

# PIED-PIPING BY CYCLIC AGREE. IN DEFENSE OF FEATURE PERCOLATION

MAKSYMILIAN DĄBKOWSKI  
UNIVERSITY OF CALIFORNIA, BERKELEY  
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ABSTRACT. I argue that pied-piping is a consequence of WH-feature percolation. To formalize my proposal, I adapt Béjar and Rezac’s (2009) model of Cyclic Agree, independently motivated in the domain of  $\varphi$ -agreement. In doing so, I offer a solution to the problem of pied-piping which avoids the pitfalls of previous feature percolation approaches without increasing the complexity of syntactic theory.

The present proposal predicts that cross-linguistic variation with respect to pied-piping and WH-inversion resides in featural specification of functional heads. I demonstrate preliminary typological evidence which corroborates this prediction.

I present a case study of Basque (iso 639-3: eus). I show that the present proposal correctly derives the facts of Basque clausal pied-piping. Finally, I discuss competing accounts, which predict that Basque facts should be unattested (Cable, 2007, 2010a,b; Heck, 2004, 2008, 2009).

## 1 INTRODUCTION

In many languages, content questions are formed by dislocating the question word from its canonical position towards the left edge of the sentence. In English, for example, objects typically follow the verb (1a). When asking about the identity of the object, however, the question word which corresponds to it appears at the front of the interrogative phrase (1b).

- (1) a. VERB-OBJECT WORD ORDER  
*I had cake.*
- b. OBJECT FRONTING IN A WH-QUESTION  
What did you have?

Question words are often designated morphologically. In English, for example, they begin with *wh*-. More importantly, question words are commonly assumed to have a distinguishing morphosyntactic feature [WH]. Correspondingly, they are often referred to as *wh-words* and the operation of fronting they undergo—*wh-movement*.

The obligatory *wh*-movement to the front of the interrogative phrase is known as the *wh-criterion* (Aoun, Hornstein, and Sportiche, 1981; Pesetsky, 1982; others). The *wh-criterion* can be stated as the requirement that the *wh*-phrase appear in [Spec, CP] in an interrogative (or relative) clause. In formalizing the *wh-criterion*, one could reasonably assume that it targets specifically the *wh*-feature associated with *wh*-words. This predicts that only *wh*-words should front.

The present paper investigates the phenomenon of so-called *pied-piping*,<sup>1</sup> known as least since Ross (1967, 1986). *Pied-piping* takes place when a constituent larger than the *wh*-word itself is fronted (2). *Pied-piping* presents a challenge to the *wh-criterion*.

- (2) CAR PIED-PIPED BY WHOSE  
Whose car did he steal?

In structures such as (2), the constituent which undergoes the movement *whose car* only contains the *wh*-word *whose*, but is not identical with it. Thus, the question arises: Why does *car* front together with *whose*? This is the problem of *pied-piping*. To tackle the problem, one must abandon one of the two assumptions: (i) only *wh*-words carry the *wh*-feature or (ii) the *wh-criterion* only targets the *wh*-feature.

<sup>1</sup> The evocative coinage alludes to the legend of the Pied Piper of Hamelin, whose eponymous protagonist retaliates against townsmen by using his magical pipe to lead away their children. Thus, in (2), *whose* is analogized to the Pied Piper and the *pied-piped car*—to the children.

In this paper, I argue that pied-piping takes place when functional heads Agree with the *WH*-feature, “passing it up” to higher projections. The novelty of my proposal lies in the adaptation of Béjar and Rezac’s (2009) model of Cyclic Agree, independently motivated in the domain of  $\phi$ -agreement. In doing so, I offer a solution to the problem of pied-piping which avoids the pitfalls of previous feature percolation approaches without increasing the complexity of syntactic theory.

In exploiting Agreement to pass the *WH*-feature up, the current proposal rejects assumption (i); *WH*-words are not the only carriers of the *WH*-feature. Thus, the current proposal is a refinement of traditional “feature percolation” approaches which predominated in the literature on pied-piping until quite recently (e.g. Cowper, 1987; Grimshaw, 2000; Koopman, 2000; Moritz and Valois, 1994). At the same time, it marks a sharp departure from more recent proposals which reject assumption (ii) and eschew feature percolation at the cost of revising the *WH*-criterion (Cable, 2007, 2010a,b, 2012, 2013; Heck, 2004, 2008, 2009).

The rest of the paper is organized as follow. In Section 2, I put forward the core proposal and apply it to English data.

I observe that the present proposal predicts that cross-linguistic variation with respect to pied-piping and *WH*-inversion resides in featural specification of functional heads. In Section 3, I demonstrate preliminary typological evidence which corroborates this prediction.

In Section 4, I outline the two main competing accounts (Cable, 2007, 2010a,b; Heck, 2004, 2008, 2009) and address their challenges to feature percolation approaches.

In Section 5, I present a case study of Basque (iso 639-3: eus). I show that the present proposal correctly derives the facts of Basque clausal pied-piping. I discuss competing accounts, which predict that Basque facts should be unattested. In Section 6, I conclude.

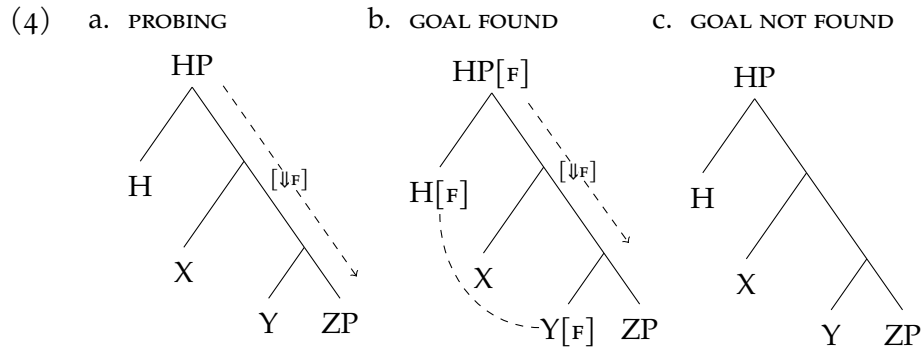
## 2 CORE PROPOSAL

I propose that the interrogative  $C_Q$ -head probes for the *WH*-feature. The *WH*-probe is bundled with an EPP feature which causes movement. The probe locates the structurally closest constituent which carries the *WH*-feature (*what*<sub>[*WH*]</sub>), copies the *WH*-feature to the  $C_Q$ -head ( $C_Q$ [*WH*]), and moves the constituent to [Spec,  $CP_Q$ ] (3).

- (3) *WH*-PROBE VALUED BY A *WH*-WORD
- [ $CP$  *What*<sub>[*WH*]</sub> *did* <sub>$C_Q$ [*WH*]</sub> [ $TP$  *you have what*<sub>[*WH*]</sub>? ] ]
-

The  $WH$ -feature found on  $WH$ -words is represented as  $[WH]$ . The  $WH$ -probe is represented with a double down arrow ( $[\Downarrow_{WH}]$ ). The EPP feature on the  $WH$ -probe is represented with an asterisk ( $[\Downarrow_{WH}^*]$ ). A successful probe-goal relation is represented with a dashed line (----). Movement is represented by striking out the moved constituent and an arrow ( $\leftarrow$ ).

I assume Deal's (2015, 2020) Interaction/Satisfaction model of Agree. In Deal's model, head  $H$  carrying probe  $[\Downarrow_F]$  probes into its sister (4a). Probing is represented with a dashed arrow ( $----\rightarrow$ ). The probe probes past nodes which do not carry the  $F$ -feature ( $X$ ) until it encounters a node which does ( $Y[F]$ ). Then, the feature  $[F]$  is copied onto the head ( $H[F]$ ) and the search is halted, leaving the structurally farther nodes ( $ZP$ ) unprobed (4b). When the goal is not found, no features are copied onto the head ( $H$ ), but the derivation does not crash (4c). In other words, a failure to find the satisfaction features of a probe does not result in ungrammaticality.



