Quantifier Raising: A historical précis
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1 Introduction

• How sensitive are the truth conditions of a sentence to its syntactic structure?

(1) Two views about scope (e.g. of quantifiers):

a. The ‘transparent LF’ view (May 1985)
Scope relationships are set in the syntax and mapped transparently to the semantics.

b. Direct compositionality (Cooper 1983; Barker 2002)
Scope relationships can be set by the semantic interpretation.

• If scope established by independently needed syntactic processes, then (1a) would be preferred.
• Today I will focus on is the extent to which (1a) is a viable alternative.

2 QR according to May (1985)

• Quantifiers in object position are of the wrong type to be composed with verbs

(2) a. John [VP saw everyone ]

b. \([\text{see}] = \lambda x \lambda y [\text{see}(y, x)]\)

c. \([\text{everyone}] = \lambda Q (e, t) \forall x [\text{person}(x) \rightarrow Q x]\)

• Allowing the quantifier to move above the verb — QR — solves this problem:

(3) a. \([S \text{ everyone } 1 [S \text{ John } [VP \text{ saw } x_1]]]\)

b. \([1 \text{ John saw } x_1] = \lambda y [\text{see}(j, y)]\) (by Predicate Abstraction)

c. \([\text{everyone}] (\lambda y [\text{see}(j, y)]) = \forall x [\text{person}(x) \rightarrow \text{see}(j, x)]\)

• The clearest syntactic parallel to QR in this view is wh-movement.

(4) a. \([S\text{ who} 2 [S \text{ did John see } t_2]]\)

b. \([S \text{ everyone} 2 [S \text{ John saw } t_2]]\)

1This section is based on May (1985), chapters 1 and 2. All examples are May’s unless otherwise cited.
2Throughout I use a syntax and an extensional semantics roughly equivalent to the (Heim and Kratzer 1998). I will mostly use every and some for illustration so I can stick with predicate logic interpretations.
• QR and wh-movement are not identical: wh-movement is viewed as movement to COMP (today’s [Spec, CP]), QR is adjunction to S (today’s TP/IP). (We will return to this distinction below.)

• The main purpose of May’s book was to argue for a level of syntax called Logical Form (LF).

(5)  
\[
\text{deep structure (DS)} \rightarrow \text{surface structure (SS)} \rightarrow \text{logical form (LF)}
\]

• Overt wh-movement takes place between DS and SS, while QR takes place between SS and LF.

• Another application of LF (=covert) movement: Assume that the verbs believe, wonder, and know subcategorize for ±wh CP; and assume a wh-criterion s.t. a +wh-feature in COMP must be matched with an overt wh-word.

(6)  
a. Who	extsubscript{1} does Philby believe [S’ that[−wh] Angleton suspected \(t_1\)]?

b. Philby wonders [S’ who\textsubscript{1} COMP[+wh] Angleton suspected \(t_1\)].

(7)  
a. Who	extsubscript{1} does Philby know [S’ that[−wh] Angleton suspected \(t_1\)]?

b. Philby knows [S’ who\textsubscript{1} COMP[+wh] Angleton suspected \(t_1\)].

(8)  
from (Huang 1982b)

a. Zhangsan xiangxin [ ta muqin kanjian shei ]

Z. believes his mother see who
‘Who does Zhangsan believe that his mother saw?’

b. Zhangsan xiang-zhidao [ ta muqin kanjian shei ]

Z. wonders his mother see who
‘Zhangsan wondered who his mother saw.’

c. Zhangsan zhidao [ ta muqin kanjian shei ]

Z. knows his mother see who
a. ‘Who does Zhangsan know his mother saw?’

b. ‘Zhangsan knows who his mother saw.’

• So Chinese wh-movement is LF-movement; the wh-criterion holds at LF.

• Both QR and wh-movement trigger crossover effects, which supports a unified analysis.

