# Does position matter?
## Attaching NRCs to quantificational heads

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December 19, 2013

(1)    a.    Paul invited **Nick**, who lives next door.

        b.    Paul invited **Nick**. He lives next door.

(2)    a.    Paul invited **the/a boy**, who lives next door.

        b.    Paul invited **the/a boy**. He lives next door.

(3)    a.    Paul invited **every boy**, *who lives next door.

        b.    Paul invited **every boy**. *He lives next door.

(4)    a.    Paul invited **most boys**, who live next door.

        b.    Paul invited **most boys**. They live next door.

# Does position matter?

**Del Gobbo (2003)**:

(5)     a.     Paul invited **most students**, <span style="color:red">who</span> came very late.

          b.     **\*Most students**, <span style="color:red">who</span> arrived late, came to the party.

(6)     a.     Paul invited **most students**. <span style="color:blue">They</span> came very late.

          b.     **Most students** came to the party. <span style="color:blue">They</span> arrived late.

**Hypothesis I:** Position does affect the **grammaticality** of NRCs with plural quantificational heads. In sentence-internal (subject) position, NRCs with quantificational head are ungrammatical.

# Does position matter?

**Nouwen (2007):**

(7)    Paul interviewed less than half of the climbers, **who by the way were all French.**          (object/final)

     a.    **Restrictor-Set:** All Climbers were French.
     b.    **Intersection-Set:** All interviewed climbers were French.

(8)    Less than half of the climbers, **who by the way were all French**, reached the summit.         (subject/internal)

     a.    **Restrictor-Set:** All climbers were French.
     b.    (~~**Intersection-Set** All climbers that reached the summit were French.~~)

**Hypothesis II:** Position does affect the **interpretation** of NRCs with plural quantificational heads.

What's wrong with Del Gobbo's example?

(9)  #Most students, who arrived very late, came to the party.

    a.  **Matrix-Clause:**
        Most (but not all) students came to the party.

    b.  **NRC (Restrictor Set-Reading):**
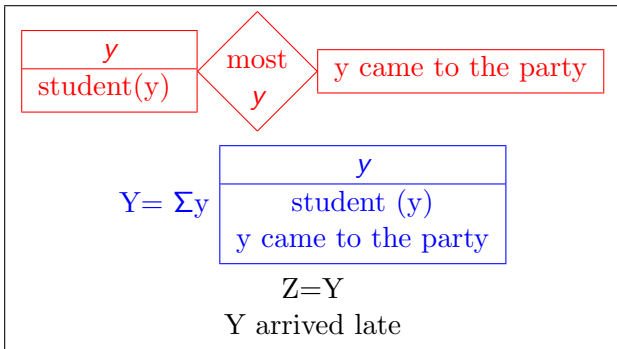        All students (in the context) arrived late at the party.

**Possible Explanation:**
In case of sentence internal NRCs the Intersection-Set is not yet
specified and hence not yet available for anaphoric reference.

(10)     Most of the students came to the party. They arrived very late.



Intersection-Set availbale by "abstraction" only after the quantification

(11)    Three students came to the party. They arrived very late.

| $Y$ |
|:---:|
| students (Y) |
| $|Y| = 3$ |
| Y came to the party |
| Z=Y |
| Z arrived late |

▶ No Duplex-Conditions, but group-Denoting (plural) Discourse Referent

▶ Only Intersection-Set Reading available

▶ No Restrictor-Set Reading available

# Experiments in German

- **Method:** Online-questionnaire, 120 participants

- **Test 1: Acceptability**
  Are NRCs with plural quantificational heads acceptable in
  sentence-internal (subject) position?
  **Del Gobbo (2003):** No.
  **Nouwen (2007):** Yes.

- **Test 2: Interpretation**
  Can NRCs with plural quantificational head get an
  Intersection-Set-Reading in sentence-internal (subject)
  position?
  **Nouwen (2007):** No.
  **Kamp & Reyle (1993):** No.

