Wh-reciprocals, quantifier raising, and Binding Theory*

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1 Goals

• Establish a constellation of facts regarding a class of sentences I call *wh*-reciprocals:

(1) John and Mary wondered what each other would win.

• Demonstrate that *wh*-reciprocals are not marginal, and merit detailed investigation.

• Discuss some strong parallels between *wh*-reciprocals and the distribution of wide-scope each NP in embedded clauses.

• Argue that *wh*-reciprocals are licensed by quantifier raising (QR).

2 *Wh*-reciprocals: background

A central observation of Binding Theory (BT): English anaphors may not appear in the subject position of a finite clause.

(2) a. *Himself, knew that Sally saw him_1.
   b. *[Sally and John], knew that [each other], left.

• Attempts to explain the prohibition against finite subject anaphors have often required additional mechanisms beyond the basic conditions on the binding of anaphors.

  ◦ The ‘anaphor agreement effect’ (Rizzi 1990)
  ◦ Conditions on chain formation (Reinhart and Reuland 1993)
  ◦ Morphological gaps (Brame 1977; Pollard and Sag 1992)

The exception: subject reciprocals are licensed in a systematic set of finite embedded *wh*-clauses.

(3) [John and Mary], wondered [CP what [each other], would win].

• Sentences like (3) will be called *wh*-reciprocals.

*Thanks to Jim McCloskey, Matt Wagers, and Adrian Brasoveanu for advice and support on this project.
2.1 The empirical status of \textit{wh}-reciprocals

- \textit{Wh}-reciprocals were noted in the syntactic literature as early as Lebeaux (1983).
- Though \textit{wh}-reciprocals have been discussed in subsequent research, they have largely been dismissed as ‘marginal’ (e.g. Woolford 1999:261n).
- But \textit{wh}-reciprocals are well-attested in large balanced corpora...
  
  - Corpus of Contemporary American English (COCA; http://www.americancorpus.org/)
  - 400+ million words, including both spoken and written English, balanced for genre.
  - COCA contains (at least) 41 \textit{wh}-reciprocals:

\begin{itemize}
  \item \textit{Wh}-reciprocals found in COCA
    \begin{itemize}
      \item a. We can talk to each other or understand what \textit{each other} did.
      \item b. In a business world they had a lot of faith in what \textit{each other} had to say.
      \item c. How do you know we don’t feel what \textit{each other}...
      \item d. They never really listened to each other or cared that much about what \textit{each other} said.
    \end{itemize}
\end{itemize}

- ...and many speakers find \textit{wh}-reciprocals fully acceptable.
  
  - An informal survey of 62 speakers of American English found that \textit{wh}-reciprocals were rated nearly as good as control sentences (1 = unacceptable, 5 = perfect).

\begin{itemize}
  \item a. Maggie and Linda wondered what \textit{each other} ate for breakfast. (Median = 4)
  \item b. Cooper and Emma wondered what \textbf{Alicia} sent to the mayor. (Median = 5)
\end{itemize}

2.2 Two core contrasts

\textit{Wh}-reciprocals are more acceptable than corresponding examples that:

- Lack \textit{wh}-movement in the embedded clause.\footnote{Such examples are attested in COCA, but at a much lower rate than \textit{wh}-reciprocals (\textit{that each other} = 6; \textit{whether each other} = 2; \textit{if each other} = 0).}

\begin{itemize}
  \item ??\textit{[Jacob and Ralph]}$_1$ knew \textit{[\textit{CP that} [each other], lived in Boston]}]. (SURV)
\end{itemize}

- Contain an embedded subject \textit{reflexive}.

\begin{itemize}
  \item *\textit{Katja}, found out \textit{[\textit{CP what} \textit{herself}, won in the contest]}]. (SURV)
\end{itemize}

- The analysis developed here will focus on explaining these two contrasts.
2.3 *Wh*-reciprocals are not logophors

Some instances of English anaphors have been analyzed as *logophors*, i.e. anaphors that are exempt from Condition A of BT (e.g. Pollard and Sag 1992; Reinhart and Reuland 1993).

(8) Logophoric anaphors (Pollard and Sag 1992:264-5)

a. [Kim and Sandy]_i knew that Computational Ichthyology had rejected [each other]'s papers.

b. [Each student]_i was confident that the teacher would criticize everyone but himself.

