Uniqueness Effects in Donkey Sentences and Correlatives: A Unified Account

The Phenomenon. The goal of this paper is to provide a unified account of (the variability of) the uniqueness implications associated with cross-clausal anaphora in: (i) the donkey sentences (1) and (2) ([3] attributes (2) to B. Partee) and (ii) the Hindi correlatives (3) and (4) (from [1]).

- (1) Every\textsuperscript{u} farmer who owns a\textsuperscript{u} donkey beats it\textsuperscript{u}.

- (2) Every\textsuperscript{u} man who has a\textsuperscript{u} son wills him\textsubscript{u} all his\textsubscript{u} money.

- (3) jo\textsuperscript{u} laRkii khar\textsuperscript{u}i hai, vo\textsubscript{u} lamb\textsuperscript{u}i hai. (4) jis\textsuperscript{u} laRkii-ne jis\textsuperscript{u} laRk\textsubscript{k}e saath khel\textsuperscript{u}a,

which girl standing is, she tall is. which girl-Erg which boy-with together played, she-Erg he-Acc. defeated.

Sentence (1) does not exhibit donkey-uniqueness effects, i.e. it is (generally) taken to apply to any farmer that owns one or more donkeys, while sentence (2) intuitively applies only to men that have exactly one son (see [3]). Similarly, (3) exhibits girl-uniqueness effects, i.e. it is interpreted as "the one girl who is standing is tall", while (4) does not, i.e. it is interpreted as "every girl who played with a boy defeated him (i.e. the one boy she played with)" (see [1]).

The Dynamic System. The analysis of the variable uniqueness effects associated with donkey anaphora and correlatives is formulated in a novel compositional dynamic system couched in classical type logic, which extends Compositional DRT (CDRT; see [2]) with plural information states (following [4]). That is, besides individuals (type e) and truth-values (type t), we add a basic type s whose elements i\textsubscript{s}, j\textsubscript{s} etc. model variable assignments (subscripts on terms represent their types) – and plural info states I\textsubscript{st}, J\textsubscript{st} etc. are modeled as sets of assignments of type st.

Given the underlying type logic, compositionality follows automatically: in a Fregean / Montagovian framework, the compositional aspect of interpretation is largely determined by the types for the 'saturated' expressions, i.e. names and sentences. Let's abbreviate them as e and t.

An extensional static logic is the simplest: e is e (individuals) and t is t (truth-values). We go dynamic by making the 'meta-types' e and t finer-grained. Thus, e will stand for the type se of discourse refers (dref's) u\textsubscript{se}, u'\textsubscript{se} etc. A dref u\textsubscript{se} is a function from assignments to individuals: intuitively, u\textsubscript{se}i\textsubscript{s} is the individual assigned to the dref u by the assignment i. Sentences are interpreted as binary relations between plural info states, i.e. t will stand for (st)((st)t)). A sentence is represented as a DRS of the form [new dref's \lnot conditions], which abbreviates the following term of type t: \lambda I\textsubscript{st}, \lambda J\textsubscript{st}. I[new dref's]J \land conditions/J. where [new dref's] is of type (st)((st)t) and conditions is of type (st)t. That is, the output state J differs from the input state I at most with respect to the new dref's and each condition is satisfied in the output state J. If there are no new dref's, we have a DRS of the form [conditions], i.e. a test, which abbreviates the term \lambda I\textsubscript{st}, \lambda J\textsubscript{st}. I=J \land conditions/J. Lexical items are assigned denotations of the expected type, e.g. the denotation of the common noun man is of type et and the denotation of the generalized determiner every is of type (et)((et)t), as shown in (10) below.

Crucially, plural info states enable us to store and pass on both (i) the sets of individuals introduced in discourse and (ii) the quantificational dependencies between these sets. Consider (4) above, for example. After the update contributed by the relative clause, we have a plural info state I\textsubscript{st} and two dref's u\textsubscript{se} and u'\textsubscript{se} that store two sets of individuals with respect to I, namely uI := \{ui: i\in I\}, i.e. the set of girls that played with a boy, and u'I := \{u'i: i\in I\}, i.e. the set of boys that the u'-girls played with. Moreover, the plural info state I encodes the quantificational dependency between these two sets: we require each assignment i\in I to be such that the girl ui played with the boy u'i. The matrix clause in (4) is simultaneously anaphoric to the sets of individuals and the dependency / correlation between them: each assignment i\in I has to be such that ui defeated u'i.

The Analysis. (The variable) uniqueness effects emerge as a consequence of three ingredients. First, the indefinites in (1) & (2) and the wh-indefinites in (3) & (4) contribute a maximization
operator $\text{max}^u(D)$, which introduces the dref $u$ and stores in it the maximal set of entities that satisfies the DRS $D$ (a dynamic form of $\lambda$-abstraction). Analyzing the wh-elements as indefinites is independently motivated by languages in which they are morphologically identical / related, e.g. Yucatec Mayan, Romanian etc. Second, the singular number morphology on the anaphors in (1) through (4) contributes a uniqueness condition $\text{unique}\{u\}$. Third, we have a distributivity operator $\text{dist}_u$ (or $\text{dist}_{st,u}$) contributed by the determiner every in (1) & (2) and by the entire quantificational structure (e.g. aspect can influence which particular operator – $\text{dist}_u$, $\text{dist}_{st,u}$ etc. – is selected) in (4); $\text{dist}_u(D)$ requires $D$ to be interpreted one $u$-individual at a time.