I propose that a functional head may also carry a  $WH$ -probe which probes into its complement. If its complement has the  $WH$ -feature, the probe copies that feature onto the functional head. In this way, the  $WH$ -feature “percolates” up, making the entire phrase a potential target for a higher  $WH$ -probe. Thus pied-piping is derived. Now, I will outline the featural specification of English function heads.

I propose that the English non-stranding prepositions carry the non-EPP probe  $[\Downarrow_{WH}]$ . Thus, I will represent them as  $P[\Downarrow_{WH}]$  (5). The preposition probes into its  $c$ -command domain ( $[\Downarrow_{WH}]$ ), establishes Agree with the  $WH$ -word (----), and copies the feature  $[WH]$  onto the head (5a). Given the assumptions of bare phrase structure, the features of a head are the features of the entire phrase (Chomsky, 1995, 2000). Thus,  $[WH]$  becomes a feature of the entire PP. In (5b), the  $C_Q$ -head  $WH$ -probes into its  $c$ -command domain. The structurally closest constituent carrying the  $WH$ -feature is the PP. Thus, the entire PP ends up undergoing movement to  $[Spec, CP_Q]$ .

- (5) P[ $\downarrow_{WH}$ ]
- a. P AGREEING WITH WH-WORD  
 [PP[ $_{WH}$ ] *in*<sub>P[ $_{WH}$ ]</sub> *what*<sub>[ $_{WH}$ ]</sub> *way?* ]  
 '---[ $\downarrow_{WH}$ ]-'
- b. PP[ $_{WH}$ ] EXTRACTED BY C<sub>Q</sub>  
 [CP [PP[ $_{WH}$ ] *In what way* ] *is*<sub>C<sub>Q</sub>[ $_{WH}$ ]</sub> *it good* [PP[ $_{WH}$ ] *in what way?* ] ]  
 '-----[ $\downarrow_{WH^*}$ ]-----'

A degree phrase in English can follow the noun (6a) or precede it (6b). I assume that the DegP originates low and optionally moves to [Spec, DP]. If the DegP contains a WH-word, that movement is obligatory (6c-d).

- (6) VARIABLE DegP HEIGHT
- a. *He bought a car that big.*  
 b. *He bought that big a car.*  
 c. \**A car how big did he buy?*  
 d. *How big a car did he buy?*

I propose that the English determiner *a* carries the EPP probe [ $\downarrow_{WH^*}$ ]. Thus, I will represent it as D[ $\downarrow_{WH^*}$ ] (7). The D-head copies the WH-feature and extracts the WH-bearing constituent from its c-command domain to [Spec, DP] (7a). Since [ $_{WH}$ ] is a feature of the entire DP, that DP becomes a goal of the higher WH-probe and undergoes movement to [Spec, CP<sub>Q</sub>] (7b).

- (7) D[ $\downarrow_{WH^*}$ ]
- a. D EXTRACTING Deg[ $_{WH}$ ]  
 [DP[ $_{WH}$ ] [DegP[ $_{WH}$ ] *how big* ] *a*<sub>D[ $_{WH}$ ]</sub> *car* [DegP[ $_{WH}$ ] *how big?* ] ]  
 '-----[ $\downarrow_{WH^*}$ ]-----'
- b. DP[ $_{WH}$ ] EXTRACTED BY C<sub>Q</sub>  
 [CP [DP[ $_{WH}$ ] *How big a car* ] *did*<sub>C<sub>Q</sub>[ $_{WH}$ ]</sub> *he buy* [DP[ $_{WH}$ ] *how big a car?* ] ]  
 '-----[ $\downarrow_{WH^*}$ ]-----'

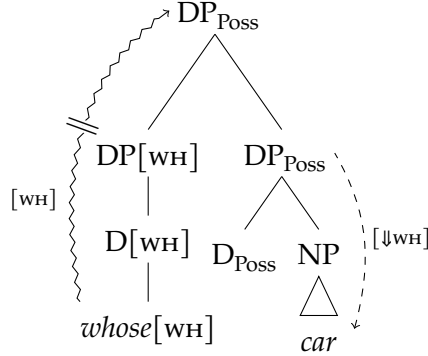
Now consider (8). I assume that *whose* originates in the specifier position of a DP headed by a phonologically null possessive D<sub>POSS</sub>. This presents us with a different configuration from (7), where the WH-element originated below the D-head.

- (8) CAR PIED-PIPED BY WHOSE  
Whose car did he steal?

This configuration is an apparent challenge to the mechanism of Agree assumed so far. D<sub>POSS</sub> probes for [ $_{WH}$ ] into its complement NP (--->). However, the WH-feature is located on its specifier. A mechanism is needed to

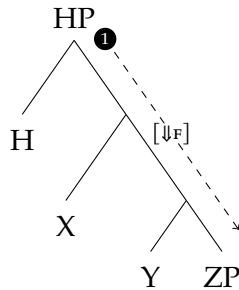
get the *wh*-feature to “percolate up” from [Spec, DP<sub>Poss</sub>] to DP<sub>Poss</sub> (9). The challenging feature copying is represented with a squiggly arrow ( $\leftarrow\rightsquigarrow$ ) and the apparent barrier—with a double vertical line ( $\parallel$ ).

(9) SPEC-H AGREEMENT CHALLENGE

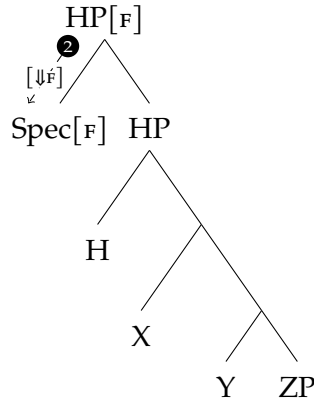


To address the challenge, I adopt Béjar and Rezac’s (2009) model of Cyclic Agree (10), independently motivated in the domain of  $\varphi$ -agreement. In the model of Cyclic Agree, head H first merges with its complement, and probes into it (1) immediately upon merging (10a). Then, HP combines with its specifier. If the probe was not fully satisfied on the first cycle of Agreement, it reprojects and probes into its specifier (2), resulting in a second cycle of Agreement (10b).

(10) a. 1ST CYCLE OF AGREE



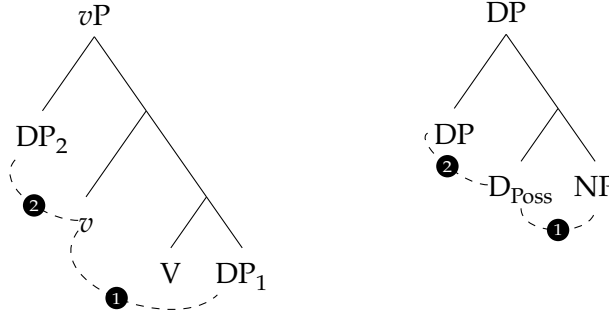
b. 2ND CYCLE OF AGREE



In Béjar and Rezac’s (2009) original proposal, the mechanism of Cyclic Agree is used to model  $\varphi$ -agreement realized on *v*. The *v*-head probes for  $\varphi$ -features preferentially into its internal argument (DP<sub>1</sub>). It  $\varphi$ -probes into its external argument (DP<sub>2</sub>) only if the probe was not fully satisfied on the first cycle (11a).

I propose that the behavior of the  $\varphi$ -probe on  $v$  is mirrored by the behavior of the  $WH$ -probe on  $D$  (11). Specifically, the  $D_{Poss}$ -head first probes for the  $WH$ -feature into its complement (NP). If not fully satisfied on this first cycle, the  $WH$ -probe looks into its specifier (DP) on the second cycle (11b).

- (11) a. CYCLIC  $\varphi$ -AGREE ON  $v$                       b. CYCLIC  $WH$ -AGREE ON  $D$



A possessive  $D$ -head first probes for the  $WH$ -feature into its complement. If it does not find it, the probe reprojects into its specifier. If the specifier carries the  $WH$ -feature, the probe copies it onto the head and the search is halted (12a).<sup>2</sup> The entire  $DP_{Poss}$  then becomes the goal for the higher  $WH$ -probe and moves to [Spec,  $CP_Q$ ] (12b).

