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In situ Interpretation without Type Mismatches

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In this paper I argue for interpreting quantified noun phrases in their surface position, contra the quantifier movement approach of Heim and Kratzer (1998). I argue that noun phrases uniformly denote type ⟨1⟩ functions, which reduce arity of predicates they combine with by 1. I offer both empirical and conceptual arguments in favor of this approach.

Keywords quantifiers,semantics,scope,logical types,compositionality

Introduction

Heim & Kratzer (H&K 1998),[1] which we address here, claim (p.178) that quantified DPs in object position, as in (1), constitute a "type mismatch".

(1) John offended every linguist

Quantified DPs are assigned a semantic type ((e,t),t) in which they map *properties*, denotations of type (e,t), to truth values, denotations of type t. *properties* are functions from entities to truth values. Ss like (1) are problematic for them since the transitive verb *offend* has type (e,(e,t)), not the type for properties but rather that of functions from entities to properties. So on H&K's analysis neither *offend* nor *every linguist* is interpreted as a function whose domain contains the denotation of the other, so their interpretative mechanisms "are stuck" (H&K p.179) and cannot assign an interpretation to *offend every linguist*.

H&K adopt a Fregean solution to the problem by changing the syntax of (1) so that *offend every linguist* is not a logical constituent. Rather the syntactic object which is compositionally interpreted is (2), in which the DP *every linguist* has been moved:

(2) ((every linguist),(n,(John offended t_n)))

The type mismatch problem disappears since *every linguist*, of type ((e,t),t), now combines with an expression *(n,(John offended t_n))* of type (e,t). It denotes the function more usually denoted by $\lambda x.$*john offended x*, which maps an entity b to the truth value of *John offended x* when the variable x is set to denote b.[2]

[1] Less introductory works, such as van Benthem (1986) also find this type mismatch.

[2] In $\lambda x.\phi$ the symbol λ can be eliminated (as in H&K's notation) without loss. We just need to know which variable has been abstracted, x in our example, and what its scope is, ϕ here.

H&K contrast their movement solution with one in which *every linguist* is interpreted *in situ*. The option they present involves assigning multiple types to quantified DPs. *Every linguist* would have type ((e,t),t) when used as a subject, combining with an expression of type (e,t) to form one of type t, but it has type ((e,(e,t)),(e,t)) when used as an object. There it maps binary relations, such as that denoted by *offend,* to properties, such as that denoted by *offend every linguist*. H&K acknowledge that the two approaches are sufficiently different on a global level to resist easy comparison. And they allow that it is "conceivable" that the two approaches are simultaneously useful. Then they present three "standard" (p. 193) arguments in favor of movement, offering no comparable merits of *in situ* approaches.

In this Reply I offer a more natural *in situ* analysis not involving multiple types, drawn from Keenan (1992, 1993) and Keenan & Westerståhl (1997). I argue that it is the natural, or default, interpretation of DPs. An analogue of movement is used for a variety of "marked" cases. These claims are compatible with Hornstein's (1995) minimalist analysis in which movement is a "last resort requirement" (p.157).

Formal preliminaries

It will behoove us to be explicit about the basics of defining functions, so we repeat here some information that many readers know, if just implicitly. A *function* F from a set A to a set B is a way of associating with each α in A a unique element β in B, and we say that F maps α to β and write $F(\alpha) = \beta$. A is the *domain* of the function F, noted Dom(F), and B its *codomain*, Cod(F). The set $\{F(\alpha) | \alpha \in A\}$ of *values* of F is the *range* of F. We use *map* as a synonym for *function*. In general to define a function F you must say: (1) what Dom(F) is, (2) what Cod(F) is, and (3) for each $\alpha \in$ Dom(F), what $F(\alpha)$ is. We note the *set* of functions from A into B as [A→B]. (B^A is more common, but hard to iterate).

For V any set and $\alpha_1,\ldots,\alpha_n$ n choices of elements from V, we write $\langle\alpha_1,\ldots,\alpha_n\rangle$ for that *sequence of length* n, called an *n-ary sequence*, whose *first coordinate* is α_1, whose *second* is $\alpha_2,\ldots$, and whose n^{th} is α_n[3]. e is the unique sequence of length 0. Now we define a simple function referred to in the sequel:

(3) Let V be the two element set {a,b} and V* the set of finite sequences of elements of V. So V* = {e, ⟨a⟩, ⟨b⟩, ⟨a,a⟩, ⟨a,b⟩, ...}. We define a function h which maps each non-empty such sequence to the result of deleting its last coordinate. Formally, Dom(h) = V*−{e}, Cod(h) = V*, and for all $n \geq 0$, $h(\langle\alpha_1,\ldots,\alpha_{n+1}\rangle) = \langle\alpha_1,\ldots,\alpha_n\rangle$. □

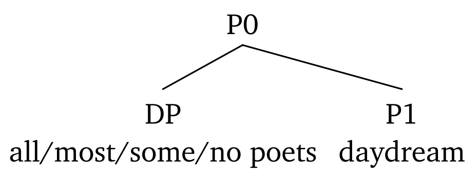
So h(⟨a,a,a⟩) = ⟨a,a⟩. Also h(⟨a,a,b⟩) = ⟨a,a⟩. Note that for each $n \geq 0$, h has all sequences of length n+1 in its domain, mapping each to a sequence of length n. But there is no sense in which h is "ambiguous". We have well defined h in giving its domain, V*−{e}, its codomain, V*, and in stating its unique value at each argument in its domain.

