Relative pronoun pied-piping
in English non-restrictive relatives[*]

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Abstract We investigate the structure and interpretation of *non-restrictive relative clauses* in English, concentrating in particular on evidence from the interpretation of *relative pronoun pied-piping*. We propose that in non-restrictive relatives, relative pronouns are interpreted *in-situ* within the pied-piped constituent at LF, using Rooth-Hamblin alternative computation. The proposal here has the consequence that non-restrictive relatives are fundamentally *proposition-denoting* in contrast to restrictive relatives which are *property-denoting*. We discuss some implications of this proposal.

1 Introduction

English is one of many languages in which *wh*-words can be used as *relative pronouns* in the construction of relative clauses (RC). The relative pronoun originates lower in the clause and A̅-moves to the edge of the RC. This movement can *pied-pipe* other material with it, resulting in *relative pronoun pied-piping* (RPPP), which will be the focus of the present paper:

(1) Non-restrictive relative with relative pronoun pied-piping (RPPP):
  Mary, [RC [RPPP *whose* talk] I saw ___ at the conference], is clearly brilliant.

  In this paper, we investigate the structure and interpretation of *non-restrictive relative clauses* in English.[1] We propose that in non-restrictive relatives, relative pronouns are interpreted *in-situ* within the pied-piped constituent (RPPP) at LF, using Rooth-Hamblin alternative computation (Hamblin 1973, Rooth 1985, 1992: a.o.) rather than through movement. Evidence comes from the presence of *intervention*

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1 Non-restrictive relatives are also often called *appositive* relatives and sometimes *supplemental* relatives.

effects in RPPP; intervention effects (Sauerland & Heck 2003, Beck 2006: a.o.) can be used to distinguish regions of alternative computation from regions where covert movement has occurred (see Kotek & Erlewine to appear, Erlewine & Kotek 2014). Our proposal builds on previous work which proposes that relative pronouns in non-restrictive relatives are interpreted as E-type anaphors (Sells 1985, Demirdache 1991, Del Gobbo 2007).

The proposal here has the consequence that non-restrictive RCs are fundamentally *proposition-denoting* in contrast to restrictive RCs which are *property-denoting*, as argued by Del Gobbo (2007) on independent grounds. Our proposal helps explain two differences between restrictive and non-restrictive relatives in English. First, non-restrictive relatives must use relative pronouns whereas restrictive relatives also have a *that*/∅ complementizer option. The relative pronoun strategy must be used in non-restrictive relatives to arrive at the propositional denotation. Second, relative pronoun pied-piping in non-restrictive relatives can be substantially larger than in restrictive relatives. This is due to the semantics of Rooth-Hamblin alternative computation, used to interpret relative pronouns in non-restrictive relatives, which is insensitive to syntactic barriers such as islands, although it is susceptible to intervention effects.

2 Setting the stage

In this section we will discuss the desired semantics for relative clauses. We first examine restrictive relative clauses in section 2.1, which motivates the idea that RCs are property-denoting. In section 2.2 we discuss the complications introduced by relative pronoun pied-piping and three different approaches to the interpretation of RPPP. Then in section 2.3 we discuss the interpretation of non-restrictive relatives.

2.1 Interpreting restrictive relative clauses

In approaching the semantics of relative clauses, it is instructive to first examine restrictive relatives, whose semantic contribution has been well-studied and is quite clear. Consider for example the relative clause in (2) below.

(2) Restrictive relative clause with relative pronoun:
Every phonologist [$_{RC}$ *who* I met ___ at the conference] gave a great talk.

Following Quine (1960), Partee (1973), and much subsequent work, the restrictor of *every* in (2) is interpreted as the set of individuals satisfying both *phonologist* and the predicate "λx . I met x at the conference." The relative clause acts to restrict the domain that the quantifier *every* quantifies over.

We arrive at the interpretation of the relative clause by interpreting the $\overline{\text{A}}$-movement of the relative pronoun (Chomsky 1977) as λ-abstraction.[2] Following the presentation in Heim & Kratzer (1998), the trace position of movement is interpreted as a variable, x, and a λ-binder introduced below the target of movement abstracts over this variable (3).

(3) Deriving and interpreting the relative clause:
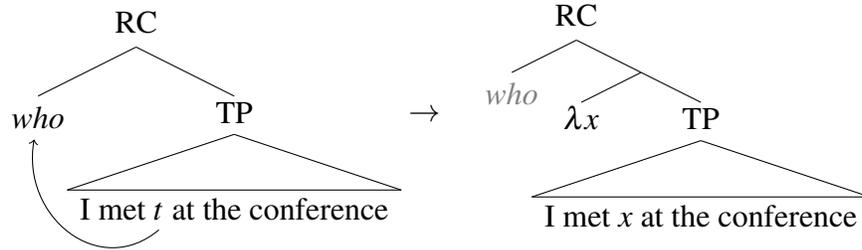
For the purposes of this illustration, we assume that the relative pronoun itself does not contribute to the semantics of the RC, as in the discussion in Heim & Kratzer (1998: p. 186). This results in the desired denotation for the relative clause, $[\![\text{RC}]\!]$ = "λx . I met x at the conference," a property of extensional type $\langle e,t \rangle$.

We can say that this interpretation of the RC is *property-denoting*. In this restrictive relative, this property modifies the head noun *phonologist* intersectively, resulting in the desired restriction of the domain of quantification. It is important for the semantics of restrictive RCs that the RC denotes a property. While the focus of this paper will be on non-restrictive relatives, we will return to the analysis of restrictive relatives later in section 4.4.

2.2 The problem of pied-piping

This procedure for interpreting the relative clause as a derived property is complicated by pied-piping. Consider the relative clause in (4) below.

(4) Restrictive relative with relative pronoun pied-piping (RPPP):
Every phonologist [RC [RPPP *whose* talk] I saw ___ at the conference] is clearly brilliant.

Following the discussion above, we want the relative clause in (4) to denote the property "λx . I saw x's talk at the conference." However, the procedure introduced

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2 We will largely abstract away from the question of whether or not any of the nominal material outside of restrictive relative clauses, such as the head noun (here, *phonologist*), originated within the relative clauses. We will briefly discuss so-called raising and matching analyses of restrictive relatives later in section 4.4. See also Sauerland (1998), Bhatt (2002), Hulsey & Sauerland (2006) and references therein for discussion.

in the previous section, illustrated in (3) above, is insufficient to derive this meaning. Interpreting the movement of the RPPP using λ-abstraction and again assuming the relative pronoun—now with its pied-piping—does not contribute semantically, we yield the derived predicate "λx . I saw x at the conference" (5), which is not the desired denotation. Clearly, what goes wrong is that the semantic contribution of the pied-piped material is missing.

(5) A failed attempt at interpreting a relative clause with RPPP:
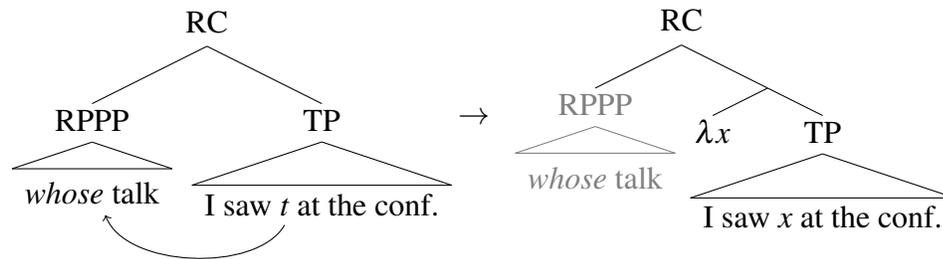
There are at least three possible approaches to solving this problem, which we discuss in turn here. The first approach is to covertly move the relative pronoun out of the RPPP.[3] This approach is illustrated in (6). Covert movement is indicated by dashed arrows here and throughout.

(6) Approach 1: covertly move the relative pronoun out of the RPPP

   a. <u>LF:</u> [$_{RC}$ *who* λy [[$_{RPPP}$ y's talk] λx . I saw x at the conference]]

   b. $[\![RC]\!] = \lambda y$. $(\lambda x$. I saw x at the conference$)$ $(y$'s talk$)$
        $= \lambda y$. I saw y's talk at the conference

We can interpret the covert movement step as another instance of λ-abstraction. The denotation of the RPPP constituent, "y's talk," becomes the argument for the predicate derived by the overt RPPP-movement step, and is bound above by λy. Again assuming that the relative pronoun (*who*, in gray) itself does not contribute interpretationally, we yield the desired denotation for the relative clause in (6b).

The second approach is to interpret the RPPP constituent, modulo the relative pronoun itself, in the base position of movement, within the RC. That is, although the pied-piped material is pronounced high, in the LF representation it reconstructs.

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3 For our current purposes, Approach 1 subsumes all derivations which result in binding of the relative pronoun position inside the RPPP from the edge of the RC. This could, for example, be the movement of the head noun (here, *phonologist*) from the position of *who* to its surface position, as in the analyses of Kayne (1994), Bhatt (2002) a.o. Such an analysis will be discussed again later in section 4.4. Another option which we will briefly discuss later in section 4.3 is an option where the relative pronoun is simply bound by the antecedent.