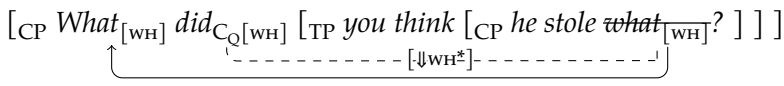
- (12)  $D_{Poss}[\downarrow WH]$
- a.  $D_{Poss}$  AGREEING WITH SPEC  
 $[DP_{[WH]} \textit{whose}_{[WH]} D_{Poss}[WH] [NP \textit{car} ] ]$   
 $\uparrow [\downarrow WH] \textcircled{2} \text{---} \textcircled{1} [\downarrow WH] \text{---} \rightarrow$
- b.  $DP[WH]$  EXTRACTED BY  $C_Q$   
 $[CP [DP_{[WH]} \textit{Whose car} ] \textit{did}_{C_Q[WH]} \textit{he steal} [DP_{[WH]} \textit{whose car?} ] ]$   
 $\uparrow \text{---} [\downarrow WH^*] \text{---} \downarrow$


Finally, I propose that subordinate  $C$ -heads do not bear the  $WH$ -probe (13). Thus, I will represent them as  $C[ ]$ . With no  $WH$ -probe on the subordinate  $C$ -heads, the  $WH$ -feature does not percolate up to the level of the clause. In other words, English does not allow for clausal pied-piping. This results in one of two possibilities. If the subordinate  $CP$  is not an island for movement, the interrogative  $C_Q$ -head may probe into it, extracting the  $WH$ -word by itself (13a).<sup>3</sup> If the subordinate  $CP$  is an island, probing is blocked, yielding ineffability (13b).

2 Note that  $WH$ -agreement differs from  $\varphi$ -agreement in some crucial ways. For example, in the case of  $\varphi$ -agreement, the agreement feature copied onto the head does not play any grammatical role other than being morphologically exponed. In the case of  $WH$ -agreement, the agreement feature feeds  $WH$ -movement.

3 Here, I am not representing cyclic  $WH$ -movement to [Spec,  $CP$ ] in subordinate clauses. I assume that the movement of the  $WH$ -constituent through intermediate specifier positions is

- (13) C[ ]
- a. WH-EXTRACTION OUT OF CP  

$$[_{CP} \textit{What}_{[WH]} \textit{did}_{C_Q[WH]} [_{TP} \textit{you think} [_{CP} \textit{he stole } \cancel{\textit{what}}_{[WH]}? ] ] ]$$

- b. WH-EXTRACTION BLOCKED BY CP ISLAND<sup>4</sup>  

$$* [_{CP} \textit{---} \textit{will}_{C_Q} \textit{you be happy} [_{CP} \textit{if you catch } \textit{what?} ] ]$$


### 3 TYPOLOGICAL PREDICTIONS

In the previous section, I have proposed that English has P-, C-, and D-heads which exemplify all three different WH-probe values: P[ $\downarrow_{WH}$ ], C[ ], and D[ $\downarrow_{WH^*}$ ], respectively. This was motivated empirically, but no principled reason was given as to why a particular probe goes with a particular head.

In this section, I will argue that there is no principled reason and that any functional head can go with any probe. I will support my claim by showing that each head-probe combination is cross-linguistically attested. Recall the consequences of each WH-probe value for pied-piping and word order.

H[ ]—the head does not probe for [WH]. If HP is not an island, the WH-word is extracted without pied-piping. If HP is an island, ineffability results.

H[ $\downarrow_{WH}$ ]—the head probes for [WH] but does not trigger movement. The WH-word pied-pipes HP and remains HP-internal.

H[ $\downarrow_{WH^*}$ ]—the head probes for [WH] and triggers movement. The WH-word pied-pipes HP and fronts to [Spec, HP].

In English, we saw an instance of P[ $\downarrow_{WH}$ ] (5). P[ ] can also be found in English. In preposition-stranding constructions, the P-head does not probe for [WH]. Since PP is not an island, the WH-word is extracted without pied-piping (14).

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not featurally-driven. Proposals of “featureless” intermediate movement compatible with the present approach include Bošković (2002, 2007) and Chomsky (2013). Bošković (2002, 2007) proposes that the WH-constituent moves to establish c-command relation required for Agree. Chomsky (2013) assumes that intermediate movement results from well-formedness conditions on syntactic structure.

<sup>4</sup> Assuming Deal’s (2020) Interaction/Satisfaction model of Agree, a failure of C<sub>Q</sub> to Agree with a WH-word does not by itself explain the ungrammaticality of (13b); in the Interaction/Satisfaction model, underagreement does not generally result in a derivational crash. Following Simpson (2000), Watanabe (2006), Adger and Ramchand (2005), and others, I assume that (13b) is ungrammatical on semantic grounds. Specifically, the C<sub>Q</sub>-head must establish a syntactic dependency with the WH-word for a sentence to receive an interrogative interpretation.



- (14) P[ ] English  
 [CP *What*<sub>[WH]</sub> *do*<sub>C<sub>Q</sub>[WH]</sub> [TP *you believe* [PP *in what*<sub>[WH]</sub>? ] ] ]
- 

P[↓<sub>WH</sub>\*] can be found in Chol. P[↓<sub>WH</sub>\*] probes for [WH] and triggers movement. The WH-word pied-pipes PP and fronts to [Spec, PP] (15).

- (15) P[↓<sub>WH</sub>\*] Chol
- a. [<sub>PP</sub> **Maxki**<sub>i</sub> [<sub>PP</sub> *tyi* [<sub>NP</sub> *iyotyoty* *t*<sub>1</sub> ] ] ] *tyi majliyety?*  
 whose to house you.went  
*Whose house did you go to?*
- b. \* [<sub>PP</sub> *Tyi* [<sub>NP</sub> *iyotyoty* **maxki** ] ] *tyi majliyety?*  
 to house whose you.went
- c. \* [<sub>PP</sub> *Tyi* [<sub>NP</sub> **maxki** *iyotyoty* ] ] *tyi majliyety?*  
 to whose house you.went

(Cable, 2010a, p. 186)

In English, we saw an instance of C[ ] (13). C[↓<sub>WH</sub>] can be found in Haida. The WH-word pied-pipes the subordinate CP, but it remains internal in that subordinate clause (16).

- (16) C[↓<sub>WH</sub>] Haida  
 [<sub>CP</sub> *k'yuwec* **guusrahl** 'la *srasgadaan* ]-uu *7wii qeeng.ulaang?*  
 the.door what.with he strike FOC it.is.easy.to.see  
*What is it easy to see that he hit the door with?*

(Enrico, 2003, p. 205; Cable, 2007, p. 295)

C[↓<sub>WH</sub>\*] can be found in Ancash Quechua. C[↓<sub>WH</sub>\*] probes for [WH] and triggers movement. The WH-word pied-pipes the subordinate CP and fronts to [Spec, CP] (17).

- (17) C[↓<sub>WH</sub>\*] Ancash Quechua  
 [<sub>CP</sub> **Imata**<sub>i</sub> [<sub>IP</sub> *wawa* *t*<sub>1</sub> *mikuchun* ] ]<sub>2</sub>-taj *Maria* *t*<sub>2</sub> *munan?*  
 what child eat Q Maria want  
 a. *What does Maria want the child to eat?*  
 \* [<sub>CP</sub> [<sub>IP</sub> *wawa* **imata** *mikuchun* ] ]<sub>2</sub>-taj *Maria* *t*<sub>2</sub> *munan?*  
 b. child what eat Q Maria want

(Cable, 2007, p. 292)

In English, we saw an instance of D[↓<sub>WH</sub>\*] (7). D[ ] can be found in Russian. D[ ] does not probe for [WH]. Since DP in Russian is not an island, the WH-word is extracted without pied-piping (18).