[3]In effect an n-ary sequence of elements of V is a function α from {1,...,n} into V. Its i^{th} coordinate is noted α_i rather than α(i). (In more formal treatments Dom(α) is {0,...,n−1}).

Interpreting DPs

We consider first the model theoretic interpretation of the subject DPs in (4), where for notational uniformity we use 'Pn' for *n-place predicate* – they combine successively with n arguments to form a P0 or zero place predicate (Sentence, IP, ...).

(4)



As in H&K, P0s are of type t and denote in the set {0,1} of truth values (0 = False, 1 = True) and P1s are of type (e,t), and so in a model with domain E, denote *properties*, functions from E into {0,1}. Nouns like *poet* are also property denoting. We write the noun in upper case for the set of elements of E the noun property maps to 1. So POET $\subseteq$ E. Then, as in H&K, **Def 1** gives correct denotations (in upper case) for the Dets in (4). They map the subsets A of E to functions mapping properties to truth values.

Def 1 For all subsets A of E and all properties p from E into {0,1},

a. $\text{ALL}(A)(p) = 1$ iff $A \subseteq \{b \in E | p(b) = 1\}$

b. $\text{SOME}(A)(p) = 1$ iff $A \cap \{b \in E | p(b) = 1\} \neq \emptyset$ ($\emptyset$ is the empty set)

c. $\text{NO}(A)(p) = 1$ iff $A \cap \{b \in E | p(b) = 1\} = \emptyset$

d. $\text{MOST}(A)(p) = 1$ iff $|A \cap \{b \in E | p(b) = 1\}| > |A|/2$
($|X|$ = the cardinality of X)

So ALL(POET) is true of the DAYDREAM property iff each $b \in$ POET is a b that DAYDREAM is true of. That is, each poet daydreams. SOME(POET) maps DAYDREAM to True iff the intersection of the set of poets with the set of objects that daydream is not empty. *No poet daydreams* is true iff that set is empty. And *Most poets daydream* is true iff the number of poets who daydream is greater than half the number of poets.

So we agree with H&K on the values that ALL(POET), etc. have at P1 denotations. But we differ from them in not claiming that the domain of those functions is *just* the set of properties. Rather we will treat these functions as mapping Pn+1 denotations, noted **Pn+1**, to **Pn** (Pn denotations), all n, just as our function h above took sequences of length n+1 as arguments yielding sequences of length n as values, *all* n. The difference is that our new functions map each *set* of n+1-ary sequences to a *set* of n-ary sequences. And the crucial idea here is that the value of one of these functions at any **Pn+1** is uniquely determined by its values at the **P1**s. So once we have defined one of these functions on the **P1**s (e.g. ALL(A), MOST(A), etc.) we have uniquely determined its values at all **Pn+1**s. First let us formally define the sets **Pn** in which Pn's denote (E is arbitrary and held constant throughout).

Def 2 i. **P0** = {0,1} and ii. for all n, **Pn+1** = [E → **Pn**]

So **P1** is [E → {0,1}], **P2** is [E → **P1**] = [E → [E → {0,1}]], both as in H&K. And now we take the domain of the functions F we are defining to be $\cup_{n\geq 0}$**Pn+1**, the set of n+1-ary relations, all n. So all the unary relations, the maps from E into {0,1}, are in that set. And all the binary relations (maps from E into the unary relations) are in that set, etc. The codomain of these functions is $\cup_{n\geq 0}$**Pn**. And for each each H ∈ **Pn+1**, F(H) is that element of **Pn** given by:

(5) $F(H)(b_n)\ldots(b_1) =_{def} F(\lambda x(H(x)(b_n)\ldots(b_1)))$ all $b_1,\ldots,b_n \in E$

F(H) takes n arguments and so is a **Pn**. It maps those arguments to the same truth value F maps the **P1** $\lambda x.H(x)(b_n)\ldots(b_1)$ to. The values F takes at **P1**s can be anything we like, but once specified its values at all **Pn**s, n > 1, are determined by (5). Note: when n = 0, **Pn+1** = **P1** = [E → {0,1}] and F(H) is a truth value, F(λx(Hx)). (Note that λx(Hx) *is* H).

To see that (5) yields correct results in a simple case let *John* denote an element j ∈ E. Then, writing ⟦·⟧ for the usual compositional interpreting function,

(6) ⟦John admires all poets⟧ =

=	((ALL(POET))(ADMIRE))(j)	Def ⟦·⟧
=	(ALL(POET))(λx.ADMIRE(x)(j))	(5)
=	1 iff POET ⊆ {b∈E|ADMIRE(b)(j) = 1}	Def ALL, λ

The last line says that *John admires all poets* iff each poet is a member of the set of objects John admires. The value that ALL(POET) assigns to the **P2** ADMIRE, line 1 above, is determined by the values it assigns to **P1**s, line 2.