λ-abstraction applies over just the relative pronoun's position.[4] The differing PF and LF representations under this view are illustrated in (7):

(7) Approach 2: RPPP low at LF, abstract over just the relative pronoun
   a. <u>PF:</u> [$_{RC}$ [$_{RPPP}$ *whose* talk] I saw *t* at the conference]
   b. <u>LF:</u> [$_{RC}$ *who* λx . I saw [$_{RPPP}$ *x*'s talk] at the conference]

From this LF representation, the relative clause can be straightforwardly interpreted as the intended property "λx . I saw *x*'s talk at the conference."

One property of this second approach is that the choice of the exact size of pied-piping is predicted not to have any effect on the representation at LF. Consider for example the non-restrictive relatives in (8) below, where there is optionality in the surface size of pied-piping. Because this second approach interprets the RC with the pied-piped material in its base position at LF, the LF representations for the RC in (8) will all be as in (9). This predicted LF insensitivity to pied-piping size will be discussed later.

(8) Optionality in the size of pied-piping:
   I'm planning a trip to the Republic of Zubrowka,
   a. [$_{RC}$ [$_{RPPP}$ a film about *which*] I saw ___ last summer].
   b. [$_{RC}$ [$_{RPPP}$ about *which*] I saw a film ___ last summer].
   c. [$_{RC}$ [$_{RP}$ *which*] I saw a film about ___ last summer].

(9) Approach 2 predicts identical LF representations for (8a–c):
   <u>LF:</u> [$_{RC}$ *which* λx . I saw a film about *x* last summer]

Safir (1999) presents evidence from Binding Condition C which supports this second approach.[5] The examples in (10) show that material in the RPPP that cannot be Late Merged (here, the complement of *depiction*, *Jesse*) must be interpreted lower in the relative clause, in the gap position. In this position, *he* will bind *Jesse*, leading to the observed Condition C violation.

(10) RPPP is interpreted low for Condition C purposes: (Safir 1999: p. 600)
   a. *? I always respect a journalist
           [$_{RC}$ [$_{RPPP}$ *whose* depiction of Jesse$_i$]$_j$ he$_i$ objects to ___$_j$].
   b. ?? Max, [$_{RC}$ [$_{RPPP}$ *whose* depiction of Jesse$_i$]$_j$ he$_i$ objects to ___$_j$], ...

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4 We can think of this discrepancy between the PF and LF representations as the result of covertly reconstructing much of the RPPP at LF or as an indication that the movement of the pied-piped material (somehow) only occurs at PF.

5 We thank Anonymized (p.c.) for bringing this data to our attention.

We believe, however, that this evidence is ultimately inconclusive. The effect does not hold when the R-expression is introduced in an adjunct in RPPP (11), in contrast to *of Jesse* which is a complement of *depiction* in (10). The ability of $\overline{\text{A}}$-movement to bleed Condition C effects with R-expressions in adjuncts is well known (Lebeaux 1988). The effect in (10) can then be explained without fully reconstructing the RPPP below, using the Copy Theory of movement (Chomsky 1993, Fox 1999).

(11)   Adjuncts can be Late Merged above, avoiding Condition C:
✓ I just saw Mary, [RC [RPPP *whose* car parked in Jesse$_i$'s garage]

he$_i$'s still upset about __].

One argument against the idea shared by approaches 1–2, that the relative pronoun is separated from the rest of the RPPP via movement, comes from island diagnostics. Example (12b), based on the baseline in (12a), shows that the relative pronoun can be inside an island inside RPPP, in a non-restrictive relative.[6] This evidence is immediately problematic for Approach 1, where the relative pronoun must move out of RPPP. It is also problematic for Approach 2, assuming that interpretation of RPPP in the base position, abstracting over just the relative pronoun position, requires a movement step.

(12)   The relative pronoun can be inside an island, inside RPPP:
a.   This portrait, [RC [RPPP the background of *which*] is quite stunning], sold for a million dollars at auction.
b.   This portrait, [RC [RPPP the background [RC that was chosen for *which*]] is quite stunning], sold for a million dollars at auction.

The third approach to RPPP we consider then is to interpret the relative pronoun *in-situ* within the RPPP, using *Rooth-Hamblin alternative computation*, a method of scope-taking through a different mode of semantic composition, without the use of movement. Such an approach is briefly discussed but not ultimately adopted in Sternefeld (2001) and Sauerland & Heck (2003). We will introduce this approach by first discussing its use in the interpretation of *wh*-in-situ questions such as the Korean example in (13), where such a mechanism is commonly invoked:

(13)   Korean *wh*-in-situ question:

Minsu-nun *nuku*-lûl   po-ass-ni?
Minsu-TOP who-ACC see-PAST-Q

'Who did Minsu see?'

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6 This argument cannot be reproduced for restrictive relatives, due to the smaller relative pied-piping size allowed in restrictive relatives (Emonds 1976, 1979, Jackendoff 1977, Nanni & Stillings 1978: a.o.).

Hamblin (1973) was the first to propose a mechanism for interpreting *wh*-words *in-situ*—that is, without overt or covert movement. This procedure is illustrated for (an English version of) example (13) in (14) below.[7] Here we follow Beck's (2006) presentation, which adopts Rooth's (1992) multidimensional Alternative Semantics and notation: a set of *alternatives* for each node in the tree can be computed using the denotation function $[\![\cdot]\!]^f$ whereas ordinary semantic values are computed with $[\![\cdot]\!]^o$. Interrogative elements have only alternative-semantic values defined. The squiggly arrow in (14a) identifies the region in which alternatives are computed.

(14) Interpreting (13a), presented for convenience as *wh*-in-situ English:

    a. [$_{CP}$ C$_Q$ [$_{TP}$ Minsu saw *who*]]

    b. $[\![who]\!]^f$ = {John, Mary, Lucy,...}

    c. $[\![TP]\!]^f$ = {Minsu saw John, Minsu saw Mary, Minsu saw Lucy,...}

The *wh*-word introduces the set of corresponding possible short answers—in this case, animate individuals—as the alternative-semantic value of *who* in $[\![who]\!]^f$. Each of these individual values composes pointwise with the verb *saw* and then with the subject *Minsu* to yield the alternatives in $[\![TP]\!]^f$. These alternatives correspond to possible answers to the question and are interpreted by C which contributes the question force (Shimoyama 2001, Beck & Kim 2006, Kotek 2014a). This is illustrated in detail in the (simplified) tree in (15).

(15) Scope-taking through pointwise composition of alternatives:

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                              CP
                     ┌────────┴────────┐
              ⎧ Minsu saw John, ⎫      C
              ⎨ Minsu saw Mary, ⎬
              ⎩ Minsu saw Lucy  ⎭
                  ┌──────┴──────┐
               {Minsu}    ⎧ λx.x saw John, ⎫
                  |       ⎨ λx.x saw Mary, ⎬
               Minsu      ⎩ λx.x saw Lucy  ⎭
                             ┌──────┴──────┐
                      {John, Mary, Lucy}  {λy.λx.x saw y}
                             |                  |
                            who                saw
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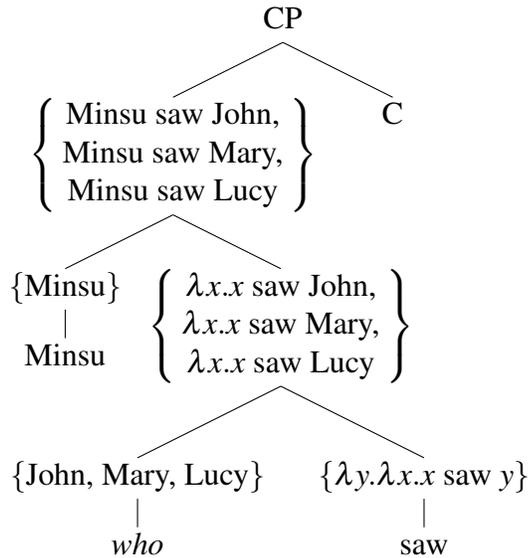
7 We assume here that Korean in-situ *wh*-words are indeed interpreted in-situ at LF (Beck 2006: a.o.). The facts for *wh*-in-situ in English multiple *wh*-questions, however, are more complicated. See Pesetsky (2000), Kotek (2014a) for discussion.

We will refer to this mechanism as *Rooth-Hamblin alternative computation* after Rooth (1985) and Hamblin (1973) and throughout we will indicate regions where alternatives are computed using a squiggly arrow.

This process of Rooth-Hamblin alternative computation can also be used to interpret interrogative *wh*-words inside pied-piped constituents (Cable 2007, Kotek & Erlewine to appear). Consider the structure in (16) below, based on an example sentence from Cable (2007).