(9)  
a. ??Who	extsubscript{1} [ does his\textsubscript{i} mother love \(t_1\)]?

b. ??His\textsubscript{i} mother loves everyone\textsubscript{i}.

c. everyone\textsubscript{i} [ his\textsubscript{i} mother loves \(t_1\)]

• QR also explains a problem brought up by Antecedent-Contained Deletion:

(10)  
The Infinite Regress Problem for ACD

a. Dulles [\(VP_1\) suspected Philby], and Angleton did \(\Delta_1\) too.

b. Dulles [\(VP_1\) suspected Philby], and Angleton did ⟨suspect Philby⟩ too

(11)  
a. Dulles [\(VP_1\) suspected everyone who Angleton did \(\Delta_1\).]

b. Dulles [\(VP_1\) suspected everyone who Angleton did ⟨suspect everyone who Angleton did \(\Delta_1⟩ ⟩

(12)  
a. [S [NP\textsubscript{2} everyone who Angleton did \(\Delta_1\)] [S Dulles [\(VP_1\) suspected \(t_2\)]]

b. [S [NP\textsubscript{2} everyone who Angleton did ⟨suspect \(t_2⟩ ⟩ [S Dulles [\(VP_1\) suspected \(t_2\)]]]
Quantifier Raising

• Interim summary:
  – QR allows quantificational objects to be interpreted with their natural type.
  – QR is LF movement, akin to wh-movement in Chinese.
  – QR triggers crossover effects, like wh-movement.
  – QR provides a natural solution to ACD.

• Recall that while wh-movement for May was movement to [Spec, CP], while QR was adjunction. This distinction was motivated by differences between multiple wh-questions (which show Superiority effects) and the ability of multiple quantifiers to take inverse scope:

  (13) a. \( \text{Who}_1 t_1 \text{ saw what?} \)
      b. \( *\text{What}_1 \text{ did who see} t_1 ? \)

  (14) a. Everybody saw somebody. (\( \forall > \exists, \exists > \forall \))
      b. \( \left[ S' \left[ S \text{ somebody}_2 \left[ S \text{ everybody}_1 \left[ S t_1 \text{ saw } t_2 \right] \right] \right] \right] \)

• May did not actually that scope ambiguity arises from structural ambiguity, only that QR enables scope ambiguities to arise based on the Scope Principle.\(^3\)

  (15) \( \alpha \text{ c-commands } \beta =_{df} \) for every maximal projection dominating \( \alpha \) dominates \( \beta \), and \( \alpha \) does not dominate \( \beta \).

  (16) \textit{Scope Principle} (paraphrase)
      For any occurrence of operators \( O_i \) and \( O_j \) where \( O_i \text{ c-commands } O_j \) and \( O_j \text{ c-commands } O_i \), \( O_i \) and \( O_j \) are free to take on any relative scope relation.

• The Scope Principle also accounted for the ambiguity of quantifiers in wh-questions:

  (17) \text{What did everyone buy for Max?}

  (18) a. Everyone bought Max a Bosendorfer piano.
      b. Mary bought Max a tie, Sally a sweater, and Harry a piano.

  (19) \( \left[ S' \left[ S \text{ what}_2 \left[ S \text{ everyone}_1 \left[ S t_1 \text{ buy } t_2 \text{ for Max} \right] \right] \right] \right] \)

• This ambiguity is surprising if scope at LF is isomorphic to semantic scope. More examples:

  (20) a. \text{Who did everyone say admired Bill?}
      b. \text{Who did everyone say Bill admired?}

  (21) a. \text{When did everyone see Max?}
      b. \text{When did Max see everyone?}

• However, pair-list readings are absent in subject wh-questions:

  (22) \text{Who bought everything for Max?}

  (23) a. Oscar bought everything for Max.
      b. Mary bought Max a tie, Sally a sweater, and Harry a piano.

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\(^3\)I think this is an sometimes forgotten piece of May’s theory, as other analyses make different assumptions. For example, Heim and Kratzer (1998) have syntactic ambiguity give rise to semantic ambiguity; they do not adopt anything like the Scope Principle.
(24)  a. Which of Dickens’s books has each of you read?
    b. Which of you has read each of Dickens’s books?

- May’s solution relies on the Empty Category Principle; \( t_1 \) in (25b) is not properly governed.\(^4\)

(25)  a. \([S’ \textit{what}_2 [S \textit{everyone}_1 t_1 \textit{buy}_2 \textit{for Max }]]\)
    b. \(*[S’ \textit{who}_1 [S \textit{everything}_2 t_1 \textit{buy}_2 \textit{for Max }]]\)

(26)  \([S’ \textit{who}_1 [S t_1 [\textit{VP} \textit{everything}_2 \textit{buy}_2 \textit{for Max }]]\)

- Setting these issues aside, we now move on to consider the relative scope of \(wh\)-movement and QR.