Elements of Den_E(DP), the set of possible denotations of DPs over a domain E, will be called *functions of type ⟨1⟩*. They reduce arity (adicity) by 1. The claim that DPs should be interpreted as type ⟨1⟩ functions will be called **The Rich DP Hypothesis** (or just **Rich DP**). It differs from H&K's **Move DP** in which DPs only take properties as arguments. On **Rich DP** they take elements of **Pn+1** as arguments, all n. And we note without proof:

Theorem 1 For every F from **P1** to **P0** there is exactly one element of Den_E(DP) which takes the same values at the elements of **P1** as F does. □

Thus we can define a type ⟨1⟩ function F by giving its values on the **P1**s and saying that F is that type ⟨1⟩ function with those values on the **P1**s. On this understanding we might continue to write the type of DPs as ((e,t),t), though we might prefer a more transparent notation, such as (p_{n+1},p_n). Note that no type ⟨1⟩ function is "ambiguous", but each has a large domain.

Some Linguistic Implications of the Rich DP Hypothesis

1. An immediate, and encouraging, consequence of **Rich DP** is that we have at least a partial account for why English speakers utter DPs in object position. **Move DP** is, on reflection, quite discouraging. It says that to interpret transitive Ss like *John admires all poets* we must change the structure English provides so that *all poets* occurs outside the scope of *admires*.

But why then does English use these structures? Why don't we speak in LFs of the sort H&K provide? **Rich DP**, on which we interpret just the constituents of *John admires all poets*, provides an answer to this question, **Move DP** does not.

Note that we are not impugning Frege's achievement. He found, and found first, a solution to the problem of "multiple quantification"– it can be understood as iterated unary quantification. But Frege's problem was to provide a foundation for mathematics. Ours is to model natural language. We might state our problem as "How can we interpret transitive Ss with Frege's degree of logical adequacy using the structures natural language provides?". Frege was free to make up structures to say what he wanted. We linguists lack that freedom.

2. A second merit of **Rich DP** is that it prompts us to look for (and find) new logical types of DPs. **Move DP** can only model object DPs that could be interpreted as subjects since they just map **P1s** to **P0s**. Now Keenan and Stavi (1986) showed that over a finite E all maps from **P1** to **P0** are denotable – for any such function F we can construct a (possibly quite tedious) DP which could be interpreted as F. But on **Rich DP** we consider functions from n+1-ary relations to n-ary ones, in particular ones from binary to unary ones. A moment's reflection shows that the maps from **P2** = [E → [E → {0,1}]] to **P1** = [E → {0,1}] *vastly* outnumber those from **P1** to **P0** = {0,1}. Indeed for |E| = n the latter number is just 2^k, for k = 2^n. But the former number is $2^{n \cdot m}$, for m = 2^j, j = n^2. So in an E with just two entities there are 2^{32} or about four thousand million maps from **P2** →**P1**. Only 16 of them are type ⟨1⟩ (!).

2.1 DP Anaphors Are there not other object DPs, ones that do not occur as subjects (with the same interpretation) which enable us to denote some of these other maps from **P2** to **P1**? There are. Two such classes, discussed in Keenan (1987a), are *nominal (DP) anaphors* and *predicate anaphors*. The former are illustrated by the italicized DPs in (7).

(7)
a. No poet admires *himself /only himself*
b. John criticized *every student but himself / no student but himself*
c. John praised *both himself and the teacher / neither himself nor any other student*
d. Zakanya ta kula de *kwikwiyo-n kanta* (Hausa; Brenda Clark pc)
   lioness she watch of cub-of herself
   The lioness watched over her own cub
e. No woman read *a book about herself* (H&K, p.204)

Re (7d), languages with DP anaphors as opposed to clitic or verbal affix ones, commonly allow them to occur as possessors: Hindi, Japanese, Georgian, Chinese, Basque, Korean, Uzbek, and Hebrew are other examples. English disallows possessor anaphors (**She lost herself's wallet*). Other languages may have designated anaphoric Dets not built as possessor's of a DP. Here we class Latin *suus*, Russian *svoi*, and Norwegian *sin*.

Here first are plausible denotations for some of these anaphors,[4] writing SELF

[4] The formation of these complex anaphors uses the same derivational processes as for DPs that are not properly anaphoric. So those processes would have to be extended to take anaphoric DPs as arguments. This is completely doable, but each case would have to be handled separately, as we have

for the (gender neutral) denotation of *himself*, *herself*, etc. H is arbitrary in **P2**, a is arbitrary in E:

(8) a. SELF(H)(a) = H(a)(a)
b. (ONLY SELF)(H)(a) = 1 iff for all b∈E, H(b)(a) = 1 iff b = a
c. (EVERY A BUT SELF)(H)(a) = 1 iff a ∈ A & {b∈A|H(b)(a) = 1}=A−{a}

Theorem 2 (Keenan 1987c, 1992) For |E| ≥ 2, there is no type ⟨1⟩ function F such that F(H) = SELF(H) all H ∈ **P2.** Ditto for ONLY SELF, NO E BUT SELF, SELF's CUBS,...