## Test 1: Acceptability

(12) **Test item (NRCs with plural quant. head)**
**Die meisten** Mütter, die **ja** nur das Beste für ihr Kind
wollen, kaufen Bio-Produkte. (**Most** *mothers, who* **PART**
*only want the best for their child, buy organic products.*)

(13) **False Filler (NRCs with singular quant. head)**
**Kein** Kind, das **übrigens** auf der Rutsche sitzt, trägt eine
blaue Jacke. (**No** *child, which is* **PART** *sitting on the
slide, is wearing a blue jacket.*)

(14) **Correct Filler (RRCs with singular quant. head)**
**Jeder** Student, der am Tutorium teilgenommen hat, hat
die Prüfung bestanden. (**Every** *student that participated
at the tutorial passed the exam.*)

## Test 1: Acceptability

- ▶ 3 Test-Items (NRCs with plural quantificational heads)
- ▶ 3 False Fillers (NRCs with singular quantificational heads)
- ▶ 3 Correct Fillers (RRCs with singular quantificational heads)
- ▶ In each condition, 2 RCs in intern position and 1 in final position
- ▶ Acceptability Judgement on a scale from 0 (totally unacceptable) to 5 (fully acceptable)

# Test 1: Overall Results (scale from 0 to 5)
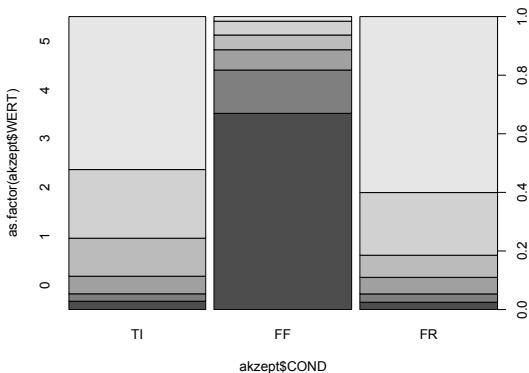


- Highly significant difference between TI and FF (t=-9.946)
- No significant difference between TI and CF (t=0.432)
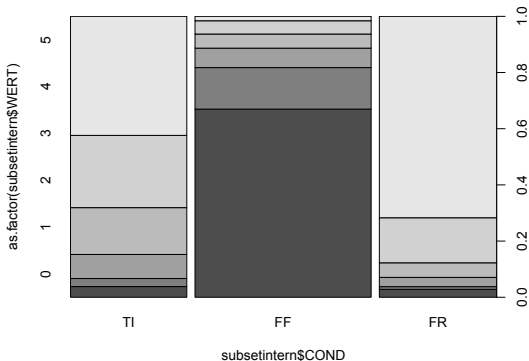
- Highly significant difference between TI and FF (t=-12.11)
- Highly significant difference between TI and CF (t=4.37)

Das Lego-Set City umfasst über 300 Steine **verschiedener Farben und Grössen**, unter anderem für eine Poststelle und eine Polizeistation. Die meisten Steine, **die natürlich alle rot sind**, gehören zu einem Feuerwehrhaus.

*The Lego-Set "City" contains more than 300 bricks of* **different color and size**, *for example for a post office and a police station. Most bricks, which of course are* **all red**, *belong to a fire station.*

**Question:** Ist das möglich? (*Is this possible?*)
**Answer:** Ja. Das ist möglich. (*Yes. This is possible*) / Nein. Das ist völlig ausgeschlossen. (*No. This is completely ruled out.*)

# Test 2: Design

- **12 Test-Items in 4 Conditions**
- **Attachment:** only subject-attachment
- **Factors:**
  POSITION (internal / final)
  STRENGTH (weak/strong)
- **Quantifiers:**

| STRONG | WEAK |
|---|---|
| *die meisten* (*most*) | *mehr als* (*more than*) |
| *die wenigsten* (*few*) | *weniger als* (*less than*) |
| *ein Drittel* (*a third*) | *genau* (*exactly*) |