3 Quantifier scopes

- QR and \(wh\)-movement have obey \textit{prima facie} similar locality restrictions (Chomsky 1975; Rodman 1976).\(^5\) If the correlation were absolute, this would be another compelling argument for QR.

(27)  a. A doctor will interview every new patient.
    b. A doctor will try to assist every new patient personally.
    c. A doctor will make sure that we give every new patient a tranquilizer.

(28)  a. Which patients\(_1\) will a doctor interview \(t_1\)?
    b. Which patients\(_1\) will a doctor try to assist \(t_1\) personally?
    c. Which patients\(_1\) will a doctor will make sure that we will give \(t_1\) a tranquilizer?

(29)  a. A doctor will examine the possibility that we give every new patient a tranquilizer.
    b. A doctor should worry if we sedate every new patient.

(30)  a. *Which patients\(_1\) will a doctor will examine the possibility that we give \(t_1\) a tranquilizer?
    b. *Which patients\(_1\) should a doctor worry if we sedate \(t_1\)?

- But indefinites display ‘exceptional’ wide scope, violating islands for movement (e.g. Fodor and Sag 1982; Ruys 1992):

(31)  a. Somebody reported that Max and \textit{all the ladies} had disappeared.
    b. Somebody will be offended if we don’t invite \textit{most philosophers}.
    c. Many students believe anything that \textit{every teacher says}.

(32)  a. Everyone reported that Max and \textit{some lady} had disappeared.
    b. Most guests will be offended if we don’t invite \textit{some philosopher}.
    c. All students believe anything that \textit{many teachers say}.

\(^4\)Chierchia (1993) shows that if pair-list readings are ‘functional readings’, involving a covert variable, these facts can be reduced to Weak Crossover violations:

(i)  a. \([S’ \textit{what}_2 \textit{bought.by.him}_1 [S \textit{everyone}_1 t_1 \textit{buy}_2 \textit{for Max }]]\)
    b. \([S’ \textit{who}_1 \textit{that.bought.it}_2 [S \textit{everything}_2 t_1 \textit{buy}_2 \textit{for Max }]]\)

More recent analyses of pronouns as D-type anaphora (e.g. Elbourne 2005) could incorporate this insight easily.

\(^5\)This section borrows heavily from ch. 2 of Reinhart (2006). Unless cited otherwise, the examples are Reinhart’s.
• Wh-in situ — assumed to involve LF-movement since Huang (1982a) — also does not observe island restrictions:

(33)  
  a. Who reported that Max and which lady had disappeared?  
  b. Who will be offended if we don’t invite which philosopher?  
  c. Who believes anything that who says?

• Sluicing also does not observe island restrictions Ross (1969):

(34)  
  a. Max and some lady disappeared, but I can’t remember which lady ∆.  
  b. If a certain linguist shows up, we are supposed to be particularly polite, but do you remember who ∆?  
  c. Max will believe anything that someone will tell him, and you can easily guess who ∆?

On the other hand, for some reason, strong quantifiers (e.g. every, most) are even more restricted than wh-movement:

(35)  
  a. A doctor said that the nurse saw us give a tranquilizer to every new patient.  
  b. A doctor believes that the nurses said that every new patient is cured.

(36)  
  a. Who did a doctor say that the nurse saw us give a tranquilizer to?  
  b. Who does a doctor believe that the nurses said is cured?

• These observations led to the following view:
  
  – Overt wh-movement can occur over long distances/ successive cyclically, but not out of islands (like relative clauses).  
  – Covert movement, including QR, wh-in situ, and sluicing, do not observe island restrictions/subjacency effects.  
  – Strong quantifiers (e.g. every, most) are even more restricted than wh-movement, roughly clause-bound.

• This is not a pretty picture anymore; to some extent the initial promise of QR has been diminished.

4 Indefinites and choice functions

• Recall the exceptional wide-scope readings of indefinites:

(37)  
  a. Everyone reported that Max and some lady had disappeared.  
  b. Most guests will be offended if we don’t invite some philosopher.  
  c. All students believe anything that many teachers say.