- (18) D[ ] Russian  
 Ja sprosil kakuju<sub>2</sub> ty čital [DP t<sub>2</sub> knigu ]<sub>3</sub>.  
 I asked whose you read book  
 ‘I asked whose book you read.’  
 (Ross, 1986, p. 145; Heck, 2008, p. 155)

D[↓<sub>WH</sub>] can be found in Hungarian. D[↓<sub>WH</sub>] probes for [WH] but does not trigger movement. The WH-word pied-pipes the larger possessive DP but it remains inside of that DP (19).

- (19) D[↓<sub>WH</sub>] Hungarian  
 [DP<sub>1</sub> János [DP<sub>2</sub> melyik fiát ] ] szereted legjobban?  
 John which son you.like best  
 a. *Which son of John's do you like the best?*  
 [DP<sub>1</sub> Az anyád [DP<sub>2</sub> hány barátjének ] ] telefonáltál?  
 the your.mother how.many her.friends you.phoned  
 b. *How many of your mother's friends did you call?*  
 (Horvath, 2007; Szabolcsi, 1984; Cable, 2007, p. 296)

The present proposal predicts that cross-linguistic variation with respect to pied-piping and WH-inversion resides in featural specification of functional heads. In this section, I showed that this prediction is borne out, as all combinations of functional heads P, C, and D with [], [↓<sub>WH</sub>], and [↓<sub>WH</sub>\*] are attested. Table 1 summarizes the cross-linguistic findings.

	P	C	D
[]	English (14)	English (13)	Russian (18) <sup>5</sup>
[↓ <sub>WH</sub> ]	English (5)	Haida (16) <sup>6</sup>	Hungarian (19)
[↓ <sub>WH</sub> *]	Chol (15) <sup>7</sup>	Quechua (17)	English (7)

Table 1: Languages by functional head and WH-featural specification.

#### 4 COMPETING ACCOUNTS

The two recent influential accounts of pied-piping are proposed in Cable (2007, 2010a,b) and Heck (2004, 2008, 2009). Heck proposes to view pied-piping as a repair strategy and formalizes his proposal in Optimality Theory (McCarthy and Prince, 1986; Prince and Smolensky, 1993). Cable considers

<sup>5</sup> also Polish (51)

<sup>6</sup> also Bangla (52), Marathi (53)

<sup>7</sup> also Finnish (54)

pied-piping to be an illusory phenomenon, resulting from the movement of a phrase headed by a silent Q-particle.

Despite their differences, Heck and Cable agree that feature percolation is not a viable solution to the problem of pied-piping, and seek alternatives to it. In this section, I give a brief overview of Heck's and Cable's approaches and address their challenges to feature percolation.

#### 4.1 Heck (2004, 2008, 2009)

Heck (2004, 2008, 2009) begins by observing that pied-piping is often possible only when extraction of out of the pied-piped constituent is independently impossible. Thus, pied-piping has the flavor of a repair strategy, formulated by Heck as the repair generalization (20).

- (20) REPAIR GENERALIZATION  
 Pied-piping of  $\beta$  by a WH-phrase  $\alpha$  is possible only if movement of  $\alpha$  out of  $\beta$  is blocked. (Heck, 2008, p. 117; Heck, 2009, p. 92)

Heck accepts the common assumption that WH-movement is triggered by Agreement between the WH-word and the interrogative C-head, but adopts a nonstandard view of how Agreement functions. Specifically, Heck proposes a violable OT constraint LOCALAGREE, which penalizes projections intervening between two constituents in an Agree relation (21).

- (21) LOCALAGREE  
 If a probe  $\alpha$  Agrees with a goal  $\beta$ , then there is no XP which dominates  $\beta$  but not  $\alpha$ .  
 (Heck, 2008, p. 191; Heck, 2009, p. 80; Cable, 2012)

LOCALAGREE derives the requirement on WH-movement. In (22), the first candidate (without WH-movement) incurs three violation marks, one for each XP between the unpronounced C-head and the WH-word *who*. The second candidate (with WH-movement) incurs only one violation, so it emerges as the winner. Thus, LOCALAGREE forces WH-movement.

(22) WH-MOVEMENT TRIGGERED BY LOCAL AGREE

<b>Input:</b> [CP C <sub>[wh]</sub> [TP Bill [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> introduced John to <b>who</b> ]]]]	<b>Local Agree</b>
a. [CP C <sub>[wh]</sub> [TP Bill [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> introduced John to <b>who</b> ]]]]	!***
b. [CP <b>Who</b> [CP C <sub>[wh]</sub> [TP Bill [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> introduced John to <i>t</i> ]]]]]]	*

(Cable, 2012, p. 819)

Other structural conditions modulate the degree to which LOCALAGREE is satisfied. For example, Heck proposes the LEFTBRANCHCONDITION, which prohibits extraction from left branches of DPs (23).

(23) LEFTBRANCHCONDITION, or: LBC

If  $\alpha$  is the leftmost category within DP, then  $\alpha$  cannot undergo movement from DP.

(Heck, 2008, p. 121; Heck, 2009; Cable, 2012, p. 820)

In (24), the winning candidate (with piped-piping) incurs one violation mark of LOCALAGREE more than the third candidate (with WH-extraction), but it manages to avoid a violation of LEFTBRANCHCONDITION. Thus, pied-piping emerges as a consequence of optimal satisfaction of competing demands on syntactic structure.

(24) PIED-PIPING LICENSED BY LOCAL AGREE

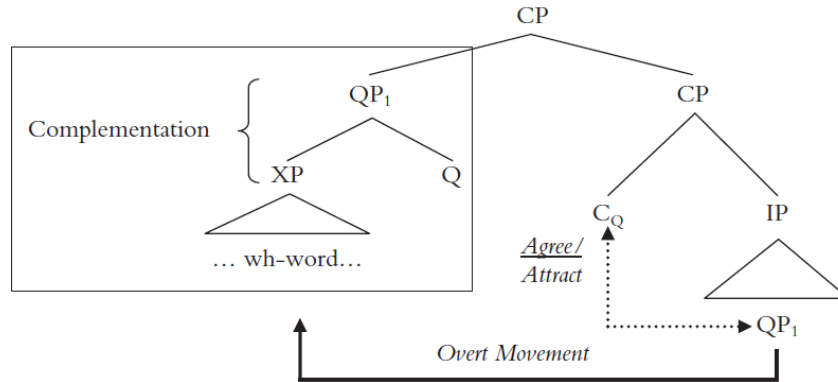
<b>Input:</b> [CP C <sub>[wh]</sub> [TP you [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> read [ <sub>DP</sub> whose book ]]]]]]	<b>LBC</b>	<b>Local Agree</b>
a. [CP C <sub>[wh]</sub> [TP you [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> read [ <sub>DP</sub> whose book ]]]]]]		!****
b. [CP [ <sub>DP</sub> Whose book ] [CP C <sub>[wh]</sub> [TP you [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> read <i>t</i> ]]]]]]		**
c. [CP <b>Whose</b> [CP C <sub>[wh]</sub> [TP you [ <sub>IP</sub> $\nu$ [ <sub>VP</sub> read [ <sub>DP</sub> <i>t</i> book ]]]]]]]]	!*	*

(Cable, 2012, p. 820)

## 4.2 Cable (2007, 2010a,b)

Cable (2007, 2010a,b) proposes that pied-piping is fundamentally an illusory phenomenon. This is to say, it is incorrect to think of the WH-word as a pied-piper leading away additional words to [Spec, CP]. Rather, pied-piping structures result from the movement of a question phrase (QP), with the Q-head (or Q-particle) heading a phrase which contains the WH-word (25).

## (25) PIED-PIPING AS QP-MOVEMENT



(Cable, 2010a, p. 38; Cable, 2010b, p. 567; Cable, 2012, p. 823)

Cable's proposal is inspired by the facts of Tlingit. Tlingit shows WH-movement. The fronted WH-constituent is always followed by *sá* 'Q.' Importantly, if any additional material, e. g. *teen* 'with,' fronts along with the WH-word, *sá* 'Q' appears outside of that fronted material (26).