*Wh*-reciprocals are not logophoric:

(i) Logophoric anaphors can be licensed over a distance (see (8)), but *wh*-reciprocals cannot.

(9) a. *[Maggie and Curt]_i thought Jasmine read what [each other]_i wrote.

b. *We_i knew he would understand what [each other]_i wanted. (Bruening 2006)

(ii) Logophoricity doesn’t explain why embedded subject reflexives are prohibited.

(10) *Jaime_i wondered [CP what himself damaged in the engine]. (SURV)

• The ungrammaticality of (10) cannot be attributed to the lack of morphologically nominative anaphors in English (*cf.* Brame 1977; Pollard and Sag 1992).

  ∙ *wh*-reciprocals do contain (syntactically) nominative anaphors.²

(11) a. [John and Bill]_i knew what [each other]_i won at the fair.

b. John_i knew what he_i/*him_i won at the fair.

  ∙ Nominative each other is still subject to Condition A.

(12) a. *[Each other]_i left.

b. *Herself_i slept.

  ∙ Ungrammaticality of matrix subject reflexives and reciprocals should be given a unified explanation.

²Note further that Irish English actually allows subject reflexives in matrix clauses (though without a reflexive interpretation):

(i) Did *himself* come home yet?  (Irish English; Jim McCloskey p.c.)

Nevertheless, sentences like (10) are also ill-formed in Irish English.
3 Wh-reciprocals are licensed by QR

What’s so special about each other?

- Heim, Lasnik and May (1991): each other is both anaphoric and quantificational.
  - each other contains the universal (distributive) quantifier each.
  - each other must be locally bound like a reflexive.

- The quantificational character of each other explains why it requires a plural antecedent (Heim et al. 1991; McCloskey 2005).

(13) a. [The spies]$_i$ suspected [each other]$_i$.
    b. *[The spy]$_i$ suspected [each other]$_i$.

Key claim: since each other is quantificational, it is eligible to undergo quantifier raising (QR).

3.1 Binding each other by QR

Proposal: in wh-reciprocals, each other undergoes covert QR to the edge of the embedded CP, and can then be bound from the matrix clause.

Local domain for Condition A: minimal TP/CP containing the anaphor.

- Immediately explains why subject reflexives are prohibited in finite embedded clauses.\(^3\)

(14) a. *Mary was deciding [CP whether [TP herself should leave] ]. (Lebeaux 1983)
    b. *John didn’t know [CP what [TP himself had done] ]. ibid.

- What about wh-reciprocals?
  - Embedded subject reciprocals undergo covert QR to the edge of their immediately containing CP.
  - After QR, each other can be bound from outside the embedded clause.

\(^3\)Examples like (14a) are problematic for versions of BT that assume the local domain for Condition A is the minimal strong phase, i.e. phase with a filled specifier (Lee-Schoenfeld 2004; Quicoli 2008). In (14a), the specifier of the embedded CP is empty, yet the reflexive herself cannot be bound by the matrix subject (which presumably originates in [SPEC,vP], the next-highest phase).
Embedded subject reciprocals undergo QR to CP. 4

After undergoing QR, each other can be bound within the matrix vP.

Recent phase-based approaches to binding assume that the local domain for the binding domain of anaphors is no smaller than vP.

- Minimal strong phase (e.g. Lee-Schoenfeld 2004; Quicoli 2008).
- Any domain accessible to binding by v head (e.g. Kratzer 2009).

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If the local domain for Condition A is the minimal CP containing the anaphor, then QR must involve adjunction rather than movement to a specifier position (cf. Bruening 2001). Otherwise, after QR each other would still be contained within the embedded CP.
3.2 **Wh-reciprocals and wide-scope each NP**

Is there independent evidence for QR of *each other* in *wh*-reciprocals?

- Wide-scope readings of subject *each NP* are possible in embedded clauses, but only if *wh*-movement has occurred (Moltmann and Szabolcsi 1994; Krifka 2001; Fox 2000).

(17) \[\text{DP Some waiter] knows } [\text{CP that [DP each customer] will tip well}. (\ast \text{each } \gg \text{some})\]

(18) \[\text{DP Some teacher] knows } [\text{CP what [DP each student] likes to read}. (\checkmark \text{each } \gg \text{some})\]

- Wide-scope subject *each NP* is found in *exactly* those embedded clauses that permit subject reciprocals.

