Exceptional Scope as Scopal Independence

Adrian Brasoveanu, Donka F. Farkas — UC Santa Cruz

The problem of quantifier scope can be conceptualized in two ways: either as dependence on or as independence from another quantifier. Previous linguistic accounts favored dependence-based theories, while in logic both roads have been taken. We argue here that an approach based on a suitably modified independence-friendly logic has significant empirical advantages.

I. The Phenomena One of the main empirical challenges in this area is to account for the free upwards scope of indefinites while also capturing the constraints on this kind of exceptional scope taking behavior. Concretely, while a universal cannot take scope upwards beyond its clause, indefinites may do so, disregarding even island boundaries (Farkas 1981, Fodor & Sag 1982, Abusch 1994 among many others). This is shown by the contrast between sentence (1), where the universal *every*^{y} *professor* cannot scope out of its relative clause, and sentence (2), where the indefinite can take narrowest, intermediate or widest scope – see (3), (4) and (5), the last two of which show insensitivity to islands. The IS reading in (4) is particularly important because it shows that exceptional scope cannot be analyzed away as a referential phenomenon (contra Fodor & Sag 1982).

1. John read a^x paper that every^y professor recommended.

2. Every^x student read every^y paper that a^z professor recommended.

3. Narrowest Scope (NS): for every student x, for every paper y such that there is a professor z that recommended y, x read y.

4. Intermediate Scope (IS): for every student x, there is a professor z such that, for every paper y that z recommended, x read y.

5. Widest Scope (WS): there is a professor z such that, for every student x, for every paper y that z recommended, x read y.

Crucially, however, exceptional scope cannot be completely divorced from syntactic structure, as a pristine independence-friendly account would have it. As Abusch (1994) and, more recently, Chierchia (2001) and Schwarz (2001) noticed, an indefinite cannot take exceptional scope over a quantifier without taking scope over everything below that quantifier. For example, sentence (6) does not have a reading in which the indefinite *a*^{z} *gift* takes scope over *every*^{x} *man*, but under *most*^{y} *women*. The paraphrase of this unavailable reading would be: for most women, there is a gift such that every man decided to give it to her.

6. Every^x man decided to give most^y women a^z gift.

Furthermore, the upwards scopal freedom of indefinites is constrained in that an indefinite cannot scope over a quantifier that binds into its restrictor. For example, in (7), the indefinite *one*^{z} *of its*$_y$ *authors* can have only narrowest scope.

7. Every^x student read every^y paper that one^z of its$_y$ authors recommended.

These facts are accounted for in Abusch (1994), where a special scoping mechanism that can disregard clausal boundaries is set up for indefinites but not for other quantifiers. However, there is no connection in her account between exceptional scope and the semantics of existentials, thus leading us to expect a language in which universals, for instance, would exhibit exceptional scope behavior, while indefinites would not. Capturing the connection between exceptional scope and existentials is at the heart of choice/Skolem-function based approaches, which are dependence-based accounts, as well as our current, independence-based proposal, to which we now turn.

II. Outline of the Account Our account is based on a minimally modified first-order language that has restricted quantification, so that in a formula $\forall x[\phi](\psi)$, the restrictor is ϕ and the nuclear scope is ψ. We can define a compositional translation procedure from English into (a higher-order version of) this language in the usual Montagovian way. The main novelty is that while in standard Tarskian semantics, evaluation indices are single assignments, in the language we define the indices of evaluation have a more articulated structure.

We add structure in two ways. First, we evaluate formulas relative to *sets* of assignments G, G' etc., a move independently motivated by quantificational and modal subordination. A set of assignments G, which can be represented as a matrix with assignments as rows, enables us to encode when a quantifier $\mathbf{Q}'y$ is *not* dependent on another quantifier $\mathbf{Q}x$ by requiring the variable y to have a fixed value relative to the varying values of x: for all $g, g' \in G$, $g(y) = g'(y)$, while leaving open the possibility that $g(x) \neq g'(x)$. Thus, using sets of assignments enables us to state that y does not covary with x – which means that the quantifier $\mathbf{Q}'y$ is not in the *semantic* scope of $\mathbf{Q}x$, though it can very well be in its *syntactic* scope. Separating syntactic scope from semantic scope is a main feature of our proposal.

