Attaching NRCs to Plural Quantificational Heads

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Abstract

This paper presents the results of two experiments in German investigating the acceptability and interpretation of non-restrictive relative clauses (NRCs) with (plural) quantificational heads. Contrary to standard assumptions, NRCs with strong quantificational head are grammatical in sentence-internal subject position and even can get a reading in this position according to which the relative pronoun is referring to the intersection of restrictor and scope of the quantification. This observation does not only give interesting insights into the nature of NRCs, but might have far reaching consequences for existing dynamic approaches to plural anaphora in discourse.[1][2]

1 Introduction

As is well known, non-restrictive relative clauses (NRCs) pattern quite consistently with standard discourse anaphora. Just as anaphoric pronouns, NRCs are felicitous with referential (1), but heavily restricted with singular quantificational antecedents (2). Plural quantificational heads, by contrast, allow for anaphoric reference as well as for attachment of a NRC (3).

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

(2) a. Paul invited **every boy**, *who lives next door.
b. Paul invited **every boy**. *He lives next door.

(3) a. Paul invited **most boys**, who live next door.
b. Paul invited **most boys**. They live next door.

Due to this striking similarity, most accounts assume that NRCs are interpreted (at least in a certain way) like independent propositions involving a discourse pronoun (Sells 1985 [10], Del Gobbo 2003 [3], Schlenker 2010 [9]). However, it has been argued that this parallel between NRCs and their matrix clause paraphrases should not be straightened too far. Del Gobbo (2003) [3] for example observed that (4b), where the NRC is attached to a quantificational antecedent in subject position, sounds strange while (4a), where the NRC is attached to a similar antecedent in object position, is perfectly acceptable. No contrast can be found for the corresponding matrix clause paraphrases in (5).

(4) a. Paul invited **most students**, who came very late.
b. ***Most students**, who arrived late, came to the party.

(5) a. Paul invited **most students**. They came very late.
b. **Most students** came to the party. They arrived late

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Based on contrasts such as (4), Del Gobbo (2003) [3] concludes that position affects the grammaticality of NRCs such that NRCs with plural quantificational head are ungrammatical if attached in subject (sentence-internal) and not in object (sentence-final) position.[3] Nouwen (2007) [7], by contrast, argues that the position of a NRC does not affect its grammaticality but its interpretation. According to Nouwen (2007), both sentences in (4) are grammatical, but differ in interpretation. In (4)a, the NRC can refer to the intersection of restrictor and scope of the quantification (intersection-set), giving rise to an interpretation according to which all of the invited students arrived late. In (4)b, by contrast, such an intersection-set reading is unavailable. The NRC can only refer to the maximal set of all students in the discourse (restrictor-set), which leads to a contradiction. Whereas the matrix clause implicates that most but not all students came to the party, the NRC tells us that all students (in the discourse) arrived very late at the party. A simple explanation for this contrast could be that at the time of evaluation of the NRC in (4)b, the intersection of restrictor and scope of the quantification is not yet specified and hence not yet available for anaphoric reference. In fact, this is quite what one would expect following standard theories of plural discourse anaphora. In DRT, for example, strong quantifiers introduce so-called "duplex-conditions". Discourse referents introduced within these duplex conditions are inaccessible from outside of the quantifier's scope, which explains the ungrammaticality of (2). Only after the duplex condition is evaluated, a separate antecedent formation process, called "abstraction" (Kamp & Reyle 1993 [4]), can be applied. This abstraction process allows to introduce a new discourse referent, which represents the set of all individuals satisfying restriction and scope of the preceding quantification (reference-set), making it available for plural reference. The crucial point, however, is that "abstraction" can only be applied after the quantification itself has been processed. Interestingly enough, the latter assumption has been motivated by closely related examples with restrictive relative clauses (RRCs), such as (6). According to Kamp &Reyle (1993) [4], sentence (6) only has a reading according to which both matrix and relative clause are interpreted distributively. In particular, (6) has no reading in which the plural pronoun "they" refers to the intersection-set of the quantification.[4]

(6) Most lawyers hired a secretary they liked.

Note that all this holds for strong (non-intersective) quantifiers only. In DRT, weak (intersective) quantifiers do not introduce duplex-conditions but set-denoting (plural) discourse referents, which are available even before the quantifier's scope is specified. Thus, from a DRT perspective, it would be expected that the contrast in examples such as (4) shows up with strong (non-intersective) quantifiers only.