Theorem 2 says that the way SELF, etc. map **P2**s to properties is new – no type ⟨1⟩ function takes just those values at all **P2**s. It is instructive to see why this is so. Imagine a situation in which we are talking only about people and (9a) is true. Then (9b) must hold, and its truth does not change upon replacing *most poets* by any type ⟨1⟩ DP:

(9) a. John admires exactly the people who Bill trusts
λx(ADMIRE(x)(john)) = λx(TRUST(x)(bill))
b. Therefore, John admires most poets if and only if Bill trusts most poets
(MOST(POET))(λx(ADMIRE(x)(john))) =
(MOST(POET))(λx(TRUST(x)(bill)))

But (9b) does not follow if *most poets* is replaced with (*only*) *himself*, *everyone but himself*, etc: If John admires just Maud, Bill, Frida, Ben, and Sue, and those are just the people Bill trusts, then *John admires himself* is false, and *Bill trusts himself* is true. More formally, a type ⟨1⟩ h applied to **P2**s F and G satisfies the invariance condition in (10a). "Anaphoric" functions like SELF, etc. do not, but they satisfy the weaker condition (10b).

(10) a. For a,b ∈ E, if λx(F(x)(a)) = λx(G(x)(b)) then h(F)(a) = h(G)(b)
b. For a ∈ E, if λx(F(x)(a)) = λx(G(x)(a)) then h(F)(a) = h(G)(a)

As a particular case, (10b) says that (11) is a valid argument.

(11) John admires exactly the people he (John) trusts. Ergo, John admires everyone but himself iff John trusts everyone but himself

Let us refer to DPs which denote functions from **Pn+2** to **Pn+1** satisfying (10b) and failing (10a) for some choice of E, F and G, *anaphoric DPs* (DPAs). The italicized DPs in (7) are DPAs. DPs such as *Rosa* and *most students at UCLA* are non-anaphoric and will be called *referentially autonomous*, as their interpretation doesn't depend on anything outside them. DPAs greatly expand the number of denotable functions from **P2** to **P1**, but still come nowhere close to the total (Keenan 1987a). The set of DPAs is isomorphic to [E → Den_EDP] and so can be easily counted. (On this isomorphism SELF is mapped to the identity function). A third advantage of interpreting DPAs directly is more "traditional": it provides a partial explanation for the ungrammaticality of the Ss in (12).

chosen anaphors built in syntactically different ways. See Szabolcsi (1987) and Jacobson (1999) for extensive discussion.

(12) *(Only) Himself / *Everyone but himself / *Both himself and the teacher fell asleep

If the subjects in (12) are interpreted as DPAs then the Ss should be ungrammatical since they are uninterpretable – DPAs require **P2** arguments and the S provides none. Similarly for (13) providing that the transitive verb + object must form a P1.

(13) *Himself/*Everyone but himself/*Both himself and the teacher [$_{P1}$praised every student]
(Cf Every student praised himself/everyone but himself/both himself and the teacher)

Since the Ss in (13) fail Principle A (*Anaphors are locally bound*) given the language specific stipulation that *himself*, etc. is an anaphor, Binding Theory (BT) makes a stronger predication: (13) is ungrammatical. Our conditional prediction is weaker. It only says that IF *himself*, etc. are interpreted as DPAs in (12) then the Ss are ungrammatical. Another option is that speakers change their interpretation of these expressions once they are in subject position. In simple cases in standard English this does not happen. But there are varieties of English where it does, such as Irish English (Keenan 1988; Jim McCloskey pc) and various speech communities in the American North East. Crucially *himself* in (14a) and the first occurrence of *herself* in (14b) are not interpreted as SELF but rather deictically, as the prominent male/female in context. The Japanese "reflexive" *zibun* is also used deictically (Keenan 1988):

(14) a. (Said to a co-worker who is arriving late to work) Irish English
– Watch it. Himself is in a lousy mood today. (Himself = the boss)
b. (You, shouting at me to hurry up)
– Wait a minute! Herself is getting herself ready. (Herself = my wife)

(15) a. Hanako-ga zibun-o utagatte-iru Japanese
Hanako-nom SELF-acc doubts
Hanako doubts herself or *Hanako doubts Speaker*
b. Zibun-ga Hanako-o utagatta-iru
SELF-nom Hanako-acc doubts
Speaker doubts Hanako, **Hanako doubts herself.*

The correct generalization then concerns not simply the *distribution* of expressions like *himself / zibun* but also their *interpretations* in different positions, as our approach says. We turn now to a second new type of map from **P2** to **P1**, *predicate anaphors* (PAs).

2.2 Predicate Anaphors are dependent on the **P2** argument, as in (16c).

(16) a. Mary interviewed more/fewer poets than Sue knows
b. Mary knows more/fewer poets than Sue knows
c. Mary knows *more/fewer poets than Sue / exactly as many poets as Sue* (*does*)

The object of *read* in (16a) denotes a type ⟨1⟩ function, illustrated on **P1**s in (17).