(16)   Interpreting pied-piping using both movement and alternatives:

a.   [$_{TP}$ [$_{pied\text{-}piping}$ A picture of *which* president] λx . does Jim own x]?
       alternative computation   *movement*

b. $[\![TP]\!]^f = \left\{ \begin{array}{l} \text{Jim owns a picture of Roosevelt,} \\ \text{Jim owns a picture of Kennedy,} \\ \text{Jim owns a picture of Obama,...} \end{array} \right\}$

The introduction of alternatives at *which president* inside the pied-piping leads to an alternative-semantic denotation for this constituent of a set of pictures of different presidents. This composes with the rest of the question, which is a predicate derived by interpreting the movement chain as λ-abstraction. Composing pointwise, this results in the alternative-semantic denotation $[\![TP]\!]^f$ in (16b), corresponding to the desired set of possible answers to the question in (16a). In this way, the interrogative *wh*-word can be interpreted in-situ within the pied-piped constituent, with the overt movement step of pied-piping interpreted in the normal fashion.

This approach to interpreting *wh*-words using Rooth-Hamblin alternative computation has also been extended to non-interrogative (specifically, quantificational) uses of *wh*-words in work such as Kratzer & Shimoyama (2002). Returning now to the interpretation of relative clauses, the third approach to the problem of relative pronoun pied-piping would then be to use this same method of interpreting the relative pronoun *in-situ* using alternative computation, within RPPP, and combining it with λ-abstraction for the overt movement of RPPP:

(17)   Approach 3: interpret using both movement and alternatives
       [$_{RC}$ [$_{RPPP}$ *whose* talk] λx . I saw x at the conference]
          alt. computation   *movement*

An immediate advantage of this approach is that it is compatible with the island data presented in (12). Rooth-Hamblin alternative computation, unlike movement, is not sensitive to syntactic islands (Rooth 1985).

In section 3, we will present a diagnostic which is able to detect regions of Rooth-Hamblin alternative computation. This diagnostic shows that Approach 3—with the relative pronoun interpreted *in-situ* within the pied-piped constituent—is

ultimately correct for English non-restrictive relatives. This will, however, bring with it its own complication; specifically, there is not a straightforward way to use this in-situ mode of composition to derive a property-denotation for the relative clause in (17). We will propose that the key to solving this puzzle is the unique semantics of non-restrictive relatives themselves, to which we now turn.

2.3   Interpreting non-restrictive relative clauses

In this section we discuss the semantics of non-restrictive relatives. Although non-restrictive relatives are superficially similar to their restrictive counterparts, there are a number of significant differences of note. The defining difference is of course that non-restrictive relatives do not have the function of restricting a domain of quantification; instead, they simply introduce additional information about the antecedent described. In this paper we will concentrate on the structure and interpretation of English non-restrictive RCs, although we will return to the issue of restrictive RCs in at the end, in section 4.4.

The semantic contribution of non-restrictive RCs has traditionally been compared to that of an independent, possibly conjoined clause (Quine 1960, Ross 1967, Taglicht 1972, Thorne 1972, Emonds 1979, McCawley 1981, Demirdache 1991, de Vries 2006: a.o.), as in (18) below. More recently, Potts (2005, 2013) formally describes non-restrictive RCs—as well as other supplementals such as nominal appositives—as *conventional implicatures* which are projective (always wide scope) and not-at-issue.

(18)   The semantic contribution of a non-restrictive relative, paraphrased:
Mary, [$_{RC}$ *who* I met ___ at the conference], gave a great presentation.
≈ Mary gave a great presentation. *(And) I met Mary at the conference.*

What is important here for our purposes is that the meaning introduced by the non-restrictive relative clause is a *proposition*, in this case *I met Mary at the conference*. We can intuitively break this proposition up into two parts: *Mary*, the referent being described, and the property "λx . I met x at the conference" which must be true of Mary.

Given the semantics independently necessary for restrictive relatives (§2.1), the null hypothesis that there is a uniform, *property-denoting* semantics for both restrictive and non-restrictive RCs: restrictive relatives modify the head noun with this property whereas non-restrictive relatives are combined with their antecedent to produce a proposition which is then projected. This is summarized here:

(19)   The null hypothesis: a uniform property-denoting semantics for RCs

    a.   <u>Core, shared meaning:</u>   *property*
        $[\![_{RC}$ who I met at the conference$]\!] = \lambda x$. I met x at the conference

    b.   Restrictive use:

$[\![\text{phonologist RC}]\!] = [\![\text{phonologist}]\!] \cap [\![\text{RC}]\!]$

$= \lambda x \, . \, x$ is a phonologist and I met x at the conference

    c.   Non-restrictive use:

projects a not-at-issue proposition: $[\![\text{RC}]\!](antecedent_{\text{RC}})$

where $antecedent_{\text{RC}}$ is the referent described

The alternative hypothesis would be that the entire proposition in the paraphrase—in this case *I met Mary at the conference*—is composed *directly*, without computing the property "λx . I met x at the conference" along the way. Clearly the null hypothesis is advantageous from the point of view of parsimony. In the following section we will build an argument that, in fact, the null hypothesis in (19) is incorrect and instead non-restrictive relatives are built directly and that they are inherently *proposition-denoting*.

(20)   The alternative hypothesis: non-restrictive RCs are proposition-denoting

- Non-restrictive RCs denote an entire proposition and are computed directly without first computing the corresponding property.

- This proposition is then projected as a not-at-issue meaning.

- There is no core meaning shared between corresponding restrictive and non-restrictive RCs.

3   Intervention effects and relative pronoun pied-piping

In this section we investigate the structure and interpretation of RPPP in English non-restrictive RCs. We argue that they are proposition-denoting based on the behavior of *intervention effects* in RPPP. Background on intervention effects will be provided in section 3.1. The new data is presented in 3.2. In section 3.3 we discuss implications of this data for the theoretical approaches to relative pronoun pied-piping reviewed in section 2. We will then detail our proposal in section 4.

3.1   Intervention effects

In section 2.2 above, we discussed three potential solutions to the problem of pied-piping, i.e. how to properly incorporate the semantics of the pied-piped material when interpreting a relative clause. One of these approaches involved interpreting the relative pronoun *in-situ* using Rooth-Hamblin alternative computation, (17). In this section we introduce the phenomenon of *intervention effects*, which we have shown in previous work (Kotek 2014b, Kotek & Erlewine to appear, Erlewine & Kotek 2014) can be used as a diagnostic for regions of Rooth-Hamblin alternative

computation. In section 3.2 we will use this diagnostic to provide evidence for the view that RPPP in non-restrictive relatives is interpreted via Rooth-Hamblin alternative computation.

The term *intervention effect* has traditionally described a situation in which a question is rendered ungrammatical because an in-situ *wh*-phrase is c-commanded by an offending *intervener*—certain quantificational and negative elements, as well as focus-sensitive items—at LF (Beck 2006; see also Beck 1996, Kim 2002, a.o.). The effects of intervention are best observed in *wh*-in-situ languages such as Korean, although they are also observed in *wh*-fronting languages such as English and German. A classic example from Beck & Kim (1997) is reproduced in (21) below. Korean questions generally do not require *wh*-fronting (21a), but when the subject above the in-situ object *wh*-word is changed to the focus-sensitive expression 'only Minsu,' the question becomes ungrammatical (21b). This problem can be avoided by scrambling the *wh*-word over 'only Minsu' as in (21c), so the offending intervener no longer c-commands the *wh*-word. Interveners are bolded throughout.

(21) Intervention effect in Korean *wh*-questions: (Beck & Kim 1997)

    a.   Minsu-nun *nuku*-lûl po-ass-ni?
           Minsu-TOP who-ACC see-PAST-Q
           'Who did Minsu see?' (=13)

    b.   * Minsu-**man** *nuku*-lûl po-ass-ni?
           Minsu-only who-ACC see-PAST-Q
           Intended: 'Who did only [Minsu]$_F$ see?'

    c.   ✓ *Nuku*-lûl Minsu-**man** ___ po-ass-ni?
           who-ACC Minsu-only   see-PAST-Q
           'Who did only [Minsu]$_F$ see?'

The intervention effect in example (21b) and its amelioration via scrambling in (21c) motivate the idea that *intervention effects only affect regions of alternative computation, not movement* (Beck 2006, Beck & Kim 2006, Kotek 2014a). Informally, interveners interrupt the projection of alternatives (squiggly arrow) before they reach the interpreting operator—in this case, interrogative C.[8]

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[8] Here we will concentrate on the distribution of intervention effects and be less concerned with the mechanism that causes intervention. See Beck (2006) for one prominent view. Crucially, all interveners used for our evidence in section 3.2 are items which have been previously shown to cause intervention in interrogative *wh*-constructions.

(22) Intervention affects alternatives, not movement:

    a.   * [$_{CP}$ C ... **intervener** ... *wh*]   (21b)

    b.   ✓ [$_{CP}$ C ... *wh* **intervener** ... *t*]   (21c)

Sauerland & Heck (2003), Cable (2007), and Kotek & Erlewine (to appear) show that intervention effects also occur inside pied-piped constituents triggered by interrogative *wh*-movement.

(23) Intervention effect in English pied-piping: (based on Cable 2007: p. 262)

    a.   ✓ [$_{pied\text{-}piping}$ A picture of *which* president] does Jim own ___?

    b.   * [$_{pied\text{-}piping}$ **No** pictures of *which* president] does Jim own ___?

    c.   * [$_{pied\text{-}piping}$ **Few** pictures of *which* president] does Jim own ___?

    d.   * [$_{pied\text{-}piping}$ **Only** PICTURES of *which* president] does Jim own ___?

