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***Wh-which* relatives and the existence of pied-piping**

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This paper describes and offers an analysis of a kind of relative clause acceptable to some English speakers that we call a ***wh-which* relative**, e.g. *the snowmen whom (of) which the children loved*. We propose that these relatives involve the movement of a phrase headed by an element that we call R, analogous to the Q posited by Cable (2010a; 2010b) for interrogatives — the optional *of* in the example above being an overt form of a special variant of R. The syntax of this variant resembles particularly closely the variant of Q proposed by Coon (2009) for Ch’ol interrogatives in triggering movement to its specifier — but with a puzzle that has a parallel in Finnish, for which we propose a tentative solution. The analysis thus supports the overall explanatory landscape for pied-piping phenomena proposed by Cable, but presents a challenge to his broader claim that all pied-piping phenomena can be explained in this way. If correct, it provides yet one more instance of the “unity in diversity” of syntactic structures across the world’s languages.

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1 The phenomenon

This paper has both a descriptive and an analytical goal. First, we describe, perhaps for the first time, the properties of a kind of relative clause found in the English of some speakers (possibly limited to younger generations), which we will call a *wh-which* relative, exemplified by (1):

- (1) The snowmen **whom (of) which** the children loved went on a vacation to Hawaii.

We will argue for an analysis of this relative-clause type that bears on Cable’s (2010a; 2010b) proposed explanation for apparent pied-piping in *wh*-questions. Building on these proposals and Coon’s (2009) extension of them to Ch’ol (and some other Mayan languages), we propose an analysis of these English relative clauses almost identical to Cable’s and Coon’s proposals for *wh*-questions.

In particular, we argue that instances of apparent pied-piping seemingly motivated by the presence of a non-head relative *wh* word are actually mundane instances of movement of the maximal projection of a different element, which is the actual head of the moving constituent and the real reason for movement — just as Cable and Coon suggested for apparent pied-piping in *wh*-questions. But we will also suggest that this might not be the true characterization of all movements that appear to involve pied-piping, the exciting prospect that emerged from their work. We will suggest one analytic path that might eliminate the problem, but leave a fuller resolution of this puzzle open as a topic for future research.

One surprising property of the relative clause in (1) when compared with the more commonly described relative clauses characteristic of “Standard” or “Mainstream” English varieties (henceforth “non-*wh-which* English”), is, of course, the presence of a second *wh*-form *which*. We are not surprised by the presence of *who(m)* in a relative clause whose head is [+human] (including vacationing snowmen), but relative clauses in non-*wh-which* English introduced by *which* are otherwise generally limited to those that modify inanimate heads. We examine several variants of this construction below, not all of them introduced by *whom* — but they do all contain an instance of *which* seemingly doubling the more expected *wh-form*.¹

¹ We will not be drawing any connection to another kind of double-*wh* relative discussed by Kayne (2017: 366), pointed out to us by Gary Thoms:

- (i) That car over there belongs to my old friend John Smith, whose long-standing attachment to which is well-known to all his friends.

As Kayne notes, *which* here has a distinct antecedent from *whose*, which is not the case in examples like (1) (where there is no detectable external antecedent for *which*). Furthermore, the form *which* is used in (i) because *that car* is inanimate. If both antecedents are animate, both pronouns will of course be forms of *who* (to the extent that the construction is parsable and acceptable in the first place):

- (ii) ??That linguist over there was the dissertation advisor of my old friend Mary Smith, whose regard for whom is well-known to all her friends.

The optional presence of *of* also needs an explanation, of course. We will argue that its nature and properties hold the key to the construction as a whole. We will suggest that a phonologically null variant of this element is present in *wh-which* relatives even when *of* is not pronounced. We will therefore refer to it as R_{of} (which we will suggest is a variant of an R-element that heads the \bar{A} -moved phrase in non-*wh-which* English relative clauses as well), and will provide a generalization concerning the circumstances under which it may be overt. We will ultimately propose that what distinguishes R_{of} from other instances of English R is the fact that it triggers movement of a *wh*-headed phrase to its specifier (with *which* marking the original position of the moved element) — at which point the link to Cable’s and Coon’s proposals will be clear.

We have not formally investigated the distribution of *wh-which* relatives among English speakers. The construction seems perfectly natural to the first author of this paper, a speaker in her early 20s from Hawai’i, and to some but by no means all of her peers — but it is completely alien to the second author and to many other speakers. We have not been able to determine whether the construction is more prevalent among younger than among older speakers (though we suspect this is the case), nor have we discerned any particular geography to its distribution. The construction seems to be most prominent in casual discourse, and online attestations are easiest to find in social media posts and other texts of a similarly informal nature — but are not limited to such environments. Though we suspect most of these attestations are written by North American speakers, some appear to come from the UK and Ireland as well. In this connection, it is striking (and unfortunately not a property for which we will have an explanation) that the form *whom* is strongly preferred to *who*, despite the fact that *whom* is otherwise regarded as a more formal option than *who*.

Throughout this paper, we offer examples from online sources wherever we can — mainly because the very existence of this construction comes as a surprise to many speakers. (All internet citations have been verified on June 27, 2023.) Examples not credited to an online source reflect the judgments of the first author and four speakers that she consulted who accept examples like sentence (1).²

A sampling of relative clauses from online sources introduced by *whom of which* is given below, followed by examples introduced by *whom which* without overt R_{of} .

² These speakers were also asked to informally evaluate the online examples quoted in this paper, and in general found them acceptable. Three of these speakers volunteered simpler non-*wh-which* alternatives as preferable in a few cases, but with no apparent pattern or consistency across speakers as to which online examples prompted this response, so we do not report them here. No category of online example discussed here was uniformly (or even mostly) rejected by any consultant (except as noted). As always, a more formal and thorough study of judgments and usage might lead to revisions or clarifications of the generalizations stated in this paper, but we leave that for future research.

(2) **Whom of which relatives: online examples**

- a. God bless everyone **whom of which** has donated. (https://www.facebook.com/BayCountySO/posts/10154725235348516?comment_id=10154726715048516)
- b. Dave, Carter, Stefan, LeRoi, Boyd, and Tim are special people **whom of which** make special music together. (https://www.goodreads.com/review/show/4389105616?book_show_action=true)
- c. But they've been linked with a number of different targets over the last month, but seemingly instead spent the entire time trying to recall a player **whom of which** they sent on loan in the summer to a club and gave them an option to buy him as well. (<https://www.talkchelsea.net/opinions/chelsea-have-missed-reece-james-so-much-he-will-be-like-the-best-january-signing/>)
- d. The Daytona 500 in 2017 was very special as well as the 2014 Martinsville race where he chased down and held off Jimmie Johnson, **whom of which** was the defending series champion at the time (<https://twitter.com/frosteewolf/status/1581318772660797443>)
- e. One of my co-workers, **whom of which** I've never had a conversation with before, went out of his way to tell me how beautiful I was today. (https://twitter.com/areola_grande/status/1524193451553742849)
- f. During your discussion, you guys emphasized the detriment of being a bastard in GOT. Aegon the Conqueror was based on William the Conqueror, **whom of which** was a bastard. (<https://twitter.com/sonofmeroe/status/1580193010511273984>)
- g. Our 7th figure in the set is one of the show's main reoccurring characters, **whom of which** we all love to hate. (<https://www.brickbanter.com/post/review-lego-creator-expert-10292-friends-apartment-the-one-with-all-the-references>)

(3) **Whom which relatives (no of): online examples**

- a. You get desperate, then you lower your standards by asking the guy **whom which** you turned down 3 times that night to dance. (<https://www.angelfire.com/electronic/icyrthong/other/asianparty.html>)
- b. Oh, that's me **whom which** you're looking for; let's have a chat in DM! (https://twitter.com/jenifer_rose01/status/1582855951748542464)
- c. Don cherished being around people and he never met a person **whom which** he would not engage in a conversation. (<https://www.dignitymemorial.com/obituaries/paoli-pa/donald-keyser-7603051>)
- d. Our board is largely comprised of intelligent, driven women **whom which** we are lucky to work with! (<https://twitter.com/serveuphopeorg/status/1369075605770223616>)
- e. Just my two cents as a teacher **whom which** parents from time to time ask about videogames. (<https://www.reddit.com/r/Switch/comments/dzu95q/comment/f8axqnl/>)
- f. Give my regards to Tiff Macklem of the Bank of Canada as well **whom which** I also am extremely displeased with (<https://twitter.com/syntheticpol/status/1582248856863272960>)

- g. But presidential candidate Donald Trump would rather Kelly, **whom which** the frontrunner has attacked, stay home for the debate. (<https://www.mic.com/articles/133404/fox-news-republican-debate-2016-early-preview-for-thursday-night-debate>)
- h. Instead of a typical one-size-fits-all approach offered at many schools, we offer the unique experience of having incredibly small class sizes and a tailor-made education. While this benefits students of all abilities, it is especially helpful for a gifted student, **whom which** may require a deeper level of understanding to fully prosper (<https://tenneyschool.com/the-gifted-student-how-we-foster-exceptional-growth-in-exceptional-students/>)

That *wh-which* relatives are not slips or typing errors is suggested not only by the speakers' intuitions that we report, but also by several prescriptivist websites on which readers have asked about the propriety of *whom of which* relatives (and are uniformly advised to spurn the construction as non-standard and redundant). For example:

"I recently encountered this expression and I'm pretty much stumped. People seem to be using it in place of 'who'. Example:

[...] they were developed by non-medical professionals whom of which have applied their skills to help solve a health care / medical problem they had faced.