(17) (MORE POET THAN SUE KNOW)(CAME TO THE PARTY) = 1 iff
$|\text{POET} \cap \{b|\text{KNOW}(b)(\text{sue})\}| > |\text{POET} \cap \{b|(\text{CAME TO THE PARTY})(b)\}|$

As a type ⟨1⟩ function its values at **P2**s are as in (18):

(18) (MORE POET THAN SUE KNOW)(INTERVIEW)(a) = 1 iff
$|\text{POET} \cap \{b \in E|\text{INTERVIEW}(b)(a) = 1\}| > |\text{POET} \cap \{b \in E|\text{KNOW}(b)(\text{sue}) = 1\}|$

(16b) is interpreted similarly to (16a), but in (16c) the second P2 *knows* is missing. A correct interpretation treats *more poets than Sue* as a **P2** anaphor, mapping **P2**s to **P1**s as in (19):

(19) (MORE POETS THAN SUE)(F)(a) = 1 iff
$|\text{POET} \cap \{b \in E|F(b)(a) = 1\}| > |\text{POET} \cap \{b \in E|F(b)(\text{sue}) = 1\}|$

We note without proof the analogue of Theorem 2: No type ⟨1⟩ function takes just the values at **P2**s that MORE POET THAN SUE does. PAs require a **Pn** argument, $n \geq 2$, so we have a partial semantic explanation for the ungrammaticality of (20b) (but none for why the missing P2 cannot be filled in deictically).

(20) a. Fewer students than John knows came to the party
b. *Fewer students than we e_i know$_i$ Mary
(Intended: Fewer students than we know know Mary)

2.3 Beyond the Frege Boundary DPAs and PAs are functions that map **P2** to **P1**, but they are not type ⟨1⟩ as they can not take **P1**s as arguments and so can't outscope a subject. And matters are much worse. Given type ⟨1⟩ functions F and G define FNG to be the type ⟨2⟩ function mapping each p in **P2** to F(G(p)), a truth value. MOST(POET)NNO(PLAY) is an example, as in *Most poets have written no plays*. But English presents many subject-object pairs which determine type ⟨2⟩ functions which are provably not composites of *any* type ⟨1⟩ ones. Some examples are in (21). For others, plus proofs, see Keenan(1987c,1992):

(21) a. *Different people* like *different things*
b. *All the students* answered *the same questions* (on the exam)
c. John admires Mary but *no one else* admires *anyone else*
d. John doesn't like Bill but *everyone else* likes *everyone else*
e. *A certain number of teachers* interviewed *a much larger number of candidates*

We have illustrated *in situ* interpretations for a variety of complex DPs. Many are not type ⟨1⟩ and hence not representable in the Fregean way H&K assume. We conclude with a discussion about what semantic representation would look like with DPs interpreted as type ⟨1⟩ functions. And to this end we must consider quantifier scope ambiguities.

4. Scope ambiguities H&K support **Move DP** with arguments from quantifier scope ambiguity, antecedent contained deletion (ACD), and bound-variable anaphora. The ambiguity argument is persuasive. It is based on primary semantic data which all theories must account for. The other two arguments are based on prior decisions about the representation of quantified phrases and deletion conditions.[5]

(22a) has the readings expressed in (22b) and (22c). (22c) is true if different manuscripts were read by different editors, but (22b) may fail in such cases.

(22) a. At least one editor read every manuscript
b. There was one editor who read all the manuscripts
(ONS: Object Narrow Scope)
c. For each manuscript there was an editor who read it
(OWS: Object Wide Scope)

The reader can verify that interpreting *every manuscript* in situ as a type ⟨1⟩ function yields the ONS reading, (22b). So we need a way to represent the OWS reading in (22c). The representation in (23), an insignificant variation of H&K's notation, will do.

(23) (every manuscript)λx.at least one editor read x

(23) uses *lambda abstraction*, where for *x* a variable of any type α and ϕ an expression of any type β, λx.ϕ, abbreviated (x,ϕ), is of type (α,β), interpreted as a map from α type denotations to β type ones. In (23) x is of type e and *at least one editor read x* of type t, so (*x.at least one editor read x*) is of type (e,t), mapping an entity b to the truth value of *at least one editor read x* when *x* is set to denote b. So (23) is true iff the set of manuscripts is a subset of the set of b's that ⟦(x.at least one editor read x)⟧ maps to 1. To establish the truth of (23) we see that for each manuscript b we must choose an editor that read it – nothing prevents us from choosing different editors for different manuscripts.

So let us use lambda abstraction in forming *possible semantic representations*, sr's, for English expressions. To be explicit: define the set SR of sr's for English to be the set of English expressions closed under lambda abstraction and concatenation of lambda expressions of type (α,β) with expressions of type α yielding ones of type β. We assume variables of all types.[6] The elements of SR are compositionally

[5] H&K do not offer explicit arguments against interpreting anaphors directly as in (8). They do mention that possibility in an exercise. Their ACD argument is notation dependent, hence weak. That argument is that Ss like (i.c) should be derived by "VP deletion", a notational choice lacking

(i) a. Mary read every book that Sue wrote
b. Mary read every book that Sue read
c. Mary read every book that Sue did

natural motivation. The "deleted" VP *read t* must first be added in (!) after *did*. Then *every book that Sue did [read t]* moves to clause initial position, leaving the VP following *Mary* as *read t*. Now fiddle the numerical indices (omitted here) on the traces and the created VP can be made identical to the one following *Mary* and deleted. This derivation is simply painful to behold.