(19) a. ??[Jamal and Dan]$_i$ knew [CP that [each other]$_i$ lived in Boston].
   b. [Jamal and Dan]$_i$ knew [CP where [each other]$_i$ lived in Boston].

*Wh*-reciprocals and wide-scope subject *each NP* have the same distribution in embedded clauses.

- Suggests that embedded wide-scope subject *each NP* and *wh*-reciprocals are licensed by the same mechanism: **QR**.\(^5\)

Why should QR of *each other*/*each NP* depend on *wh*-movement?

- **Scope Economy** (Fox 2000): optional QR is only licensed when it would lead to an interpretive difference.

- QR of *each other*/*each NP* is semantically vacuous unless it alters scope relations with another scope-bearing element, e.g. a *wh*-expression.

3.3 **Obligatory QR and pair-list readings**

This analysis entails that QR of *each other* is obligatory in *wh*-reciprocals.

**Prediction:** *each other* should always outscope the *wh*-expression in the embedded [SPEC,CP].

(20) \[\text{[CP... DP$_i$... [CP } \text{wh [DP each other]$_i$...]]}\]

\(^5\)The idea that *wh*-reciprocals might be licensed by having *each other* take scope over the embedded *wh*-expression is mentioned in passing in Moltmann and Szabolcsi (1994:386).
The scope each NP ∪ wh gives rise to pair-list readings of quantifiers (May 1985; Moltmann and Szabolcsi 1994; Krifka 2001).

(21) What did each boy see?
   a. What is the x such that every boy saw x? (what ∪ each)
   b. For every boy y, what did y see? (each ∪ what)

Prediction is borne out: wh-reciprocals allow pair-list readings, but not single-answer readings.

(22) John and Bill knew what each other bought.
   a. *∃x: John knew Bill bought x ∧ Bill knew John bought x. (*wh ∪ each)
   b. ∃x: John knew Bill bought x ∧ ∃y: Bill knew John bought y. (√ each ∪ wh)

(23) A: John and Bill found out what each other saw at the aquarium.
    B1: Yeah, John saw a shark, and Bill saw an otter, right?
    B2: #Yeah, a trout, right?

A problem: single-answer reading (22a) is a special case of pair-list reading (22b) (i.e. it just happens to be the case that x = y).

But availability of pair-list reading (22b) shows that QR of each other is at least possible in wh-reciprocals.

3.4 Aggressively non-D-linked wh-expressions

Aggressively non-D-linked wh-expressions (‘wh the hell’) do not allow for pair-list interactions with universal quantifiers (den Dikken and Giannakidou 2002).

(24) What the hell did everyone buy for Max? (*every ∪ what)

So ‘wh the hell’ expressions do not license QR of universal quantifiers (or QR is blocked; see den Dikken and Giannakidou 2002).

‘Wh the hell’ expressions also fail to license wh-reciprocals.

(25) a. I wonder what the hell Dave bought at the store.
    b. ??We wonder what the hell each other bought at the store.

(26) a. I don’t know what the hell Dave found in the basement.
    b. ??We don’t know what the hell each other found in the basement.

Consistent with the claim that wh-reciprocals are licensed under QR.
4 Further predictions

If \(wh\)-reciprocals are licensed by QR, then \(wh\)-reciprocals should be possible in every position that allows for wide-scope readings of each \(NP\), provided a local antecedent is available.

4.1 QR over \(wh\)-traces

Wide-scope readings of universal quantifiers can be licensed by intermediate \(wh\)-traces (Fox 2000:65n):

\[
(27) \begin{align*}
\text{a. } & \text{What did you say that each boy bought?} \\
\text{b. } & \text{What did you say } [\text{CP } \langle \text{what} \rangle \text{ that each boy bought}]? \quad (\check{each} \gg \text{what})
\end{align*}
\]

\(Wh\)-reciprocals can also be licensed by intermediate \(wh\)-traces.

\[
(28) \begin{align*}
\text{a. } & \text{?What did [Lupe and Adam]\textsubscript{i} think [each other]\textsubscript{i} baked for dessert?} \quad (\text{SURV}) \\
\text{b. } & \text{?What did [Lupe and Adam]\textsubscript{i} think } [\text{CP } \langle \text{what} \rangle \text{ [each other]\textsubscript{i} baked}..]? \\
\end{align*}
\]

4.2 Predicting non-parallelism for each other and each \(NP\)

Wide-scope each \(NP\) is also possible in several configurations that do not license \(wh\)-reciprocals.