• One way of trying to explain these away would be by treating indefinites as free variables, then applying existential closure (Heim 1982), wherever we needed to in the absence of QR (unselective binding). But this gives us bad truth conditions for examples with material implication:

(38)  
  a. If we invite some philosopher, Max will be offended.

6Heim never endorsed such a view; she assumes QR applies in these cases before EC.
b. **Unselective binding**: \( \exists x[(\text{philosopher}(x) \land \text{invite}(\text{we}, x)) \to \text{offended}(m)] \)

c. There is an individual \( x \) s.t. if \( x \) is a philosopher and we invite \( x \), then Max will be offended.

- “If (38a) is construed this way, can it every be used falsely? Not in our present world, where there are many non philosophers, hence, it is necessarily true that if they were both philosophers and invited, Max will be offended” (Reinhart 2006, p. 74).

(39) \( \text{QR: } \exists x[\text{philosopher}(x) \land (\text{invite}(\text{we}, x) \to \text{offended}(m))] \)

- The problem arises whenever the indefinite is lodged in a downward-entailing context:

(40) a. Every joke about some philosopher got published.

b. Max did not consider the possibility that some politician is corrupt.

(41) a. \( \text{QR: } \exists x[\text{politician}(x) \land \neg (\text{Max consider the possibility that } x \text{ is corrupt})] \)

b. **Unslt bndng**: \( \exists x[\neg (\text{Max consider the possibility that } (x \text{ is corrupt } \land x \text{ is a politician})]] \)

- “It is highly likely that there is some non politician entity about which Max did not consider the possibility that it is a politician (and corrupt) (Reinhart 2006, p. 75).

- Another problem comes from collective vs. distributive readings of plurals:

(42) a. A guard is standing in front of two buildings.

b. There are two buildings such that in front of each there stands a guard.

- Only the distributive reading in (42b) is predicted if ‘two’ is a quantized existential quantifier:

(43) \( \exists_2 x[\text{building}(x) \land \exists y[\text{guard}(y) \land \text{stands.in.front.of}(y, x)]] \)

- Yet distributive readings are not allowed if numerals are lodged in islands (Ruys 1992):

(44) If three relatives of mine die, I will inherit a house.

- Reinhart (1997) and Winter (1997) argue interpreting wide-scoping indefinites as choice functions solves these problems:

(45) **Choice function interpretation of (38a)**

a. \( \exists f[\text{CH}(f) \land (\text{we invite } f(\text{philosopher}) \to \text{Max will be offended})] \)

b. A function exists, such that if we invite the philosopher it selects, Max will be offended.

(46) **Choice function interpretation of (40b)**

a. \( \exists f[\text{CH}(f) \land \neg (\text{Max considered the possibility that } f(\text{politician}) \text{ is corrupt})] \)

b. A function exists, such that Max considered the possibility that the politician it selects is corrupt.

(47) **Choice function interpretation of (44)**

a. \( \exists f[\text{CH}(f) \land (f(\text{three relatives of mine die} \to \text{I inherit a house})] \)

b. \( \exists f[\text{CH}(f) \land (f(\{Y \mid \text{relatives-of-mine}(Y) \land Y \models 3\}) \text{ die} \to \text{I inherit a house})] \)
c. A function exists, such that if the three relatives of mine that it selects die, I inherit a house.

- Further comments:
  - There has been lots of debate about whether existential closure of choice functions is needed (Kratzer 1998; Matthewson 1999; Chierchia 2001).
  - Choice functions permit a promising unification of wide-scope indefinites and definite descriptions, which are well-known to allow differential scope, but are unrestricted in their scope like indefinites (Chierchia 2005). Note that $\iota$ is just a contextually restricted choice function.
  - Treating wide-scope indefinites as choice-functions allows us to abandon the idea that QR is not island sensitive; this allows us to view the locality restrictions on strong-quantifiers as the restrictions on true QR.
  - The collective/distributive interpretation of numeral indefinites above support this conclusion.

5 Towards an explanation for the clauseboundedness of QR

- Recall that strong quantifiers are “basically clause-bound.”

  (48) a. A doctor said that the nurse saw us give a tranquilizer to every new patient.
    b. A doctor believes that the nurses said that every new patient is cured.

  (49) a. Who did a doctor say that the nurse saw us give a tranquilizer to?
    b. Who does a doctor believe that the nurses said is cured?

