Full Title: Pied-Piping: Introducing Two Recent Approaches

Running Head: Pied-Piping, Part 1

Author Name: Seth Cable

Affiliation: Department of Linguistics, University of Massachusetts Amherst

Address: Seth Cable
                     Department of Linguistics
                     University of Massachusetts Amherst
                     226 South College
                     150 Hicks Way
                     Amherst, MA 01003-9274 United States

Email Address: scable@linguist.umass.edu

Pied-Piping: Introducing Two Recent Approaches

ABSTRACT:
The term 'pied-piping' is used by linguists to refer to structures where a movement operation applies to a constituent that is in some sense 'larger than expected'. More precisely, pied-piping occurs when a movement operation that usually targets expressions of a particular type (*e.g.* wh-words) instead targets a phrase that *contains* an expression of that type. Pied-piping structures have long been a deep and difficult puzzle for formal syntactic theory. This is the first of two articles that present and compare two recent approaches to pied-piping, those of Heck (2008, 2009) and Cable (2010a,b). These works offer two very different perspectives on the nature of pied-piping, and thus yield rather different analyses of specific sub-phenomena. Nevertheless, there is much overlap in their general predictions and in several core assumptions. In this article, I present the basic phenomenon of pied-piping, as well as general summaries of Heck (2008, 2009) and Cable (2010a,b). I also explain why these works eschew the mechanism of 'feature percolation', an operation which has until recently been a staple of much work on pied-piping.

1.   Pied-piping in Movement Structures: An Overview

The picturesque term 'pied-piping' was invented by the linguist Robin Lakoff in the mid 1960's and first popularized in the influential PhD dissertation by John 'Haj' Ross (Ross 1967, 1986). As it is used by linguists, 'pied-piping' refers to structures where a movement operation applies to a constituent that is in some sense 'larger than expected'. More precisely, pied-piping occurs when a movement operation that usually targets expressions of a particular type instead targets a phrase that *contains* an expression of that type.

To illustrate, contrasts like that between (1a) and (1b,c) have classically been taken to show that *wh*-questions (constituent questions) in English require movement of a *wh*-word (interrogative pronoun) to the left periphery of the clause.

(1)   a.   Who did Dave introduce John to?
         b.   * Dave introduced John to who? [1]
         c.   * John did Dave introduce to who?

Thus, there seems to be a movement operation at work in English *wh*-questions that targets *wh*-words. Although this might appear to be a trivial observation, this general perspective on the facts in (1) is immediately faced with a rather fundamental challenge: how to analyze sentences like those in (2), where more than the wh-word undergoes movement.

(2)   a.   [Whose book] did you read?
         b.   [In what way] is he a natural choice?
         c.   [How long a book] did she write?

The possibility of these structures directly challenges the notion that sentences like (1) are formed via a movement operation targeting *wh*-words specifically. After all, if the operation applies strictly to *wh*-words, how does it come to apply to the larger phrases in (2)? Note that,

---

[1] The asterisk marking (1b) is intended to represent the fact that (1b) does not have the same use as (1a). Although it is well-formed, use of (1b) requires a special prosody and a specific context not required for the use of (1a).

crucially, the moved constituents in (2) are not headed by the *wh*-word, and so do not otherwise inherit the syntactic properties of the *wh*-word. For example, contrasts like those in (3) reveal that a possessive DP does not inherit the number properties of a *wh*-possessor. How, then, does the DP seem to inherit the "*wh*-property" that supposedly triggers the fronting seen in (1)/(2)?

(3)   a.   Who is / *are coming to your party?
        b.   [Whose sisters] are / *is coming to your party?

        The classic response to this has to been to appeal to a notion of 'pied-piping', as in (4).

(4)   *Pied-piping* occurs when an operation that targets the features of a lexical item L applies to a phrase properly containing the maximal projection of L (L^{Max})

Thus, the way that linguists commonly understand the facts in (1)/(2) is that (i) there is indeed a movement operation of English that specifically targets *wh*-words, but (ii) *pied-piping* is a phenomenon of natural language, and can be seen at work in structures like (2). As we will see in a moment, it is useful to contrast the term *pied-piping* with the more descriptive, theory-neutral term *pied-piping structure*, defined below.

(5)   A *pied-piping structure* is one where a phrase properly containing the maximal projection of a *wh*-word (or related operator) has undergone movement typically associated with that operator.

Note that the term *pied-piping structure* does not assume that the movement operation in question actually *targets* the (*wh*-)operator, only that it is 'typically associated with' that operator. Thus, as we will see, the sentences in (2) uncontroversially contain pied-piping *structures*, while their status as cases of *pied-piping* is debatable, and rests upon whether the movement operation at work in (1)/(2) truly targets the *wh*-word specifically.

        Given the existence of pied-piping structures like (2), there are three possible paths a formal syntactic theory can pursue, each of which is attested in the literature. First, one can adjust the theory of movement operations, so that movement operations targeting a lexical property/feature L (*e.g.* the '*wh*-feature' of the *wh*-word) can in principle apply to phrases properly containing L. Under this view, explored by such figures as Ross (1967, 1986), Bresnan (1976), Emonds (1976), Heck (2008, 2009), pied-piping structures demonstrate that the property triggering the movement operation needn't actually be a property of the expression moved.
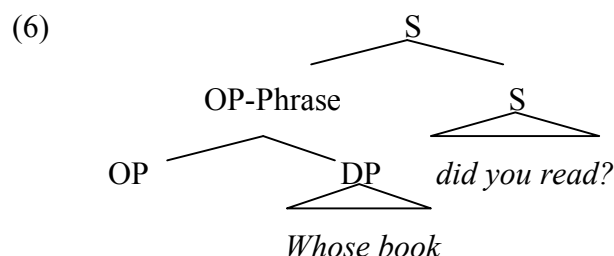
        The second approach one can take is to suppose that there is some mechanism – usually called 'feature percolation' – which serves to place lexical features of a head H onto nodes outside the maximal projection of H. Under this perspective, which pervades the literature on pied-piping, the movement operation in (1) truly is restricted to expressions bearing the *wh*-feature of the *wh*-word. In structures like (2), however, the mechanism of 'feature percolation' moves this feature from the *wh*-phrase onto the larger expression it is embedded in. Exactly what this 'feature percolation' mechanism is often remains unclear, as different authors suggest different answers, if any (Chomsky 1973, Cowper 1987, Webelhuth 1992, Grimshaw 2000).