- **Latin Square Design**
- **16 Fillers (8 Correct / 8 False)**

## Test 2: Conditions

(15) **Die meisten Steine**, die natürlich alle rot sind, gehören zu einem Feuerwehrhaus.(*Most bricks, which PART are all red, belong to a fire station.*) **(strong/intern)**

(16) Zu einem Feuerwehrhaus gehören **die meisten Steine**, die natürlich alle rot sind. (*Most bricks, which PART are all red, belong to a fire station)*) **(strong/final)**

(17) **Mehr als 100 Steine**, die natürlich alle rot sind, gehören zu einem Feuerwehrhaus.(*More than 100 bricks, which PART are all red, belong to a fire station.*) **(weak/intern)**

(18) Zu einem Feuerwehrhaus gehören **mehr als 100 Steine**, die natürlich alle rot sind.(*More than 100 bricks, which PART are all red, belong to a fire station.*) **(weak/final)**

# Test 2: Results / Strength ∼ Position
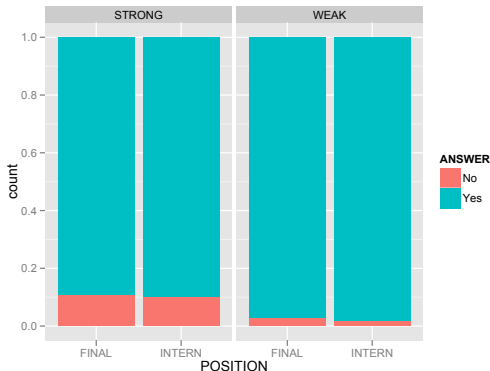


- ▶ Significant effect of the Quantifier's Strength ($p < 0.001$)
- ▶ No effect of position (p=0.979)
- ▶ No interaction of Strength and Position (p=0.887)
- ▶ High acceptance rate even with strong quantifier (0.9)

# Test 2: Results / Strong Quantifiers $\sim$ Position
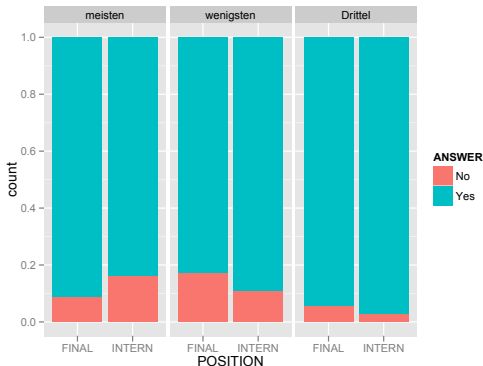


- Difference between *drittel* and *meisten* (p=0.00304)
- Difference between *meisten* and *wenigsten*? (p=0.196)
- Acceptance rate with *meisten* in intern position (0.86)

## Main Findings:

- NRCs attached to plural quantified heads are grammatical at sentence-internal (subject) position.
- NRCs attached to plural quantified heads can get Intersection-Set-Readings with strong quantificational head in sentence-internal (subject) position.
- The latter finding comes unexpected for standard theories of plural anaphora (DRT).

## Possible explanations:

- **Discourse-level repair strategy (Nouwen 2007)**
  But: We would expect lower acceptance rates.

- **High Attachment of the NRC**
  But: We lose the intuitions behind Del Gobbo's example.

- **Intersection-Set Reading is not missing but only less salient in sentence-internal position.**
  But: We need a more fine-grained approach of Plural Anaphora

# Alternative Approaches

**More fine-grained approaches:**

- Nouwen (2003)
- Brasoveanu (2010)

**Both:**

- Plural Information States (van den Berg 1996)
- Quantifiers introduce **two separate referents**, one for the Restrictor-Set and one for the Intersection-Set.