## (26) PIED-PIPING AS QP-MOVEMENT

Tlingit

- a. [<sub>QP</sub> [<sub>PP</sub> **Aadóo** *teen*] **sá**] yeegoot?  
 who with Q you.went  
*Who did you go with?*
- b. \* [<sub>PP</sub> [<sub>QP</sub> **Aadóo** **sá**] *teen*] yeegoot?  
 who Q with you.went

(Cable, 2010b, p. 575; Cable, 2012, p. 825)

Cable proposes that *sá* 'Q' is a Q-particle heading the question phrase (QP) *aadóo teen sá* 'who with Q.' Importantly, movement to [Spec, CP] targets not the WH-word *aadóo* 'who,' but rather the entire QP. Thus, if the problem of pied-piping is defined as the fronting of additional material (e. g. *teen* 'with') despite the fact that it is not the target of movement, the problem is illusory. Movement targets not the WH-word by itself, but rather the QP which contains the WH-word as well that additional material. Thus, there is no pied-piping to begin with.

Cable proposes to extend this analysis to languages where the Q-particle is unpronounced, such as English. Thus, in (27), the Q-head takes the DP *whose brother's friend's father* as its complement. The entire QP *whose brother's friend's father*  $\emptyset$  then moves to [Spec, CP]. Thus, the difference between Tlingit and English is that the English Q-particle is phonologically null.

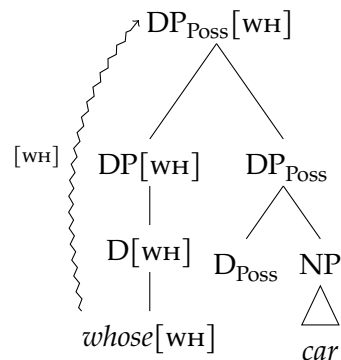
- (27) PHONOLOGICALLY NULL Q English  
 [QP [DP [DP [DP **Whose** brother ]'s friend ]'s father ]  $\emptyset_Q$  ] did you see?  
 (Cable, 2010b, p. 577; Cable, 2012, p. 826)

### 4.3 Challenges to WH-percolation

Despite their obvious differences, both Cable (2007, 2010a,b) and Heck (2004, 2008, 2009) reject feature percolation as a solution to the problem of pied-piping. Their three main challenges relevant to the present proposal are summarized below, largely recapitulating the discussion in Cable (2012, pp. 826–829).

First, feature percolation has exceptional status. Typically, features of head H extend only to projections of H. This ubiquitous mechanism is known as “feature projection.” In striking contrast to feature projection, feature percolation is an operation whereby the features of H extend beyond the projections of H (Cable, 2012, p. 827). The mechanism of feature percolation is schematized in (28), where the WH-feature projects from *whose*[WH] and then “percolates up” ( $\leftarrow$ ) from DP[WH] in [Spec, DP<sub>Poss</sub>] to DP<sub>Poss</sub>.

- (28) FEATURE PERCOLATION



Yet, few features have been proposed to percolate other than the WH-feature (Cable, 2010a). Clearly, it would be preferable to dispense with a separate grammatical operation stipulated only to account for pied-piping.

Second, if feature percolation were to be adopted, it should be derived from one of the basic operations of the grammar: Merge, Move, or Agree. Heck

(2008, pp. 56–74) argues that it cannot be reduced to either of the three operations. Here, I summarize only the argument that feature percolation cannot be reduced to Agree.

Heck observes that under Government & Binding approaches, it was possible to view feature percolation as a consequence of agreement between the  $D_{\text{POSS}}$ -head and the  $_{\text{WH}}$ -possessor (Heck, 2008, p. 57). Specifically,  $DP_{\text{POSS}}$  gained the  $_{\text{WH}}$ -feature “parasitically” by agreeing with the  $_{\text{WH}}$ -constituent in  $[\text{Spec}, DP_{\text{POSS}}]$ . However, current theories of Agreement do not predict such parasitic transmission of features on their own (Cable, 2012, p. 828). If parasitic agreement were reintroduced as a solution to pied-piping, it would be purely stipulative, with no motivation outside of pied-piping structures.

Third and last, agreement between the head and its specifier is often difficult to motivate on independent grounds. In (29), for example, the  $DP_{\text{POSS}}$  *father* is third person singular, whereas the possessor *our* in  $[\text{Spec}, DP_{\text{POSS}}]$  is first person plural. The  $\varphi$ -features of the  $DP_{\text{POSS}}$  are those of its head *father*, as seen by the agreement on the inflected verb.

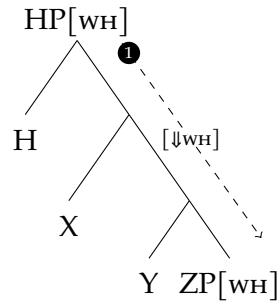
- (29) NO  $\varphi$ -AGREEMENT BETWEEN H AND SPEC English  
*Our father is / \*are / \*am at the party.*  
 (adapted from Cable, 2012, p. 829)

In general, there seems to be no feature with respect to which the head and specifier must agree. Therefore, treating  $[_{\text{WH}}]$  as an Agreement feature is at best stipulative.

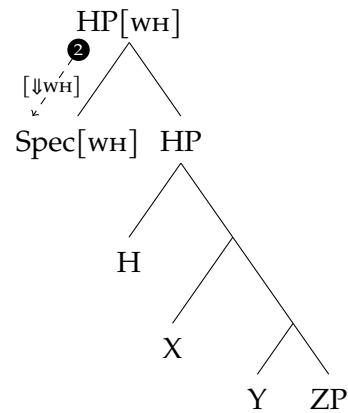
#### 4.4 *Response to challenges*

I reduce feature percolation to Cyclic Agree (Béjar and Rezac, 2009). In the model of Cyclic Agree, a  $_{\text{WH}}$ -probe located on head H may copy the  $_{\text{WH}}$ -feature from its complement (30a) as well as its specifier (30b).

## (30) a. H-COMP AGREEMENT



## b. H-SPEC AGREEMENT



Modeling WH-feature percolation with Cyclic Agree immediately addresses the first two challenges. First, feature percolation is not exceptional, but rather reducible to Agree. Second, the mechanism used to model feature percolation (Cyclic Agree) is not stipulative, since it is independently motivated in the domain of  $\phi$ -agreement.

Finally, I concur with Cable and Heck that treating [WH] as an agreement feature predicts that [WH] should interact with  $\phi$ -features. I argue that this prediction is borne out, as this is precisely what we find in patterns of anti-agreement and WH-agreement. In anti-agreement, a verb agreeing with a WH-phrase shows an impoverished set of  $\phi$ -features (31a). In WH-agreement, the verb agreeing with a WH-phrase has a special WH-agreeing form (31b).

(31) SENSITIVITY OF  $\phi$ -AGREEMENT TO [WH]

## a. ANTI-AGREEMENT

Fiorentino (Romance)

*Quante ragazze gli/\*le ha/\*hanno parlato*  
 how many girls 3SG.M/3PL.F have.3SG/have.3PL spoken  
*con te?*  
 with you

‘How many girls (it) has spoken to you?’

(Brandi and Cordin, 1989, pp. 124–5; Baier, 2018, p. 1)

## b. WH-AGREEMENT

Tarifit (Berber)

*man tamghart<sub>i</sub> ay yzrin/\*t<sub>i</sub>-zra* Mohand  
 which woman C see.PTCP/3SG.F-see Mohand

‘Which woman saw Mohand?’

(Ouhalla, 1993, p. 479; Baier, 2018, p. 1)



## 5 A CASE STUDY: BASQUE

Basque (iso 639-3: eus) is a language isolate spoken predominantly in the Basque Provinces of Spain. In this section, I provide an overview of Basque WH-fronting and clausal pied-piping. I demonstrate how the present proposal can capture the Basque facts. Finally, I show that Basque clausal pied-piping is problematic for competing accounts (Cable, 2007, 2010a,b; Heck, 2004, 2008, 2009).