If an intervener is placed between the *wh*-word and the edge of the pied-piping constituent, it results in ungrammaticality. This is explained by the view, introduced briefly in (16) above, that interrogative *wh*-words are interpreted *in-situ* within pied-piping constituents, using Rooth-Hamblin alternative computation. The following schema illustrates this configuration:

(24) The pied-piping intervention schema:

    *[$_{pied\text{-}piping}$ ... **intervener** ... *wh* ...] λx .   ... *x* ...

                             alt. computation   *movement*
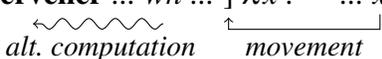
In (23), only example (23a) is grammatical, because (23b–d) involve an intervener occurring inside the region where alternatives (squiggly arrow) must be projected for the interpretation of the question.

(25) An intervener inside pied-piping disrupts the computation of alternatives:

    [$_{CP}$ [$_{pied\text{-}piping}$ ✓**A**/*__**No**__ picture of *which* president] λx . does Jim own *x*]?

                       alternative computation   *movement*

We know that it is specifically this region within the pied-piping that is sensitive to intervention because different choices of pied-piping size can lead to structures where the intervener is stranded outside the pied-piped material. Such questions are grammatical, (26). This reflects the fact that intervention effects affect Rooth-Hamblin alternative computation, here used to interpret the pied-piping constituent, but not structures that are derived through movement chains and interpreted through λ-abstraction.

(26) Intervention avoided with smaller pied-piping: (Cable 2007)

    a.   ✓ [$_{pied\text{-}piping}$ Of *which* president] does Jim own **no** pictures ___?

    b.   ✓ [$_{pied\text{-}piping}$ *Which* president] does Jim own **no** pictures of ___?

3.2 Intervention effects in relative pronoun pied-piping

We now turn to the investigation of RPPP in English non-restrictive RCs through intervention effects. Here we will use non-restrictive RCs with the antecedent *this recipe*, as in the baseline in (27) below. The singular deictic *this* ensures a non-restrictive interpretation of the RC. The test sentences in (28) shows that the region between the relative pronoun and the edge of the pied-piping is indeed susceptible to intervention effects.

(27) Baseline non-restrictive relative:
I want to try this recipe, [RC [RPPP the ingredients for *which*]
I (already) have ___ at home].

(28) Intervention effect in RPPP:
I want to try this recipe,

   a.   * [RC [RPPP **no** ingredient(s) for *which*] I have ___ at home].

   b.   ?? [RC [RPPP **very few** ingredients for *which*] I have ___ at home].

   c.   ?? [RC [RPPP **only** [one]F ingredient for *which*] I have ___ at home].

This pattern parallels the behavior of material pied-piped with interrogative *wh*-words, reviewed above. The interveners in (28) are known pied-piping interveners in English, observed by Cable (2007) in examples such as (23) and further discussed in Kotek & Erlewine (to appear) and Erlewine & Kotek (2014).

It's important to note that this effect is not simply due to the use of any quantificational expression inside the RPPP. Other, non-intervening quantifiers do not have this effect:

(29) Non-intervening quantifiers in RPPP do not lead to ungrammaticality:
I want to try this recipe,   (cf 28)

   a.   ✓ [RC [RPPP an ingredient for *which*] I'm missing ___].

   b.   ✓ [RC [RPPP three ingredients for *which*] I (already) have ___ at home].

   c.   ✓ [RC [RPPP many ingredients for *which*] I (already) have ___ at home].

It is also not the case that the ungrammatical examples in (28) express particularly strange meanings. Take example (28a) above. If a smaller constituent is chosen for fronting, so that the intervener is not included within the RPPP, no intervention occurs:

(30) Intervention avoided with smaller RPPP:
I want to try this recipe,

   a.   * [RC [RPPP **no** ingredients for *which*] I have ___ at home].   (=28a)

   b.   ✓ [RC [RPPP for *which*] I have **no** ingredients ___ at home].

    c. $^{\checkmark}$[$_{RC}$ [$_{RP}$ *which*] I have **no** ingredients for ___ at home].

This parallels the contrast observed in interrogative pied-piping between (23) and (26) above. Intervention effects occur in RPPP whenever an intervener occurs above the relative pronoun, inside the pied-piping:

(31)   The pied-piping intervention schema for relative pronoun pied-piping:
     *[$_{RC}$ [$_{RPPP}$ ... **intervener** ... *wh* ...] λx .   ... x ...]   (cf 24)
               alt. computation   *movement*

A second set of examples is given in (32a–e). We again observe ungrammaticality with the same set of known pied-piping interveners. Examples (33a–d) illustrate again that the intervention effect is not due to a fundamental problem with the resulting meaning, but instead from a problem with the size of pied-piping: when the pied-piping does not include the intervener, the result is grammatical.

(32)   I hope to some day meet the President,
     a. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ a cousin of *whom*] I've met ___ before].
     b. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ the supporters of *whom*] are out of their minds].
     c.   * [$_{RC}$ [$_{RPPP}$ **no** supporters of *whom*] I've (ever) met ___ before].
     d.   * [$_{RC}$ [$_{RPPP}$ **only** [one]$_F$ supporter of *whom*] I've (ever) met ___ before].
     e.   * [$_{RC}$ [$_{RPPP}$ **very few** supporters of *whom*] I've (ever) met ___ before].
(33)   a. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ of *whom*] I've met **no** supporters ___ before].
     b. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ *who(m)*] I've met **no** supporters of ___ before].
     c. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ of *whom*] I know **no** supporter ___].
     d. $^{\checkmark}$[$_{RC}$ [$_{RPPP}$ *who(m)*] I know **no** supporter of ___].

The susceptibility of RPPP to intervention effects shows that *relative pronouns are interpreted in-situ within the RPPP using Rooth-Hamblin alternative computation*, similarly to pied-piping in *wh*-questions. This is compatible only with Approach 3 to the problem of pied-piping presented in section 2.2 above, (17). This effect would not be explained if the relative pronoun is moved out of RPPP (Approach 1) as movement is not sensitive to intervention. It is also not explained if the content of RPPP is interpreted low at LF, in the base position of movement (Approach 2), as the sensitivity to the size of movement (30) would be unexplained.

Note that we present this evidence here solely for non-restrictive relatives. This is due to a methodological issue: non-restrictive RCs in English allow for substantially larger RPPP than restrictive relatives (Emonds 1976, 1979, Jackendoff 1977, Nanni & Stillings 1978: a.o.), and this extra structure in the RPPP is necessary to construct the intervention test cases as in (28) and (32) above.

(34)   Restrictive relatives disallow larger RPPP: (exx Cable 2010)

    a.   This book, [$_{RC}$ [$_{RPPP}$ the reviews of *which*] were awful], is really quite nice.

    b.   * No book [$_{RC}$ [$_{RPPP}$ the reviews of *which*] are awful] is really quite nice.

3.3   The problem of pied-piping again

Having shown Rooth-Hamblin alternative computation to be involved in the interpretation of RPPP in non-restrictive relatives, let us now consider how Approach 3 can yield the desired semantics for the non-restrictive RC. Recall example (1), repeated here, which we began this paper with:

(35)   Non-restrictive relative with relative pronoun pied-piping (RPPP): (=1)
    Mary, [$_{RC}$ [$_{RPPP}$ *whose* talk] I saw ___ at the conference], is clearly brilliant.

Consider the LF representation of the relative clause in Approach 3, repeated here:

(36)   One attempt at interpreting RC using Approach 3:

    a. [$_{RC}$ [$_{RPPP}$ *whose* talk] [$_\alpha$ λx . I saw x at the conference]]   (=17)
          alt. computation   *movement*

    b. $[\![\alpha]\!]^o = \lambda x$. I saw x at the conference   type $\langle e,t\rangle$

    c. $[\![who]\!]^f = \{$John, Mary, Lucy,...$\}$ set with elements of type e

    d. $[\![RPPP]\!]^f = \{$talk A, talk B, talk C,...$\}$ set with elements of type e

    e. $[\![RC]\!]^f = \left\{ \begin{array}{l} \text{I saw talk A at the conference,} \\ \text{I saw talk B at the conference,} \\ \text{I saw talk C at the conference,...} \end{array} \right\}$ set of propositions

Consider the interpretation of this structure. Like in the interpretation of *wh*-questions using alternative computation, here we take the *wh* relative pronoun to have the set of animate individuals as its alternative-semantic value. This composes with the rest of the pied-piping, yielding a set of talks as the alternative-semantic denotation of RPPP. Without loss of generality, we refer this set as {talk A, talk B, talk C,...} (36d). Composing these values pointwise with α, we yield the alternative-semantic denotation for the entire RC in (36e), a set of propostions.[9]

Recall the null hypothesis in (19) above: non-restrictive relative clauses, like their restrictive counterparts, are *property-denoting*. In the case of (36), the property

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9 For convenience, extensional types are presented here. These propositions can be thought of as intensionalized truth conditions, rather than as truth values.

we want to derive is a function that takes an individual, corresponding to the relative pronoun *who*, and returns the corresponding proposition in $[\![RC]\!]^f$ (36e).