"Another example:

As well as Dave, special thanks goes to the 'Girls in Pink' for providing a high service throughout the whole day, as well as club chairman, Bob Thomsett and Chrissie whom of which manned the kitchen which was busy all day.

"I can't quite wrap my head around the expression, but I figured it might be one of the many idiosyncrasies of the English language. Is this a valid expression or some newfangled bastardisation?"

(<https://english.stackexchange.com/questions/106180/whom-of-which-a-valid-expression>)

Some typical responses:

"No, it is not a valid expression. It's simply bad English"

"They're wrong. Who is all you need and what you want. And there's more wrong with those sentences besides 'whom of which'"

"I'm voting to close this question as off-topic because it is based on a grammatical mistake and no definitive answer could be made."

A similar extended discussion of the construction can be found at <https://www.usingenglish.com/forum/threads/using-whom-of-which.159982>. The website *Grammarhow*, which describes

itself as “on a mission to help you become better at English”, devotes an entire page to this construction — followed by multiple examples of appropriate substitutions for it.

“In English, there can be plenty of times when new words or phrases seem to be created as idiosyncrasies. Phrases such as “whom of which” seem to develop over time, even though they don’t make all that much sense. This article will explore whether it works grammatically.

“Is ‘Whom of Which’ Correct?”

“‘Whom of which’ is never grammatically correct. It never makes sense to write this phrase as it is a long-winded version of the simple ‘who.’

“There is never a situation where ‘whom of which’ makes sense. It’s not something that you should be comfortable with using. Most native speakers will look at it and think it sounds bizarre.

The only time that people seem to use it is when they’re trying to be overly wordy. They might use it when they feel like they need to ‘pad out’ the word count in their writing. Even in these cases, ‘whom of which’ is never correct.”

(<https://web.archive.org/web/20221219114332/https://grammarhow.com/whom-of-which/>)

There is of course no better sign that a syntactic construction forms part of the real grammar of real speakers than prescriptivists protesting against its use.

Apart from the contents of its left periphery, the syntax of *wh-which* relatives is that of non-*wh-which* relative clauses, involving \bar{A} -movement from within the relative clause. For example, this movement may cross a clause boundary, but obeys islands, as shown in (4); and can license a parasitic gap, as shown in (5):

(4) **Obedience to islands**

- a. ✓ The person whom (of) which Sue believes that we should visit __ is on the phone.
- b. *The person whom (of) which I met [the snowman that talked to __] is my friend
- c. *The children whom (of) which Santa asked [why I gave a present to __] had a very merry Christmas.
- d. *The linguist whom (of) which [an article by __] impressed that snowman is visiting our department.

(5) **Licensing of parasitic gaps**

The reindeer whom (of) which Donner gave a carrot to __ after sledding with __ is a fine animal.

As examples throughout this paper demonstrate, the construction is available in both restrictive and non-restrictive relatives, as well as relative clauses with a variety of modified heads — definite, indefinite, quantificational, and pronominal. Throughout our investigation of this construction, we have come across a general feeling on the part of speakers that the restrictive relatives are somehow “more restrictive” than their non-*wh-which* counterparts, but we have not been able to make this feeling precise — and the use of the construction in non-restrictive contexts makes it clear that there is no restrictivity requirement imposed by the construction.

We will thus assume, possibly wrongly, that *wh-which* relatives are interpreted semantically just like their non-*wh-which* English counterparts. This favors analyses in which the main differences between the two types of relative clauses can be shown to be purely syntactic in nature, ideally invoking parameters of variation familiar from other puzzles with a similar character. Our proposal will have that property.

Turning now to the left periphery of the construction, we note first that a *whom-(of)-which* relative can only modify a [+human] nominal, just like non-*wh-which* English *who*-relatives. If the head is inanimate, one might expect a *which-(of)-which* relative to be possible. These are rejected by the speakers we consulted, possibly to avoid repetition — but online attestations, though seemingly rare, do occur:³

(6) **Which of which relatives: online examples**

- a. He’s an excellent governor, with none of the Trump baggage **which of which** Trump did on his own (<https://twitter.com/kurtfisher18333/status/1581853032807272448>)
- b. I don’t know if I would 100% agree with that the one thing Obama did successfully was marry John McCain (rightly or wrongly) to George Bush’s wars **which of which** had grown unpopular by then especially Iraq which Obama essentially ran on ending in favor of focusing on Afghanistan (<https://twitter.com/jch6289/status/1572999060142841857?s=61&t=ppYz-7H2VFVOvh6mioUq6Q>)
- c. I recall numerous very boring family lunches in the 1990s which would be enlivened by bar staff being asked for Dubonnet, a drink **which of which** few had heard of and which even fewer kept in stock. (<https://twitter.com/drcharlielynch/status/1571178231813885953>)

Where and *when* are also possible as the initial *wh*-form in a *wh-which* relative. Speakers may feel slightly less comfortable with these than with examples whose first element is *whom*, and attestations seem to be correspondingly sparser:

³ We do not present online examples that lack overt R_{of} since occurrences of *which which* (also attested) might well be typing errors (a possibility we cannot exclude, of course, for the rare examples cited in (6) as well, as a reviewer notes). See also footnote 20 below for other examples of inanimate heads with *wh-which* relatives.

(7) **Where/when (of) which relatives: online examples**

- a. Since termination of any innocent person at any point of their life is clearly immoral and always should be prohibited under the law in any civilised country, there has to be a clear temporal point **where of which** the law recognises the start of such a life. (<https://twitter.com/max43833673/status/1542638408631259142>)
- b. My experience was very seamless - but it was through St. Luke's, **where of which** I was already a pre-established patient through my primary care doc. (<https://twitter.com/kaileyholt14/status/1279991484368867329>)
- c. Listen Chaps, some of us live in apartments with toilets that simply aren't made for bidet attachments so we carry the bidet box from apartment to apartment hoping we finally moved into a place **where which** we can properly clean our butts! (<https://twitter.com/ughcmomn/status/1458299240292175873>)
- d. Applications are taken at any time and you will be told of the next available unit at the time **when which** you apply. (<https://www.methodisthealth.org/articles/applying-for-cpe>)
- e. three of the top use cases are sales-centric, showing that those adopting AI are doing so to grow their business significantly and with a strong focus on customers and sales, at a time **when which** the economy is struggling. (<https://techunwrapped.com/investment-in-systems-based-on-artificial-intelligence-will-exceed-300000-million-in-2026/>)

2 More than just which: towards an analysis

Since the transformation of a *wh*-word into a complementizer is a well-known diachronic path (Heine & Kuteva 2007: 242–244; Kuteva et al. 2019: 354–355), one might wonder whether *which* is a complementizer in the variant of the construction lacking overt R_{of} , in which case *whom* could be viewed as a specifier of CP in a “doubly-filled COMP” configuration.⁴ This proposal makes it hard to find a place for R_{of} in the variant that includes it, however, and runs afoul of constituency evidence from coordination that we present in section 5. While this introductory section might be the optimal place to present that evidence, creation of the relevant examples will require us to exploit certain resources of the construction that we are not yet in a position to introduce.

⁴ A precedent for this alternative could be found in German dialects in which relative clauses can be introduced by a relative pronoun followed by an invariant neuter *wh*-form otherwise translatable as ‘what’ (Wiltschko 2013; Janebová et al. 2022):

[...] dea Briaftroga [**dea wos** bei uns austrogn hot] is jetzt in Pension
 DET_F mailman REL.PRO COMP at us delivered has is now in retirement
 ‘the mailman who delivered in our neighborhood is now retired’

(“Austro-Bavarian German”; Wiltschko 2013: 159, ex. 4)

In these constructions, however, the *wos* component cannot, as far as we know, be replaced with a *wh*-phrase, making its analysis as a complementizer plausible — in contrast to *which* in the English examples discussed below in this section. We are grateful to Martina Wiltschko and Dalina Kallulli for bringing this construction to our attention.

We argue instead for a different proposal, according to which the sequence *wh-(of)-which* seen in the examples presented above forms a constituent \bar{A} -moved in its entirety to the specifier of CP by the same process familiar from non-*wh-which* English relative clauses like *the person who you met*. We propose an internal structure for this constituent like that seen in (8) in which “*wh*” occupies a specifier position internal to the moved constituent and R_{of} is the constituent’s head (in the examples seen so far). The reason we have surrounded both “*wh*” and “*which*” with sets of three dots will become clear as we proceed.

(8) [[...*wh*...] [R_{of} [...*which*...]]]

In the non-*wh-which* English counterparts of all the examples seen so far, what is relativized would be a single word, e.g. *the snowmen who(m) the children loved* (though of course more complex analyses of words like *where* are imaginable). When a phrasal PP is relativized — a case where non-*wh-which* English appears to show pied-piping (e.g. *the person with whom you disagree*) — one of the outcomes for speakers who command the *wh-which* construction sandwiches the preposition between the initial *wh* and *which*, as seen in (9) and (10) below.⁵

(9) **PP pied-piping → preposition between *whom* and *which*: online examples**

- a. It must be nice to be able to silence those **whom with which** you disagree. (<https://twitter.com/hvacjdub/status/1468656565431451655>)
- b. [...] it struck me that my idea of heaven would be having a friend **whom with which** I could sing Falling In Reverse lyrics out loud down the street (<https://twitter.com/fulconafterdark/status/1445015294884384772>)
- c. It’s wild. There isn’t a celebrity out there **whom to which** I would devote that much advocacy. (https://twitter.com/alan_smithee_jr/status/1517550584743841793)
- d. Your family is not only those **whom to which** you are related by blood but those you love and choose to celebrate life. (https://twitter.com/ryan_iori/status/1342519660676321280?)
- e. I also have a little brother, someone **whom without which** I would have never had a villain to star in my movies growing up (true story). (<https://www.lorenaparkour.com/bio>)
- f. Thanks to all our attendees and presenters **whom without which**, none of this would happen (<https://inog.net>)

⁵ There appear to be no restrictions on the kinds of prepositions that may be sandwiched in this fashion. This fact argues against a connection with the inversion of prepositions with *wh* elements in the construction first discussed by Ross (1969), dubbed “Swiping” by Merchant (2001: 64), e.g. *I know Mary is traveling with someone, but I don’t know who with*. Swiping is limited to “light” prepositions (e.g. *with*, but not *without*; cf. (9f)). It also must cooccur with the Sluicing variety of ellipsis, not a characteristic of the *wh-which* construction — and is limited to bare *wh*-words, also not a property of this construction, as we shall see in section 4 (cf. (23)). Furthermore, while *wh-which* relatives show the mysterious preference for *whom* over *who* that we mentioned above, Swiping shows the opposite pattern (\checkmark *who with?* / \ast *whom with?*), as observed by Lasnik & Sobin (2000: 346 ex. (5h)).