(5) $\text{max}^u(D) := \lambda J_{st}\lambda J_{st}. \exists H_{st}(I[u]H \land DHI) \land \forall K_{st}(\exists H_{st}(I[u]H \land DHK) \rightarrow uK \subseteq uJ)

(6) $\text{dist}_u(D) := \lambda J_{st}\lambda J_{st}. uL = uJ \land \forall xL \in uJ(DL_{ua},J_{ua})$, \quad where $I_{ua} := \{i\in I: ui = x\}$

(7) $\text{unique}\{u\} := \lambda J_{st}. I \notin \emptyset \land \forall i, i' \in I(\forall u \in u')$

(8) $\text{dist}_{st,u}(D) := \text{dist}_u(\text{dist}_u(D)) \equiv \text{dist}_u(\text{dist}_u(D))$

The lexical entries for the relevant items are given below. The symbol ';' stands for dynamic conjunction, defined as $D; D' := \lambda J_{st}\lambda J_{st}. \exists H_{st}(DIH \land D'HJ)$. Indefinite articles are ambiguous: the entry without $\text{max}$ yields the weak donkey reading needed to account for examples like Every man who has a\textit{weak} dime will put it\textit{u} in the meter, while the entry with $\text{max}$ yields the strong donkey reading, needed for (1) and (2) above (the full paper justifies this analysis of weak/strong readings and compares it with alternative static and dynamic approaches). Wh-indefinites are strong; this is independently justified by their interpretation in 'exhaustive-answer' questions.

(9) $\text{ill}_u \equiv \lambda P_{et}. \text{unique}\{u\}; P(u)$

(10) $\text{every}^u \equiv \lambda P_{et}\lambda P'_{et}. \text{max}^u(P(u)); \text{dist}_u(P(u))$ (or: $\text{dist}_{st,u}$)

(11) $\text{a\textit{strong}} / \text{a\textit{weak} } / \text{a\textit{universal}} \equiv \lambda P_{et}\lambda P'_{et}. \text{max}^u(P(u)); P'(u)$

(12) $\text{a\textit{strong}} / \text{a\textit{weak} } / \text{a\textit{universal}} \equiv \lambda P_{et}\lambda P'_{et}. [u] P(u); P'(u)$

Example (3) is compositionally interpreted as $\text{max}^u([\text{girl}\{u\}. \text{standing}\{u\}]$; $\text{unique}\{u\}. \text{tall}\{u\}]$.

The uniqueness effect is due to the combination of $\text{max}$ and $\text{unique}$: the strong wh-indefinite $\text{a\textit{weak} }$ introduces the set of all girls that are standing, while the singular anaphor $\text{vodu}$ requires this set to be a singleton. We derive the uniqueness effects in (2) in a similar way: (2) is interpreted as $\text{max}^u([\text{man}\{u\}]$. $\text{max}^u([\text{son}\{u\}. \text{have}\{u,u'\}]$); $\text{dist}_u([\text{unique}\{u\}. \text{unique}\{u\}, \text{will\textit{money\{u,u'\}}}]$, i.e., for every $u$-father, we introduce the $u'$-set of all his sons and, then, for each $u$-individual, we require the corresponding $u'$-set to be a singleton. Crucially, the $\text{unique}\{u\}$ condition contributed by $\text{his}_u$ in (2) is vacuously satisfied because it is in the scope of the $\text{dist}_u$ operator.

We use the same 'dist & unique' strategy in (4), which is interpreted as $\text{max}^u([\text{girl}\{u\}]$; $\text{max}^u([\text{boy}\{u'\}. \text{play\textit{with}\{u,u'\}}])$; $\text{dist}_u([\text{unique}\{u\}. \text{unique}\{u\}. \text{defeat}\{u,u'\}]$). The condition $\text{unique}\{u\}$ is again vacuously satisfied, while the fact that the $u'$-boy is intuitively unique relative to each $u$-girl (as observed in [1]) is captured in the same way as the son-uniqueness in (2). Finally, the strong non-unique donkey reading of sentence (1) is captured by letting every contribute a $\text{dist}_{st,u'}$ operator, which neutralizes the condition $\text{unique}\{u'\}$ contributed by the donkey pronoun $\text{it}_u$. In general, which operator is contributed by every is pragmatically determined, i.e. the indexation on $\text{dist}$ is used to pragmatically specify the granularity level of the quantifier domain: we can quantify over $u$-individuals, as in (2) (hence, $u'$-uniqueness), or over cases/minimal situations in which a $u$-farmer owns a $u'$-donkey, as in (1) (hence, no uniqueness).

The fact that, in principle, we can also use any distributivity operator in correlatives enables us to successfully generalize the account to single and multiple wh correlatives in Romanian which can have universal (non-unique) readings, e.g. (3) can be interpreted as "\textit{every} girl who is standing is tall" and (4) as "\textit{every} girl she played with".