This desired property thus requires a mapping between *speakers* and *talks*, and the corresponding proposition of the form *I saw X at the conference*. However, here we encounter a problem: This information cannot be reverse-engineered from the set of propositions in $[\![RC]\!]^f$. Intuitively, the propositions in (36e) lack the information on *whose* talks are being discussed. For example, the propositions in $[\![RC]\!]^f$ are compatible with John having given talk A, Mary having given talk B, and Lucy having given talk C, but they are also compatible with Mary having given talk A, John having given talk B, and Lucy having given talk C. We are hence unable to derive the correct property denotation required by the null hypothesis (19).

Rooth (1992) notes that this construction of a "decoding function" is in general not possible, giving the following explanation in footnote 15:

> "Ede Zimmermann has proposed an argument to me: Suppose f is a bijective function on the set of individuals E, and P and Q are distinct properties such that for any individual x, $P(x)$ and $Q(f(x))$ are the same proposition. Then the sets $\{P(x) \mid x \in E\}$ and $\{Q(f(x)) \mid x \in E\}$ are the same sets of propositions. Since f is a bijection, the latter equals $\{Q(x) \mid x \in E\}$. Then since $\{P(x) \mid x \in E\} = \{Q(x) \mid x \in E\}$, any putative decoding function would fail on either P or Q. For instance, take P to be λt ['it rains in Stuttgart at t'], Q to be λt ['it rains in Stuttgart an hour before t'], and f to be the function which maps a time t to an hour after t, and anything else to itself."

This "decoding" problem has been observed by previous authors who have considered Approach 3 (Sternefeld 2001, Sauerland & Heck 2003), leading them to ultimately not pursue the use of alternative computation for the interpretation of RPPP.

We now seem to be at an impasse. On the one hand, evidence from intervention effects and island effects suggests that the relative pronoun inside RPPP in non-restrictive relatives is interpreted via Rooth-Hamblin alternative computation. On the other hand, we are unable to use the result of Rooth-Hamblin alternative computation with the standard Hamblin semantics for *wh*-words and result in a property denotation for the relative clause, as required by the null hypothesis in (19), that non-restrictive relatives include a property-denoting core shared with corresponding restrictive relatives.

4 Proposal

We propose to resolve this problem by rejecting the null hypothesis (19). Instead, *non-restrictive relative clauses are computed directly as propositions, rather than first computing the corresponding property.* Del Gobbo (2007) also reaches this same conclusion, based on the investigation of the behavior of non-restrictive relatives with quantificational antecedents.

The remainder of this section is structured as follows: In section 4.1, we introduce our proposal for the interpretation of non-restrictive relatives using Rooth-Hamblin alternative computation. This proposal crucially relies on the observation that the antecedents of non-restrictive relatives can be picked out by E-type anaphors, the evidence for which we present in section 4.2. In section 4.3 we return to the pattern of intervention effects in RPPP and show how it is explained by our analysis. In section 4.4 we return to the analysis of restrictive relatives, and in section 4.5 we show how our proposal can account for two important differences between restrictive and non-restrictive relatives—the size of RPPP and the fact that only restrictives, but not non-restrictives, can be introduced by a that/∅ complementizer. Finally, in section 4.6 we address an alternative set of judgments that has been reported to us by some speakers, which suggest an interesting point of inter-speaker variation in how non-restrictive relatives are computed.

4.1 Non-restrictive relative clauses

We begin in this section by presenting our proposal for English non-restrictive RCs. Here we will continue to discuss example (1), repeated here:

(37) Non-restrictive relative with relative pronoun pied-piping (RPPP): (=1)
Mary, [$_{RC}$ [$_{RPPP}$ *whose* talk] I saw ___ at the conference], is clearly brilliant.

As discussed in the previous section, if we interpret the relative pronoun *wh*-word using the ordinary Hamblin denotation of $[\![who]\!]^f$ as the set of animate individuals, we will end up with a whole set of propositions in $[\![RC]\!]^f$ and we will be unable to identify the proposition which corresponds to the antecedent described. We propose to avoid this issue by radically contextually restricting the alternative-semantic denotation of the relative pronoun (here, *who*) to the singleton set denoting the antecedent described by the RC, (38). We adopt from Sells (1985), Demirdache (1991), Del Gobbo (2007) the idea that *antecedent*$_{RC}$ is an E-type anaphor, similar to a cross-sentential anaphor. This contrasts with the denotation proposed for *wh*-words in interrogative and quantificational constructions in (39), where the alternative-semantic value of *wh* ranges over the entire set of possible corresponding short answers.

(38) Relative pronoun *who*: (39) Regular *who*: (Beck 2006: a.o.)

    a. $[\![who_{RP}]\!]^o$ undefined   a. $[\![who]\!]^o$ undefined

    b. $\boxed{[\![who_{RP}]\!]^f = \{antecedent_{RC}\}}$ b. $[\![who]\!]^f = \{x \mid x \in D_e \text{ animate}\}$

Consider now the interpretation of the non-restrictive relative in example (1) under this approach, in a context where Mary's talk was talk B:

(40) Proposed structure and interpretation:

    a. $antecedent_{RC}$ = Mary

    b. [$_{RC}$ [$_{RPPP}$ *whose* talk] [$_\alpha$ λx . I saw x at the conference]]
       alt. computation   *movement*

    c. $[\![\alpha]\!]^o = \lambda x$. I saw x at the conference   type $\langle e,t \rangle$

    d. $[\![who_{RP}]\!]^f = \{antecedent_{RC}\}$ = {Mary}   set with a single element of type e

    e. $[\![RPPP]\!]^f$ = {talk B (= Mary's talk)}   set with a single element of type e

    f. $[\![RC]\!]^f$ = {I saw talk B (= Mary's talk) at the conference}
                                  set with a single proposition

Although the resulting alternative-semantic denotation $[\![RC]\!]^f$ is a set of propositions, it is always a *singleton set*. As a result, there is no problem identifying the proposition corresponding to the antecedent *Mary*. All that remains is to introduce this one element of $[\![RC]\!]^f$ into the discourse as a not-at-issue projective meaning.

We follow Potts (2005) in positing a COMMA operator which does this work of introducing the not-at-issue meaning and also corresponds to the "comma intonation" associated with non-restrictive relatives (Emonds 1976).[10] The interpretation of COMMA we will use is given in (41). Like the COMMA operators in Potts (2005), the entire COMMA-structure has no effect on the at-issue (ordinary) dimension of meaning.[11]

(41) [COMMA RC]
introduces the conventional implicature: for $\phi \in [\![RC]\!]^f$, ϕ is true;
does not compose in the at-issue dimension

Our COMMA operator differs from those in Potts (2005) in two ways. First, because the argument of COMMA has no ordinary semantic value, our COMMA in

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10 Note that for Potts (2005), COMMA is a special syntactic feature on non-restrictive relatives, interpreted through a special rule of *feature interpretation* (Potts 2005: §3.6.5), rather than a separate syntactic node. This presentational choice is not important here.

11 This is enforced in Potts's (2005) system by his rule of *CI application*. See his §3.6.3 and discussion there.

(41) accesses the alternative-semantic values of its argument. Second, our COMMA converts an at-issue *propositional* meaning into a corresponding conventional implicature, corresponding to an operator of type $\langle t^a, t^c \rangle$ in Potts's (2005) terms, where t^a is the at-issue type t and t^c is the conventional implicature type t. A COMMA operator with this type signature is not discussed in Potts (2005), but such a propositional COMMA operator of type $\langle t^a, t^c \rangle$ could be thought of as the most primitive version, with the $\langle\langle e^a, t^a \rangle, \langle e^a, t^c \rangle\rangle$ and $\langle\langle t^a, t^a \rangle, \langle t^a, t^c \rangle\rangle$ versions in Potts (2005: see e.g. 4.114) derived from it through type-shifting rules.

For our example from above, the COMMA operator in (41) introduces the not-at-issue meaning that the proposition "I saw Mary's talk at the conference" is true, based on the denotation $[\![\text{RC}]\!]^f$ computed in (40).

(42)   [COMMA [$_{RC}$ *whose* talk I saw at the conference]]

$\rightsquigarrow$ "I saw Mary's talk at the conference" is true

Notice that there is no step in this computation where we compute the property "λx . I saw x's talk at the conference."

4.2   The antecedent of the non-restrictive relative

In the last section we proposed that relative pronouns in non-restrictive relatives are interpreted through alternative computation, projecting a singleton alternative set. In this section we will briefly motivate the idea that there is always exactly one individual described by a non-restrictive relative and that this referent is identified through an E-type anaphor, the latter following previous work such as Sells (1985), Demirdache (1991), Del Gobbo (2007).