2 Experiments

We set-up an online-questionnaire in German (survey monkey), which 106 native speakers completed. The questionnaire consisted of two parts, an acceptability test and an interpretation test.

2.1 Part 1: Acceptability Test

The first experiment was designed to test the general acceptability of plural NRCs with quantificational heads. It contained 9 items which were presented each in one and the same condition. These included 3

[3]Del Gobbo (2003) [3] provides a syntactic explanation for this contrast: For the NRC to be interpreted as a independent sentence, it has to rise to a text node higher than the matrix sentence. This can be achieved by a restructuring process, but only if the NRC is attached in (sentence-final) object position. Note that this explanation is based on the assumption that the NRC is attached at DP level. If we would attach the NP higher in the tree, at IP or CP level, we would not expect such a contrast.

[4]What Kamp & Reyle (1993) [4] do not mention in this context is that in case of examples such as (6) the intersection set reading is unavailable for independent reasons. RRCs, in contrast to NRCs, contribute to the scope of a quantification. That's why any attempt to derive an intersection set reading of a pronoun inside a RRC ends up in circularity. We will come back to this problem at the end of the paper.

plural NRCs with quantified heads (test-items), all with strong quantifiers, 2 of them in sentence-internal position (subject-attachment) and 1 in sentence-final position (object-attachment). These test-items were contrasted with two types of fillers: 3 NRCs with singular quantificational heads, which were expected to be judged as clearly unacceptable (false fillers), and 3 RRC with singular quantificational heads, which were expected to be judged as fully acceptable (correct fillers). (7) provides an example for each condition.[5]

(7) a. Die meisten Mütter, die ja nur das Beste für ihr Kind wollen, kaufen Bio-Produkte. (TI)
(*Most mothers, who PART only want the best for their child, buy organic products.*)

b. Kein Kind, das übrigens auf der Rutsche sitzt, trägt eine blaue Jacke. (FF)
(*No child, which is PART sitting on the slide, is wearing a blue jacket.*)

c. Jeder Student, der am Tutorium teilgenommen hat, hat die Prüfung bestanden. (CF)
(*Every student which participated at the tutorial passed the exam.*)

The participants were asked to judge the acceptability of the items on a scale from 0 (completely unacceptable) to 5 (fully acceptable). Note that, in this part, the test-items were designed to be neutral with respect to a possible restrictor-set or intersection-set reading.

PREDICTIONS: According to Del Gobbo (2003) [3], the test-items are expected to pattern with wrong fillers, Nouwen (2007)[7] predicts the test-items to get a rating comparable to correct fillers.

RESULTS: Using the lme4 package in R, we fitted a model of mixed logistic regression with CONDITION (Test-Item, Correct Filler, False Filler) as fixed effect and random effects for subjects and items including the corresponding slopes, first for the whole data set and then for the subset with sentence-internal position of the RC. In the full data set, the test-items rated nearly as high (4.02 on a scale form 0 to 5) as the corresponding correct fillers (4.26) and significantly higher than wrong fillers (0.72) (t=-9.946 for the comparison between test-items and false fillers).[6] At least in our model, there was no significant difference between test-items and correct fillers (t=0.432). Only in the subset of items with sentence-internal position of the RC, we could find a difference between test-items and correct fillers. As expected, the test-items rated significantly lower than the correct fillers (t=4.37), but still very high, especially in comparison with the false fillers in the data set (t=-12.11), namely at 3.87 compared to 0.70 for the wrong fillers and 4.27 for the correct fillers. Only 3 out of 106 participants rejected all the test-items they were confronted with (ratings below 3).

2.2 Part 2: Interpretation Test

The second experiment was designed to investigate whether the availability of intersection-set readings depends on the NRC's POSITION in the matrix clause (internal versus final) and/or on the STRENGTH of the head's quantifier (strong versus weak). We presented the NRCs in contexts in which the intersection-set reading was explicitly ruled out. The participants were asked to judge whether the whole context seemed plausible or clearly contradictory to them. If the participants didn't get the intersection-set reading they were expected to judge the context as contradictory. The following is an example for the condition with strong quantifier and sentence internal position of the NRC.

[5] In German, unlike in English, both, NRCs and RRCs, are separated by comma. To mark the test-items as NRCs, we introduced discourse-particles (e.g. *übrigens/by the way*), which should rule out a restrictive interpretation.

[6] According to Baayen et al. (2008), we can be confident that the comparison is significant if the absolute value of the t-value is bigger than 2 (or: 1.96).