- g. Funny how the people **whom for which** this law was meant won't be affected by it. (https://twitter.com/otherthan_jay/status/1532680990170263552)
 - h. The students that have been affected and will continue to suffer are those on the academic bubble. Those **whom for which** this is a critical make or break time in their education. (<https://www.pgfreepress.com/the-bctf-is-getting-warmer-2/>)
 - i. This protects trustees against beneficiaries **whom of which** they have no knowledge.⁶ (<https://www.chegg.com/flashcards/trusts-and-equity-three-certainties-and-secret-trust-c0eb07aa-7acd-4444-b238-59fb641e9a3c/deck>)
- (10) **PP pied-piping** → **preposition between *where/when* and *which*: online examples⁷**
- a. Part of a separate series of GEICO commercials **where in which** actor Mike McGlone walks into an empty room and asks a rhetorical and/or obvious question. (https://en.wikipedia.org/wiki/GEICO_Cavemen, accessed: 10/29/2022)
 - b. Saying this in response to a tweet **where in which** Jeremy is defending a Jewish man is comical. (<https://twitter.com/alfkebab/status/1585577278347558912>)
 - c. Any area **where to which** a person has legal standing to admit or decline admittance < sic > to another person is considered a “dwelling” under Castle. (<https://twitter.com/stevebooth13/status/1585668136170315776>)
 - d. Everyone should have a place **where to which** they can return and feel at home. (<https://erinalmond.com/tag/north-carolina/>)
 - e. I can't remember when I realized I wasn't going to have a normal life. There had to have been some point, I'm sure, a moment in time **when before which**, I was certain I'd get a teaching degree, fall in love, get married, churn out a couple of kids, house in a nice neighborhood, barbecues, newspaper subscription, all of that [...] (<https://www.avclub.com/the-x-files-dreamland-millennium-closure-1798173250>)
 - f. Pick a time of day **when after which** you'll no longer accept a business call. (<https://twitter.com/chicsoo9/status/1520206554791923713>)
 - g. Watch the movie “Charlie Wilson's War” starring Tom Hanks. It's about the time we used Afghanistan to fight our Cold War with russia. You know, the time **when during which** we trained Bin Laden (<https://twitter.com/familiaseneriz/status/1519385737174597634?>)

The presence of a preposition between *wh* and *which* as in (9) and (10) blocks the presence of overt R_{of} :

- (11) a. *those **whom with of which** you disagree...
 b. *those **whom of with which** you disagree...

⁶ Note that *of* in this example is the preposition required by *knowledge*.

⁷ Because of potential synonymy between the *wh*-words and PPs used in these examples and the limited number of prepositions that could take *when* and *where* as complements, it is more possible here than elsewhere that some of these examples may be typing errors.

This fact might seem to suggest that a preposition sandwiched between *wh* and *which* occupies the same position as that occupied by R_{of} . Note, however, that these sandwiched prepositions head PPs that are all licensed in the clause-internal position from which relativizing \bar{A} -movement was launched. In this respect they contrast with R_{of} , which is not licensed in the clause-internal relativized position (e.g. *the children loved (*of) the snowmen.*) This fact already militates against the proposal that R_{of} occupies the same position as the sandwiched prepositions of (9) and (10).

We propose instead that the sandwiched prepositions in (9) and (10) are heads of a PP complement of the position occupied by R_{of} , and that the obligatory silencing of R_{of} should be explained in some other way (to which we turn below). We thus propose a structure like (12) below (with P thus belonging to the three dots preceding *which* in (8)):

(12) $[RP_{of} [\dots wh \dots] [R_{of} [_{PP} P \textit{ which}]]]$

In fact, a PP containing *which* as a subconstituent is not the only kind of full phrase that can occupy the position we are identifying as the complement of silent R_{of} . A nominal containing *which* as a subconstituent can also occur in this position:⁸

(13) **Which as proper subpart of larger nominal following whom: online examples**

- a. College is weird. You pack up your stuff and move away from your parents for the first time ever. You move into a place with 60,000 other students **whom none of which** you know, leaving the group of friends you have spent 12 years with. (<https://u.osu.edu/trimble93hseportfolio/category/yearinreview/>)
- b. I am 14 years old and have had a crush on a boy (and if it really matters I'm female) since I met him, however because he was surrounded by my friends **whom several of which** he dated (we were kids so I don't think it counts as a red flag cause we were trying to figure ourselves out) [...] (https://www.reddit.com/r/Advice/comments/xuj534/how_can_i_get_over_someone_i_have_liked_for_two/)
- c. Oh look how I will conveniently stand by the window talking to children **whom a couple of which** I've never met in order to get my mug on the news. (https://twitter.com/julzd_martin/status/1532643591578914816)
- d. We don't have a single top of the rotation pitcher currently starting for the Royals. The GM has been here for 15 years. This isn't a comment solely on the pitching draft class of 2018, **whom some of which** we are seeing get chances at the MLB level. (https://twitter.com/upton_4/status/1409552955230101509?s=61&t=J2ISJ6gM-QnGRMHwHEntnA)
- e. How the heck do y'all make friends on here like I've been on here since 2017 and I made like 5 friends, **whom none of which** I still talk to. (https://twitter.com/pjm_delight/status/1097686681048805376)

⁸ Though we have not found online examples, the two phenomena just discussed may be combined, so that *which* is contained within a larger nominal that is itself the object of a preposition: e.g. *the person whom about pictures of which we were talking.*

- f. Their warrior caste include the fearsome barbarians **whom stories about which** are told to scare children. (<https://trolllord.com/forums/viewtopic.php?t=4604>)
- g. “All I think about is you” she said to three men **whom two of which** could literally be her father because of their age and also don’t know she exists (<https://twitter.com/mythicalllamaxo/status/1512549060363767808>)
- h. I truly can’t say enough nice things about this place. It’s the staff that make it for me, my husband and our best friend **whom all of which** have become regulars! (<https://www.yelp.com/biz/island-girl-cigar-bar-ponte-vedra-beach>)
- i. As far as I am aware GRRM said that he will not be introducing new POV characters in the next book. So we have an existing pool of POVs, **whom some of which**, will most likely die at some point in the next book. (https://www.reddit.com/r/asoiaf/comments/7emnj1/spoilers_extended_who_will_be_the_first_pov/)

Strikingly, overt *of* is disallowed in such examples as well.⁹ A variant of (13f) with *of*, for example (e.g. **barbarians whom of stories about which are told to scare children*) is not acceptable, and we have not found online examples with this configuration. This fact supports our view that the complementary distribution of overt *of* and the boldfaced prepositions seen in (9) and (10) is not a sign that they occupy the same position. Instead, we propose the following rule governing the pronunciation of R_{of} :

(14) **Overttness of R_{of}**

R_{of} is optionally realized as *of* when its complement is bare *which*, and is null otherwise.

3 Proposal

There is a simple way to convert any *wh-which* relative clause into a non-*wh-which* relative clause: replace *which* with the element we have been calling *wh*, replace *whom* with *who* as appropriate, and do not pronounce R_{of} . This procedure will convert *the snowmen whom (of) which*

⁹ Because of the absence of *of* in attested examples of this type, it is conceivable that in (13f–i) only *whom* has raised to spec,CP, and the phrase containing *which* is occupying the subject position — in which case we would be dealing with a different puzzle entirely. The examples in (13a–e), however, involve relativization of a position lower than the highest subject of the relative clause, and are thus immune to analysis of that type. In addition, as Guglielmo Cinque (personal communication) reminds us, such an analysis would entail a violation of the Subject Condition, banning subextraction from subjects in languages like English. Note finally that the mysterious use of *whom* characteristic of *wh-which* relatives is found in these examples, another reason to be suspicious of the alternative analysis in which only *who* has undergone \bar{A} -movement in (13f–i). Some subject extraction attestations do contain *who*, however:

- (i) The majority of the experimental group believed the actions within the scenario were legal, but at the same time they also identified the actions to be more immoral than the control group, **who the majority of which** found the actions to be illegal. (<https://epublications.regis.edu/cgi/viewcontent.cgi?article=1853&context=theses>)
- (ii) When three New Yorkers, **who all of which** used to make a steady living in stage production, found themselves with some extra time on their hands, they decided to craft a blend of metal, thrash, and doom to form High Strange. (<https://www.noecho.net/features/high-strange-metal-band>)

the children loved into the snowmen who the children loved; those whom with which you disagree into those with whom you disagree; and barbarians whom stories about which are told to scare children into barbarians stories about whom are told to scare children. In this fact, we suggest, may lie the key to the correct analysis of the *wh-which* construction: the initial *wh* originates in the position of *which*, and reaches its surface position by movement to the specifier of R_{of} . Our preliminary proposal for the analysis of a *wh-which* relative is thus the following:¹⁰

(15) **Preliminary proposal**

1. **inside RP_{of} :**

- (a) R_{of} contains a probe that searches for a constituent bearing [+*wh*], triggering movement of the maximal projection of its goal to Spec, RP_{of} (with a complication discussed below).
- (b) *Which* marks the original position of the phrase moved to Spec, RP_{of} .
- (c.) The pronunciation of R_{of} is governed by (14).