Basque word order is predominantly SOV, where V stands for a nonfinite participle followed by a finite auxiliary.<sup>8</sup> The order of the bracketed constituents can permute (32).<sup>9</sup>

- (32) SOV WORD ORDER  
 [Ene aitak] [amari] [gona gorria] [ekarri dio].  
 my father.ERG mother.DAT skirt red.DET bring AUX  
 ‘My father brought mother a red skirt.’  
 (Hualde and Ortiz de Urbina, 2003, p. 448)

Basque is a WH-fronting language. The WH-word must appear immediately before the verb. In (33), nothing can come between *zer* ‘what’ and *egiten* ‘do.IMPF.’ In other words, Basque exhibits v2 in WH-interrogatives.

- (33) WH-EXTRACTION  
*Zer egiten duzu zuk hemen?*  
 what do.IMPF AUX you.ERG here  
 ‘What are you doing here?’ [Atx. Ob.:56]  
 (Hualde and Ortiz de Urbina, 2003, p. 464)

Following Ortiz de Urbina (1986), I assume this is a consequence of obligatory movement of the verb to C and movement of the WH-constituent to [Spec, CP] (34).

- (34) WH-MOVEMENT TO [Spec, CP]  
 [CP Zer<sub>[WH]</sub> egiten duzu<sub>C<sub>Q</sub>[WH]</sub> [TP zuk hemen zer<sub>[WH]</sub>? ] ]  
 (-----[↓WH\*]-----)

WH-words inside DPs pied-pipe the entire DP when they move to [Spec, CP] (35). D-heads with the WH-feature pied-pipe their complements (35a). WH-words in [Spec, DP<sub>POSS</sub>] pied-pipe the entire DP<sub>POSS</sub> (35b).

<sup>8</sup> Most of the data and generalizations come from Hualde and Ortiz de Urbina (2003). Uncited data was collected by the author.

<sup>9</sup> The order of the verb and the auxiliary in some stylistic contexts can invert too (Hualde and Ortiz de Urbina, 2003, p. 466).

- (35) PIED-PIPING OF DP
- a. PIED-PIPING BY D  
*Zer bide du hartzen idazlariak?*  
 which way AUX take.IMPF writer.ERG  
 ‘Which way does the writer take?’ [Etch. *Id.* I:293]  
 (Hualde and Ortiz de Urbina, 2003, p. 466)
- b. PIED-PIPING BY [Spec, DP]  
*Noren bide hartzen du idazlariak*  
 whose way take.IMPF AUX writer.ERG  
 “Whose way does the writer take?”

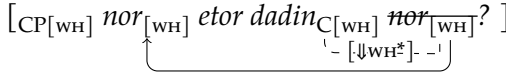
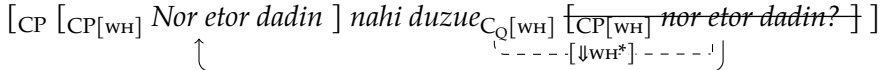
### 5.1 Clausal pied-piping

Now consider structures with WH-words originating in subordinate CPs (36). The WH-word can pied-pipe the entire clause (36a), but it can also be extracted out of clausal complements (36b).

- (36) WH-WORD ORIGINATING IN CP
- a. PIED-PIPING OF CP  
*Nor etor dadin (\*zuek) nahi duzue*  
 who come AUX(SUBJ).COMP you.PL want AUX  
 (zuek)? (pied-piping)  
 you.PL  
 ‘Who do you want to come?’
- b. WH-EXTRACTION OUT OF CP  
*Nor nahi duzue (zuek) etor dadin? (extraction)*  
 (Hualde and Ortiz de Urbina, 2003, pp. 487–8)

In (36a), we see unambiguously that the entire CP is pied-piped because the subject *zuek* ‘you.PL’ cannot intervene between the WH-constituent (here, the pied-piped CP) and the verb.

This can be modeled by proposing that Basque has two C-heads for subordinate clauses:  $C[\downarrow_{WH^*}]$  and  $C[ ]$ . The clausal pied-piping of (36a) can be modeled with  $C[\downarrow_{WH^*}]$  (37). The WH-extraction out of CP in (36b) can be modelled with  $C[ ]$  (38).

- (37)  $C[\downarrow_{WH^*}]$
- a. C EXTRACTING WH-WORD  
 $[CP_{[WH]} \text{ nor}_{[WH]} \text{ etor dadin}_{C[WH]} \text{ nahi}_{[WH]}? ]$   

- b.  $CP_{[WH]}$  EXTRACTED BY  $C_Q$   
 $[CP [CP_{[WH]} \text{ Nor etor dadin } ] \text{ nahi duzue}_{C_Q[WH]} [CP_{[WH]} \text{ nor etor dadin? } ] ]$   


- (38) C[ ]  
 [CP Nor<sub>[WH]</sub> nahi duzue<sub>C<sub>Q</sub>[WH]</sub> [CP etor dadin nor<sub>[WH]</sub>? ] ]
- 

Pied-piping is mandatory when the WH-word originates inside of an island, such as a clausal *when*-adjunct. In declarative sentences, a *when*-clause can come to the right of the main clause (39). The example headings schematize syntactic structure and word order. The matrix clause is represented as CP<sub>M</sub>. The *when*-clause is represented as CP<sub>when</sub>.

- (39) CP<sub>M</sub> CP<sub>when</sub>  
**Etxera joango naiz NEUK nahi dudanean.**  
 home.to go.FUT AUX I.INTS.ERG want AUX.when  
 ‘I will go home when I want to.’

(Hualde and Ortiz de Urbina, 2003, p. 515)

A WH-word originating in a *when*-clause fronts and pied-pies the *when*-clause (40). WH-movement can be diagnosed by the fact that nothing can come between the WH-phrase *zenbat gai* ‘how many subjects’ and the verb *suspenditzen* ‘fail.IMPF.’ CP<sub>Q</sub> represents the matrix clause of an interrogative sentence. Constituents fronted to specifier positions are represented with brackets in the example headings ([ ]).

- (40) [[WH] CP<sub>when</sub>] CP<sub>Q</sub>  
**Zenbat gai suspenditzen denean pasa daiteke**  
 how.many subject fail.IMPF AUX.when pass AUX  
**hurrengo urtera?**  
 next course.to  
 ‘When one fails how many subjects can he pass to the following course?’

(Hualde and Ortiz de Urbina, 2003, p. 490)

As we just saw, WH-movement in Basque is obligatory. This is to say, the WH-word or the phrase containing the WH-word has to end up in [Spec, CP<sub>Q</sub>]. Now, let us turn our attention to doubly embedded clauses. First, consider an underlying word order before WH-movement (41). CP<sub>1</sub> and C<sub>1</sub> represent the first embedded CP and its head. CP<sub>2</sub> and C<sub>2</sub> represent the more deeply embedded CP and its head.

- (41) /CP<sub>Q</sub> CP<sub>1</sub> CP<sub>2</sub> WH/ (UNDERLYING WORD ORDER)  
 / [ C<sub>Q</sub> *Esan dute haiek* [ C<sub>1</sub> *uste duela Mikelek*  
 say AUX those.ERG think AUX.COMP Mikel.ERG  
 [ C<sub>2</sub> *etorri dela nor?* ] ] ] /  
 come AUX.COMP who  
 “Those said that Mikel thinks that who has come?”

For a structure such as (41), there are four ways of satisfying Basque’s requirement of WH-initiality. I propose that they can be captured by allowing either of the two subordinate clause heads (C<sub>1</sub> and C<sub>2</sub>) to have either of the two WH-probe values present in Basque ([ ] and [ $\Downarrow$ WH\*]).

First, the WH-word can be extracted. This structure is modeled with C<sub>1</sub>[ ] and C<sub>2</sub>[ ]. Without WH-probes on C<sub>1</sub> and C<sub>2</sub>, CP<sub>1</sub> and CP<sub>2</sub> do not inherit the WH-feature from *nork* ‘who.ERG.’ Thus, when the matrix C<sub>Q</sub> WH-probes into its c-command domain, the closest WH-bearing constituent it finds is *nork* ‘who.ERG.’ The WH-word *nork* ‘who.ERG’ moves to [Spec, CP<sub>Q</sub>] and no pied-piping takes place (42).