The idea that non-restrictive relatives always describe exactly one individual is a crucial aspect of the analysis, and is required for it to succeed. If it is ever possible for a non-restrictive RC to describe non-singleton sets of individuals, we will again encounter the problem described in 3.3 above of identifying the correct antecedent for the RC and our proposal in 4.1 will fail to apply. However, this does not occur. Consider the examples in (43) below, which contrast a restrictive and non-restrictive relative:

(43)   Restrictive RC vs non-restrictive RC with plural head:
    a. Every mother [$_{RC}$ [$_{RPPP}$ *whose* son] is in the army] is concerned.
       $\Rightarrow$ Each (relevant) mother has her own son.   *restrictive*
    b. Mary and Sue, [$_{RC}$ [$_{RPPP}$ *whose* son] is in the army], are concerned.
       $\Rightarrow$ Mary and Sue have a son together.   *non-restrictive*

In the restrictive case in (43a), the relative clause property is tested against each individual mother to restrict the domain of quantification. In contrast, in the

non-restrictive case in (43b), the antecedent *Mary and Sue* are necessarily described together. Non-restrictive RCs do not "distribute" over antecedent individuals. There is always one (possibly plural) antecedent which is described.

The idea that the antecedent is identified by an E-type anaphor is motivated by Sells (1985), Demirdache (1991), Del Gobbo (2007) by showing that cross-sentential anaphora can pick out the correct referent for the antecedent of parallel non-restrictive relatives. This works in simple cases such as (44a) and also works to explain the availability of non-restrictive relatives with certain quantificational antecedents but not others (Thorne 1972, Karttunen 1976, McCawley 1988, Potts 2002: a.o.). The availability of cross-sentential anaphora to refer to such antecedents patterns with the availability of corresponding non-restrictive relatives (44b–c).

(44) Non-restrictive relatives and parallel cross-sentential anaphora:

    a. <u>Definite individual:</u>   (Demirdache 1991: p. 114–116)

        i. I saw Mary, [$_{RC}$ *who* was late].

        ii. I saw Mary$_i$. She$_i$ was late.

    b. <u>Indefinites:</u>   (Emonds 1979: p. 236)

        i. {$^\checkmark$One, $^\checkmark$some, *each, *no} student at this conference, [$_{RC}$ *who* I talked to ___ on the phone], is happy.

        ii. [{$^\checkmark$One, $^\checkmark$some, *each, *no} student at this conference]$_i$ is happy. I talked to him/her$_i$ on the phone.

    c. <u>Non-specific indefinite under negation:</u>   (Demirdache 1991: p. 134)

        i. * I didn't see a donkey, [$_{RC}$ *who/which* eats too much].

        ii. * I didn't see a donkey$_i$. It$_i$ eats too much.

This parallel between non-restrictive relatives and cross-sentential anaphora has recently also been verified experimentally.[12] Poschmann (2013) carries out two experiments that respond to objections in Del Gobbo (2003), who discusses some unexpected differences between non-restrictive relatives and cross-sentential anaphora. These differences are shown to be statistically absent, so that instead the two phenomena always pattern together.

Non-restrictive relatives are able to describe non-individual antecedents as well. Here too we observe that parallel cross-sentential anaphora can identify the correct antecedents:

(45) Parallel behavior with non-individual antecedents:[13]

    a. i. We [read *Tom Sawyer*], [$_{RC}$ *which* we had never done ___ as children].

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12 We thank Anonymized (p.c.) for brining this work to our attention.

    ii. We [read *Tom Sawyer*]$_i$. We had never done it/that$_{i,*j}$ as children.

(Thompson 1971)

    b.   i. I go there [whenever I have time], [$_{RC}$ *which* isn't actually very often].

        ii. I go there [whenever I have time]$_i$. It/that$_{i/*j}$ isn't actually very often.   (Sells 1985)

Note that the ability to describe a non-individual antecedent is unique to non-restrictive relatives, pointing to a fundamental difference between the derivations of restrictive and non-restrictive relatives.

In addition, Demirdache (1991) notes that this approach provides a natural solution to split-antecedent relative clauses (Perlmutter & Ross 1970), exemplified in (46a). The non-restrictive relative *who were quite similar* in (46a) describes the sum of the man and woman introduced discontinuously. Split-antecedent relative clauses have been notoriously difficult to model for common approaches to relative clause formation.[14] Example (46b) shows that cross-sentential anaphora can indeed be used to identify the correct antecedent for the relative clause in (46a).

(46)   Split-antecedent RC and parallel cross-sentential anaphor:

    a. A man$_i$ entered the room and a woman$_j$ went out, [$_{RC}$ *who*$_{i\oplus j}$ were quite similar].   (Perlmutter & Ross 1970)

    b. A man$_i$ entered the room and a woman$_j$ went out. They$_{i\oplus j}$ were quite similar.   (Demirdache 1991: p. 116)

4.3   Explaining intervention effects and its exceptions

In this section we will illustrate how our analysis explains the patten of intervention effects we observed in section 3.2 and which motivated our proposal above. Consider example (47), which summarizes the intervention pattern we observed in RPPP. Example (47a) exemplifies an intervention effect in RPPP. In the absence of an intervener, pied-piping of this size is generally allowed, (47b). Furthermore, if a smaller pied-piping constituent is chosen, such that the intervener is left outside of it, the example is again grammatical, (47c).

(47)   Intervention effect in RPPP:

    I want to try this recipe,

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13 These examples are modified minimally from Demirdache (1991: p. 114–116) and the original sources she draws upon to make them sound maximally natural to our ears. For example, Demirdache gives only the anaphor *it*, but the anaphor *that* is also good for us, if not better.

14 See McKinney-Bock (2013) for a recent review of approaches.

   a.   * [$_{RC}$ [$_{RPPP}$ **no** ingredient(s) for *which*] I have ___ at home].   (= 28a)

   b.   ✓ [$_{RC}$ [$_{RPPP}$ the ingredient(s) for *which*] I have ___ at home].   (= 27)

   c.   ✓ [$_{RC}$ [$_{RP}$ *which*] I have **no** ingredients for ___ at home].   (= 30c)

We adopt the schema in (48) for the interpretation of intervention effects in RPPP. This builds on work showing similar effects in *wh*-question pied-piping discussed in section 3.1 (see also Cable 2007, 2010, Kotek & Erlewine to appear) and in focus pied-piping (see Sauerland & Heck 2003, Erlewine & Kotek 2014).

(48)   The pied-piping intervention schema for relative pronoun pied-piping:

       *[$_{RC}$ [$_{RPPP}$ ... **intervener** ... *wh* ...] λx .   ... x ...]   (cf 24)

                         alt. computation   *movement*

This schema predicts that RPPP will be susceptible to intervention effects precisely when an intervener occurs *above* the *wh* relative pronoun, *inside* the RPPP. Hence, we predict the ungrammaticality of (47a), where the known intervener **no** occurs above *which* inside RPPP. We additionally correctly predict the grammaticality of (47b), lacking an intervener altogether, and of (47c), where the intervener occurs outside RPPP—that is, outside the region susceptible to intervention effects, where Rooth-Hamblin alternatives are computed—and hence is not in a position to cause intervention effects.

We note that because we contextually restrict $[\![wh_{RP}]\!]^f$ to be a singleton set in (38), our proposal in 4.1 is very similar to the effect of enforcing coindexation between the relative pronoun and the antecedent. This alternative was mentioned above in footnote 3 and is illustrated in (49).

(49)   An alternative with coindexation in place of alternative computation:

        Mary$_i$, [$_{RC}$ [$_{RPPP}$ *who$_i$*'s talk] I saw at the conference], is clearly brilliant.

The crucial difference is that, under the proposal here, we are computing the RPPP using Rooth-Hamblin alternatives—albeit the projection of just a single alternative—which makes it susceptible to intervention effects. The intervention effect pattern we observe above is also not predicted by theories that use covert movement for the interpretation of *wh*-pronouns in RPPP (Approach 1 in §2.2), nor by theories with massive reconstruction at LF (or where pied-piping is assumed to somehow only take place at PF) (Approach 2 in §2.2).

Finally, we note that if the pied-piping material is larger than the size discussed here, the intervention effect may disappear (50). Such data counterexemplify our analysis that *wh* relative pronouns are interpreted strictly *in-situ* with RPPP and subject to the intervention schema in (48) above.[15]

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15 We thank Anonymized (p.c.) and Anonymized (p.c.) for discussing this data with us.

(50)   Intervention may disappear if additional structure is added within RPPP:
This is the unfortunate recipe,

    a.   ✓[$_{RC}$ [$_{RPPP}$ **none** of the ingredient(s) for *which*] I have ___ at home].

    b.   ✓[$_{RC}$ [$_{RPPP}$ the cookbook containing **no** pictures of *which*] I have ___ at home].

We speculate that such examples are grammatical because a position has now become available for movement of the *wh*-pronoun *inside* the pied-piping, targeting a position above the intervener. Rooth-Hamblin alternatives are computed from this landing position, bypassing the intervener. The DPs in the core data discussed above in section 3.2 are too small to get around intervention in this way. See Kotek (2014a) for evidence that English chooses to invoke covert movement specifically in order to avoid intervention effects.