        The third imaginable reaction to (2) is to revise one's assumptions regarding the feature (or lexical item) targeted by the movement. Under this perspective, pursued by Horvath (2000, 2007b), Sternefeld (2001), and Cable (2010a,b), pied-piping structures like (2) effectively show

that the *wh*-feature of the *wh*-word is not the actual target or trigger of the movement operation. What is? One possibility is that there is a phonologically empty (unpronounced) operator in the structure, one that obligatorily accompanies and c-commands the *wh*-word. If this assumption can be independently supported, one can then suppose that the movement in sentences like (1)/(2) actually targets the unpronounced operator and *not* the *wh*-word itself. Pied-piping structures like (2) would then simply be cases where the targeted null operator is not directly adjacent to the *wh*-word.

These analysis-sketches will be further fleshed out in the sections below, as I will summarize and compare two recent, concrete theories of pied-piping structures, one of which pursues the first of these three perspectives (Heck 2008, 2009), and the other of which purses the third (Cable 2010a,b). For reasons that are elaborated in Section 4, I will not in this paper consider any 'feature percolation' analysis of pied-piping. For an overview of such analyses, the reader is referred to Horvath (2007a) and Heck (2008: Chapter 1).

Although this will become clearer in Section 3, it is worth noting now a unique feature of the third general approach to pied-piping structures. Under such approaches, the movement operation at play in the pied-piping structure is thought *not* to target the (*wh*-)operator properly contained in the moved expression. Rather, the movement targets some distinct (usually unpronounced) operator, one that provides the category of the moved expression. To illustrate, the structure of a sentence like (2a) is taken to be something like that in (6), where the OP-Phrase projected by the null operator OP is the true target of the movement operation.

(6)

```
                         S
                   _____
              OP-Phrase         S
              _____        _____
            OP      DP    did you read?
                  _____
                  Whose book
```

Importantly, since the movement operation in (6) is assumed to target the features of OP^{Max} (the OP-Phrase), pied-piping structures like those in (2) would not actually constitute cases of *pied-piping* as defined in (4). In this sense, analyses pursing the third general perspective above needn't actually appeal to the existence of pied-piping. Consequently, it is possible to develop a theory whereby pied-piping (as defined in (4)) does not actually exist (Cable 2010a,b). For this reason, it is important to acknowledge the distinction between 'pied-piping' (4) and 'pied-piping structures' (5). Although pied-piping structures (5) are unquestionably a feature of human language, it is an open question whether the phenomenon of 'pied-piping' (4) is real.

As mentioned above, the literature on pied-piping is vast and far-flung, spanning many decades and theoretical frameworks. Consequently, I will in no way attempt an extensive review of past or even current approaches to the problem. For more substantial reviews of the literature, I refer the reader to Horvath (2007a) and Heck (2008: Chapter 1). In this paper, I will instead concentrate upon two recent, book-length treatments of the subject, Heck (2008, 2009) and Cable (2010a,b). These two works are appropriate as (i) they are the most recent extensive treatments of the subject, (ii) the work of Heck (2008) is based upon an encyclopedic overview of published data concerning pied-piping in a wide variety of languages, and (iii) the similarities and contrasts between these works could provide a foundation for future work to build upon.

2. Heck (2008, 2009): Pied-Piping and the Violability of Agreement Locality

Based upon a uniquely extensive survey of published pied-piping data, Heck (2008, 2009) develops an elegant theory of pied-piping structures, whereby they result from the gradient violability of the constraints that trigger the movement of the (*wh*-)operator.
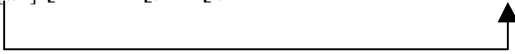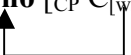
      The core idea underlying the work of Heck (2008, 2009) is that pied-piping is a means of balancing the opposing demands of conflicting syntactic constraints. To begin, Heck adopts the assumption, now standard in GB/Minimalism, that the movement seen in (1) is triggered by Agreement between the *wh*-word and an (unpronounced) complementizer $C_{[wh]}$ in the left periphery of the clause.[2] However, the way in which Agreement triggers this movement differs under Heck's view from what is more generally assumed in GB/Minimalism. Heck postulates the existence of a constraint 'Local Agree', defined as in (7).

(7)   **Local Agree (Heck 2008: 191, Heck 2009: 80)**
       If a probe α Agrees with a goal β, then there is no XP which dominates β but not α

Clearly, Local Agree (LA) will only be completely satisfied in cases where α and β are sisters.[3] How then is it possible for *non*-sisters to Agree with one another? Heck (2008, 2009) proposes that the constraint LA is *violable* and *gradient*, in the senses developed within Optimality Theory (OT).[4] To illustrate, consider the OT tableaux below.

(8)   **Local Agree Triggers Movement**

Input: [CP C[wh] [TP Bill [vP *v* [VP introduced John to **who**]]]]	Local Agree
a. [CP C[wh] [TP Bill [vP *v* [VP introduced John to **who**]]]	!***
b. [CP **Who** [CP C[wh] [TP Bill [vP *v* [VP introduced John to *t*]]]	*

---

[2] For reasons of space, I will not review here the theory of 'Agree-driven movement' that has developed over the past fifteen years in GB/Minimalism. For more information, the reader is referred to Chomsky (2000, 2001), as well as Heck (2008: Chapter 3).

[3] Actually, this depends upon whether in a phrase XP, the XP node that dominates the specifier of XP counts as the *same* node that dominates the head X. It seems that Heck (2008) implicitly assumes that it *does*, and so Local Agree is completely satisfied in cases of Spec-Head Agreement. The success of Heck's system, however, does not depend upon this assumption, and so for purposes of simplicity, I assume here that the Spec of XP is dominated by a different XP node from the head of XP.

[4] Again, for reasons of space, I will not review here the tenets of Optimality Theory. For more information, the reader is referred to McCarthy (2001).