(8) 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 includes more than 400 bricks* **of different colour and size**, *for example for a post office and a police station. Most bricks,* ***which are of course all red****, belong to a big fire station).*

In this part, we tested 12 items in 4 conditions, varying the NRC's POSITION in the matrix clause (internal/final) and the quantifier's STRENGTH (strong/weak). In total we tested six different quantifiers, 3 STRONG quantifiers (*die meisten/most, die wenigsten/few, ein Drittel/a third of*) and 3 WEAK quantifiers (*mehr als n/more than n, weniger als n/less than n, genau n/exactly n*). Conditions and quantifiers were equally distributed over a latin square design.[7] Additionally, the test-items were interspersed with fillers (18 similar constructed texts, 8 without an intended contradiction (Correct Fillers), 8 with an intended contradiction outside of a relative clause (False Fillers)).

PREDICTIONS: According to Nouwen (2007) [7] and Kamp & Reyle (1993) [4], it is expected that both the quantifier's strength and the position of the NRC in the matrix clause have an effect on the availability of an intersection-set reading. First, the intersection-set reading of NRCs with plural quantificational heads is expected to be better available with weak than with strong quantifiers. Notably, it is predicted that with strong quantifiers in internal position the intersection-set reading is not available at all. With strong quantifiers in final position the intersection-set reading is predicted to be available but still expected to rate lower than with weak quantifiers. In the case of strong quantifiers, the restrictor-set is presupposed to be contextually given and hence available for anaphoric reference. Weak quantifiers, by contrast, do not carry such a presupposition and as a consequence the restrictor-set is not available for anaphoric reference. Thus, whereas in case of strong quantifiers there are two competing readings available for the NRC in final position, weak quantifiers allow for the intersection-set reading only, independently of the NRC's position in the matrix clause.

RESULTS: Using the lme4 package in R, we fitted a model of mixed logistic regression for the interaction of STRENGTH and POSITION as fixed effects and random effects for subjects and items including the corresponding slopes. As expected, we found a highly significant effect of the quantifiers STRENGTH (weak versus strong) ($p < 0.001$), but we didn't find any significant effect of POSITION (final versus internal) (p=0.979), or of the interaction of STRENGTH and POSITION (p=0.887). Moreover, although conditions with strong quantifiers rated significantly lower than those with weak quantifiers, their overall acceptability was surprisingly high (the relative frequency of accepted intersection-readings was 0.9 for strong quantifiers versus 0.98 for weak quantifiers). For comparison, the correct fillers rated at 0.97 and the false fillers at 0.03. However, we found differences within the subset of items with strong quantifiers. Firstly, the quantifier "ein Drittel" (a third of) rated nearly as high as the average of the weak quantifiers (namely at 0.96 and significantly different compared to "die meisten" (most) with 0.87 and "die wenigsten" (few) with 0.86) (z=-2.964, p=0.00304 for the comparison between "ein Drittel" (third of) and "die meisten" (most)). Moreover, "die meisten" (most) and "die wenigsten" (few) seem to be more sensitive to POSITION than the rest of the quantifiers we tested. Whereas with "die meisten", final position of the NRC rated higher than internal position (0.91 versus 0.83), with "die wenigsten" final position rated lower than internal position (0.82 versus 0.89). This looks like an effect of monotonicity. But at least in our model, it didn't turn out to be significant ("die meisten": z=-1.29, p= 0.196 / "die wenigsten" z= 1.862, p =0.062).

[7] Note that in German, the word order can be changed quite freely and subjects can appear as well in internal as in final position. To keep the parameters involved as minimal as possible, we tested only NRCs with subject-attachment.