- This section reviews modifications to QR theory since May (1985) which attempt to account for this distinction between wh-movement and QR.
- The basic thrust of these modifications is that QR is not actually wh-movement, but is only movement of the object to some lower position.
- In the late ‘80’s and early ‘90’s, syntacticians began to agree that the surface position of subjects in English is derived by movement from a lower, VP-internal position:

  (50) \[
  \text{IP Everybody}_1 \text{ didn’t [VP } t_1 \text{ talk to Mary ]}. \\
  \]

- At the same time, movement was reconceptualized as a copying operation (Chomsky 1993, 1995; Bobaljik 1995), where the same element was simply merged into the tree twice, rather than having a distinct operation “Move-$\alpha$”:

  (51) \[
  \text{IP Everybody}_1 \text{ didn’t [VP } \langle \text{everybody}_1 \rangle \text{ talk to Mary ]}. \\
  \]

- A major motivation for this view of movement was the observation that moved constituents, especially those which have wh-moved, seem to be interpreted in their base position:

  (52) a. [Which picture of himself$_1$]$_2$ did Max$_1$ take $t_2$?
    b. [Which]$_2$ did Max$_1$ take $\langle$ picture of himself$_1$]$_2$?

---

7This section draws from Johnson and Tomioka (1997); Fox and Nissenbaum (1999); Fox (2002, 2003) and Szabolcsi (2010).
8See McCloskey 1997 for a review of the arguments for this position; this is not controversial.
(53)  
  a.  [Which of his children]$_2$ did Max$_1$ kiss $t_2$?
  b.  [Which]$_2$ did Max$_1$ kiss ⟨of his children⟩$_2$

* The ability to interpret the lower copy, so-called reconstruction, enables a natural explanation for the ability of subjects to scope under negation:

(54)  [IP Everybody$_1$ didn’t [VP ⟨everybody⟩$_1$ talk to Mary]].

* Whether everybody has high or low scope comes down now to which copy is interpreted. Interpreting the lower copy is sometimes called Quantifier Lowering (QL).  

* This enables a view of object QR as movement a lower position, above the subject trace:

(55)  [IP Everybody$_1$ didn’t [VP ⟨someone⟩$_2$ [VP ⟨everybody⟩$_1$ talk to someone$_2$]]].

* Is there any evidence for this view? Johnson and Tomioka (1997) argue that there is:

(56)  Billy hasn’t answered two-thirds of the questions on the exam.
  a.  = Billy answered less than two-thirds of the questions on the exam. \( \neg > 3/2 \)
  b.  = Billy left two thirds of the questions of the questions on the exam unanswered. \( 3/2 > \neg \)

(57)  Some student or other hasn’t answered two thirds of the questions on the exam.
  a.  = There’s a student that answered two-thirds of the questions. \( 3_{\text{student}} > 3/2 \)
  b.  = Two thirds of the questions got answered. \( 3/2 > 3_{\text{student}} \)

* J&T argue that sentence like (58) show that (55) is on the right track:

(58)  Some student or other hasn’t answered two thirds of the questions on the exam.

* This isn’t as bad as it looks; some is a positive polarity item, so it can’t get below negation. This only leaves three interpretations, J&T argue that only the first two are possible:

(59)  a.  = There’s a student that answered just less than two-thirds of the questions.
  b.  = There’s a student that left two thirds of the questions unanswered.
  c.  = *For two thirds of the questions, there was a student that didn’t answer them.

(60)  a.  \( 3_{\text{student}} > \neg > 3/2 \)
  b.  \( 3_{\text{student}} > 3/2 > \neg \)
  c.  *= \( 3/2 > 3_{\text{student}} > \neg \)

* Johnson and Tomioka (1997) suggest that QR is like Scrambling in Germanic languages, specifically like Scrambling in Dutch, which allows object NPs to scramble past negation, like in German (61), but not past subjects (62):

(61)  . . . weil Hans ein neues Buch über Ellipse$_1$ nichtt $t_1$ gekauft hat.
    because Hans a new book about ellipses not bought has
    ‘. . . because Hans hasn’t bought a new book about ellipses.’