As shown above, the observed syntactic output (8b) incurs one violation of the constraint LA, since there is one XP intervening between the probe C[wh] and the goal *who*.[5] While this structure does violate LA once, any competing structure where the *wh*-word remains *in-situ*, such as (8a), will incur *three* violations of LA, one for each XP node intervening between C and *who*.[6] Thus, the most optimal derivation proceeding from the input CP structure is one in which the *wh*-word *who* is moved into the specifier of the Agreeing C[wh] head. In this way, the constraint LA in (7) forces *wh*-movement, even though the resulting structure still violates the constraint.

With this in mind, consider now the pied-piping structures in (2), specifically the case of possessor pied-piping in (2a). To begin, note that extraction of the possessive *wh*-word *whose* in (2a) is ill-formed, as shown in (9a). Consequently, Heck (2008, 2009) proposes that the constraint 'Left Branch Condition' (LBC) in (9b) is inviolable in English.
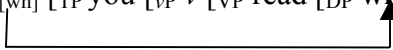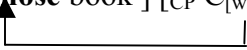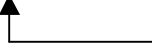
(9) a. * Whose did you read book.

   b. **Left Branch Condition (Heck 2008, 2009)**
       If α is the leftmost category within DP, then α can't undergo movement from DP

We might capture this inviolability of LBC in English by assuming it to be undominated in the constraint ranking. Consequently, when the interrogative CP is formed by Merger of C[wh], the OT-competition proceeds as in (10).

(10) **Local Agree Licenses Pied-Piping**

Input: [CP C[wh] [TP you [vP v [VP read [DP **whose** book]]]]]	LBC	Local Agree
a. [CP C[wh] [TP you [vP v [VP read [DP **whose** book]]]]]		!****
b. [CP [DP **Whose** book] [CP C[wh] [TP you [vP v [VP read *t*]]]		**
c. [CP **Whose** [CP C[wh] [TP you [vP v [VP read [DP *t* book]]]]]	!*	*

---

[5] Regarding the input to the OT computation, Heck (2008: 186-188) proposes that such OT-optimization occurs after every application of Merge. Thus, the input to the OT-computation in (8) is the result of having Merged some element – in this case, the complementizer C[wh] – to the prior result of OT-optimization in the derivation – in this case, the TP *Bill introduced John to who*.

[6] Presumably, a candidate where there is no Agreement at all between C and *who* will ultimately lead to a derivational crash at the LF interface, and so needn't be considered in the OT competition in (8).

As before, the observed syntactic output (10b) incurs violations of Local Agree. In this case, it incurs two violations of Local Agree, since *who* and $C_{[wh]}$ are separated by a CP and a DP node. Again, though, this is fewer violations of LA than any candidate where no movement takes place, and so (10b) is more optimal than (10a). But now consider the candidate in (10c), where no pied-piping of the possessive DP takes place. Although this structure incurs fewer violations of LA than (10b), it incurs an additional violation of LBC, which is ranked above LA. Following standard OT reasoning, it follows that (10b) is more optimal than (10c) as well. Thus, the most optimal derivation proceeding from the input CP structure in (10) would yield the pied-piping structure in (10b).

The preceding discussion glosses over many important details of Heck's intricate theory, some of which will be introduced in the next paper. However, even at this level of abstraction, one can perceive many key aspects of the approach. First it is evident that pied-piping structures are viewed as a kind of 'necessary evil'. Although they incur more violations of LA than structures without pied-piping, those latter structures are ruled out by more highly ranked syntactic constraints, leading pied-piping to be the best of the remaining options. In this way, pied-piping emerges as a solution for balancing conflicting syntactic demands: the demand that Agreement be local, and the demand that certain movement constraints be observed.

It directly follows from this general perspective that pied-piping should be subject to several generalizations, universal across languages. Heck (2008, 2009) identifies five such generalizations. In this section, we will consider the first three; the others will be introduced in the next paper, when we discuss 'massive pied-piping'.

It is clear from the logic of the OT-calculation in (10) that Heck (2008, 2009) predicts pied-piping to be subject to the generalization in (11), dubbed 'the Repair Generalization'.

(11) **The Repair Generalization (Heck 2008: 117, Heck 2009: 92)**
Pied-piping of β by α is possible only if movement of α from β is blocked.

As the reader can confirm, if movement of α from β is *not* blocked by some constraint C ranked above LA, then the competition between extraction of α and pied-piping of β will be decided by how many violations of LA the structures incur. Since pied-piping of β will necessarily incur at least one more violation of LA than extraction of α, it follows that LA will always view extraction of α as more optimal than pied-piping of β. Consequently, pied-piping of β by α will only be an optimal output if extraction of α is ruled out by some higher syntactic constraint.

Heck (2008, 2009) marshals extensive evidence in support of (11). We will return to this issue in the second paper, where I discuss problems surrounding the apparent optionality of some cases of pied-piping. For now, let us consider the second of Heck's key generalizations.

(12) **The Edge Generalization (Heck 2008: 88, Heck 2009: 89)**
If α pied-pipes β (and movement of α to the edge of β is grammatically possible), then α must be at the edge of β.
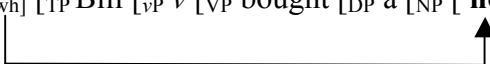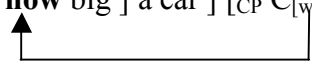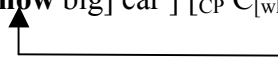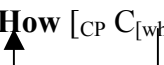
I should note that Heck's statement of (12) does not include the parenthetical material above. However, it is clearly an implicit part of the generalization, as discussed in a moment. To illustrate the content of this generalization, consider the English data below.

(13)   a.   [[**How big**] a car] did Bill buy?
       b.   * [A [**how big**] car] did Bill buy?
       c.   Bill would never buy [[**that big**] a car].

We see that in (13a) the *wh*-degree head *how* can pied-pipe a DP containing it. As shown by (13b), however, such pied-piping requires that *how* be moved to the left edge of that DP.[7] The general possibility of such movement for degree heads is illustrated by (13c).

The contrast between (13a) and (13b) follows directly from Heck's general perspective on the nature of pied-piping. Consider the tableaux in (14).