Interpreting (i.a,b) is unproblematic, each presents two type ⟨1⟩ DPs, the second with a relative clause. What is semantically missing (or "pro-verbed" by *did*) in (i.c) is the P2 *read*. Interpreting the gap (or *did*) as the preceding P2 as with Predicate Anaphors yields a correct interpretation without applying **Move DP**, as in Lappin (1992), cited in Hornstein (1995). For a computational analysis that does not involve **Move DP** see Fox & Lappin (2004).

[6] LFs for English will be drawn from SR, and LFs for other languages will be drawn from their

interpreted with all DPs interpreted in situ. We use (24a,b) to represent the two scope readings of (22a).

(24) a. (ONS) At least one editor read every manuscript
b. (OWS) (every manuscript)(x.at least one editor read x)

The sr in (24a) is string identical to the English expression (22a). But as an sr it is interpreted with *every manuscript* in situ and thus with narrow scope. In (24b) *every manuscript* of type ((e,t),t) concatenates with *(x.at least one editor read x)* of type (e,t) and thus has *at least one editor* in its scope. No movement, only concatenation, is used in deriving (24b).

SR properly includes LF. It has lambda terms that abstract over variables deep in islands and hence represent the meaning of no English expression. It also allows vacuous binding – $(x.\phi)$ for ϕ with no occurrences of x. Our intent is simply that SR be rich enough to provide all the semantic representations we need. To represent the meanings of English expressions d we must associate with d a possibly empty set sr(d) of sr's such that (1) each meaning of d is represented by one of the sr's in sr(d), and (2) each sr in sr(d) expresses a meaning of d. Following H&K we would do this by moving *every manuscript* in (22a) to some pre-subject position, possibly one of many (Beghelli and Stowell 1997) thereby deriving (24b) from (22a). To derive (24a) from (22a) no movement is needed.

In response to the pre-theoretical question "What class of formal objects might we use to represent the meanings expressible in English?" the naive sensible answer is "English expressions themselves", since they are what we already use to express the meanings of English expressions. But a scientific shortcoming of this answer is that many English expressions are used to express more than one meaning, and in the interests of precision and clarity we want to represent each meaning unambiguously. One option is to simply augment the class of English expressions with some additional structure (such as lambda abstraction) and then associate each English expression d with a set sr(d) as above. We take this route to keep our sr's as close as possible in form to the LFs adduced in H&K. But there are at least two other options: (1) as in Montague (1969) enrich the syntax of English so that different scope readings of Ss like (22a) are derived differently and then compositionally interpret the derivations. And (2) just give unambiguous paraphrases in ordinary English for each scope ambiguity, as we did in (22b) and (22c). So each sr(d) would just be a set of ordinary English expressions. But can we always make each element of each sr(d) unambiguous? Can we always disambiguate English in English? It would be unwise to assume that we can.

Now we can reconstruct the claim that the LFs associated with a given expression d are derivable from d by applying rules of the sort independently motivated in the overt syntax. But we can also do more. We can say that an expression such as (25a)

SRs. So LFs for different languages will be different – not only will they contain different lexical items they normally have a different syntax (as in Hornstein 1995:185). This is unproblematic just as it is unproblematic to show in Elementary Logic that $(P \vee Q)$ and $\neg(\neg P \wedge \neg Q)$ are logical paraphrases (true in exactly the same models) despite being syntactically quite different. Once we know how to show that distinct syntactic structures have the same meaning the pressure to make LF the same for all languages (Hornstein 1995:7-9) diminishes to zero.

fails to have an sr such as (25b) since any attempt to derive (25b) from (25a) violates a constraint on movement.

(25) a. The photographer who took most of the pictures sued the magazine
b. *(Most of the pictures)(x.the photographer who took x sued the magazine)

The sr (25b) is compositionally interpretable and would be true if many pictures were taken, each by a different photographer and most of the photographers sued the magazine. But (25a) is not true in such a case. Now we want to be able to exhibit the sr that (25a) would have if the movement constraint was not in force. We want this precisely to show that movement constraints are not semantically motivated, but are purely syntactic in nature.[7] But H&K cannot do this, as the relevant sr, (25b) is not an LF as all ways of deriving it violate a movement constraint. We now present our general proposal concerning scope assignment:

The Principle of Natural Scope (PNS)

> Referentially autonomous DPs can always be interpreted *in situ*. Some may also receive a wide scope interpretation, conditions permitting.

Type ⟨1⟩ DPs interpreted *in situ* have narrow scope relative to type ⟨1⟩ DPs which c-command them.[8] So in transitive Ss the PNS implies that ONS (Object Narrow Scope) readings are always available; OWS ones may fail to be, and when available are often dispreferred to the ONS one. Further, many conditions disfavor or block OWS readings entirely (e.g. nominal and predicate anaphors). Few block an ONS reading.[9] Elevating this observation to the status of a "Principle" is possibly original here, but the claim itself is not. For example "The scope interpretation that matches surface hierarchy often outshines the one that does not" (Szabolcsi 1997b:110)

Strict DPAs, PAs, and the object DPs in (21) are not referentially autonomous so the PNS does not apply to them. We are only concerned with DPs that can take **P1**s as arguments and thus which *can* have wide scope. The "conditions permitting" clause is a hedge. The empirical significance of the PNS depends on both the extent to which *in situ* interpretations predominate over wide scope ones and the extent to which we can state explicitly the conditions which permit or block wide scope interpretations.