Second, our indices of evaluation contain the sequence of variables $\langle x_1, \ldots, x_n \rangle$ introduced by the previous quantifiers – much like the partial assignments of classical DRT/FCS (we use total assignments plus a separate sequence of variables instead of simply using partial variable assignments only for formal/logical convenience). These are the variables an indefinite *could* covary with. When we interpret an indefinite, we choose a position m and break $\langle x_1, \ldots, x_n \rangle$ into two subsequences: the initial one $\langle x_1, \ldots, x_m \rangle$ stores the variables that the indefinite covaries with, while the final one $\langle x_{m+1}, \ldots, x_n \rangle$ stores the variables that the indefinite does *not* covary with. We therefore dub the resulting language Choice-FOL or C-FOL for short.

A model $\mathfrak{M}$ for C-FOL is the familiar pair $\langle \mathfrak{D}, \mathfrak{I} \rangle$ ($\mathfrak{D}$ is the domain of individuals, $\mathfrak{I}$ the basic interpretation function). An $\mathfrak{M}$-assignment g is a total function from the set of variables $\mathcal{V}$ to $\mathfrak{D}$. Let $g'[x]g$ abbreviate that the assignments g and g' differ at most with respect to the value they assign to x, i.e., for all other variables $v \in \mathcal{V}$, $g'(v) = g(v)$. Let $G'[x]G$ abbreviate that the sets of assignments G and G' satisfy the following two conditions: (i) for all $g' \in G'$, there is a $g \in G$ such that $g'[x]g$ and (ii) for all $g \in G$, there is a $g' \in G'$ such that $g'[x]g$. That is, $G'[x]G$ is the 'cumulative-quantification-style' generalization of $g'[x]g$. The relevant clauses of the definition of the interpretation function $[\![\cdot]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle}$ are provided below. The condition $\{x_{i_1}, \ldots, x_{i_{n'}}\} \subseteq \{x_1, \ldots, x_n\}$ in (8) bans free variables; we assume that deictic pronouns require the discourse-initial sequence of variables to be non-empty, just as in DRT/FCS.

8. $[\![R(x_{i_1}, \ldots, x_{i_{n'}})]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$ iff $\{x_{i_1}, \ldots, x_{i_{n'}}\} \subseteq \{x_1, \ldots, x_n\}$, $G \neq \emptyset$ and, for all $g \in G$, $\langle g(x_{i_1}), \ldots, g(x_{i_{n'}}) \rangle \in \mathfrak{I}(R)$ (i.e., we distribute over G and require each $g \in G$ to satisfy the formula).

9. $[\![\phi \wedge \psi]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$ iff $[\![\phi]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$ and $[\![\psi]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$.

10. $[\![\forall x[\phi](\psi)]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$ iff $[\![\psi]\!]^{\mathfrak{M}, G', \langle x_1, \ldots, x_n, x \rangle} = \mathbb{T}$, for some G' that is a maximal set of assignments such that $G'[x]G$ and $[\![\phi]\!]^{\mathfrak{M}, G', \langle x_1, \ldots, x_n, x \rangle} = \mathbb{T}$ ("maximal" means: there is no set $G'' \neq G'$ such that $G''[x]G$ and $[\![\phi]\!]^{\mathfrak{M}, G'', \langle x_1, \ldots, x_n, x \rangle} = \mathbb{T}$ and $G' \subseteq G''$).

11. $[\![\exists^m x[\phi](\psi)]\!]^{\mathfrak{M}, G, \langle x_1, \ldots, x_n \rangle} = \mathbb{T}$ iff $0 \leq m \leq n$ and $[\![\psi]\!]^{\mathfrak{M}, G', \langle x_1, \ldots, x_n, x \rangle} = \mathbb{T}$, for some G' such that (i) if $m = 0$: $G'[x]G$ and $g(x) = g'(x)$ for all $g, g' \in G'$ and, finally, $[\![\phi]\!]^{\mathfrak{M}, G', \langle x \rangle} = \mathbb{T}$; (ii) if $m \neq 0$: $G'[x]G$ and $g(x) = g'(x)$ for all $g, g' \in G'$ that are "$x_1, \ldots, x_m$"-identical (i.e., such that $g(x_1) = g'(x_1), \ldots, g(x_m) = g'(x_m)$) and, finally, $[\![\phi]\!]^{\mathfrak{M}, G', \langle x_1, \ldots, x_m, x \rangle} = \mathbb{T}$.