2.3 Discussion

Besides of some minor relativizations considering monotonicity, the main results of the two experiments are rather clear. (i) Against Del Gobbo's (2003) [3] predictions, NRCs attached to plural quantificational heads are grammatical even at sentence-internal (subject) position in German. (ii) And against Nouwen's (2007) predictions [7], NRCs in German can get an intersection-set reading even if attached to strong (non-intersective) quantifiers in sentence-internal (subject) position. (iii) As expected, the quantifiers strength does influence the availability of intersection-set readings, with NRCs attached to strong quantifiers rating lower then those attached to weak quantifiers, both in internal and in final position of the NRC. (vi) Quite unexpected is that, besides of the reported monotonicity effect, we didn't find an effect of position on the availability of the intersection-set reading with strong quantifiers. This does not only run counter the expectations of Kamp & Reyle (1993) [4], but also counter the intuitions reported by Del Gobbo (2003) [3] and Nouwen (2007) [7]. There are at least two options to explain this lack of position effect in our experiment. First, one could argue that these unexpected readings are the result of a discourse-level repair strategy. This is what Nouwen (2007) [7] suggests for similar effects in nominal appositions. From our point of view, however, the acceptability rates are too high for such an explanation, especially since the participants were hunting for contradictions and the comments the participants were invited to give showed that most of them didn't even realize the existence of a competing restrictor-set reading. The other option is to assume that, in case of strong quantificational head and internal position of the NRC, the intersection-set reading is not missing but only less salient than the restrictor-set reading, since the former in contrast to the latter is not yet specified. This assumption would be compatible with both, the intuitions behind Del Gobbo's (2003) [3] and Nouwen's (2007) [7] examples and the results of our experiment.[8] If we follow the second option, however, we need a more fine-grained approach of plural anaphora. In the remainder of this paper, we will make a proposal how the plural anaphora account of Brasoveanu (2010) [2] can be modified to make it compatible with both the intuitions behind Del Gobbo's (2003) [3] original example and the results of our experiments.

3 Alternative Approaches to Plural Anaphora

Brasoveanu (2010) [2] offers a very fine-grained dynamic view of discourse anaphora based on plural information states in the sense of van den Berg (1996)[1]. In contrast to standard information states (which represent single assignments i,j etc.) these plural information states are modeled as sets of variable assignments I, J, which are able to store not only the values of the variables/discourse referents introduced (quantificational domains) but also the (quantificational) dependencies established between them. More importantly (for the interest of this paper), Brasoveanu (2010) [2] assumes that quantifiers introduce two separate referents, one for the restrictor-set and one for the intersection-set, with the intersection-set being defined as proper subset of the restrictor-set. What will matter as well for our argumentation is the fact that the proposal of Brasoveanu (2010) [2] is couched into a C(ompositional)DRT framework in the sense of Muskens (1996) [5].[9] By consequence, in Brasoveanu (2010) [2] quantification is defined

[8] Note that our experiment only tested the availability of the intersection-set reading in contexts in which the competing restrictor-set reading was explicitly ruled out. We didn't test for salience of a particular reading.

[9] Dynamic info states I, J, etc are plural: they are sets of variable assignments, i.e., terms of type st. An individual dref x stores a set of individuals with respect to a plural info state I, abbreviated as uI def = $u_s e\ i_s : i_s \in I_s t$, i.e., uI is the image of the set of assignments I under the function u. A sentence is interpreted as a Discourse Representation Structure (DRS), which is a relation of type (st)((st)t) between an input state $I_s t$ and an output state $J_s t$, as shown in (a) below. A DRS requires, the input info state I to differ from the output state J at most with respect to the new drefs and all the conditions to be satisfied relative to the output state J. The definition of dref introduction (a.k.a. random assignment) is given in (b) below.
(a) DRS: $[\mathbf{newdrefs}|\mathbf{conditions}] = \lambda I_{st}.\lambda J_{st}.I[\mathbf{newdrefs}]J \wedge I[\mathbf{conditions}]J$
(b)New Dref: $[\mathbf{u}] = \lambda I_{st}.\lambda J_{st}.\forall i_s \in I(\exists j_s \in J(i[u]j)) \wedge \forall j_s \in J(\exists i_s \in I(i[u]j))$

as quantification over DRT-like (plural) discourse referents. In (9), you see the definition of a quantifier as it is defined in Brasoveanu (2010) [2].

(9) DET (Brasoveanu 2010)
$\lambda P.\lambda P'.max^{u}(dist_{u}(P(u)));max^{u'\subseteq u}(dist_{u'}(P'(u')));[DETu,u']$