2. **at the CP-level:**

- C contains a probe that searches for a constituent headed by R_{of} , triggering \bar{A} -movement of the entire RP_{of} to Spec,CP.

In the simplest examples with which this paper began, the complement of R_{of} moves within RP_{of} to form its specifier, and the entire RP raises to spec,CP, as shown in (16a).¹¹ Examples like those in (9) and (10) involve preposition-stranding subextraction of a *wh* element to form a specifier of RP, as shown in (16b). Examples like those in (13) involve comparable subextraction of *wh* from a nominal, as shown in (16c):

¹⁰ There are of course multiple proposals for the overall syntax of relative clauses, including those that posit raising of the modified NP from within the relative clause (as proposed by Brame 1968; Vergnaud 1974; Schachter 1973 and many others since; cf. Bhatt 2002: 44). We do not explore these variants here, making the (possibly wrong) assumption that the fundamentals of our analysis can remain intact in the face of a fairly wide variety of different views about the details of relative clause formation. For example, head-raising analyses can easily be made compatible with our proposal, with the *wh*-head constituent undergoing the movement described here as a property of *wh* alone. We might then ask if the mysterious *which* of the *wh-which* construction might be a functional element that selects a *wh*-head pair (Kayne 2008) as a complement — its shape possibly reflecting *wh*-agreement with the *wh* in its complement — and is stranded by movement of that pair to the specifier of RP_{of} .

We should also note that, if it should turn out that the \bar{A} -movement characteristic of English relative clauses targets a position different from the specifier of CP (Rizzi 1997), nothing important is likely to need changing in our proposal.

¹¹ This movement is string-vacuous if R_{of} is unpronounced, suggesting that the overttness of R_{of} might be limited to environments in which it causes movement to have a phonological effect (cf. George 1980 and Chomsky 1986: 48–54). It also violates the “anti-locality” condition proposed by Abels (2003) (and developed in much subsequent work) that bans movement from complement to specifier position of the same head. If Abels’ proposal is correct, an alternative to our proposal might view *of* in *wh-which* relatives, not as R_{of} itself, but rather as a “spacer” inserted between R_{of} and what would otherwise be its complement precisely in those circumstances where it is necessary, in order to avoid an anti-locality condition. This would explain why it is disallowed except in the environment specified in (14), i.e. why it is never found in cases where the specifier of R_{of} is formed by subextraction from its complement. The optional overttness of *of* would remain a puzzle, however.

(16) **Sample analyses of *wh-which* relatives**

- a. ...the snowmen [CP: [RP **whom** R_{of} *which*] | C the children loved — ... cf. (1)
- b. ...those [CP: [RP **whom** R_{of} [PP with *which*]] | C you disagree — ... cf. (9a)
- c. ...students [CP: [RP **whom** R_{of} [DP none of *which*]] | C you know — ... cf. (13a)
-

If this analysis of *wh-which* relatives is correct, what looks like *wh*-movement in a *wh-which* relative —i.e. movement triggered by a [+*wh*]-probe on C — is actually RP_{of} movement. The fact that R_{of} is sometimes silent but (silent or not) requires a *wh* creates the illusion that it is C that needs [+*wh*] — but the relationship is actually indirect: C interacts with RP_{of} and R_{of} interacts with *wh*. This analysis can immediately be extended to non-*wh-which* English relatives like *the snowmen who the children love* that lack the distinctive properties of *wh-which* relatives, if these involve RP movement as well. All that is necessary is to posit a distinct flavor of R for these relatives that does not trigger movement of its *wh* goal (unlike R_{of}) and is always silent.¹²

An attractive feature of this proposal, we believe, is its extreme *unoriginality*. It is in fact a faithful analogue for relativization of Cable's (2010a; 2010b) theory of pied-piping phenomena in *wh*-questions.¹³ Our proposal is especially close to Coon's (2009) analysis of the syntax of questions in the Mayan language Ch'ol that built on Cable's work.

Following work by Hagstrom (1998) and others on similar phenomena in other languages, Cable observed what looks like interrogative *wh*-movement in Tlingit always includes a particle *sá* at the right periphery of the phrase that undergoes \bar{A} -movement to C, a particle that he assigned to the category Q. Since Tlingit is head-final in all syntactic categories, Cable concluded that *sá* is the head of the moved constituent. Consequently, what interrogative C probes for is Q, and what it causes to move is its maximal projection QP. Internal to QP, Tlingit Q in turn requires the presence of a *wh* element within its complement, just as we have suggested for R_{of} internal to RP_{of}. When a question involves what has traditionally been viewed as pied-piping, Tlingit makes

¹² Or perhaps the *which* mentioned in the pronunciation rule (14) must be a *which* that marks the position from which movement took place, in which case the fact that R in non-*wh-which* English relatives must be silent follows directly from the fact that it does not trigger movement of *wh*, unlike its *wh-which* counterpart.

¹³ Cable himself briefly sketched an extension of his analysis to non-*wh-which* English relative clauses in his concluding chapter (Cable 2010a: 202).

clear that we are simply observing a situation in which Q has merged with a constituent larger than the *wh*-word itself, and what moves is QP:¹⁴

(17) **Pied-piping as movement of QP in Tlingit**

- a. Aadóo yaagú sá ysiteen?
 who boat Q you.saw.it
 ‘Whose boat did you see?’
- b. Aadóo teen sá yeegoot?
 who with Q you.went
 ‘Who did you go with?’
- c. Daakw keitl sá asháa?
 which dog Q it.barks
 ‘Which dog is barking?’

(Cable 2010b: 8 ex. (11))

When an island boundary separates the *wh*-element from interrogative C in Tlingit, *sá* must follow the entire island. Certain locality conditions also hold between *sá* and the *wh* that it is looking for.

Cable argued that Tlingit holds the key to the proper analysis of interrogative \bar{A} -movement and pied-piping cross-linguistically. In a language like English, in which we see no overt Q in *wh*-questions, Cable proposed, Q is still present but phonologically null — and its interaction with *wh* can still be detected in locality conditions that limit the syntactic distance between the *wh*-word and the edge of the constituent that \bar{A} -moves.

Coon used Cable’s proposal to explain a puzzling pattern of pied-piping phenomena in Ch’ol (earlier explored in the closely related language Tzotil by Aissen 1996). Unlike Tlingit, but like English, Ch’ol does not display an overt Q-morpheme at the edge of the phrase that \bar{A} -moves in *wh*-questions. However, the *wh*-word of the phrase obligatorily occupies its left-periphery. Thus, though a non-*wh* possessor always follows the possessum in Ch’ol, as seen in (18) —

(18) **Possessum-possessor order in non-*wh* nominal (Ch’ol)**

- Tyi yajl-i [i-plato [i-ts’in’ aj-Maria]].
 PRFV fall-ITV A3-plate A3-dog CL-Maria
 ‘Maria’s dog’s plate fell.’

(Coon 2009: 168, ex. (5))

— a *wh*-possessor will always be found to the left of the possessum, with the options seen in (19a-c), which also displays Coon’s analysis. As our diagrams show, Coon proposed that this pattern is a consequence of a null Q like that posited by Cable for English questions, but with a twist:

¹⁴ Other research since Cable has provided support for this proposal from other languages. Sulemana (2017), for example, notes that in Bùlì a head-initial Mabia (Gur) language of Ghana, an overt morpheme *ka* obligatorily introduces any in situ *wh*-expression that undergoes covert movement — as diagnosed by island effects and the absence of intervention effects. On an overtly moved interrogative phrase, it is optionally overt in the first place.

the *wh*-probe on Ch’ol Q (unlike English and Tlingit Q) triggers movement of its *wh*-goal to its specifier. In a structure with possessor recursion and a *wh*-element as the innermost possessor, the size of the constituent that moves to spec,CP is determined by how high Q attached within the nominal. Wherever Q attaches, it attracts the *wh*-element to its specifier. As a consequence, the \bar{A} -moved interrogative phrase comes in a variety of sizes, depending on how big a constituent Q merged with — but its leftmost element is always the *wh*-word, as illustrated in the examples of (19), where the arrow marks the movement of *who* to form a specifier of Q, and the QP as a whole has moved to the specifier of CP from the trace position indicated with t_{QP} .¹⁵

(19) **Possessor-possessum order in *wh* nominal: *wh*-movement to Q followed by QP movement to C (Ch’ol)**

a. **Q merged with ‘[who]’**

[_{QP} **Maxki** [Q —]] C tyi yajl-i [i-plato [i-ts’i’ t_{QP}]]?
 who PRFV fall-ITV A3-plate A3-dog

‘Whose dog’s plate fell?’

b. **Q merged with ‘[dog of who]’**

[_{QP} **Maxki** [Q [_{NP} **i-ts’i’** —]]] C tyi yajl-i [i-plato t_{QP}]?
 who A3-dog PRFV fall-ITV A3-plate

‘Whose dog’s plate fell?’

c. **Q merged with ‘[plate of [dog of who]]’**

[_{QP} **Maxki** [Q [_{NP} **i-plato** [_{NP} **i-ts’i’** —]]]] C tyi yajl-i [t_{QP}] ?
 who A3-plate A3-dog PRFV fall-ITV

‘Whose dog’s plate fell?’