12. Truth: A formula ϕ is true relative to a model $\mathfrak{M}$ iff $[\![\phi]\!]^{\mathfrak{M}, G, \langle \rangle} = \mathbb{T}$ for any set of assignments G (where $\langle \rangle$ is the empty sequence of variables).

An existential $\exists^m x[\phi](\psi)$ is interpreted relative to a sequence of variables $\langle x_1, \ldots, x_n \rangle$ introduced by a sequence of n quantifiers that take syntactic scope over the existential. The superscript m on the existential indicates that only the first m quantifiers also take semantic scope over it: m indicates the *non-variation* of the existential with respect to the quantifiers following the m^{th} one. Such superscripts can meaningfully occur only on indefinites – and not on universals because their semantics cannot be given in terms of single witnesses.

The IS reading for sentence (2) above is translated in C-FOL as shown in (13) below. The crucial component is the superscript on $\exists^1 z$, which indicates that only the first universal quantifier $\forall x$ takes semantic scope over the existential. The other two readings are obtained by simply changing this superscript to the other two possible values it can take: we get the NS reading if the superscript is 2 and the WS reading if the superscript is 0. Thus, the scopal properties of the indefinite are locally, i.e., strictly compositionally, determined.

13. $\forall x[student(x)](\forall y[paper(y) \wedge \exists^1 z[professor(z)](recommend(z, y))](read(x, y)))$

III. Deriving Syntax/Semantics Constraints on Exceptional Scope There are two salient alternatives to the present account that share our goal of capturing the essential connection between exceptional scope and the semantics of existentials. These are (i) the independence-friendly logic of Hintikka (1973) and Hodges (1997) (among others) that inspired C-FOL and (ii) the choice/Skolem-function accounts in Reinhart (1997), Winter (1997) and Kratzer (1998) (among others).

Standard independence-friendly accounts specify which quantifiers the indefinites are independent of by indexing existential quantifiers with them. A problem with this account is that it predicts that a sentence like (6) above could have the unattested reading in which the indefinite *a*^{z} *gift* takes scope over *every*^{x} *man*, but under *most*^{y} *women*. The C-FOL account avoids this unwelcome result because the scopal independence of an indefinite is determined relative to *the sequence* of quantifiers that take syntactic scope over it: if an indefinite is not independent of a quantifier **Q**, it is necessarily not independent of all the quantifiers that take syntactic scope over **Q**.

Both independence-friendly and choice/Skolem-function accounts predict that indefinites with bound variables in their restrictors are able to take exceptional scope over the binders of those variables, i.e., the unattested IS or WS readings for sentence (7) above are predicted to be available. The C-FOL account allows only the NS reading: (11) above requires the restrictor formula ϕ to be interpreted only relative to the quantifiers $\langle x_1, \ldots, x_m \rangle$ that the indefinite depends on – i.e., the semantic scope of the restrictor is the same as the semantic scope of the existential. Hence, making the indefinite independent from *every*^{y} *paper* makes the variable y contributed by the pronoun its_y a free variable, which is ruled out by the clause for atomic formulas in (8) above.

Finally, the cross-linguistic typology of indefinites indicates that exceptional scope is a matter of scopal independence rather than a matter of scopal dependence. In particular, dependent indefinites (see Farkas 1997) use additional morphology on top of the ordinary indefinite morphology to mark scopal *dependence* – e.g., in Hungarian, the indefinite article is reduplicated, while in Romanian the particle *cîte* is added immediately before the indefinite article. The Skolem functions in Steedman (2007) or the parametrized choice functions in Kratzer (1998) are ways of producing dependent witnesses, i.e., depending on a particular choice of values for a certain sequence of parameters, we have one witness verifying the nuclear scope formula. As such, these function-based accounts are better suited for items that mark quantificational dependence rather than the upwards scopal independence that seems to be a universal property of ordinary, unmarked indefinites.

The picture that emerges is that indefinites are upwards free by default, can be scopally independent and are interpreted in terms of semantic non-variation, while morphology added on top of the indefinites can exert an opposite kind of pressure and push the scope of the indefinite downwards by marking scopal dependence and requiring semantic covariation with another quantifier.

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