**A Difference:**

- The account of Brasoveanu (2010) is additionally couched into a C(ompositional) DRT Framework (Muskens 1996).
- Quantification over discourse-referents

(19) Quantificational Determiner:
$\lambda P_{et}.\lambda P'_{et}.max^u(dist_u(P\{u\}))$; $max^{u'\subseteq u}(dist_{u'}(P'\{u'\}))$;
$[DET\{u, u'\}]$

(20) *max*-Operator:
$max^u(D) = \lambda I_{st}.\lambda J_{st}.$ $([u]; D)IJ \wedge \forall K_{st}(([u]; D)IK \rightarrow$
$uK_{u\neq\#} \subseteq uJ_{u\neq\#}$ )

(21) *dist*-Operator:
$dist_u(D) = \lambda I_{st}.\lambda J_{st}.$ $uI = uJ \wedge \forall x_e \in uI(DI_{u\neq x}J_{u\neq x})$

(22) Structured Inclusion:
$u' \subseteq u = \lambda I_{st}.$ ( $u' \subseteq u$ ) $I \wedge \forall i_s \in I_{st}$ $(ui \in u'I_{u'\neq\#} \rightarrow$
$ui = u'i)$

(23)   Quantificational Determiner (Brasoveanu 2010):
$\lambda P_{et}.\lambda P'_{et}.max^u(dist_u(P\{u\})); max^{u'\subseteq u}(dist_{u'}(P'\{u'\}));$
$[DET\{u, u'\}]$

(24)   Quantificational Determiner (Modified):
$\lambda P_{et}.\lambda P'_{et}.[u];[u'];[DET \{u,u'\}]; max_u(dist_u(P\{u\}));$
$max_{u'\subseteq u}(dist_{u'}(P'\{u'\}))$

# Modifying Brasoveanu 2010

(25) **sentence-internal attachment**
Most climbers, who were all French, reached the summit.
$[u]$ ; $[u']$;$[MOST\{u, u'\}]$; $max_u(dist_u(climbers\{u\}))$;
$[\textbf{French}\{\textbf{u}'\}]$;
$max_{u' \subseteq u}(dist_{u'}(reached\_the\_summit\{u'\}))$

(26) **sentence-final attachment**
Paul interviewed most climbers, who were all French.
$[u]$ ; $[u']$; $[MOST\{u, u'\}]$; $max_u(dist_u(climbers\{u\}))$;
$max_{u' \subseteq u}(dist_{u'}(interview\{Paul, u'\}))$;
$[\textbf{French}\{\textbf{u}'\}]$.

**Compositionality-Problem:**

► Discourse referents are "invisible" in the syntactic tree.

► Consequence: We have to split-up the syntactic tree.

**Proposal: Four-Place-Quantifier (2 predicative and 2 referential arguments)**

(27)    Modified Definition of the Determiner:
        $\lambda P_{et}.\lambda P'_{et}.\lambda v_e.\lambda v'_e.[DET\{v, v'\}];$
        $max_v(dist_v(P\{v\}));max_{v'\subseteq v}(dist_{v'}(P'\{v'\}))$

# NRC Attachment

$$(...)$$
$$\mathrm{DP2}$$
$$\lambda P'_{et}.\lambda v_e.\lambda v'_e$$
$$max_v(dist_v(climbers\{v\})); max_{v'\subseteq v}(dist'_v(P'\{v'\}));$$
$$[MOST\{v, v'\}];$$
$$[French\{v'\}]$$

$$\mathrm{DP1}$$
$$\lambda P'_{et}.\lambda v_e.\lambda v'_e$$
$$max_v(dist_v(climbers\{v\})); max_{v'\subseteq v}(dist_{v'}(P'\{v'\}));$$
$$[MOST\{v, v'\}]$$
$$(...)$$

$$\mathrm{NRC}$$
$$\lambda x_e.[French\{x\}]$$

# D-Ref Introduction

$$(\ldots)$$
$$\mid$$
$$\text{DP3}$$
$$\lambda P'_{et}.[u]; [u'];$$
$$max_u(dist_u(climbers\{u\})); max_{u'\subseteq u}(dist'_u(reach\_the\_summit\{u'\}));$$
$$[MOST\{v, v'\}];$$
$$[French\{u'\}]$$
$$\mid$$
$$\text{DP2}$$
$$\lambda P'_{et}.\lambda v_e.\lambda v'_e$$
$$max_v(dist_v(climbers\{v\})); max_{v'\subseteq v}(dist_{v'}(P'\{v'\}));$$
$$[MOST\{v, v'\}];$$
$$[French\{v'\}]$$
$$\mid$$
$$(\ldots)$$