* May (1985) uses the term Quantifier Lowering for subject-to-subject raising examples where raised indefinites seem to be able to take scope in the lower clause. We will not have time to consider these examples today.
(62) *... omdat het boek een meisje gekocht heeft.
   since the book a girl bought has

- Scrambling is also clause-bound, and it allows NPs to be moved out of other NPs, like what May (1985) called inverse linking:

(63) Somebody from every city despises it.
(64) ... weil über Ellipse ein neues Buch erscheinen ist.
   because about ellipsis a new book published is
   “... because a new book about ellipsis was published”

- Is this the only position for QR though? A surprising set of data from Fox (2002, 2003) suggest that QNPs may also occur high, above the subject. Consider the following examples where wh-movement affects binding relations:

(65) a. [John and Bill], know [[ which picture of each other/ themselves Mary bought ]].
   b. (Guess) [which picture that John saw ] [he likes ].

- QR initially seems to lack the ability to affect binding relationships in this way:

(66) ??[John and Bill], said that [Mary bought [ every picture of each other/ themselves ]].

- However, if the lower subject is replaced with a quantifier, this doesn’t seem to be true any longer:

(67) a. ??The two rivals hoped that Bill would hurt (every one of) each other’s operations.
   b. The two rivals hoped that someone would hurt (every one of) each other’s operations.

- There is a further prediction, that (67b) should only allow the wide-scope reading for the object quantifier. The following examples seem to confirm this prediction:

(68) a. The two friends hoped that someone would buy each-other’s pictures of Mary.
   b. *The two friends hoped that someone would buy each-other’s pictures of himself.
   c. *The two friends hoped that someone would buy each other’s pictures of his mother.

- But what explains the ungrammaticality of (66)? Fox (2002) attributes it to Scope Economy (p. 21):

(69) Economy condition on scope shifting (Scope Economy)
   QP can apply only if it affects semantic interpretation (i.e., only if inverse scope and surface scope are semantically distinct.)

- Fox explicitly favors the lower position for QR, though, at least in his 2002 book:

(70) Shortest Move QR must move a QNP to the closest position in which it is interpretable. In other words, a QNP must always move to the closest clause-denoting element that dominates it.

- This prefers subject QL to object QR above the subject, which may just be forced in examples like (67b).

- Back to Scope Economy, it seems to be supported by a striking effects in VP-ellipsis:
(71) a. Some boy admires every teacher. Mary does, too. 
(b) Some boy admires every teacher. Every girl does, too.

(72) a. Some boy admires every teacher. Some girl does, too.
(b) Some boy admires every teacher. Many girls do, too.

- The explanation is the Parallelism requirement of ellipsis, which ensures that an elided clause must be syntactically isomorphic to its antecedent.
- Fox’s arguments also provide striking evidence that QR is syntactically real.
- Summary:
  - Locality constraints on QR are different from wh-movement; Scrambling is a closer parallel.
  - Subjects scope below objects and negation by reconstructing to their base position (‘QL’), not by undergoing further QR.
  - QR and QL may not always apply; they only do when interpretive differences are at stake.
  - Unlike May, these more modern approaches take scope to be isomorphic to syntactic height, rather than relying on the Scope Principle.
- To the extent that these revisions can be maintained, the syntactic view of scope is rehabilitated.

6 More problems

- Two further classes of problems:
  - Different scope possibilities for different quantifiers (Beghelli and Stowell 1997; Szabolcsi 1997):

(73) a. More than one soprano sings in every show.
   OK ‘every show has more than one (potentially different) soprano in it’
   b. Every soprano sings in more than one show.
      #‘more than one show has every soprano in it’

(74) a. Zdenka did not greet a famous soprano.
    OK ‘there is a famous soprano who Zdenka did not greet’
    b. Zdenka did not greet more than one famous soprano.
       OK ‘there is more than one famous soprano who Zdenka did not greet’
    c. Zdenka did not greet every famous soprano.
       #‘every famous soprano is such that Zdenka failed to greet her’

- Quantifiers can bind pronouns out of very deeply embedded positions (Barker 2012):

(75) a. [Everyone’s mother’s lawyer’s dog] likes him.
   b. [Someone from every city] hates it.
   c. [At least one picture of every senator] graced his desk.
   d. [After unthreading each screw], but before removing it, make sure to hold the screw in place while separating the screw from the driver.
   e. The grade [that each student receives] is recorded in his file.
References


Heim, Irene. 1982. The semantics of definite and indefinite noun phrases. Doctoral Diss., University of Massachusetts, Amherst.