(Coon 2009: 168, ex. (7))

Our analysis of *wh-which* relatives thus proposes a head in relative clauses that plays a syntactic role analogous to that played by Q in Cable and Coon’s proposals — which is why with malice aforethought we have called the head found in *wh-which* relatives R_{of} (R being the letter after Q, as well as the first letter of “relative”), and treat R_{of} as an instance of R. Like English and

¹⁵ Cable (pp. 181 ff.) proposes a variant of Coon’s analysis according to which it is not Q itself that attracts *wh* to its specifier, but the D heading Q’s complement in examples like those discussed. This analysis parallels Cable’s similar analysis of English constructions like *How big a boat did he buy?*, in which a special version of the indefinite article with a *wh*-feature is responsible for the fronting of the *wh* Degree phrase *how big* (and this fronting in turn is made obligatory *de facto* by locality conditions on the permissible distance between Q and *wh* within QP). Placing the blame for QP-internal fronting in this construction on D rather than on Q itself has the advantage (noted by Cable, p. 179) of localizing the fronting requirement to phrases containing the special *wh*-attracting indefinite article — but its consequences seem otherwise indistinguishable for both English and Ch’ol from the alternative that posits Q itself as the element attracting *wh*. If we are correct in identifying *of* in English *wh-which* relatives as the relative-clause counterpart of Q, however, we cannot adapt Cable’s alternative here. We are grateful to an anonymous reviewer for drawing our attention to these questions.

Ch’ol Q but unlike Tlingit Q, English R can be silent — but like Tlingit Q, it can also be overt for speakers whose grammar permits *wh-which* relatives. Like Ch’ol Q but unlike English and Tlingit Q, English R triggers movement of a *wh* element in the domain that it c-commands.

It is also a general cross-linguistic fact about the QP proposed by Cable for questions — and equally well must be a fact about RP in relative clauses under the analysis developed here — that in all of its non- \bar{A} -positions, its external syntax is identical to the external syntax of the complement of its head. If R_{of} or Q merges with a DP, for example, the resulting RP_{of} or QP behaves as a nominal behaves — satisfying selectional requirements that only a DP can otherwise satisfy, triggering agreement as a DP does, and undergoing A-movement as if the Q or R_{of} that merged with it were not there. Likewise, if R_{of} or Q merges with a PP, the external syntax of its maximal projection below the CP level is identical to the syntax of that PP. Though Cable (2010b: 62 ff.) attributes this phenomenon in the case of QP to the semantic type transparency of Q, we will assume that QP and RP are syntactically transparent as well, inheriting syntactic features from the complements of their heads as well as from the head itself, exemplifying Grimshaw’s (2000; 2005) notion of “Extended Projection” (as proposed for Q and other similar particles by Branan & Erlewine to appear: section 4.2).¹⁶ We will continue to notate phrases headed by R and Q as “RP” and “QP” in this paper for the sake of brevity — assuming throughout, however, that the features of their complement also form part of the labels of these phrases — so that an RP whose head takes a DP or PP as its complement, for example, also bears the features of that DP or PP.

The only actual novelty of *wh-which* relatives that we have seen so far besides the pronunciation condition in (14) is the fact that the original position of the *wh*-element is obligatorily marked by an overt element *which* rather than a gap. Crucially, the relation between *which* and the *wh*-element in the specifier of RP_{of} obeys islands — a fact that strongly argues for the movement that we are proposing, but also suggests that *which* is not a resumptive pronoun (which one might expect to ameliorate island violations), but perhaps a syntactic companion of the *wh*-element obligatorily stranded by movement.¹⁷ The unstarred examples below, which do not violate

¹⁶ In a similar vein, Kotek (2019: 75 and *passim*) argues for an alternative to Cable’s semantics for *wh*-questions according to which Q is semantically inert — a proposal probably extendable to R and relative clauses as well, in a manner compatible with our proposals here. See also Branan & Erlewine (to appear) for related discussion. We will not offer any proposals of our own concerning the semantics of R, leaving further specification of its semantics for future research. We thank two reviewers for helpful comments concerning these points.

¹⁷ Kotek and Erlewine (2016) present experimental evidence of subtle quantifier- and negation-induced intervention effects in complex relative clause constructions parallel to those studied by Beck (1996; 2006), Pesetsky (2000), and Kotek (2014; 2019), among others, in the context of *wh*-questions. In particular, they show that speakers reject to some degree relative clauses like *I want to try this recipe, [very few ingredients for which] I (already) have at home*, with *very few* (also *no*, *only one*, etc.) impeding the ability of *which* to serve as a relativizer from within the complex \bar{A} -fronted relative phrase. Building on the previous work cited and related studies, they propose that this kind of intervener-sensitivity diagnoses a non-movement interpretation strategy for relative *wh* contained in a larger expression (i.e. what is traditionally viewed as pied-piping). If the *wh* element underwent (covert) movement, it would be

islands, are judged awkward and stylistically peculiar — but contrast clearly in acceptability with the starred examples:

- (20) **Island effects on the R *wh* relation: R_{of} merged with a nominal**
- a. These students, [**whom a claim about which**] we discussed in class, are my friends.
 - b. *These students, [**whom a claim that we had met which**] we discussed in class, are my friends.
 - c. *These students, [**whom people that know which**] we met __ yesterday, are my friends.
- (21) **Island effects on the R *wh* relation: R_{of} merged with a gerundive clause**
- a. These students, [**whom talking to which**] I recommend as a strategy, are my friends.
 - b. These students, [**whom claiming (that) you know which**] I recommend as a strategy, are my friends.
 - c. These students, [**whom trying to visit which**] I recommend as a strategy, are my friends.
 - d. *These students, [**whom meeting the person who taught which**] I recommend as a strategy, are my friends.
 - e. *These students, [**whom asking when you should visit which**] I recommend as a strategy, are my friends

We do not have an explanatory account of the obligatory use of *which*, rather than a gap (or some other element) as a marker of the extraction site, unfortunately. So we stipulate this fact and leave it as a topic for future investigation.¹⁸

sensitive to islands in a manner that *wh*-elements in this kind of example are not, but would also not be sensitive to interveners like *very few*. Our proposal that *wh-which* relatives involve actual movement, combined with our demonstration of island-sensitivity, thus predicts that under similar experimental conditions intervention effects (which diagnose non-movement) should not be detected. We leave the testing of this prediction for future research. We are grateful to Seth Cable for pointing out the relevance of Kotek and Erlewine's work to our proposal.

¹⁸ An anonymous reviewer suggests an interesting possible connection to proposals by Nunes (2004: 40–63). Nunes argues that the reason multiple positions occupied by a moved element often receive distinct pronunciation patterns is the linearization contradiction that would otherwise arise when the phonology attempts to pronounce a constituent whose terminals are compelled by Kayne's (1994) Linear Correspondence Axiom (or other similar principle) to simultaneously precede and follow other elements, due to its multiple structural positions. In the most commonly described cases, the phonological content of all but one position is deleted (the typical pattern for "traces"), resolving the contradiction in that fashion. But in other instances, Nunes suggests, a morphological process applying to one or another of these positions may also resolve the linearization contradiction — because the phonological content of these positions has been changed in a manner that obviates the contradiction. (We simplify his actual proposal, which also posits an alteration in the syntax, for the sake of brevity.) A morphological rule replacing the phonology of the RP_{of}-internal trace under our analysis with invariant *which* might serve this purpose as well.

As the reviewer notes, a proposal along these lines might help explain the generally negative evaluation that our consultants (and the first author) give to *which-of-which* relatives with inanimate head nouns, like those in (6) — since the input and output of the rule in this case would not be distinguishable. Interestingly, however, such examples

Finally, we should note at this point that there does not appear to be any form of interrogative for the *wh-which* speakers we have consulted that is comparable to a *wh-which* relative.¹⁹ This suggests that even for *wh-which* speakers, Q contrasts with R in lacking a pronunciation as *of* and does not attract *wh* as its Ch'ol counterpart does.

4 More than just *wh*: is pied-piping a concept after all?

An important consequence of the Q theory of interrogative phrase movement is its potential to explain pied-piping phenomena without the need for a special theory of pied-piping. If one views *wh*-question or *wh*-relative clause formation as a result of a *wh*-probe on C, movement of a phrase headed by a *wh*-word is expected — but not movement of a phrase that merely contains a *wh*-word that is not its head. If mere containment is sufficient (i.e. if apparent pied-piping turns out to be real), the theory must include some special mechanism such as “feature percolation” that copies the *wh* feature from a non-head to a node that dominates it. If, on the other hand, the probe on C is actually looking for Q or for R — with Q and R being the only heads with an actual interest in *wh* — then what looks like pied-piping can be understood instead as garden-variety movement of the maximal projection of the head bearing the feature C is actually looking for. If this is the end of the story, then, as Cable (2010b: 9) writes, “the concept of ‘pied-piping’ may be eliminated from the theory of grammar”.