(14)   **Emergence of the Edge Generalization**

Input: [CP C[wh] [TP Bill [*v*P *v* [VP bought [DP a [NP [**how** big] car]…]	LBC	Local Agree
a. [CP C[wh] [TP Bill [*v*P *v* [VP bought [DP a [NP [**how** big] car]…]		!******
b. [CP [DP [**how** big] a car] [CP C[wh] [TP Bill [*v*P *v* [VP bought *t*]…]		***
c. [CP [DP a [NP [**how** big] car] [CP C[wh] [TP Bill [*v*P *v* [VP bought *t*]…]		!****
d. [CP **How** [CP C[wh] [TP Bill [*v*P *v* [VP bought [DP a [NP *t* big car]…]	!*	*

As shown above, the observed output (14b) incurs three violations of LA, as the *wh*-word *how* is separated from C by (i) a CP, (ii) a DP, and (iii) the phrasal node dominating *how big*. However, the ill-formed (14c) incurs *four* violations of LA, since the C and *wh* are separated by an additional NP node. Thus, (14b)/(13a) is more optimal than (14c)/(13b). Finally, as in previous tableau, extraction of the *wh*-word alone (14d) violates the highly ranked LBC, while leaving the *wh*-word *in-situ* incurs far more violations of LA than either (14b,c).

We find, then, that LA will always favor movement of a pied-piping operator to the edge of the pied-piped phrase. Thus, the first (non-parenthetical) half of generalization (12) follows from the basic logic of violable, gradient constraints. Note, however, that the optimality of (14b) depends upon it violating no constraint ranked higher than LA. We know from the possibility of (13c) that no such constraint exists in English. But now consider the contrast between (15a,b) below.

---

[7] To simplify the discussion, we will ignore the fact that movement of *how* to the edge of DP pied-pipes the adjective *big*.

(15) a.   [In [**whose** honor]] was this made?
      b.   * [[**Whose** honor] in] was this made?
      c.   * This was made [[Dave's honor] in]

As shown by the ill-formedness of (15c), it is not possible for complements of prepositions to move to SpecPP in English. Intuitively, the ill-formedness of (15b) should follow from this broader generalization. Indeed, under Heck's approach, the constraint LA would not in this case force movement of the pied-piper *whose honor* to the left edge of the PP, as in (15b). As the reader can verify, such movement would violate the highly ranked constraint witnessed by (15c) – call it 'No Movement to SpecPP' – and so the competition between (15a,b) would not be determined by LA. Consequently, (15a) will correctly emerge as the optimal output for the *wh*-question. In this way, the parenthetical half of (12) follows from the logic of constraint ranking.

   The third key generalization proposed by Heck is stated below.

(16) **The Generalization on Recursive Pied-Piping (Heck 2008: 76, Heck 2009: 85)**
   If α can pied-pipe β and β is in a canonical position to pied-pipe γ, then α can pied-pipe γ

To illustrate, consider the widely-observed fact that *wh*-possessors buried *inside* possessors can pied-pipe the larger possessive phrase.

(17) a.   [**Whose** father] did you see?
      b.   [[**Whose** friend]'s father]] did you see?
      c.   [[[**Whose** brother]'s friend]'s father] did you see?

For Heck, a 'canonical position to pied-pipe γ' is a position from which a bare *wh*-word could pied-pipe γ. From cases like (17a), we know that SpecDP is a canonical position to pied-pipe DP (in English). Thus, the generalization in (16) correctly predicts the pied-piping in (17b) to be possible, and therefore also the pied-piping in (17c). Heck (2008, 2009) presents several other cases of 'recursive pied-piping', supporting the truth of (16).

   Unlike (11) and (12), generalization (16) does not follow from the logic of violable constraint interaction. Rather, it follows from plausible assumptions regarding the 'probe/Agree' relation. This same general perspective is adopted by many theorists, including Cable (2010a,b). For this reason, as well as the uncontroversial status of the generalization itself, I will not in this paper explore this generalization in detail. It will suffice to note that (16) is a widely recognized universal of pied-piping, one that any theory should easily derive.

   The preceding discussion outlines the core of Heck's (2008, 2009) theory of pied-piping. More details will be introduced in second of these articles. In the following section, I will outline another recent approach to pied-piping, one that in a sense claims it not to exist.

3.   Cable (2010a,b): Pied-Piping Structures and QP-Movement

Cable (2010a,b) develops a relatively novel theory of *wh*-movement in *wh*-questions, one that leads to some dramatic conclusions regarding the nature of pied-piping structures.[8]

---

[8] As noted by Heck (2008: 35) and Cable (2010a,b), Cable's 'Q-based' analysis of *wh*-questions and pied-piping structures was first developed by Tanaka (1999) and Sternefeld (2001). Sternefeld, Tanaka, and Cable each seem to have discovered the general approach independently.

Cable's general, 'Q-based' theory of *wh*-movement is summarized by the diagram below.

(18)   **The Q-Based Analysis of *Wh*-Movement (Cable 2010a: 38, Cable 2010b: 567)**
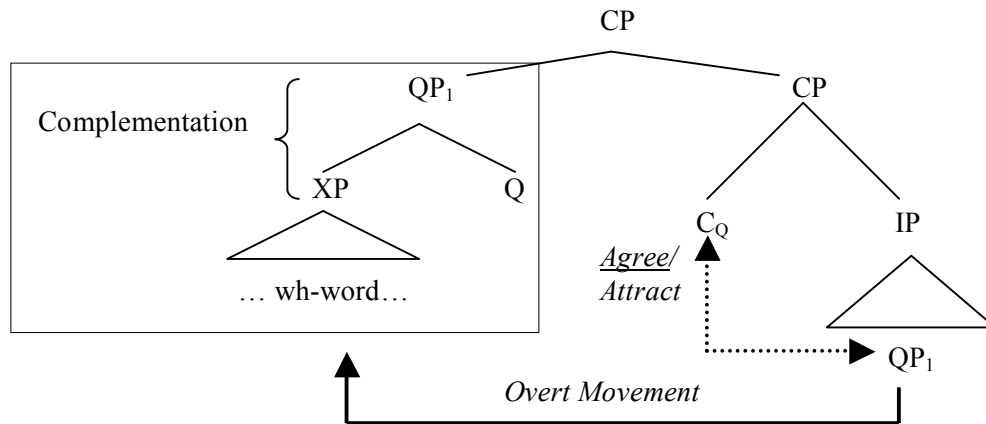
As illustrated above, Cable (2010a,b) proposes that *wh*-questions contain three key syntactic elements: the *wh*-word, the interrogative complementizer C_Q (formerly $C_{[wh]}$), and a so-called 'Q-particle'. The Q-particle is assumed to merge with some phrase containing the *wh*-word, taking that phrase as complement. Finally, the interrogative complementizer C_Q is assumed to probe and Agree with the QP projected by this Q-particle, and (crucially) *not* the *wh*-word itself. Following this Agreement, the usual tenets of Agree-driven movement require that the QP move to SpecCP. Since, by assumption, the QP contains the *wh*-word, the *wh*-word is brought along into SpecCP as an epiphenomenal consequence.