According to this, a quantificational determiner DET is of type $(et(et(t)))$, as usual, but it does not compare two sets of assignments, but two sets of individuals, the maximal set of all individuals that distributively satisfy the restrictor property P (restrictor-set) and the maximal set of all individuals that distributively satisfy the nuclear scope property P‘ (intersection-set). For each of these two sets the quantifier introduces a (plural) discourse referent, u and u‘, with the intersection-set referent u‘ being defined as a proper (structured) subset of the restrictor-set-referent u.[10] The quantification itself is defined as a static test over these two referents. The maximization and distributivity operators max_u and $dist_u$ are defined as selective maximization and selective distributivity operators in the sense of van den Berg (1996) [1], which allow to dynamize λ-abstraction over both values (i.e., quantifier domains) and structure (i.e., quantificational dependencies). Very roughly, the *max*-operator introduces a new discourse-referent u and assigns to it the maximal set of all individuals which satisfy the condition D, whereas the *dist*-operator ensures that we previously split up the plural information state in its single information states (i,j), guaranteeing that we sum up with the *max*-operator the maximal set of individuals which distributively satisfy D. Note that in contrast to the *max*-operator, the *dist*-operator is not superscripted but subscripted with u. This represents the fact that the *max*-operator introduces a new discourse referent for u, while the *dist*-operator is only making anaphoric reference to it.

(10) $max^{u}(D) = \lambda \mathrm{I}_{st}.\lambda \mathrm{J}_{st}.\ ([\mathrm{u}];\mathrm{D})\mathrm{IJ} \wedge \forall\ \mathrm{K}_{st}(([\mathrm{u}];\mathrm{D})\mathrm{IK} \rightarrow \mathrm{uK}_{u\neq\#} \subseteq \mathrm{uJ}_{u\neq\#}\ )$

(11) $dist_{u}(D) = \lambda \mathrm{I}_{st}\ .\lambda \mathrm{J}_{st}.\ \mathrm{uI} = \mathrm{uJ} \wedge \forall\ \mathrm{x}_{e} \in \mathrm{uI}(\mathrm{DI}_{u\neq x}\mathrm{J}_{u\neq x})$

Note that in the actual version of Brasoveanu (2010) [2], the discourse referents are introduced in the scope of the respective *max*-operator. As a consequence, the discourse referent for the intersection-set is only available after the nuclear scope set is specified by P'. Thus, although this approach is much more fine grained than the standard DRT-account of Kamp & Reyle (1993) [4], the account of Brasoveanu (2010) [2], as it stands, makes the same predictions with respect to our data.[11]

3.1 Modifying Brasoveanu (2010)

In the following, we will argue, that the account of Brasovenau (2010) [2] can be slightly modified such that the intersection-set can be made available for reference in sentence-internal position. The main idea is rather simple: Since in Brasoveanu (2010) [2] u and u' are discourse referents, we can easily pull the discourse referents out of the scope of the *max*-operators and introduce them even before they are specified. To achieve this, we only have to define the *max*-operator as anaphoric, as is represented by the fact that the *max*-operator is now subscripted (and not superscripted) by u and u'. The equivalent modified definition of the max-operator is given in (13) below.

[10] To guarantee that subsets not only inherit the value but also the structure of their supersets, Brasoveanu (2010) [2] defines $u' \subset u$ as "structured inclusion" (i), with # representing dummy-individuals that are used as a tag for the cells in the matrix that should be discarded in order to obtain a structured subset u' of a superset u.
(i) $u' \subseteq u = \lambda I_{st}.\ (\ u' \subseteq u)\ \mathrm{I} \wedge \forall i_s \in I_{st}\ (ui \in u' I_{u'\neq\#} \rightarrow ui = u'i)$

[11] Note that similar holds for the closely related account of Nouwen (2003). Since in Nouwen (2003) quantification is defined over sets of assignment and the intersection-set-assignment is defined only if the nuclear scope property P is defined, intersection-set-reference is available only after the quantification itself has been processed.

(12) DET (First Modification):
$\lambda P.\lambda P'.[u];[u'];[DETu,u'];\ max_u(dist_u(P(u)));max_{u'\subseteq u}(dist_{u'}(P'(u')))$

(13) (Modified *max*-operator):
$max_u(D) = \lambda I_{st}.\lambda J_{st}.\ \text{DIJ} \wedge\forall\ K_{st}((\text{[u]; D)IK} \rightarrow \text{uK}_{u\neq\#} \subseteq \text{uJ}_{u\neq\#})$

By this little trick, we can make the intersection-set referent *u'* available even before the nuclear scope-property P' is specified. Thus, it would be in principle possible to attach the NRC either in internal or in final position. (14) represents the equivalent translations of the test-item represented in (8) with internal position of the NRC.[12]

(14) **sentence-internal attachment**
Most bricks, which are (of course) all red, belong to a big fire-station.
$[u]\ ;\ [u'];[MOSTu,u'];\ max_u(dist_u(bricks(u)));\ \mathbf{red}(\mathbf{u'});$
$max_{u'\subseteq u}(dist_{u'}(belong\_to\_firestation(u')))$