It is in fact important to the logic of Coon’s discussion that neither of the movements she discusses in her analysis of Ch’ol *wh*-questions requires anything beyond movement of the maximal projection of the head bearing the feature sought by the probes that she posits on C and on Q. Indeed, the central observation that motivated her paper is the fact that there is no fourth word-order pattern alongside the three seen in (19). Just as there is no need to posit a special pied-piping mechanism for movement of an interrogative phrase to C, there is also no pattern that would require us to posit pied-piping in the movement of *wh* to Q. Q attracts a *wh*-headed constituent — and is not interested in other QPs or any phrase that merely contains *wh* but is not headed by it. As a consequence, we never find any sign that the phrase ‘whose dog’ moves

improve when the second *which* is embedded in a nominal of the sort seen in (13), and online examples of this configuration seem (in our informal assessment) more abundant than simple *which of which* constructions like those in (6). The examples below, suggested by a reviewer, were judged more acceptable than those of (6) (though “wordy”).

- (i) a. There were 60,000 books, which none of which I had read.
- b. I gifted him my books which several of which he had read already.

The fact that *wh-which* relatives introduced by *which* improve when greater distance separates the two occurrences of *which* might support the suggestion advanced in our discussion of (6) that simple repetition avoidance is at stake in speakers’ uneasiness with *which of which*, rather than the more interesting possibility suggested by the reviewer. We leave the resolution of these issues for future research.

¹⁹ As we discuss in an appendix, however, *wh-which* free relatives do exist.

internal to the QP in examples like those in (19). What moves to the specifier position of CP never looks like ‘[whose dog] plate’ or ‘[dog (of) whom] plate’.

Troublingly, the situation looks different in *wh-which* relatives, at least under the analysis we have developed here. Constructions seemingly analogous to the missing fourth pattern in Ch’ol do exist. In *wh-which* relatives it is possible for a phrase that merely contains *wh* but is not headed by it to occupy the initial position in this construction. This raises the possibility that though Q and R might be real, and though their properties might indeed permit us to dispense with pied-piping as an account of specific examples, something like pied-piping and the special mechanisms needed to account for it is also real after all.

The examples in (22) show movement of a nominal that contains a non-head *wh* to the specifier of R, with and without overt *of*. The more complex examples in (23) show movement of similar nominals stranding a preposition.²⁰

(22) ***phrasal-wh (of) which* relatives: online examples**

- a. This threat, the pandemic, is to address the worse threat that is global warming **whose impacts of which** the World is already experiencing. (https://twitter.com/em_lickspittle/status/1523896512186568709)
- b. If I buy a puppy **whose parents which** both have good hip scores am I guaranteed that my puppy will be OK? (<http://british-samoyed-club.co.uk/bsc/wp-content/uploads/Hip-Scoring-cheat-sheet-final.docx>)
- c. like i said, i have multiple friends (**none of whom which** are diabetic or obese) that have been hospitalized due to covid. (https://twitter.com/perc_nobrickski/status/1443000193083850756)
- d. The entertainment, treats, and experience is still nothing compared to gathering with Wyoming fans, **many of whom of which** I have known most of my life. (<https://wyo4news.com/news/wandering-amylessly-venturing-into-the-byu-cougar-den/>)
- e. Closer to Vermeer in brush handling were Pieter de Hooch (1629–1684), Gabriel Metsu, Frans van Mieris, Gerrit ter Borch (1617–1681) and Gerrit Dou (1613–1675), **all of whom of which** possessed subtly distinctive brushwork. (http://www.essentialvermeer.com/glossary/glossary_a_c.html)

(23) ***phrasal-wh P which* relatives: online examples**

- a. My girlfriend would assume that I had finally clobbered either a) a former co-worker or b) a former pastor, **both of whom with which** I had rather intense disagreements. (<https://twitter.com/mythigator/status/1474031603554787330?>)

²⁰ The possibility of a complex phrase as the specifier of RP_{of} permits us to show that the head of a *wh-which* relative does not need to be animate, independent of the questionable status of the examples in (6) above:

- (i) The table **whose leg (of) which** Mary tried to repair is in the next room.
- (ii) The book **whose main ideas about which** I’m going to speak today is this one.

- b. Yet my feeds get populated with libtards, **none of whom to which** I subscribe (<https://twitter.com/unapologeticit1/status/1586022953313001472>)
- c. I mean chronic illnesses that cause a person to lose weight or affect a persons gastrointestinal health, people who are physically or mentally impaired, people who are incapacitated, **all of whom to which** a restriction on diet would be a potential detriment to their wellbeing (https://twitter.com/eva_priest/status/1479170191938535424)
- d. This sets us apart from the world of banks and loan providers, **all of whom for which** the starting point and goal is their product [...] (<https://thefundingnexus.com/about-us>)
- e. The owner of the four bedroom Maili house at 87-794 Farrington Highway said the 83-year-old tenant died in August 2020 and since then the owner has been in a dispute with the tenant’s two adult sons, **one of whom which** was notified last week by a deputy sheriff that the property must be vacated by July 23. (<https://www.staradvertiser.com/2021/07/29/hawaii-news/fire-destroys-apparently-abandoned-home-in-maili>)
- f. He will be greatly missed by his nieces Sydney, Adelyn and Madison and his nephews Ethan, Grant, Sean and Gavyn **all of whom for which** he always had a warm smile, bear hug and a bit of advice. (https://www.shellhouseriversfuneralhome.com/obituaries/print?o_id=4819475)
- g. The estimates are regularly updated and currently suggest there are 4,800 people with long COVID – **1,000 of whom for which** it is severely affecting their daily activities. (<https://www.local.gov.uk/publications/must-know-long-covid-what-role-local-government>)
- h. NSDS has a very large customer base nationally, including most of the biggest customers in the screen printing market, **some of whom for which** we have assisted in facilitating many large growth projects. (<http://www.nlds.co.za/content/screen.html>)
- i. It is interesting too that she is just like my mother & my ex-wife in this way, **both of whom from which** I am estranged, & perhaps permanently in both cases ;-)
(<https://twitter.com/pearltiresias/status/1582349607312404480>)
- j. how dare someone **whose work of which** I partake and enjoy be a human being with a complexity and inner world (<https://twitter.com/beesbrain/status/1573428695477661697>)²¹
- k. My goodness! Although I have absolutely no knowledge of Betty (Mabry) Davis, she influenced (directly and indirectly through her producer Greg Errico) many people and bands **whose music of which** I am aware. (<https://twitter.com/i4eye2th4tooth/status/1554896576190881792>)

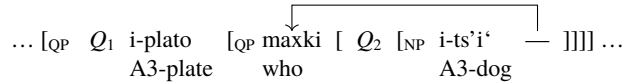
Clearly, if our overall approach to the construction is correct, examples of this kind pose a threat to the prospects for the elimination of pied-piping mechanisms as a component of the grammar. It is worth noting, however, that examples like these can at least be fit into a pigeonhole compatible

²¹ *Of* here is a preposition stranded within RP_{of} rather than an instance of R_{of} , and is selected by *partake* (again exemplifying the syntactic transparency of RP, discussed earlier). The same is true of *of* in the next example, where it is selected by *aware*.

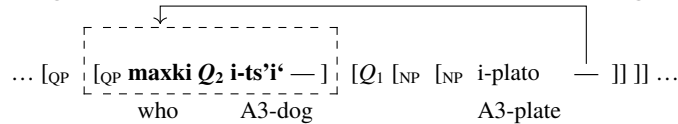
with our overall analysis that removes the threat, albeit by purely technical means. A centerpiece of Coon’s account of the Ch’ol pattern is a sharp distinction between C, which attracts only the maximal projection of Q, and Q itself, which attracts only the maximal projection of *wh*. If QPs were permitted to contain QPs within them — and if, crucially, Q were permitted to attract another QP (or if Q and *wh* were not distinct features in the first place) — we might expect a “roll-up” movement pattern to be acceptable, in which *wh* raises to the specifier of a QP that then raises to form the specifier of a higher Q within the same interrogative phrase. Such a derivation is in fact forbidden in Ch’ol:

(24) **A forbidden derivation (Ch’ol)**

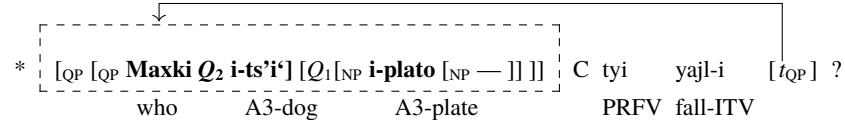
a. **step 1: movement of inner possessum *wh* to specifier of lower QP**



b. **illegal step 2: lower QP moves to specifier of a higher Q**



c. **step 3: QP moves to specifier of CP**



‘Whose dog’s plate fell?’