(i) \(Wh\)-reciprocals are not licensed across two clause boundaries.

\[
(29) \quad \text{Someone knew } [\text{CP what Emma said } [\text{CP that each boy bought}]].^6 \quad (\check{each} \gg \text{some})
\]

\[
(30) \quad *[\text{Kenji and Sean}i, \text{i knew } [\text{CP what Tom said } [\text{CP [each other]i stole}]]. \quad (\text{SURV})
\]

(ii) \(Wh\)-reciprocals are not licensed in embedded object position.

\[
(31) \quad \text{I know which boy John introduced each girl to.}^7 \quad (\check{each} \gg \text{which})
\]

\[
(32) \quad *[\text{Sonja and Kim}i, \text{i knew } [\text{CP who Carlos introduced [each other]i to}}]. \quad (\text{SURV})
\]

---

4.2.1 Limiting QR of each other

What might explain the breakdown in parallelism between each other and wide-scope each NP?

**Proposal:** each other can only undergo one instance of QR.

(i) Wh-reciprocals are not licensed across two clause boundaries.

(33) a. *[Kenji and Sean], knew what Tom said [each other], stole.
    b. *[Kenji and Sean], knew [CP what Tom said [CP ⟨what⟩ [each other], stole]].

- each other must attach to the highest embedded CP in order to be bound from the matrix clause.
- Locality conditions prevent each other from raising directly to the highest embedded CP (Fox 2000; Bruening 2001).
- Licensing each other across two clause boundaries thus requires two instances of QR, one to each embedded CP.
- The second instance of QR is illicit.

(ii) Wh-reciprocals are not licensed in embedded object position.

(34) a. *[Sonja and Kim], knew who Carlos introduced [each other], to.
    b. *[Sonja and Kim], knew [CP who Carlos [vP introduced [each other], to]].

- Object quantifiers must undergo QR to vP to avoid type-clash and allow interpretation (Heim and Kratzer 1998; Fox 2000).
- Since each other is quantificational, object each other obligatorily raises to vP.
- QR to vP prevents each other from raising any further.
Regular (non-anaphoric) quantifiers freely undergo multiple instances of QR, as long as each application is independently licensed.  

(35)  
a. Someone knows what you said that each boy bought.  
\[ (√ \text{each} \gg \text{some}) \]
b. Someone knows [CP what you said [CP ⟨what⟩ that [each boy] bought]].

(36)  
a. I know which boy John introduced each girl to.  
\[ (√ \text{each} \gg \text{which}) \]
b. I know [CP which boy John [vP introduced [each girl] to]].

But why is each other restricted to a single instance of QR?

5 Why are \textit{wh}-reciprocals (sometimes) degraded?

If \textit{wh}-reciprocals are indeed well-formed for many speakers (see section 2.1), why have they been characterized as marginal in previous literature?

(i) An agreement puzzle

- \textit{Wh}-reciprocals interact with subject-verb agreement in a non-uniform pattern.
  - Some \textit{wh}-reciprocals are found with singular verb agreement…

(37) \textit{Wh}-reciprocals with singular verb agreement (COCA)  
a. Now they know what each other is doing.  
b. We have enough mutual respect to know where each other resides.
  
- …but other \textit{wh}-reciprocals are found with plural verb agreement.

(38) \textit{Wh}-reciprocals with plural verb agreement (COCA)  
a. We pretty much know what each other are going to do before it’s done.  
b. We are all aware enough of what each other need.

- In some cases, verb agreement appears to be contingent on the plurality of the \textit{wh}-expression (see also Kimball and Aissen 1971; Kayne 2000).

(39)  
a. Sally and Ralph forgot \textit{which medication} each other ?\textit{was/\*were} taking.  
b. Sally and Ralph forgot \textit{which medications} each other ??\textit{was/were} taking.