The PNS is a naturaleness constraint: it says that natural language does not mislead us by putting quantified DPs in positions where we cannot interpret them. Rather the natural interpretation of DPs is precisely one in which they are interpreted right where we say them. Other interpretations require more complicated, less

[7] Thanks to Sarah van Wagenen for discussion of this point.

[8] This assumes a compositional semantic interpretation and it assumes that the c-command relations reflect the order of composition. For example it assumes we do not derive *at least one editor read every manuscript* by first deriving *at least one editor read it* and then substituting *every manuscript* for *it*.

[9] Beghelli & Stowell (1997) claim that negative Ss such as *Every student didn't read two poems* just have the ONS reading, though OWS is available on the unnegated S. But my judgment is that this S can function as a direct denial of the ONS reading of *Every student read two poems* and thus does have an ONS reading.

natural, semantic representations. To adapt an adage "Language is subtle but she is not mean".

Below we provide some support for the PNS. A thorough study would have to treat the thousands of pairs of DPs built from the Dets presented in Keenan & Moss 1985 or Keenan & Stavi 1986. In addition boolean compounds of DPs would have to be treated, as well as transitive verbs of different sorts. We can not undertake such a study here, but we will note some common scope patterns which enable us to evaluate the PNS to some extent.

The choice of Dets is perhaps the single most crucial factor in determining the possibility of scope ambiguity in transitive clauses. For example, given that both ONS and OWS are available in (26a), we see that they are also available in (26b) and (26c), since the Dets are unchanged. But in (26) when *no* replaces *at least one* we lose the OWS reading.

(26)	a.	At least one editor read every manuscript	ONS OWS
	b.	At least one student read every assignment	ONS OWS
	c.	At least one judge read every brief	ONS OWS
(27)	a.	No editor read every manuscript	ONS *OWS
	b.	No student read every assignment, etc.	ONS *OWS

The OWS analysis of (27a) is expressed by *Every manuscript has the property that no editor read it*. But speakers do not assert (27a) intending that meaning. Thus we cannot claim that *every Y* in object position may always take wide scope over *Det X* in subject position. It does for Det = *at least one* but fails for Det = *no*. Thus (Ben-Shalom 1993) relative scope is a *relation* between expressions, here the subject and object DPs, not just a property of one or the other. The pattern in (27) generalizes (Liu 1990) to decreasing DPs:

(28)	a.	Neither John nor Mary read every manuscript	ONS *OWS
	b.	Less than half the editors read every manuscript	ONS *OWS
	c.	Fewer than five editors read every manuscript	ONS *OWS
	d.	None of the editors read every manuscript	ONS *OWS
	e.	Not more than two editors read every manuscript	ONS *OWS
	f.	No student's advisor read every manuscript	ONS *OWS

Can we generalize further over the Dets in object position? Surprisingly the judgments in (28) change little when *every* is replaced by *each*, known to seek wide scope in a variety of contexts (Hornstein 1995:237). Perhaps some of the *'s change to ?? or even ?, but ONS is the most available reading in all cases;. So (29) is one pattern that supports the PNS:

(29) DPs in subject position tend to block OWS readings of universal DPs.

An additional range of cases in (30) seems to further support (29) and thus the PNS:

(30)	a.	No pupil memorized more than two poems	ONS *OWS

		Neither John nor Mary / Less than half the pupils/	ONS *OWS
	b.	None of the pupils / Not more than two pupils/ No pupil's teacher memorized more than two poems	

But it is known (Schlenker 2004) that modified numerals in object position resist wide scope:

(31)	a.	Every pupil memorized more than four poems	ONS *OWS
	b.	Every pupil memorized exactly four poems	ONS *OWS
	c.	Every pupil memorized fewer than four poems	ONS *OWS

So the pattern in (30) is independently predicted by (32), further supporting PNS:

(32) Modified numerical Dets in object position require or strongly prefer narrow scope

Also two place cardinal Dets (Keenan 1987b, Keenan & Moss 1985) resist wide scope:

(33)	a.	Every pupil read more poems than plays	ONS *OWS
	b.	Every pupil read fewer poems than plays	ONS *OWS
	c.	Every pupil read exactly as many poems as plays	ONS *OWS
	d.	Every pupil read twice/half as many poems as plays	ONS *OWS

The OWS analysis of 33a) says that more poems than plays are such that every pupil read them. But speakers do not use (33a) with that meaning. So (34) further supports the PNS:

(34) Object DPs built from two place Dets prefer or require narrow scope

So far we have seen one example of a scope ambiguity and many examples of transitive Ss in which object DPs prefer or require narrow scope. And our one example of scope ambiguity only generalizes very slightly to other increasing subject DPs:

(35)	a.	More than two editors read every / each manuscript	ONS OWS
	b.	Some editor read every / each manuscript	ONS ?OWS
	c.	Either John or Mary read every / each manuscript	ONS ??OWS/?OWS

The strong preference in interpreting (35c) is that either John read every ms or that Mary did. The OWS would be true if John read only some and Mary read the others. With some other universal DPs in subject position the ONS and OWS readings are logically equivalent, whence we cannot make a case for a scope ambiguity:

(36)	a.	Every editor read every manuscript	ONS = OWS
	b.	Both John and Mary read every manuscript	ONS = OWS