(Coon 2009: 170, based on ex. (9) and (10a))

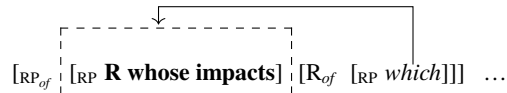
Let us suppose, however, that *wh-which* English dialects permit an analog for relative clauses to what Ch’ol forbids for questions: a probe on R that attracts another RP rather than *wh*. If so, examples like those in (22) and (23) can be derived as instances of RP movement forming a specifier of a higher RP:

(25) **A possible derivation (English)**

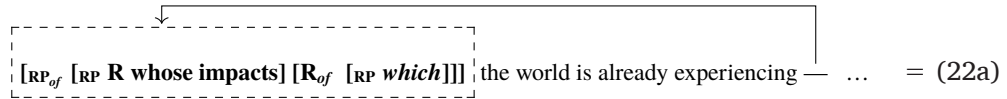
a. **step 1: merge non-*wh-which* English RP with R_{of}**

R_{of} [RP R [DP whose impacts]] ...

b. **step 2: lower RP moves to specifier of higher R_{of} (*which* marks extraction site)**



c. **step 3: higher RP moves to specifier of CP**

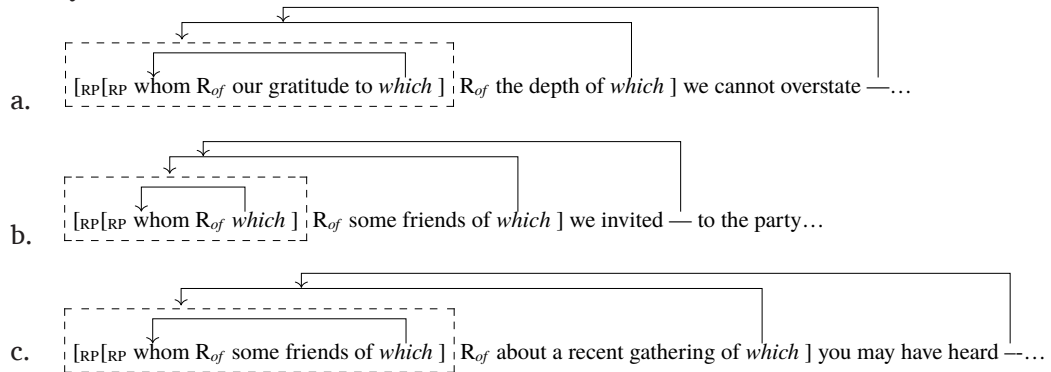


If RP recursion is possible, then we predict the possibility of “snowballing” movement whenever a movement-inducing R_{of} embeds a constituent that contains another movement-inducing R_{of} (with *which* present at each extraction site). In fact, *wh-which* recursion of exactly this sort does appear to be possible:²²

(26) **Snowballing in *wh-which* relatives: RP recursion and movement to embedded specifier of R_{of}** ²³

- a. these heroes, **whom our gratitude to which the depth of which** we cannot overstate ...
‘these heroes, the depth of our gratitude to whom we cannot overstate...’
- b. Mary, **whom of which some friends of which** we invited to our party ...
‘Mary, some friends of whom we invited to our party ...’
- c. Sue, **whom some friends of which about a recent gathering of which** you may have heard ...
‘Sue, about a recent gathering of some friends of whom you may have heard ...’

(27) **Analysis of (26)**

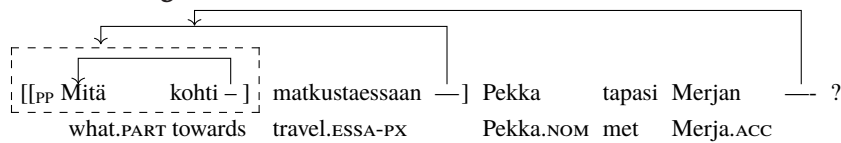


²² We are extremely grateful to Stanislaw Zompì for urging us to investigate this possibility, for suggesting example (26a) to us, and for pointing us in the direction of the parallel with Finnish discussed below.

²³ Examples of this sort seem to be most acceptable when some reasonable distance separates occurrences of *which*. Thus *Sue, whom some friends of which with which you are going to talk later today...* is less acceptable than any of the examples here, which embed the second *which* in a larger phrase that puts some distance between the two occurrences of this element. This consideration may be sufficient to rule out **whom of which of which*, which is judged completely unacceptable.

This pattern has a precedent outside English. As explored by Huhmarniemi (2012: 62, 223) and by Huhmarniemi & Brattico (2013), a comparable pattern of “snowballing” movement in \bar{A} -constructions is observed in Finnish. This pattern is exemplified in (28), where interrogative ‘what’ has moved within the PP ‘towards what’, which itself has moved within the phrase that undergoes clause-level \bar{A} -movement. Note that the movement within the phrase that moves to the specifier of CP leaves an ordinary gap rather than an element comparable to *which* (whose presence in the *wh-which* relatives we have in any case not successfully explained):

(28) “Snowballing” in Finnish



‘Towards what was Pekka travelling when he met Merja?’ (Huhmarniemi & Brattico 2013: 188, ex 27b)

The absence of an overt Q (or R) element in Finnish has made it possible to envision proposals to explain this phenomena that do not involve an interrogative or relativizing head as the trigger for what they call “secondary movement” within the phrase that moves to the specifier of CP (the path that Huhmarniemi 2012 and Huhmarniemi & Brattico 2013 in fact take). If we are correct in analyzing the overt *of* in (some) English *wh-which* relatives as just such an element, however, then we may seek an analysis of the Finnish patterns along similar lines to that proposed here.

At the same time, we must regard our proposal in this section as a speculative pigeonhole, a proof-of-concept demonstration that Cable’s most ambitious claim might not have to be weakened after all, if Q and R may embed and attract other instances of QP and RP. Whether this proposal is actually correct is a question we must leave open, pending stronger evidence for the possibility of RP recursion.

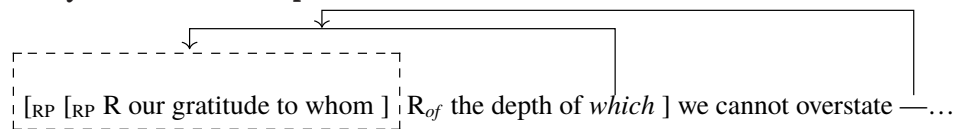
One obvious issue to resolve concerns the semantic contribution, if any, of R and Q, if RP and QP recursion is possible. One of Cable’s important contributions was a semantics for questions that assigned a specific role to Q, explaining its obligatory presence in *wh*-questions. The extent to which QP and RP recursion can be accommodated into this theory remains an open question that we will not attempt to answer here. Even if R bears a movement-inducing probe that searches for RP in *wh-which* dialects of English, it must also be required to find a *wh*-phrase in its c-command domain (as in Cable’s and Coon’s proposals) — perhaps as a consequence of a distinct probe, or perhaps as a necessity imposed by semantic interpretation.

Another issue concerns the nature and scope of cross-linguistic variation. As (25) suggests, on our analysis of the English side of the puzzle discussed in this section, movement-inducing R_{of} must be permitted to embed not only a phrase headed by a second occurrence of movement-inducing R_{of} , but also a phrase headed by plain non-movement-inducing R. This fact correctly

predicts the existence of variants of examples like those in (26) in which no movement takes place within the most embedded RP:

- (29) **Less snowballing: RP recursion without movement to embedded specifier of R_{of}**
- a. these heroes, **our gratitude to whom the depth of which** we cannot overstate ...
 - b. Sue, **some friends of whom about a recent gathering of which** you may have heard ...

- (30) **Analysis of (29a) (compare (27a))**



This option is not available in Finnish, where Huhmarniemi & Brattico (2013) observe that deviations from snowballing pattern seen in (28) are forbidden or possible only with an echo-question reading.

Taking stock: we have seen languages without movement-inducing Q or R (Tlingit; non-*wh-which* English), a language in which Q induces movement of *wh* alone (Ch'ol), and languages in which Q or R may induce movement of QP or RP (*wh-which* English dialects optionally in relative clauses; Finnish obligatorily). Against this backdrop of limited variation, what the Q theory of *wh*-questions and the analogous R theory of relative clauses continue to offer is a uniform and parsimonious explanation of why pied-piping phenomena should exist cross-linguistically in the first place — reinforced by the documented overtiness of Q and, we have argued here, R in some languages, in just the positions where we expect to find them. We leave for future work the systematic charting of the spectrum of variation.

5 Constituency tests

Finally, returning to the English *wh-which* construction, let us redeem a promissory note from the introductory section of this paper. The availability of the complex phrasal specifiers of RP_{of} seen in (22) and (23) and the availability of the complex phrasal complements to R_{of} seen in (9) and (13) now permit us to construct examples that use coordination to verify the overall constituency for *wh-which* relatives that we have proposed throughout.

The examples in (31) below support the internal constituency of RP_{of} proposed here. As shown in (31a–b), it is possible to coordinate contrasting phrases occupying both the specifier and complement positions of RP_{of} , though some judgments are reported as slightly uncertain. Note as well that the acceptability of a complex phrase in both the position of *whom* and the position of *which* in initial examples such as (1) already eliminated the possibility (which one might entertain at first) that either element is itself a head in the left periphery of the clausal spine. What might remain at stake if one is searching for alternatives to our analysis is the constituency of the *wh-which* sequence as a whole, for which (31c) below is relevant.

- (31) **Coordination: testing for constituency within RP_{of}**
- a. **coordination of complement of R_{of}**
the person **whose friends and whose enemies (%of) which** I visited ...
 - b. **coordination of specifier of R_{of}**
the person **whom pictures of which and books about which** we discussed ...
 - c. **coordination of RP_{of}**
the person [**whose friends (of) which**] **and** [**whose enemies (of) which**] I met last week ...
 - d. **non-constituent coordination**
*the person **whose friends of and whose enemies of which** I met last week

Similarly, the examples in (32) below verify the constituent structure proposed here for the CP within which \bar{A} -movement of RP_{of} takes place. Example (32a) coordinates two relative clause CPs as a baseline. The remaining examples shave off words one by one, and show that coordination cannot target any smaller sequence of words until what is coordinated is a TP (example (32a)), as predicted:²⁴

- (32) **Coordination: testing for internal constituent structure of the *wh-which* relative clause as a whole**
- a. ✓people whom of which I know well and whom of which you don't
 - b. *people **whom of which** I know well and **of which** you don't
 - c. *people **whom of which** I know well and **which** you don't
 - d. ✓people **whom of which** I know well and you don't

The wider range of configurations discussed in this section also raises questions about the constituency of acceptable and attested *wh-which* relatives whose leftmost element is a P:

- (33) **P whom (of) which: PP as specifier of RP_{of}**
- a. Bicycles are not permitted on the Bay Bridge, and the state no longer provides a shuttle service. Instead, they have a private shuttle service **with whom which** you can directly contract. (<http://bikewashington.org/routes/chesapeake/index.htm>)
 - b. I had a conversation with my republican neighbor the other day **with whom which** I had never spoken before (https://twitter.com/david_defiant/status/1567522627576647682)
 - c. Over time, he became a beloved grandparent to eight grandchildren [*sic*]: Cassandra, Katelyn, Colleen, Samantha, Emma, Sebastian, Connor and Lucien, **by whom of which** he will be greatly missed. (<https://www.kohlerfuneralhome.com/obituary/2554220>)
 - d. Because vaccine passports don't make a scrap of difference to covid and this I have seen first hand in a group of people who are ALL double vaccinated **of whom of which** over 50% tested +ve for covid (<https://twitter.com/memorylaine/status/1446742202462482432>)

²⁴ Example (32d) is more natural than (32a), but the contrast with (32b) and (32c) is clear nonetheless.