Note that this mimics quite closely the surface word order of the sentence. First, the quantificational determiner "most" introduces two separate discourse referents *u* and *u'* and tells us that we have to test whether these two discourse-referents stand in the "most"-relation. Secondly, the noun phrase "bricks" specifies our discourse referent *u* (our restrictor-set referent). Before we get the specification of the corresponding intersection-set referent *u'* by the VP, the NRC is introduced. Nevertheless, the NRC can make reference to the (still underspecified) *u'*. (14) captures quite nicely the intuitions behind Nouwen's (2007) [7] and Del Gobbo's (2003) [3] examples: Although the intersection-set referent is available for anaphoric uptake in sentence-internal position, it is not yet specified (unlike the corresponding restrictor-set-referent). Hence, it is not surprising that in internal position of the NRC the restrictor-set-reading is more prominent. To make this idea compositional, however, is a little bit more complicated.[13] The problem is that the discourse referents *u* and *u'* are literally spoken "invisible" in our syntactic tree.[14] To make the intuition behind (12) compositional, it would be necessary to make two assumptions: (i) The NRC is attached at DP-level (which is quite unproblematic) and (ii) the quantificational DP itself has to be split up syntactically. We assume that the quantificational determiner is a four-place determiner of type (et(et(e(e) (t)))), with two predicative and two referential arguments (λ-abstracts), which function as sort of place-holder for the discourse-referents *u* and *u'*, by which they are substituted at VP- (or IP-) level. The corresponding definition of the determiner and the necessary construction rules for NRC-Attachment and Discourse-Referent-Introduction are given in (16) and (17) below. [15]

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

(16) NRC Attachment Rule:
If C is a branching node consisting of two sister nodes A and B, A with the translation α being of type (et(e(e(t)))) and B with the translation β of type (et), C has the following translation γ:
$\lambda P'.\lambda x.\lambda x'.\alpha(P')(x)(x');\beta(v)$[16]

[12] Since in Nouwen 2003 [6] quantification is defined as quantification over (partial) sets of assignments, it might be the case that this trick cannot be applied to this approach. To investigate this, however, would go beyond the scope of this paper.

[13] Thanks to Caroline Reinert and T.E.Zimmermann for pointing this out to me.

[14] If we attach the NRC at DP-level (Del Gobbo 2003 [3]), we only have access to the max-set-interpretation. If we attach the NRC by contrast at IP-level or higher, we lose the possibility to differentiate between internal and final position of the NRC and would predict that max-set-readings and intersection-set readings are equally available.

[15] This construction rule is only used to show that attachment of NRCs is generally possible. It is not intended as a full-blown analysis of NRCs. For a detailed discussion of the attachment of NRCs in this framework cf. to Reinert (forthcoming) [8].

[16] v can be set equal with either x or x' depending on whether the NRC is referring to the restrictor- or intersection-set of the quantification. Note that after the application of this rule C is still of the same type (et(e(e(t)))). This makes the rule recursive, allowing for example for stacking of NRCs.

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

With these minor modifications, Brasoveanu (2010) [2] enables us to account for the observed general availability of intersection-set readings in sentence-internal position. But are these predictions not too strong with respect to the corresponding examples with RRCs such as (6)b, which originally motivated the assumption that intersection-set readings should be unavailable in sentence-internal position? A look at the corresponding translation in Brasoveanu's framework shows that this is not the case.

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

The crucial point is that RRCs (in contrast to NRCs) are attached at NP level and hence contribute to the scope of the quantification. That's why the RRC (and with it the plural pronoun it contains) is introduced inside the scope of the *dist*-operator. Inside the scope of the *dist*-operator, however, the plural information states are split up into single information states. Thus, the respective discourse referents can only refer to singular individuals and not to the maximal sum of individuals satisfying the scope property P' (intersection-set).

CONCLUSION: Contrary to standard assumptions about NRCs and plural discourse anaphora, German NRCs attached to plural quantificational heads are grammatical in sentence-internal (subject) position and even can get an intersection-set interpretation in this position. This challenges the classical assumption that the intersection-set of a quantification should be available for anaphoric reference only after the quantification itself has been processed. As we argued however, the plural anaphora account of Brasoveanu (2010) [2], in contrast to competing accounts such as Kamp & Reyle (1993) [4], can be modified to be compatible with these observations by slight modifications.

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