- (42) [WH] CP<sub>Q</sub> CP<sub>1</sub> CP<sub>2</sub> (WH-EXTRACTION)  
 ?<sup>10</sup> [ *Nork* C<sub>Q</sub> *dio Jon* *ek* [ C<sub>1</sub> *uste duela Mikelek* [ C<sub>2</sub>  
 who.ERG said Jon.ERG think AUX.COMP Mikel.ERG  
*irabaziko duela?* ] ] ]  
 win.FUT AUX.COMP  
 “Who did Jon say Mikel thinks will win?”

Second, the more deeply embedded clause can be pied-piped. This structure is modeled with C<sub>1</sub>[ ] and C<sub>2</sub>[ $\Downarrow$ WH\*]. First, C<sub>2</sub> establishes Agree with *nork* ‘who.ERG,’ moves it to [Spec, CP<sub>2</sub>], and inherits its WH-feature. C<sub>1</sub> does not probe for [WH]. Thus, when the matrix C<sub>Q</sub> WH-probes into its c-command domain, the closest WH-bearing constituent it finds is CP<sub>2</sub>. The CP<sub>2</sub> moves to [Spec, CP<sub>Q</sub>] (43).

<sup>10</sup> MAS’s comment: “I think the initial phrasing is a bit awkward, even in English I imagine most people would rephrase to say «According to Jon, who ... ?».” I interpret MAS’s comment to mean that (42) is not strictly ungrammatical, but rather clunky, given that Basque has other ways of expressing the content of (42) without creating as long a dependency between the WH-word and its trace.

- (43) [[<sub>WH</sub>] CP<sub>2</sub>] CP<sub>Q</sub> CP<sub>1</sub> (PIED-PIPING WITH SECONDARY WH-MOVEMENT)  
*Nork irabaziko duela esan du Jonek uste*  
 who.ERG win.FUT AUX.COMP say AUX Jon think  
*duela Mikelek?*  
 AUX.COMP Mikel.ERG  
 ‘That who will win did Jon say Mikel thinks?’  
 (Hualde and Ortiz de Urbina, 2003, p. 493)

Third, the first embedded clause can be extracted, and then the WH-extraction can take place within the extracted clause. This structure is modeled with C<sub>1</sub>[<sub>WH</sub>\*] and C<sub>2</sub>[]. C<sub>2</sub> does not probe for [<sub>WH</sub>]. C<sub>1</sub> establishes Agree with *nor* ‘who,’ moves it to [Spec, CP<sub>1</sub>], and inherits its WH-feature. Thus, when the matrix C<sub>Q</sub> WH-probes into its c-command domain, the closest WH-bearing constituent it finds is CP<sub>1</sub>. The CP<sub>1</sub> moves to [Spec, CP<sub>Q</sub>] (44).

- (44) [[<sub>WH</sub>] CP<sub>1</sub> CP<sub>2</sub>] CP<sub>Q</sub> (EXTRACTION WITHIN PIED-PIPING)  
 [ [*Nor* C<sub>1</sub> *uste duela Mikelek* [ C<sub>2</sub> *etorri dela* ] ] C<sub>Q</sub>  
 who think AUX.COMP Mikel.ERG come AUX.COMP  
*esan dute haiek?* ]  
 say AUX those  
 ‘Who did those say Mikel thinks has come?’

Fourth, CP<sub>2</sub> can also front to [Spec, CP<sub>1</sub>], with CP<sub>1</sub> then in turn fronting to [Spec, CP<sub>Q</sub>]. This results in a so-called roll-up. This structure is modeled with C<sub>1</sub>[<sub>WH</sub>\*] and C<sub>2</sub>[<sub>WH</sub>\*]. First, C<sub>2</sub> establishes Agree with *nor* ‘who,’ moves it to [Spec, CP<sub>2</sub>], and inherits its WH-feature. Then, C<sub>1</sub> establishes Agree with CP<sub>2</sub>, moves it to [Spec, CP<sub>1</sub>], and inherits its WH-feature. Thus, when the matrix C<sub>Q</sub> WH-probes into its c-command domain, the closest WH-bearing constituent it finds is CP<sub>1</sub>, which in turn has CP<sub>2</sub> in its specifier position. That CP<sub>1</sub> with CP<sub>2</sub> fronted inside of it moves to [Spec, CP<sub>Q</sub>] (45).

- (45) [[[<sub>WH</sub>] CP<sub>2</sub>] CP<sub>1</sub>] CP<sub>Q</sub> (SECONDARY PIED-PIPING OR ROLL-UP)  
 [*Nor etorri dela uste duela Mikelek*]  
 who come AUX.COMP think AUX.COMP Mikel.ERG  
*esan dute horiek?*  
 say AUX those.ERG  
 ‘Who did those say Mikel thinks has come?’  
 (Hualde and Ortiz de Urbina, 2003, p. 493)

In sum, the four outcomes of Basque WH-movement when the WH-word is doubly CP-embedded are captured by allowing either of the two subordi-

nate clause heads ( $C_1$  and  $C_2$ ) to have either of the two  $WH$ -probe values present in Basque ( $[\ ]$  and  $[\downarrow_{WH^*}]$ ). Table 2 summarizes the findings.<sup>11</sup>

$C_Q$	$C_1$	$C_2$	SURFACE STRUCTURE
$[\downarrow_{WH^*}]$	$[\ ]$	$[\ ]$	$[\text{WH}] CP_Q CP_1 CP_2$ (42)
$[\downarrow_{WH^*}]$	$[\ ]$	$[\downarrow_{WH^*}]$	$[[\text{WH}] CP_2] CP_Q CP_1$ (43)
$[\downarrow_{WH^*}]$	$[\downarrow_{WH^*}]$	$[\ ]$	$[[\text{WH}] CP_1 CP_2] CP_Q$ (44)
$[\downarrow_{WH^*}]$	$[\downarrow_{WH^*}]$	$[\downarrow_{WH^*}]$	$[[[\text{WH}] CP_2] CP_1] CP_Q$ (45)

Table 2: Surface structure of doubly-embedded interrogatives by featural specification of subordinate C-heads.

## 5.2 Challenges to Heck and Cable

Basque data is problematic for the accounts of pied-piping advanced by Heck (2004, 2008, 2009) and Cable (2007, 2010a,b). First, optionality is problematic for Heck, who sees pied-piping as a last-resort strategy.

The repair generalization is derived in Heck’s OT approach by making LOCALAGREE a violable constraint. Pied-piping structures will always incur more LOCALAGREE violations than  $WH$ -extraction but they might still be more harmonic than  $WH$ -extraction if  $WH$ -extraction violates higher-ranked constraints. Importantly, Heck predicts that pied-piping should take place *only* if  $WH$ -extraction is prohibited on independent grounds. Yet, we see that in Basque clausal pied-piping is optional, since  $WH$ -extraction is also possible—it is not a repair strategy.

Second, secondary movement in pied-piped clauses is problematic for Heck. Heck observes contrast between (46) and (47). In (46), the  $WH$ -phrase (DP, DegP) is spelled out at the edge of a phase (DP). In (47), the  $WH$ -phrase (DP) is not licensed at the edge of a phase (DP, CP).

- (46) a. *Horace claims to know*  $[\text{DP } \textit{whose}_{\text{DP}[\text{GEN}]} \textit{D}_{[\downarrow_{\text{GEN}]}]} \textit{sister}] \text{DP met Egbert}$ .
- b. *Egbert knows*  $[\text{DP } \textit{how hard}_{\text{DegP}[\text{DEG}]} \textit{a}_{\text{D}[\downarrow_{\text{DEG}]}} \textit{DegP problem}] \text{she solved DP}$ . (Heck, 2008, p. 222)
- (47) a. \**Horace claims to know*  $[\text{DP } \textit{who}_{\text{DP}} \textit{the}_{\text{D}} \textit{sister of DP}] \text{DP met Egbert}$ . (Heck, 2008, p. 217)

<sup>11</sup> While  $C_1$  and  $C_2$  can have either of the two  $WH$ -probe values ( $[\ ]$  and  $[\downarrow_{WH^*}]$ ), I assume that the matrix interrogative  $C_Q$ -head always comes with the probe  $[\downarrow_{WH^*}]$ . This is to say, movement to  $[\text{Spec}, CP_Q]$  is obligatory, as is definitional of a  $WH$ -fronting language.

b:\*?a book [<sub>CP</sub> which<sub>DP</sub> after<sub>C</sub> Egbert had read <sub>DP</sub> ] he fell asleep <sub>CP</sub>  
 (Heck, 2008, p. 218)

To capture the contrast, Heck proposes the PHASEEDGECONDITION (48).