Cable (2010a) provides an extended argument in support of this Q-based analysis of *wh*-fronting, discussing in detail a variety of phenomena that might receive improved analyses under this general framework. Cable's initial motivation for this approach, however, is the grammar of *wh*-questions in Tlingit, an endangered Na-Dene language of Alaska. Cable (2010a,b) shows that Tlingit *wh*-questions have the general form in (19a), as illustrated by (19b).

(19)   a.   General Form of a Tlingit Wh-Question (Cable 2010a: 4, Cable 2010b: 568)
            [s … [[… wh-word …] *sá*] … Main-Predicate ….]

        b.   [[**Wáa**   kwligeyi   CP] x̲áat NP]   **sá**   i tuwáa sigóo? [9, 10]
               how   it.is.big.REL   fish   Q   do.you.want
            How big a fish do you want?
            (Literally 'A fish that is how big do you want?')   (Cable 2010b: 572)

As shown above, a Tlingit wh-question requires the *wh*-word to precede the main predicate of the clause. Furthermore, the *wh*-word must be followed by the interrogative particle *sá*, which either directly follows the *wh*-word or a phrase properly containing it.

---

[9] For reasons of space, I will often simplify the glosses given by Cable (2010a,b) for his Tlingit sentences.

[10] In this paper, I use the following abbreviations in glosses: 'REL' *relativization marker*, 'Q' *Q-particle*, 'ERG' *ergative case marker*.

Cable (2010a,b) argues that *wh*-questions in Tlingit must receive the Q-based analysis in (18), and are not amenable to the standard assumption that *wh*-movement targets the *wh*-word directly. First, Cable argues that the requirement for *wh*-words to be pre-verbal in Tlingit questions is due to an obligatory movement operation. For reasons of space, I won't review Cable's arguments that sentences like (19b) contain movement; they chiefly consist of arguments against competing, non-movement analyses.

Having concluded that Tlingit forms *wh*-questions via movement, Cable (2010a,b) then turns his attention to the particle *sá* required in such questions. Given the pattern in (19), one might at first suppose that *sá* is an overt realization of the C$_{[wh]}$ commonly assumed in *wh*-questions. However, Cable (2010a,b) argues against such a hypothesis, on the grounds that *sá* also follows *in-situ* wh-words functioning as indefinites, illustrated below.

(20) Yá   x'úx' akwgwatóow **aadóoch**   **sá**.
      this   book   will.read   who.ERG   Q
      People will read this book.   (Cable 2010b: 569)

Given this and related data, Cable (2010a,b) concludes that *sá* should be analyzed as a 'Q-particle', in the sense of Hagstrom (1998) and Kishimoto (2005). Following those latter works, Cable proposes that the Q-particle *sá* is a kind of 'satellite' of the *wh*-word, one that must always accompany the *wh*-word at a higher, c-commanding position. Furthermore, Cable (2010a,b) assumes that Tlingit *sá* takes its sister as complement, and so projects a QP above the *wh*-word. Thus, the structure of the fronted phrase in (19b) would be as follows.

(21) [$_{QP}$ [$_{NP}$ [$_{CP}$ **Wáa**   kwligeyi   ] x̱áat] **sá**] i tuwáa sigóo?
                    how   it.is.big.REL   fish   Q   do.you.want

Finally, Cable (2010a,b) argues that the trigger/target of the movement in a Tlingit *wh*-question is the QP projected by *sá*, and not the *wh*-word itself. The principal evidence for this claim is the contrast between (19b)/(21) and (22) below.

(22) * [$_{NP}$ [$_{CP}$ [$_{QP}$ **Wáa sá**] kwligeyi   ] x̱áat] i tuwáa sigóo?
                    how   Q   it.is.big.REL   fish   do.you.want   (Cable 2010b: 572)

This contrast shows that the *wh*-word of a Tlingit *wh*-question can be located inside a syntactic island (e.g. the relative clause in (19b)/(21)) *if and only if* the QP is located outside the island. Following Cable's reasoning, this in turn shows that the well-formedness of a Tlingit *wh*-question depends only upon the locality of the *QP* to the interrogative C; the locality of the *wh*-word itself is not directly relevant. On these grounds, Cable claims it is most natural to assume that the Agreement relation driving the movement in (19b)/(21) holds between the interrogative C and the QP, and that the *wh*-word itself is not directly targeted.

In this way, Cable (2010a,b) arrives at the Q-based analysis summarized in (18), for Tlingit *wh*-questions. What does any of this have to do with pied-piping? As Cable (2010a,b) observes, the Q-based analysis of Tlingit *wh*-questions yields dramatic consequences for the analysis of the language's pied-piping structures. As illustrated below, a Tlingit pied-piping structure must locate the particle *sá* directly *after* the pied-piped phrase; it cannot be contained inside the pied-piped phrase.

(23) a. [_{QP} [_{PP} **Aadóo**   teen] **sá**]   yeegoot?
            who   with   Q   you.went
          Who did you go with?

     b. * [_{PP} [_{QP} **Aadóo**   **sá**] teen] yeegoot?
            who   Q   with   you.went   (Cable 2010b: 575)

It follows, then, that a pied-piping structure in Tlingit always has the following general form.

(24)   [_{CP} [_{QP} [_{XP} … *wh*-word …] **Q**]_i C_Q [_{TP} … t_j …]]

That is, in a Tlingit pied-piping structure, the moved constituent is always a QP. Now, recall that under the Q-based analysis in (18), it is the QP which is the target/trigger of the movement in a *wh*-question. Consequently, in a Tlingit pied-piping structure, the moved phrase does *not* properly contain the target/trigger of the movement. Thus, intriguingly, the pied-piping structures of Tlingit do not actually qualify as true cases of *pied-piping*, as defined in (4). On these grounds, Cable (2010a,b) claims that pied-piping does not actually exist in Tlingit, despite the clear existence of *pied-piping structures* (as defined in (5)).