- e. It's you **to whom which** I belong / I love it, the feeling's getting strong. (lyrics to 1988 song *I like* the band *Guy*; <https://www.youtube.com/watch?v=671GfElFygI>)²⁵

In principle, the leading preposition in these examples might belong to the specifier of RP_{of} that underwent \bar{A} -movement — in which case, they represent instances of the same phenomenon as the examples in (23), except that it is a PP that moved within RP_{of} . If so, then it is a point of interest that *which* can mark the location from which a PP has moved, not just a nominal. On the “proof-of-concept” analysis just sketched, the structures in question once again would involve a plain RP whose head does not trigger movement attracted to specifier position by a higher R_{of} .

Alternatively, the leading preposition might be external to the RP_{of} within which movement of a *wh*-element took place, in which case these examples represent something new in this section: a non-*wh-which* English RP embedding an RP_{of} :

(34) **Two possible derivations of the examples in (33)**

- a. **P internal to spec, RP_{of}**

...a private shuttle service [_{CP} [_{RP_{of}} [_{RP} **R** [_{PP} with whom]]] [_{R_{of}} *which*_{RP-containing-PP}] ...]

- b. **P external to spec, RP_{of}**

...a private shuttle service [_{CP} [_{RP} **R** [_{PP} with [_{RP_{of}} whom] **R_{of}** *which*_{DP}]]] ...]

If relative *where* and *when* are themselves prepositional, then the examples in (7) may have already taught us that the first of these parses is a possibility. Whether the second parse is also available could in principle be tested by coordinating *wh-(of)-which* following a single P, e.g. *people with [whose friends of which] and [whose enemies of which] I am equally comfortable*. The judgment is less than clear, however, so we will leave this question open.

6 Conclusions

If our analysis of *wh-which* relatives is correct, it provides yet one more instance of the “unity in diversity” of syntax structures across the world’s languages. In the present case, we have suggested that ideas developed to explain Tlingit interrogatives, which have already illuminated puzzles in Ch’ol, might also illuminate the novel set of puzzles discussed here — puzzles posed by

²⁵ The use of this variant of the *wh-which* construction here in a recorded and published song lyric probably removes any possibility that it is a mere speech error. This example was brought to our attention by Yutaka Ohno (Facebook discussion, December 23, 2021), in the context of the following Twitter post:

‘I Like’ by Guy was the first time I heard “to whom which” in a song. That lyric has been on a satisfying grammar loop in my mind since 1989. (<https://twitter.com/DonnettaLavinia/status/1285701613668257793>)

relative clauses in a (possibly innovative) dialect of English, some of which are strongly similar to phenomena earlier observed in Finnish.

Of course, the puzzles posed by English *wh-which* relatives have not been fully solved here, so it is possible that an alternative view of the construction (with different connections to phenomena in other languages) will fare better with the remaining problems. In particular, though we have argued that the relation between *which* and the pre- R_{of} phrase is a movement relation, we do not know why the original position of this relation should be marked by *which*. In addition, the surprising preference for *whom* over *who* remains unexplained.²⁶

²⁶ There are other environments where many English speakers use or even prefer *whom* over *who*, namely when it is an in-situ object of a verb or preposition — as in (apparent) pied-piping structures like *the person to whom we spoke* and multiple interrogatives like *who spoke to/visited whom?*. (See Lasnik & Sobin 2000 for a more nuanced discussion of the use of *whom* in these environments and elsewhere, and also Huddleston & Pullum 2002: 464 ff.) If there were some reason to treat the specifier of R_{of} as a position somehow analogous to these, this problem might be resolved.

Appendix: *Wh-which* free relatives

Gary Thoms (personal communication) has pointed out to us that though there is no interrogative counterpart to *wh-which* relatives, free-choice free relatives (FC-FRs; see Giannakidou & Cheng 2006) do participate in the *wh-which* construction. They occur as both arguments and adjuncts. The examples in (35) show *wh-which* FC-FRs as free adjuncts and appositives:

(35) *Wh-which* FC-FRs as adjuncts

- a. The task force shall consist of the following members: [...] Two appointed by the majority leader of the Senate, one of whom shall be a member of the Workers' Compensation Legal Advisory Panel or the Workers' Compensation Medical Advisory Panel, **whomever of which** is available for any scheduled meeting, and one of whom is a member of the Connecticut State Medical Society (<https://www.cga.ct.gov/2019/act/sa/pdf/2019SA-00010-R00HB-06916-SA.pdf>)
- b. Usually, **whatever with which** we find ourselves obsessed, whatever leads us to the archives in the first place, is something already gnawing at us, something already mapped on our existence although we may not understand how or why. (<https://www.tupeloquarterly.com/uncategorized/chetla-sebree/>)
- c. Throwing stuff at Dave is typically an approved course of action- gold, jewels, canned chili or corned beef, unpeeled oranges, peeled starlets: **whatever of which** you have a surplus. (<https://twitter.com/quietdavesocial/status/1589858499437400065>)

When functioning as arguments, however, *wh-which* FC-FRs present an interesting puzzle concerning its external and internal syntax. As we noted when first discussing Q and R, the external syntax of their maximal projections (apart from their susceptibility to \bar{A} -movement) is identical to that of their complements. A phrase headed by Q or R with a DP or PP complement has the A-syntax of a DP or PP respectively. In response, we proposed that the features of the complement of Q and R are shared by the maximal projections of Q and R, adopting Grimshaw's (2000; 2005) notion of "Extended Projection".

This is true of argumental *wh-which* FC-FRs in their pre- \bar{A} -movement positions as well — but with a twist concerning the "Matching Effect" characteristic of free relatives (Bresnan & Grimshaw 1987; Groos & Riemsdijk 1981). In argumental *wh-which* FR-FCs, it is not the syntactic behavior of the specifier of CP that determines the behavior of the free relative as a whole (which is the Matching Effect as normally described). but rather the *specifier of the specifier* of CP. Thus, in (36a–36c), though R_{of} has merged with a PP, and behaves like that PP in its original position, it is the nominal *whom* in $Spec,RP_{of}$ that determines the syntactic behavior of the free relative clause as a whole, which thus behaves as a nominal (not a PP) within the higher clause:

(36) *Wh-which* FC-FRs as arguments

- a. Doesn't show up in the 2013 doc search – try the File Exchange or ask **whomever from which** you received the code for the helper functions... (<https://www.mathworks.com/matlabcentral/answers/87828-what-is-imtile-function>)

- b. He hears a voice calling out, and enters the blazing hotel to rescue **whomever to which** it belongs. (<https://classicforareason.com/2020/11/07/i-married-a-witch/>)
- c. As the holidays quickly approach so does the next round of family travel for the year- especially road trips, both long and short, depending on how far away you live from friends, family, or **whomever with which** you'll be celebrating! (<https://picklestravel.com/healthy-snacks-for-kids-while-traveling>)

The Matching Effect in free relatives is sometimes analyzed as the result of the apparent specifier of CP being permitted to project, rather than C (Larson 1998; Iatridou et al. 2001: 224). We might analyze *wh-which* FC-FRs in the same spirit. It cannot be the \bar{A} -moved of RP in Spec,CP that provides the head for the free relative, so it cannot be this instance of movement that is followed by projection of the moved element. Instead there must be an additional movement step after this initial instance of \bar{A} -movement that extracts the internal specifier from the RP specifier of CP — and this is the element that projects after movement. This second movement step might be triggered by a higher silent head (perhaps relevant to the semantics of free relatives), or it might be self-motivated “Münchhausen movement” of the sort proposed by Fanselow (2003) and others. The absence of a Matching Effect in non-argumental FR-FRs like (35) can then be attributed to the absence of this second movement step.

Why should it be the specifier of the specifier of CP, rather than the specifier of CP itself that raises in this fashion? One avenue to explore might be the possibility that the specifier of CP is a criterial position, frozen in place to permit it to type the clause as a relative or interrogative — while the specifier of RP and QP might not have that status. What raises and projects to form the FC-FR is therefore the highest maximal projection that does not have this property.

We will not develop this proposal further here, as our main goal in this appendix has been to document the puzzle and note its interest for the analysis of the Matching Effect.

Abbreviations

ACC = accusative [Finnish], A3 = 3rd person ergative/genitive [Ch'ol], CL = proper name clitic [Ch'ol]; ESSA = ‘while doing’ [Finnish], ITV = intransitive verb suffix [Ch'ol], NOM = nominative [Finnish], PART = partitive [Finnish], PRFV = perfective aspect [Ch'ol], PX = agreement inflection (possessive suffix) [Finnish]

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Competing interests

The authors have no competing interests to declare.

Author contributions

The authors contributed equally to this article, and their names are listed alphabetically.

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