4.4   Restrictive relative clauses

We now briefly turn our attention to the analysis of restrictive relative clauses. We note that the proposal we make above for non-restrictive relatives cannot be extended to restrictive relatives. In particular, there are several reasons to believe our solution to the pied-piping problem involving an E-type anaphor and alternative computation is not supported for restrictive relatives. As example (43) above showed, restrictive relatives apply individually to their head noun domains, unlike in the case of non-restrictive relatives. In addition, the similarities between non-restrictive relatives and cross-sentential anaphora illustrated in examples (45–46), where we see that both constructions can be used with the same set of quantifiers, and can both have split antecedents, does not extent to restrictive relatives. As a result, an alternative analysis must be used for pied-piping in restrictive relatives.

Recall our discussion from section 2.1, which illustrated a movement-based analysis of restrictive relatives. In example (51), repeated from (2) above, we assume that the restrictor of *every* is interpreted as the set of individuals satisfying both *phonologist* and the predicate "λx . I met x at the conference." The relative clause is interpreted through $\overline{\text{A}}$-movement of the relative pronoun, with λ-abstraction over the position of movement.

(51)   Restrictive relative clause with relative pronoun:
Every phonologist [$_{RC}$ *who* I met ___ at the conference] gave a great talk.

(52)   [$_{RC}$ *who* λx . I met x at the conference]

Following the presentation in Heim & Kratzer (1998), the trace position of movement is interpreted as a variable, x, and a λ-binder introduced below the target position of movement abstracts over this variable (52). Assuming that the relative pronoun itself

does not contribute to the semantics of the RC, this results in a *property denotation* for the relative clause, ⟦RC⟧ = "λx . I met x at the conference."

   To interpret relative pronoun pied-piping with restrictive relatives in examples such as (53), it is necessary to abstract over the position of the relative pronoun. A movement step establishing the required abstraction occurs within the head-raising analysis of restrictive relatives as in Kayne (1994), Bhatt (2002), a.o., where the head noun originates as the sister of the relative pronoun and moves out. This derivation is illustrated in (54), based on the analysis of Bhatt (2002).[16,17]

(53)   Restrictive relative clause with relative pronoun pied-piping:
       Every phonologist [$_{RC}$ [$_{RPPP}$ *whose* talk] I saw ___ at the conference] is clearly brilliant.

(54)   [$_{NP}$ phonologist [$_{RC}$ λy [[$_{RPPP}$ [*which y*]'s talk] λx . I saw x at the conf.]]

       '[*which* ~~phonologist~~]'s' pronounced as "whose"

Again by not interpreting the overt relative pronoun, we result in a *property denotation* for the restrictive relative clause in (54), ⟦RC⟧ = "λy . I saw y's talk at the conference," a property of extensional type $\langle e,t \rangle$.[18]

   Under this proposal, then, restrictive and non-restrictive relatives have fundamentally different semantic interpretations: restrictive RCs are *property denoting*, while non-restrictive RCs are *proposition denoting*. In the next section we argue that this is a welcome result, which helps explain several important differences between restrictive and non-restrictive RCs.

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16 A head-raising analysis is illustrated here in (54), but this analysis of restrictive relative pronoun pied-piping is compatible with a head-matching analysis as well. Following the same head noun movement out of the relative pronoun pied-piping constituent, the head noun will be deleted under identity with the matching overt head.

17 The interpretation of the head noun movement in (54) is semantically equivalent to covertly moving the relative pronoun itself to the edge of the relative clause, in a completely head-external analysis of restrictive relatives, i.e. where no instance of the head noun originates within the relative clause. This was first introduced in section 2.2 above in the illustration of Approach 1 to the problem of pied-piping (6).

   (i)   [$_{RC}$ *who* λy [[$_{RPPP}$ *y*'s talk] λx . I saw x at the conference]]

18 In the structure in (54), the head noun *phonologist* will then syntactically project an NP and semantically compose with RC through modification (intersection) rather than saturation. See Bhatt (2002: §7) for discussion.

4.5 Properties of non-restrictive vs restrictive relatives

Our proposal helps explain two additional differences between restrictive and non-restrictive relatives in English. First, non-restrictive relatives must use relative pronouns whereas restrictive relatives also have a *that*/∅ complementizer option.

(55) Only restrictive relatives can be introduced by *that*/∅:

    a.   Every phonologist [$_{RC}$ that/∅ I met ___ at the conference] gave a great talk.

    b.   * Mary, [$_{RC}$ that/∅ I met ___ at the conference], gave a great talk.

The reason non-restrictive relatives must use the relative pronoun strategy is that only the relative pronoun strategy can lead to a propositional denotation for the RC, because of the unique semantic contribution of the relative pronoun, (38). There is no option in English of first computing a property for the non-restrictive RC—in this case, "λx . I met x at the conference"—and composing it with the antecedent to derive the non-restrictive RC's not-at-issue content.[19]

Note also that, under our proposal, the interpretation of the relative pronoun is itself different between restrictive and non-restrictive relatives. In non-restrictive RCs, but not in restrictive RCs, the relative pronoun itself makes a contribution to the semantics of the RC. This corresponds to the core difference between the two types of RCs: restrictive relatives are property-denoting while non-restrictive relatives are proposition denoting.

Second, relative pronoun pied-piping in non-restrictive relatives can be substantially larger than in restrictive relatives. This is due to the semantics of Rooth-Hamblin alternative computation, used to interpret relative pronouns in non-restrictive relatives, which is insensitive to syntactic barriers such as islands, although it is susceptible to intervention effects.

This contrast between restrictive and non-restrictive relatives is predicted only if Approach 3 is correct for English non-restrictive RCs—if RPPP is interpreted via Rooth-Hamblin alternative computation—but is unexplained under Approaches 1–2 to RPPP in section 2.2, which postulate covert movement of the relative pronoun.

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19 This may be a point of cross-linguistic variation. We note that there are other languages where non-restrictive relatives may be introduced by a complementizer and do not require a relative pronoun strategy. Example (i) from Cinque (2008) below includes an Italian non-restrictive relative introduced by the complementizer *che*:

  (i)   Inviterò   anche Giorgio, [$_{RC}$ *che* voi certamente conoscete].
         invite.1sg also   Giorgio,   that you certainly   know
         'I will also invite Giorgio, who you certainly know.'

There are additional differences between English restrictive and non-restrictive relative clauses in English, including their relative ordering, weak crossover, and structural size (see e.g. McCawley 1981 for a review). For an approach to these differences, see Del Gobbo (2007: §4). Note, however, that the two properties which we derive here—the necessity of relative pronouns and the availability of substantially larger pied-piping in English non-restrictive RCs—are unexplained by Del Gobbo (2007). These differences are derived here by crucially relying on our alternative-semantic approach to the interpretation of relative pronouns in non-restrictive RCs.

4.6 Another judgment pattern

Before concluding, we would like to briefly discuss a second set of judgments that has been brought to our attention by some native speakers.[20] These speakers report judgments that differ from what we reported above in two correlating ways: (i) they do not detect an intervention effect in the crucial cases we have been considering, but (ii) the position of relative pronouns in non-restrictive RPPP is sensitive to syntactic islands. Below we show these judgments using the same data set we introduced above:

(56) For some speakers, no intervention effects are observed in RPPP:
I want to try this recipe,
   a. $^\checkmark$[$_{RC}$ [$_{RPPP}$ the ingredient(s) for *which*] I have ___ at home].
   b. $^\checkmark$[$_{RC}$ [$_{RPPP}$ **no** ingredient(s) for *which*] I have ___ at home].
               (cf 27–28)

(57) For these speakers, the relative pronoun cannot be inside an island:
   a. $^\checkmark$This portrait, [$_{RC}$ [$_{RPPP}$ the background of *which*] is quite stunning], sold for a million dollars at auction.
   b. * This portrait, [$_{RC}$ [$_{RPPP}$ the background [$_{RC}$ that was chosen for *which*]] is quite stunning], sold for a million dollars at auction.
               (cf 12)

This indicates that the analysis of non-restrictive relatives that these speakers have converged on is importantly different than that of the majority of speakers we have consulted with for this paper: instead of using Rooth-Hamblin alternatives to compute RPPP in non-restrictive relatives, these speakers are using a movement

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20 We thank Anonymized for pointing this out to us.

strategy. The movement strategy is predicted to be sensitive to syntactic islands but not to intervention effects, as we can observe in the judgments above.[21]

5   Conclusion

In this paper we argued that restrictive and non-restrictive relative clauses have a fundamentally different semantic interpretation: restrictive relatives are *property-denoting*, while non-restrictive relatives are *proposition-denoting*, as also argued by Del Gobbo (2007). We support this view through novel data on the behavior of *intervention effects* in relative pronoun pied-piping (RPPP): only in-situ modes of interpretation (not movement) are sensitive to intervention effects, and indeed only RPPP in non-restrictive RCs show intervention effects, and furthermore they do not exhibit island effects. Restrictive RCs, on the other hand, are subject to stricter size restrictions, and do not exhibit intervention effects.

   We propose that non-restrictive relatives are interpreted through a combination of movement of a relative pronoun—with pied-piping—and alternative computation inside pied-piping. This bring RPPP in line with other instances of pied-piping in *wh*-questions and focus constructions, allowing for a uniform semantics for pied-piping (cf Cable 2007, 2010). Restrictive relatives, on the other hand, use covert movement to interpret the relative pronoun in pied-piping.