- (48) PHASEEDGECONDITION, or: PEC  
 A WH-phrase  $\alpha$  can be spelled out at the edge of a phase P if and only if an Agree relation between the head of P and  $\alpha$  has been established.  
 (Heck, 2008, p. 218)

In (46a), D assigns [GEN] to its specifier. In (46b), the Agreement is established with respect to the DEG-feature. Thus, WH-phrase is licensed at the edge of a phase. In (47), no Agreement is established, so the WH-phrase cannot remain at the edge of the phase.

Assuming, as Heck does, that movement to the edge of a CP phase is not feature driven, i. e. C does not establish Agreement with respect to any feature with its specifier, secondary WH-movement is unexpected (Heck, 2008, p. 234).

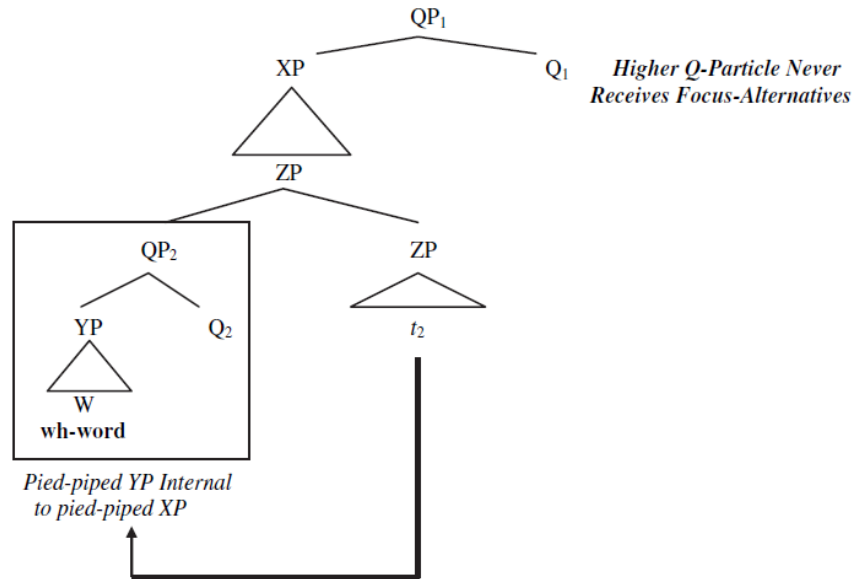
Finally, even if the first two problems were dealt with, roll-up structures will always incur more violations of LOCALAGREE than pied-piping with no roll-up. This is because in roll-up pied-piping there are more projections intervening between the C<sub>Q</sub>-head and the WH-word (49). This predicts that roll-up structures should be universally unattested, contrary to Basque data (cf. 45).

(49)	[ C <sub>Q</sub> ... [ C <sub>1</sub> ... [ C <sub>2</sub> ... WH ... ] ] ]:	LOCALAGREE
☞ i.	[ WH [CP <sub>2</sub> C <sub>2</sub> ... ] [CP <sub>Q</sub> C <sub>Q</sub> ... [ C <sub>1</sub> ... <sub>CP<sub>2</sub></sub> ] ] ]	*CP <sub>2</sub> , *CP <sub>Q</sub>
ii.	[ [ WH [CP <sub>2</sub> C <sub>2</sub> ... ] [CP <sub>1</sub> C <sub>1</sub> ... <sub>CP<sub>2</sub></sub> ] ] [ C <sub>Q</sub> ... <sub>CP<sub>1</sub></sub> ] ]	*CP <sub>2</sub> , *CP <sub>1</sub> , *CP <sub>Q</sub>

Cable (2007, 2010a,b) proposes that pied-piping is illusory; the WH-word does not pied-pipe anything, but rather it is the QP which contains the WH-word that moves. Thus, for secondary pied-piping to occur, there would have to be two Q-particles.

Structures with multiple Q-particles are ruled out on semantic grounds. The lower Q-particle closes off the focus alternatives of the WH-word, so the input to the higher Q-particle is not of the right semantic type. Thus, Cable categorically predicts absences of roll-ups (50), again contrary to Basque data (cf. 45).

## (50) IMPOSSIBILITY OF SECONDARY PIED-PIPING



(Cable, 2010a, p. 185)

## 6 CONCLUSION

In conclusion, I propose that pied-piping can be naturally captured in Béjar and Rezac's (2009) model of Cyclic Agree, which allows for "passing up" the *wh*-feature to higher projections. Thus, I formalize the notion of feature percolation using a mechanism which is independently motivated in the domain of  $\varphi$ -agreement. The current account avoids pitfalls of previous feature percolation approaches, and correctly predicts the interaction between the *wh*-feature and  $\varphi$ -features.

The account predicts that cross-linguistic variation in pied-piping and *wh*-fronting resides in featural specification of functional heads. I demonstrate that the prediction is borne out, as all combinations of functional heads P, C, and D with [], [ $\downarrow_{wh}$ ], and [ $\downarrow_{wh}^*$ ] are attested.

Finally, I show that the present account captures the variable outcomes of *wh*-movement out of deeply embedded clauses in Basque and discuss why competing accounts (Cable, 2007, 2010a,b; Heck, 2004, 2008, 2009) predict it to be impossible.

Recently, the notion of feature geometries originally motivated in the domain of  $\varphi$ -agreement (e. g. Béjar and Rezac, 2009; Deal, 2015, 2020) has been extended to account for phenomena related to  $\bar{A}$ -movement (e. g. Baier, 2018; Hedding, 2020). The current proposal extends Béjar and Rezac's (2009) model of Cyclic Agreement, also originally motivated for  $\varphi$ -agreement, to



the  $\bar{A}$ -domain. Thus, the current proposal contributes to the growing body of literature which capitalizes on the formal similarities between the  $\varphi$ - and  $\bar{A}$ -phenomena, further strengthening the connection between the two domains.

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## A APPENDIX

- (51) D[ ] Polish  
**Jaki** Paweł [<sub>VP</sub> **samochód** kupił swojej żonie \_\_\_\_]?  
 what Paweł car bought his wife  
 'What car did Paweł buy his wife?'  
 (Wiland, 2010; Urk, 2019, p. 23)
- (52) C[↓<sub>WH</sub>] Bangla  
 jOn [<sub>CP</sub> meri **kon** **boi-Ta** poRe-che], bollo ɿ?  
 John [ Mary which book-CLA read-has.3] said?  
 'Which book did John say Mary read?'  
 (Simpson and Bhattacharya, 2000, p. 590)
- (53) C[↓<sub>WH</sub>] Marathi  
 Mini-la [<sub>CP</sub> Lili-ni Ravi-la **kay** dila asa] vaTta  
 Mini-ACC Lili-ERG Ravi-ACC what gave COMP believes  
 'What does Mini believe Lili gave to Ravi?'  
 (Wali, 1988; Simpson and Bhattacharya, 2000, p. 591)

- (54) P[↓<sub>WH</sub>\*] Finnish
- a. Pekka käveli [pp kohti **puistoa**].  
 Pekka walked towards park.PAR  
 ‘Pekka walked towards the park.’
- b. [pp **Mitä** kohti] Pekka käveli?  
 what towards Pekka walked  
 ‘What did Pekka walk towards?’
- c. [pp **Mitä** yli] Pekka käveli?  
 what over Pekka walked  
 ‘What did Pekka walk over?’
- (Huhmarniemi, 2012, pp. 105, 115; Urk, 2019, p. 33)