰǰɛn]]?
 be who PRF.OV man.GEN book give.NF
 ‘Who has the man given the book to?’

Such facts provide evidence that a copy of the moving phrase occupies the verb phrase edge.

5.2. Morphological Effects in the Verb Phrase

Extraction marking is found at the verb phrase edge as well. Korsah & Murphy (2019) describe extraction marking in the verb phrase in Asante Twi. In this language, every verb on the path of a long-distance dependency is overwritten with a high tone, as in examples 27a and 27b:

High tone on intermediate verbs in Asante Twi

(27a) Kofí kaé [sɛ Ám'má kítá bayérɛ].
 Kofi remember that Ama hold yam
 ‘Kofi remembers that Ama is holding a yam.’

(27b) Déén na Kofí kaé [sɛ Ám'má kítá __]?
 what FOC Kofi remember that Ama hold
 ‘What does Kofi remember that Ama is holding?’

(Korsah & Murphy 2019)

Korsah & Murphy (2019) show that the distribution of high tone overwriting provides clear evidence for putting this reflex inside the verb phrase. The high tone spreads to all functional material in its scope, including aspect markers and negation, as in examples 28a and 28b. However, a high tone does not spread to tense and agreement affixes, as in example 28c, indicating that the extraction feature must reside below T:

Asante Twi high tone overwriting does not spread to T

- (28a) Deɛn na Saka n-kɛ́á ___?
 what FOC Saka NEG-import
 ‘What hasn’t Saka imported?’
- (28b) Ám'má na Kofi ré-bóá nó.
 Ama FOC Kofi PROG-help 3SG
 ‘It is Ama who Kofi is helping.’
- (28c) Déén na Yaw má-a Saka ___?
 what FOC Yaw give-PST Saka
 ‘What did Yaw give Saka?’
- (Korsah & Murphy 2019)

A similar pattern at the verb phrase edge is voice marking in Malay/Indonesian languages (e.g., Saddy 1991, 1992; Cole & Hermon 1998; Sato 2012). In these languages, movement across a verb triggers obligatory deletion of the transitivity prefix *meN-*. Other verb phrase effects may be found at least in Tagalog (Rackowski & Richards 2005) and Defaka (Bennett et al. 2012).

We can also find inversion effects in the verb phrase, as pointed out by Cognola (2013) in research on the Germanic dialect Mòcheno, spoken in northern Italy. Mòcheno allows both OV and VO orders in the verb phrase, as demonstrated by examples 29a and 29b:

Mòcheno allows VO and OV orders

- (29a) Gester hone [_{vP} a puach kaft].
 yesterday have.1SG a book bought
 ‘Yesterday, I bought a book.’
- (29b) Gester hone [_{vP} kaft a puach].
 yesterday have.1SG bought a book
 ‘Yesterday, I bought a book.’
- (Cognola 2008, p. 83)

However, in a long-distance dependency, only VO syntax is possible, as in examples 30a and 30b:¹⁹

Inversion in the verb phrase with *wh*-movement in Mòcheno

- (30a) En bem hòt-se [_{vP} kaft de zaitung]?
 to whom has-she bought the newspaper
 ‘Who has she bought a newspaper?’
- (30b) *En bem hòt-se [_{vP} de zaitung kaft]?
 to whom has-she the newspaper bought
 ‘Who has she bought a newspaper?’
- (Cognola 2013, p. 7)

Finally, there are agreement effects at the verb phrase edge. Bruening (2001) shows that long-distance movement in Passamaquoddy may be accompanied by agreeing participial endings on verbs on the path of the dependency, as in the *wh*-movement and relativization examples 31a and 31b:

¹⁹Interestingly, Cognola notes that the same effect is observed with subject extraction, which is unexpected (but see Cognola 2008, 2013 for arguments that this effect is nonetheless in the verb phrase).

Intervening Passamaquoddy verbs agree with moving phrase

(31a) Wen-ik kisitahatom-on-ik [CP keti-naci-wikuwamkom-oc-ik]?
 who-3PL decide.IO-2CONJ-PART.3PL IC.FUT-go.do-visit.AO-2CONJ-PART.3PL
 ‘Who all did you decide to go visit?’

(31b) Wot nit pahtoliyas [CP Mali elitahasi-c-il [CP eli wen
 this that priest Mary IC.think-3CONJ-PART.OBV c someone
 kisi-komutonom-ac-il]].
 PERF-rob.AO-3CONJ-PART.OBV
 ‘This is the priest that Mary thinks someone robbed.’

(Bruening 2006, p. 34)

Just as suggested here, Bruening (2001, p. 209) analyzes this effect as parasitic agreement as a result of movement to the verb phrase. A similar analysis might be applicable to interactions between long-distance movement and object agreement in Hungarian (see Den Dikken 2010 for extensive discussion).

To sum up this section, we have seen that virtually every reflex of successive cyclicity attested at the clause edge is found at the verb phrase edge as well. There is no qualitative asymmetry, then, between these two positions; this suggests that these are parallel domains (Chomsky 1986, 1995, 2001).

6. CONCLUDING REMARKS

In this review, I have argued that the set of attested reflexes of successive cyclicity are exactly those that are predicted by a feature-driven movement approach to long-distance dependencies (Chomsky 1995, McCloskey 2002, Abels 2012). In contrast, theories that model long-distance dependencies through feature percolation or movement alone have difficulty accounting for the full range of such phenomena. In addition, I have demonstrated that there is symmetry between the clausal and verb phrase domain (contra, for instance, Rackowski & Richards 2005; Den Dikken 2009, 2010; Keine 2016).

DISCLOSURE STATEMENT

The author is not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

This review has benefited greatly from discussions with David Adger, Doreen Georgi, and David Pesetsky, as well as audiences at the Brussels Conference on Generative Linguistics and Cambridge Comparative Syntax.

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Errata

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