   To derive the meaning of the non-restrictive relative clause, we propose that the relative pronoun projects a singleton alternative set, corresponding to the RC's antecedent. Following Demirdache (1991), we treat this antecedent as an E-type anaphor. This allows us to directly compute the proposition denoted by the non-restrictive RC without first computing the corresponding property.

   This proposal helps explain two previously unexplained differences between restrictive and non-restrictive relatives in English. First, the fact that relative pronouns must be used in order to arrive at the propositional denotation of a non-restrictive RC explains why non-restrictive relatives in English can only be constructed using relative pronouns, whereas restrictive relatives also have a *that*/∅ complementizer option. Second, the semantics of Rooth-Hamblin alternative computation, used to interpret relative pronouns in non-restrictive relatives, is insensitive to syntactic barriers such as islands. This helps to explain why RPPP in these RCs can be

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21 We speculate that this difference is due to the relatively scarce data children are exposed to when acquiring the structure of relative clauses. However, we leave to future work any attempt to quantify how often the Rooth-Hamblin alternatives method vs. the movement method is used. We note in passing that among the speakers we have consulted, the pattern reported in the rest of the paper is the most prevalent, with only a handful of speakers reporting the judgments we present in the current section.

substantially larger than in restrictive RCs, and why the relative pronoun's position inside its pied-piping is sensitive to islands only in restrictive relatives.

References

Beck, Sigrid. 1996. Quantified structures as barriers for LF movement. *Natural Language Semantics* 4. 1–56.

Beck, Sigrid. 2006. Intervention effects follow from focus interpretation. *Natural Language Semantics* 14. 1–56.

Beck, Sigrid & Shin-Sook Kim. 1997. On *wh-* and operator scope in Korean. *Journal of East Asian Linguistics* 6. 339–384.

Beck, Sigrid & Shin-Sook Kim. 2006. Intervention effects in alternative questions. *Journal of Comparative German Linguistics* 9. 165–208.

Bhatt, Rajesh. 2002. The raising analysis of relative clauses: evidence from adjectival modification. *Natural Language Semantics* 10. 43–90.

Cable, Seth. 2007. *The grammar of Q*: Massachusetts Institute of Technology dissertation.

Cable, Seth. 2010. *The grammar of Q: Q-particles, wh-movement, and pied-piping*. Oxford.

Chomsky, Noam. 1977. On *wh*-movement. In Peter Culicover, Thomas Wasow & Adrian Akmajian (eds.), *Formal syntax*, 71–132. New York: Academic Press.

Chomsky, Noam. 1993. A minimalist program for linguistic theory. In Kenneth Hale & Samuel Jay Keyser (eds.), *The view from Building 20*, 1–52. MIT Press.

Cinque, Guglielmo. 2008. Two types of non-restrictive relatives. In Olivier Bonami & Patricia Cabredo Hofherr (eds.), *Empirical issues in syntax and semantics 7*, 99–137.

Del Gobbo, Francesca. 2003. *Appositives at the interface*: University of California Irvine dissertation.

Del Gobbo, Francesca. 2007. On the syntax and semantics of appositive relative clauses. In Nicole Dehe & Yordanka Kavalova (eds.), *Parentheticals* (Linguistik Aktuell 106), 173–201. John Benjamins.

Demirdache, Hamida Khadiga. 1991. *Resumptive chains in restrictive relatives, appositives, and dislocation structures*: Massachusetts Institute of Technology dissertation.

Emonds, Joseph. 1976. *A transformational approach to English syntax*. Academic Press.

Emonds, Joseph. 1979. Appositive relatives have no properties. *Linguistic Inquiry* 10(2). 211–243.

Erlewine, Michael Yoshitaka & Hadas Kotek. 2014. Intervention in focus pied-piping. In Hsin-Lun Huang, Ethan Poole & Amanda Rysling (eds.), *Proceedings*

of NELS 43, vol. 1, 117–130.

Fox, Danny. 1999. Reconstruction, binding theory, and the interpretation of chains. *Linguistic Inquiry* 30(2). 157–196.

Hamblin, Charles. 1973. Questions in Montague English. *Foundations of Language* 10(1). 41–53.

Heim, Irene & Angelika Kratzer. 1998. *Semantics in generative grammar*. Blackwell.

Hulsey, Sarah & Uli Sauerland. 2006. Sorting out relative clauses. *Natural Language Semantics* 14. 111–137.

Jackendoff, Ray. 1977. *X-bar syntax: A study of phrase structure*. MIT Press.

Karttunen, Lauri. 1976. Discourse referents. In James D. McCawley (ed.), *Notes from the linguistic underground*, vol. 7 Syntax and Semantics, 363–385. Academic Press.

Kayne, Richard. 1994. *The antisymmetry of syntax*. MIT Press.

Kim, Shin-Sook. 2002. Intervention effects are focus effects. In *Japanese/korean linguistics 10*, 615–628.

Kotek, Hadas. 2014a. *Composing questions*: Massachusetts Institute of Technology dissertation.

Kotek, Hadas. 2014b. Intervention out of islands. In Jyoti Iyer & Leland Kusmer (eds.), *Proceedings of NELS 44*, vol. 1, 234–246.

Kotek, Hadas & Michael Yoshitaka Erlewine. to appear. Covert pied-piping in English multiple *wh*-questions. *Linguistic Inquiry* .

Kratzer, Angelika & Junko Shimoyama. 2002. Indeterminate pronouns: the view from Japanese. In *The proceedings of the third Tokyo Conference on Psycholinguistics (TCP 2002)*, 1–25.

Lebeaux, David. 1988. *Language acquisition and the form of the grammar*: University of Massachusetts Amherst dissertation.

McCawley, James. 1988. *The syntactic phenomena of English*. University of Chicago Press.

McCawley, James D. 1981. The syntax and semantics of English relative clauses. *Lingua* 53. 99–139.

McKinney-Bock, Katherine. 2013. Deriving split-antecedent relative clauses. In *Proceedings of PLC 36*, 113–122.

Nanni, Debbie L. & Justine T. Stillings. 1978. Three remarks on pied piping. *Linguistic Inquiry* 9(2). 310–318.

Partee, Barbara Hall. 1973. Some transformational extensions of Montague grammar. *Journal of Philosophical Logic* 2.

Perlmutter, David M. & John Robert Ross. 1970. Relative clauses with split antecedents. *Linguistic Inquiry* 1(3). 350.

Pesetsky, David Michael. 2000. *Phrasal movement and its kin* (Linguistic Inquiry Monographs 37). MIT Press.

Poschmann, Claudia. 2013. Attaching non-restrictive relatives to plural quantificational heads. In Maria Aloni, Michael Franke & Floris Roelofsen (eds.), *Proceedings of the 19th Amsterdam Colloquium*, 171–178.

Potts, Christopher. 2002. The lexical semantics of parenthetical-*as* and appositive-*which*. *Syntax* 5(1). 55–88.

Potts, Christopher. 2005. *The logic of conventional implicatures*. Oxford University Press.

Potts, Christopher. 2013. Presupposition and implicature. In *The handbook of contemporary semantic theory, second edition*, Oxford: Wiley-Blackwell.

Quine, Willard Van Orman. 1960. *Word and object*. Cambridge.

Rooth, Mats. 1985. *Association with focus*: University of Massachusetts, Amherst dissertation.

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1. 75–116.

Ross, John Robert. 1967. *Constraints on variables in syntax*: Massachusetts Institute of Technology dissertation.

Safir, Ken. 1999. Vehicle change and reconstruction in $\overline{\text{A}}$-chains. *Linguistic Inquiry* 30(4). 587–620.

Sauerland, Uli. 1998. *The meaning of chains*: Massachusetts Institute of Technology dissertation.

Sauerland, Uli & Fabian Heck. 2003. LF-intervention effects in pied-piping. In *Proceedings of NELS 33*, 347–366.

Sells, Peter. 1985. Restrictive and non-restrictive modification. Tech. Rep. CSLI-85-28 Center for Study of Language and Information, Stanford.

Shimoyama, Junko. 2001. *Wh-constructions in Japanese*: University of Massachusetts Amherst dissertation.

de Vries, Mark. 2006. The syntax of appositive relativization: On specifying coordination, false free relatives, and promotion. *Linguistic Inquiry* 37(2). 229–270.

Sternefeld, Wolfgang. 2001. Partial movement constructions, pied piping, and higher order choice functions. In *Audiatur vox sapientiae: A festschrift for Arnim von Stechow*, 473–486.

Taglicht, Josef. 1972. A new look at English relative constructions. *Lingua* 29. 1–22.

Thompson, Sandra A. 1971. The deep structure of relative clauses. In Charles J. Fillmore & D. Terence Langendoen (eds.), *Studies in linguistic semantics*, New York: Holt, Reinhart, and Winston.

Thorne, James Peter. 1972. On nonrestrictive relative clauses. *Linguistic Inquiry* 3(4). 552–556.

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