Cable (2010a,b) then argues that this Q-based analysis should be applied to *all wh*-fronting languages. As noted earlier, Cable's arguments consist chiefly of pointing out cases where the framework in (18) allegedly provides improved analyses of various phenomena surrounding *wh*-questions. In the next paper, we will examine some of these arguments in more detail. For the moment, let us clarify how Cable extends his Q-based account to languages like English. Clearly, in English wh-questions there does not appear to be a correlate of the Q-particle *sá* of Tlingit wh-questions. Cable proposes that in such languages, the particle 'Q' is phonologically null. Thus, a pied-piping structure like (17c) would have the syntax below.

(25)   [_{QP} [_{DP} [_{DP} [_{DP} **Whose** brother]'s friend]'s father] ∅_Q] did you see? (Cable 2010b: 577)

Under this analysis, the moved phrase in an English pied-piping structure would also be a QP. Under the Q-based syntax in (18), then, pied-piping structures in English *wh*-questions would likewise fail to be true cases of pied-piping as defined in (4). On these grounds, Cable (2010a,b) claims that the very concept of 'pied-piping' might be eliminated from the theory of grammar. In Cable's view, it is likely that pied-piping does not ever truly exist, all putative cases of it receiving analyses akin to the Q-based structure in (18).

In the second paper of this series, we will compare and contrast the competing visions of pied-piping put forth by Heck and Cable. Is pied-piping always a 'last resort' solution, as implied by Heck's 'Repair Generalization'? Is the concept of pied-piping truly dispensable, as Cable claims? And, in what ways do the empirical predictions of these approaches differ?

Before we begin examining these questions though, we will briefly consider the matter of 'feature percolation' and its possible role in a theory of pied-piping.

4.   Feature Percolation: Some Recent Considerations Against It

We saw in Section 1 that there are three possible approaches one can take to pied-piping structures like (2). First, one can amend the theory of movement so that movement triggered by a

lexical item L can apply to a phrase properly containing L^{Max}. The work of Heck (2008, 2009) follows this general path, by allowing the constraint Local Agree to be violable and gradient. Alternately, one could amend one's theory of the movement operation in question, so that it no longer targets the putative 'pied-piper', but instead targets the head of the moved phrase after all. The work of Cable (2010a,b) follows this general path, by postulating that (phonologically null) 'QPs' are the true target of movement in pied-piping structures.

However, one could also conceivably maintain both that (i) movement only ever applies to its 'trigger' (i.e., Local Agree is not violable or gradient), and (ii) the 'trigger' of the movement is indeed the features born by the alleged 'pied-piper'. Such an approach would essentially split the difference between the other two approaches, and thereby maintain two core assumptions of the standard GB/Minimalism analysis of simple movement structures like (1). This purchase comes at a cost, however. As we saw in Section 1, the assumptions in (i) and (ii) are in direct conflict with the existence of pied-piping structures like (2). Under this third approach, this conflict is resolved by introducing a new grammatical mechanism, an operation typically referred to as 'feature percolation'. Although details of implementation vary, 'feature percolation' generally has the following key property.

(26)   *Feature percolation* is an operation that moves/copies the features of some head H onto phrases *outside* the maximal projection of H (H^{Max})

Thus, feature percolation could apply to the *wh*-possessive phrase in (27a) and alter it to the structure in (27b).

(27)   a.

         b.
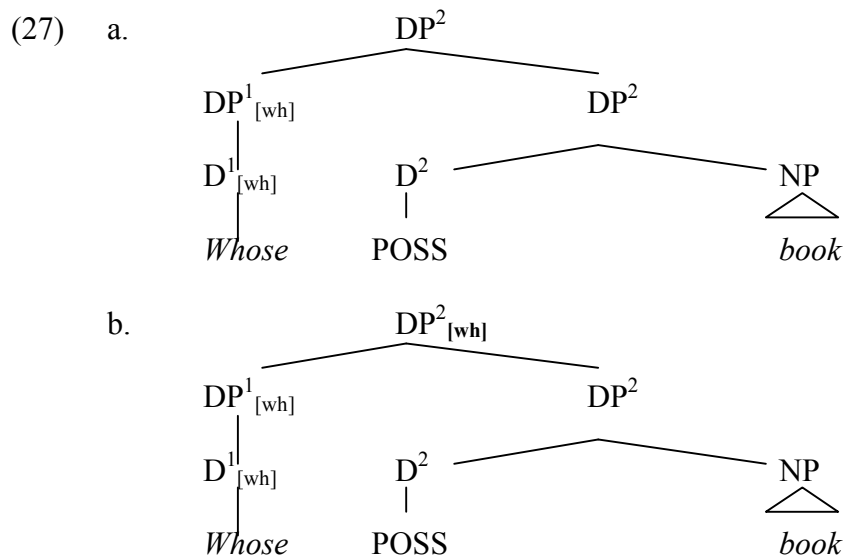
In (27b), the entire possessive DP comes to bear the *wh*-feature of the *wh*-possessor via feature percolation. Since this DP now bears '[wh]', it will serve as the target/trigger of *wh*-movement in a question containing it. Thus, the pied-piping structure in (2a) can be derived without our deviating from the core assumptions that (i) movement only ever applies to phrases bearing the feature triggering the movement, and (ii) the trigger of movement in *wh*-questions is the *wh*-feature of the *wh*-word itself.

Given the desirability of assumptions (i) and (ii), much of the existing literature on pied-piping assumes some kind of 'feature percolation' mechanism. However, such mechanisms are eschewed by both Heck (2008, 2009) and Cable (2010a,b). Besides simply offering accounts that dispense with feature percolation, Heck and Cable both offer principled reasons against ever appealing to feature percolation in the analysis of pied-piping structures. Given their consensus on this point, it is worth discussing here why both Heck and Cable feel feature percolation is not a viable analytic option. Heck (2008, 2009) was the first to note the problematic status of feature percolation in the theory of movement; Cable (2010a,b) largely repeats Heck's original arguments. For purposes of exposition, however, I will interleave Heck's and Cable's discussion, as they together form a fluid narrative.