We have already seen that with decreasing subject and universal object we do not get the OWS reading. The same holds for non-monotonic subjects:

(37)	a.	Exactly two editors read every manuscript	ONS *?OWS

b. Every editor but John read every manuscript ONS *OWS
c. More students than teachers read every manuscript ONS *OWS

However the OWS reading improves slightly to ?OWS if *each* replaces *every*. Even so this pattern provides support for the PNS:

(38) ONS is preferred with non-monotonic subjects and universal objects

Further, Ss like (39) are classically scope ambiguous (consistent with the PNS but not specifically supportive of it) but Hornstein (1995:238) finds it to have only the ONS reading:

(39) Each / Every pupil recited a poem

My judgments agree with Hornstein's. To support this we must specify what we *mean* in saying that an expression is semantically ambiguous. This is not the same as having a test for ambiguity, such as being derived from different deep structures (in early theories). The accuracy of a proposed test must still be evaluated against our primary intuitions (Does derivation from different DSs yield just the pretheoretically correct results?), just as a proposed rule of deduction (Derive Q from P and if P then Q) must be evaluated against our primary intuitions of entailment (A entails B iff B is true under all the conditions that make A true). Here is an attempt at a pretheoretical definition of semantic ambiguity:

(40) **Definition** An expression d is *semantically ambiguous* between meanings m_1, m_2,... iff a competent speaker who utters d sincerely (not in jest, ironically, etc.) intends to communicate just one of the m_i. and a good faith addressee accepts this.

(40) is pretty subjective but seems consistent with classical clear cases. If you tell me that *The chickens are ready to eat* and I ask *Do you mean they are cooked? Or that we should feed them?* You cannot answer *Hmmmm. I'm not sure*. Such a response just means that you didn't understand what you said (so you're not competent). Similarly suppose you report that *John told Bill he was bleeding* and I query you with *You mean John was bleeding? Or Bill? Or some third party?* I expect you to have an answer.

Contrast these cases with a pretheoretically clear case of vagueness or non-specificity. You tell me that a student called while I was out and I respond *Do you mean an Albanian student?* Your reaction should be one of puzzlement since nothing you said reveals an intention to communicate the nationality of the student. Even if you wanted to say that an Albanian student called, you did not in fact say that so the good faith addressee cannot be expected to infer it. Thus, though the states of affairs in which an Albanian student called and a non-Albanian one called are different, the sentence is not ambiguous according to the nationality of the student(s).

Now suppose I assert (39) and you query *Was it was the same poem?* I *can* in this case respond with *Hmmm. I'm not sure. I just know that each student recited a poem in front of the class*. So we can assert (39) without intending the OWS reading. Further, it would I think be unreasonable to respond to your query with *Of course, that's what I just said!*, piqued that you didn't understand that I meant the OWS reading. Even if

I did I didn't give you enough lexical or syntactic information to infer that. I should have said something like *a certain poem,* or at least *one* or *some* (not *sm*) *poem*. So let us consider (41):

(41) a. Every pupil recited a certain poem
b. Every pupil recited some poem
c. Every pupil recited one / two / five poems

a certain poem in (41a) can naturally scope over *every pupil*, though it admits a functional, narrow scope interpretation as well (It can be true if every pupil recited his favorite poem, regardless of whether they differ or not). Now *a certain* is a "marked" form, contrasting with the simple indefinite article *a*. *certain* here is not an independently contentful adjective applying to *poem*, such as *short* or *alliterative*, so we expect that *a certain* will have a logical meaning which incorporates the meaning of *a* but which differs from it (by the Anti-Synonymy Principle "Different words have different meanings"). Assigning it wide scope accomplishes all these requirements. So this is a case of a marked expression having a marked meaning.

In (41b) *some poem* more strongly invites a wide scope interpretation. I believe this is in part because of the blocking effect of *a*. Had Speaker had intended ONS s/he would have used *a* or reduced *sm*. Again choosing the more marked form is associated with a more marked meaning. In (41c) I find it unproblematic to get the ONS reading, as do Beghelli & Stowell (1997:80) who find both OWS and ONS readings natural. A near paraphrase of (41c), on at least one reading, is *The number of poems that every pupil recited was one / two / five*. Still (41c) does admit an OWS interpretation easily. Additional support that it is not the only reading comes from anaphora. May (1985) observed that an object anaphorically bound to a subject cannot outscope the subject. There is no ambiguity in *At least one student criticized everyone but himself*. And if *five poems* in (41c) could only have wide scope it would be surprising that we could modify it as in (42).

(42) Every pupil_i read five poems of his_i choice

In sum the PNS receives significant empirical support and it provides an explanation for why objects typically scope under subjects.

Conclusion

We have presented a formally explicit mode of direct, *in situ* interpretation of quantificational DPs that does not involve type mismatches or multiple type assignments. Moreover it coincides with the interpretations H&K assign to DPs when they occur as subjects. Advantages of this way of interpreting DPs are that it accounts for why quantificational DPs occur in object position (like Names) and why narrow scope readings are favored over wide scope ones. It has also enabled us to find a variety of object DPs that can not be interpreted as functions from properties to truth values and hence to which **Move DP** a la H&K cannot apply.

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