# Conclusion:

- ▶ Contra del Gobbo (2003): NRCs with plural quantificational heads are acceptable in sentence-internal position.
- ▶ Contra Nouwen (2007): NRCs with strong quantificational heads can get an intersection-set reading in sentence-internal position.
- ▶ In sentence-internal position of the NRC the intersection-set reading is not missing but only less salient.
- ▶ We can account for these findings by minor modifications of Brasoveanu (2010).

Thank you!

(28) **Modified Definition of the Determiner:**
$\lambda P.\lambda P'.\lambda x.\lambda x'.[DETx, x'];$
$max_x(dist_x(P(x)));max_{x'\subseteq x}(dist_{x'}(P'(x')))$

(29) **NRC Attachment Rule:**
If C is a branching node consisting of two sister nodes A
and B, A with the translation $\alpha$ being of type (et(e(e(t))))
and B with the translation $\beta$ of type (et), C has the
following translation $\gamma$: $\lambda P'.\lambda x.\lambda x'.\alpha(P')(x)(x');\beta(v)$

(30) **Introduction of Discourse-Referents:**
If A is a node of type ((et (e (e t)))) with the translation
$\alpha$, A can replaced by a node B of type ((et) t) with the
following translation: $\lambda P'.[u];[u'];\alpha(P')(u)(u')$

- **Plural information states** (van den Berg 1996)

| **I** | u | u' | (...) |
|---|---|---|---|
| $i_1$ | $\alpha(i.e., ui_1)$ | $\beta(i.e., ui_1)$ | |
| $i_2$ | $\alpha(i.e., ui_2)$ | $\beta(i.e., ui_2)$ | |
| $i_3$ | $\alpha(i.e., ui_1)$ | $\beta(i.e., ui_3)$ | |

- **Columns:** Quantifier domains
- **Rows:** Quantifier dependencies

(31)  Every$^u$ student who wrote a$^{u'}$ paper reached **it$_{u'}$** in for the conference.

# Brasoveanu (2010)

- ▶ Plural Information States (van den Berg)
- ▶ C(ompositional) DRT (Muskens 1996)
- ▶ Basic types: e (individuals), t (truth-values), s (assignments)
- ▶ DRS:
  **[newdrefs|conditions]** $=$
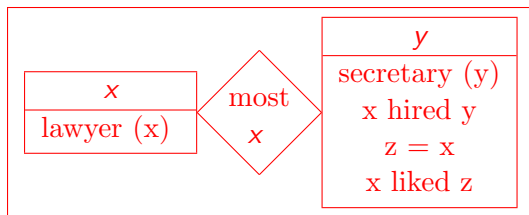  $\lambda I_{st}.\lambda J_{st}.I[\textbf{newdrefs}]J \wedge I[\textbf{conditions}]J$
- ▶ New Dref:
  $[\textbf{u}] = \lambda I_{st}.\lambda J_{st}.\forall i_s \in I(\exists j_s \in J(i[u]j)) \wedge \forall j_s \in J(\exists i_s \in I(i[u]j))$

(32)   Most lawyers hired a secretary they liked. (RRC)

   a.   ~~Matrix collective / RC collective~~
   b.   Matrix distributive / RC distributive
   c.   Matrix distributive / ~~RC collective~~



- ▶ Intersection-Set not yet available
- ▶ Circularity-Problem with Intersection-Set-Reference within the quantifier's scope

The secretary-example with RRC

(33)     Most lawyers hired a secretary they liked.
         $[u]; max_u(dist_u(lawyer(u))); [u'];$
         $max_{u' \subseteq u}(dist_{u'}([v]|secretary(v), like(u', v), hire(u', v)));$
         $[MOST u, u']$