The central problem noted by Heck and Cable is the exceptional status of 'feature percolation'. Typically, the features of a head only ever extend to the projections of the head. This ubiquitous phenomenon is commonly referred to as 'feature projection'. By contrast, 'feature percolation' is an operation whereby the features of H are extended to phrases *beyond* the projections of H. Cable (2010a) notes that, curiously, this operation of 'feature percolation' has little utility outside of deriving pied-piping structures. This is in striking contrast to the core grammatical operations of feature projection, Agreement, concatenation (Merge), and movement (Move). Thus, a theory appealing to a primitive operation of feature percolation is clearly undesirable; if feature percolation is to be maintained at all in the theory of movement, it should instead be derived somehow from the more solidly attested operations: Agree, Merge and Move.[11] The problem is that – as first noted by Heck (2008, 2009) – it can't. For reasons of space, I will only review here Heck's arguments that 'feature percolation' should not be recast as some form of 'feature movement', nor as a result of Agreement.[12]

As Heck notes (Heck 2008: 65-70, Heck 2009: 98-99), one might at first hope that the feature percolation hypothesized in (27) could be understood as a case of 'feature movement' (Chomsky 1995, Pesetsky 2000). Under this view, the *wh*-feature of the possessor doesn't 'percolate' to the larger possessive DP, but rather undergoes movement to that position. Thus, one might not need to invoke 'feature percolation' *per se* in the analysis of pied-piping, but nevertheless retain the key insights and advantages of a percolation analysis.

Of course, if 'feature percolation' were indeed feature movement, one would then expect it to be subject to the constraints generally observed to govern movement. However, as noted by Heck (2008, 2009), the feature movement hypothesized in (27) would seem to violate several major movement constraints. For example, note that the feature movement in (27) would extract the *wh*-feature from within the possessive specifier of the DP. However, it is widely known that specifiers of DP are islands for movement, particularly in English.

(28) a.   [[Whose [father]]'s book] did you buy?
      b.   * Whose$_1$ did you buy [[[t_1 [father]]'s book]

---

[11] Heck (2008, 2009) likewise maintains that 'feature percolation' cannot be taken as a grammatical primitive. However, Heck bases his claim on the notion, taken from GB/Minimalism, that *all* syntactic phenomena must be analyzed in terms of Merge and Move. Thus, Heck's argument can be characterized as hypothetical: *if* one adopts the assumptions of GB/Minimalism, *then* feature percolation cannot be a primitive operation. Cable's argument is that, regardless of one's preferred syntactic theory, a primitive operation of 'feature percolation' is suspect, since the only real evidence for it comes from pied-piping structures.

[12] For Heck's arguments that 'feature percolation' should not be viewed as some special case of 'feature merger', see Heck (2008: 70-73), (2009: 99-102).

Thus, the feature movement postulated in (27) would appear to violate a constraint that clearly governs phrasal movement in English. Of course, one could speculate that *feature* movement is somehow able to obviate the constraint seen in (28). But, in the absence of any independent evidence or rationale for such an exemption, this approach is certainly not be embraced.

We find, then, that the feature percolation in (27) could not be recast as some form of feature movement. Heck (2008: 57) also argues that it cannot be recast as some form of Agreement. As discussed by Heck, it was possible under earlier GB conceptions of 'Spec-Head agreement' to view the feature percolation in (27) as a result of Agreement between the possessive D head and the *wh*-possessor. More concretely, it was possible to claim that the head of the possessive DP gained the feature '[wh]' through agreement with the *wh*-word in its specifier. Although the possessive D did not begin the derivation with a *wh*-feature, it subsequently underwent a (phonologically unrealized) agreement operation with its *wh*-specifier. Through this agreement operation, the possessive D came to inherit the *wh*-feature 'parasitically'. The regular process of feature projection would then extend this *wh*-feature to the projections of the possessive D, and so onto the entire possessive phrase.

Although this view of 'feature percolation' enjoyed a period of popularity (Cowper 1987, Moritz & Valois 1994, Grimshaw 2000, Koopman 2000), Heck notes out that it cannot be implemented under current theories of Agreement. Simply put, current theories of Agreement do not on their own predict the possibility of such 'parasitic' inheritance of features. Such 'parasitic agreement' could perhaps be written into the current theory, but there seems to be little motivation for doing so beyond the derivation of possessor pied-piping. Furthermore, Heck notes that the postulated Spec-Head agreement is often difficult to independently motivate. For example, as just noted, the derivation of (27b) would require some kind of Agreement between the possessive D and the possessor in SpecDP. But, Agreement in what features? After all, we saw in (3) that a possessive phrase needn't agree in number with its possessor. Similarly, the data in (29) show that a possessive phrase needn't agree in person with its possessor.

(29)   [My father] is / *am at the party.

Indeed, it seems impossible to find any feature *other than [wh]* that a possessor would obligatorily share with the possessive phrase. On these grounds, Heck (2008, 2009) rejects the notion that 'feature percolation' could be reduced to the operation of Agree.

It seems, then, that it is impossible to recast 'feature percolation' as some other, independently motivated grammatical operation. Thus, any analysis of pied-piping invoking 'feature percolation' would be introducing a novel syntactic operation. Given the limited motivation for such an operation, accounts appealing to 'feature percolation' would appear extremely suspect. On those grounds, both Heck (2008, 2009) and Cable (2010a,b) argue that the only viable means for analyzing pied-piping structures are to either (i) permit movement to apply phrases larger than the trigger of the movement (Heck 2008, 2009), or (ii) reanalyze the trigger of movement as the category of the moved phrase (Cable 2010a,b).

5.   Interim Summary

In this paper, I introduced the basic notions of *pied-piping* (4) and *pied-piping structure* (5), and I discussed the analytic problems that such phenomena raise for classic theories of movement. We saw that there are three conceivable approaches to pied-piping phenomena: (i) permit

movement to apply to phrases larger than the trigger of movement, (ii) use 'feature percolation' to move the features of a head H onto nodes outside of H^{Max}, or (iii) reanalyze the trigger of movement as the category of the moved phrase. I then outlined the theory of pied-piping developed by Heck (2008, 2009), which follows the first of the analytic paths above. Following this, I outlined the theory of pied-piping developed by Cable (2010a,b), which follows the third of these paths. Finally, I outlined Heck's key arguments against accounts following the second of these analytic paths, those that appeal to an operation of 'feature percolation'.