\footnote{Though cf. Bošković (2008) for arguments to the contrary.}
• World knowledge may play a role.

(40)  
   a. ?The farmers know what each other plants in February.
   b. The farmers know what each other plant in February.

• The subtleties of determining verb agreement with *wh*-reciprocals may detract from their well-formedness.

• Potential explanations:
  ○ The ‘anaphor agreement effect’ (Rizzi 1990; Woolford 1999).
  ○ Performance factors, such as constraints on working memory (Wagers et al. 2009).
  ○ Subject reciprocals are otherwise prohibited in finite clauses; speakers may simply not know whether each other triggers singular or plural agreement.

• But agreement can’t be the whole story.
  ○ Survey controlled for agreement by using only past-tense verbs, with syncretism for singular/plural agreement.
  ○ *Wh*-reciprocals were still found to be somewhat degraded when compared with controls.

(ii) Variation in scope taking

• *Wh*-reciprocals require inverse, non-surface scope for each other.

• Within a speech community, speakers differ in their ability to assign inverse scope to quantifiers (e.g. Carden 1976; Gil 1982; Lasnik and Uriagereka 1988).

• Idiolectal and dialectal factors likely affect the acceptability of *wh*-reciprocals.

6 Conclusions

• *Wh*-reciprocals are well-formed for many speakers, though confounding factors like verb agreement can lead to degradation.

• *Wh*-reciprocals are fully compatible with recent Minimalist versions of Binding Theory: their acceptability is a direct consequence of the quantificational nature of each other.

• This analysis explains why embedded subject reciprocals are only mildly ungrammatical in the absence of *wh*-movement (e.g. (6)).
  ○ QR of each other depends on a previous instance of *wh*-movement.
  ○ Licensing subject reciprocals without prior *wh*-movement requires illicit scope taking.
Subject reciprocals without \textit{wh}-movement should be no worse than cases of illicit inverse quantifier scope.

(41) \begin{minipage}{0.95\linewidth}
\begin{itemize}
  \item a. ??Will and Pete knew that each other left.
  \item b. Someone knew that each boy left. \hfill (??each \gg some)
\end{itemize}
\end{minipage}

- Anaphor binding must interact with covert movement like QR (at some level).

### 6.1 Further prospects

Are \textit{wh}-reciprocals particular to English?

- The above analysis predicts that \textit{wh}-reciprocals should be possible in a given language only if that language has a quantificational reciprocal.

- German and Irish, which have non-quantificational reciprocals, do not allow \textit{wh}-reciprocals.

(42) \begin{minipage}{0.95\linewidth}
\begin{quote}
\[ \textit{Hans und Wilhelm wussten, was \textit{einander} gewonnen hadte}. \]
\end{quote}
\end{minipage}
\begin{quote}
\begin{itemize}
  \item Hans and Wilhelm know\textit{past} what each-other won had
  \item ‘Hans and Wilhelm knew what each other had won.’
\end{itemize}
\end{quote}

(43) \begin{minipage}{0.95\linewidth}
\begin{quote}
\[ \textit{\textsc{N}é\textsc{´ı}or thug \textit{siad caidé a \textit{dúirt} a \textit{chéile}}}. \]
\end{quote}
\end{minipage}
\begin{quote}
\begin{itemize}
  \item \textsc{NEG\textit{past}} understand they what C said each-other
  \item ‘They didn’t understand what each other said.’
\end{itemize}
\end{quote}

- Missing from the typology: another language that \textit{does} have a quantificational reciprocal.

### References


\begin{footnotesize}
\begin{itemize}
  \item[10] Jim McCloskey, p.c.
\end{itemize}
\end{footnotesize}


7 Appendix: survey results

‘nm’ = control with reciprocal replaced by name (see (6))
‘ref’ = control with reciprocal replaced by reflexive (see (7))
‘LQ’ = long-distance licensing with matrix question (see (28))
‘LD’ = long-distance licensing with declarative (see (30))
‘wh_isl’ = control with wh-island violation (Complex NP)

7.1 Wh-reciprocals and controls

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7.2 Object *wh*-reciprocals

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**Wh–reciprocals: object position**

Sentence Type

Responses

n=221 n=213 n=218

what obj obj_name
7.3 Long-distance antecedents

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Wh-reciprocals: long-distance antecedents