In the second paper of this series, I will compare in more detail the empirical predictions of Heck (2008, 2009) and Cable (2010a,b). We will see that there are both overlapping and complementary predictions regarding a variety of issues concerning pied-piping structures, including (a) the locality of pied-piping, (b) the tendency for 'pied-pipers' to occupy phrasal edges, (c) cases of optional pied-piping, and (d) so-called 'massive pied-piping'.

References

Bresnan, Joan. 1976. On the form and function of transformations. Linguistic Inquiry 7. 3-40.

Cable, Seth. 2007. The grammar of Q: Q-particles and the nature of *wh*-fronting, as revealed by the *wh*-questions of Tlingit. Cambridge, MA: MIT dissertation.

---. 2010a. The grammar of Q: Q-particles, *wh*-movement, and pied-piping. Oxford: Oxford University Press.

---. 2010b. Against the existence of pied-piping: evidence from Tlingit. Linguistic Inquiry 41. 563-594.

Chomsky, Noam. 1973. Conditions on transformations. A festschrift for Morris Halle, ed. by Steven Anderson and Paul Kiparsky, 232-286. New York: Holt, Reinhart and Winston.

---. 1995. The minimalist program. Cambridge, MA: MIT Press.

---. 2000. Minimalist inquiries: the framework. Step by step: essays on minimalist syntax in honor of Howard Lasnik, ed. by Roger Martin, David Michaels and Juan Uriagereka, 89-155. Cambridge, MA: MIT Press.

---. 2001. Derivation by phase. Ken Hale: a life in language, ed. by Michael Kenstowicz, 1-52. Cambridge, MA: MIT Press.

Cowper, Elizabeth. 1987. Pied piping, feature percolation and the structure of the noun phrase. Canadian Journal of Linguistics 32. 321-338.

Emonds, Joseph. 1976. A transformational approach to English syntax. New York: Academic Press.

Grimshaw, Jane. 2000. Locality and extended projection. Lexical specification and insertion, ed. by Peter Coopmans, Martin Everaert and Jane Grimshaw, 115-133. Amsterdam: Benjamins.

Hagstrom, Paul. 1998. Decomposing questions. Cambridge, MA: MIT dissertation.

Heck, Fabian. 2008. On pied-piping: wh-movement and beyond. Berlin: Mouton de Gruyter.

---. 2009. On certain properties of pied-piping. Linguistic Inquiry 40. 75-111.

Horvath, Julia. 2000. Interfaces vs. the computational system in the syntax of focus. Interface strategy, ed. by Hans Bennis, Martin Everaert, and eric Reuland. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

---. 2007a. Pied-piping. The Blackwell companion to syntax, ed. by Martin Everaert and Henk van Riemsdijk, Rob Goedemans, and Bart Hollebrandse, 569-630. Oxford: Blackwell.

---. 2007b. Separating 'focus movement' from focus. Phrasal and clausal architecture: syntactic derivation and interpretation; in honor of Joseph E. Emonds, ed. by Simin Karimi, Vida Samiian and Wendy K. Wilkins. Amsterdam: Benjamins.

Kishimoto, Hideki. 2005. *Wh*-in-situ and movement in Sinhala questions. Natural Language and Linguistic Theory 23. 1-51.

Koopman, Hilda. 2000. Prepositions, postpositions, circumpositions and particles: the structure of Dutch PPs. The syntax of specifiers and heads: collected essays of Hilda J. Koopman. London: Routledge.

McCarthy, John. 2001. A thematic guide to optimality theory. Cambridge: Cambridge University Press.

Moritz, Luc and Daniel Valois. 1994. Pied-piping and specifier-head agreement. Linguistic Inquiry 25: 667-707.

Pesetsky, David. 2000. Phrasal movement and its kin. Cambridge, MA: MIT Press.

Ross, John Robert. 1967. Constraints on variables in syntax. Cambridge, MA: MIT dissertation.

---. 1986. Infinite syntax. Norwood, NJ: Ablex Publishing Corporation.

Sternefeld, Wolfgang. 2001. Partial movement constructions, pied-piping and higher order choice functions. Audiatur vox sapientia – a festschrift for Arnim von Stechow, ed. by Caroline Féry and Wolfgang Sternefeld, 473-486. Berlin: Akademie Verlag.

Tanaka, Hidekazu. 1999. LF wh-islands and the minimal scope principle. Natural Language and Linguistic Theory 17. 371-402.

Webelhuth, Gert. 1992. Principles and parameters of syntactic saturation. Oxford: Oxford University Press.

Further Reading

Choe, Jae-Woong. 1987. LF-movement and pied-piping. Linguistic Inquiry 18. 348-353.

Coon, Jessica. 2009. Interrogative possessors and the problem with pied-piping in Chol. Linguistic Inquiry 40. 165-175.

Ishihara, Robert. 1984. Clausal pied-piping: a problem for GB. Natural Language and Linguistic Theory 2. 397-418.

Grosu, Alexander. 1989. Pied-piping and the matching parameter. Linguistic Review 6. 41-58.

Heck, Fabian. 2004. A theory of pied-piping. Tübingen: Universität Tübingen dissertation.

Nanni, Deborah and Justine Stillings. 1978. Three remarks on pied-piping. Linguistic Inquiry 9. 310-318.

Nkemnji, Michael. 1995. Heavy pied-piping in Nweh. Los Angeles: UCLA dissertation.

Ortiz de Urbina, Jon. 1990. Operator feature percolation and clausal pied-piping. MIT Working Papers in Linguistics 13. 193-208.

Sauerland, Uli and Fabian Heck. 2003. LF-intervention effects in pied-piping. Proceedings of NELS 33, ed. by Makoto Kadowaki and Shigeto Kawahara. Amherst MA: Graduate Linguistic Student Association.

von Stechow, Arnim. 1996. Against LF pied-piping. Natural Language Semantics 4. 57-110.

Watanabe, Akira. 1992. Wh-in-situ, subjacency and chain formation. Cambridge, MA: MIT Working Paper in Linguistics.

---. 2006. The pied-piper feature. Wh-movement: moving on, ed. by Lisa Lai-Shen Cheng and Norbert Corver. Cambridge, MA: MIT Press.