1 Some general problems with unselective binding (and possibly other theories as well)

1.1 The proportion problem

- Unselective binding gives the wrong truth conditions for sentences like (1) and (2).

(1)  Most people who own a donkey beat it.
    a. \( \neq \) ‘Most donkey-owner pairs are such that the owner beats the donkey.’
       (This meaning would be true even if 9/10 farmers are kind, but own one donkey,
        while the 10th is mean and owns 10 donkeys.)
    b. = ‘Most donkey-owners beat their donkey(s)’

(2)  At least two people who own a donkey beat it.
    a. \( \neq \) ‘More than one donkey-owner pair is such that the owner beats the donkey.’
       (This meaning would be true even if . . . [exercise])
    b. = ‘More than one donkey-owner is such that he beats his donkey(s).’

- Such sentences would of course receive the correct truth conditions if the indefinite were
treated existentially—so long as one could also represent the anaphora correctly.

(3)  a. For most \( x \), such that there is a donkey that \( x \) owns, \( x \) beats the donkey(s) he
    owns.
    b. For more than one \( x \), such that there is a donkey that \( x \) owns, \( x \) beats the
    donkey(s) he owns.

This is a central motivation for the sort of dynamic logic you find in Groenendijk and Stokhof
1990 (Dynamic Predicate Logic) or Chierchia 1995 (see webpage).
1.2 Existential readings of indefinite in the scope of universals

• In fact, the quantificational force of an indefinite is not always determined by the nearest (obvious) quantifier. Sometimes, even in the scope of a quantifier, an indefinite just has existential force, as you would expect under a traditional theory.

(4) Every man with a quarter in his pocket put it in the meter.
   a. = For every man \( x \) with a quarter in his pocket, \( x \) put a quarter in the meter.
   b. \( \neq \) For every man \( x \) and every quarter \( y \) in his pocket, \( x \) put \( y \) in the meter.

(5) If I have a quarter in my pocket, I’ll put it in the meter.

• And yet, admittedly, the existential interpretation is apparently unavailable in some cases. (6), for instance, is understood as a generalizations over all owner-slave pairs, not just some instances of them.

(6) If a man owns a slave, he owns his offspring.
   (Seems false if man doesn’t own the offspring of all his slaves.)

1.3 The special status of time variables

• As we just saw, indefinites are sometimes interpreted as bound by an adverbial (or adnominal) quantifier, but sometimes they aren’t.

• The time coordinate, on the other hand, seems always to be understood as bound to the adverbial quantifier.

(7) When a letter arrives for Mary, she is usually at home. (de Swart 1991:118)
   a. i. = For most \( t \) such that there is a letter \( x \) that arrives for Mary at \( t \):
      Mary is at home at \( t \).
   ii. i.e. Most of the times when letters arrive, Mary is at home
   b. i. = For most \( x,t \), such that \( x \) is a letter that arrives for Mary at \( t \):
      Mary is at home at \( t \)
   ii. i.e. Most letter-arrivals happen when Mary is at home
   c. i. \( \neq \) For most \( x \) such that there is a time \( t \) such that \( x \) arrives for Mary at \( t \):
      Mary is at home at \( t \).
ii. i.e. Most letters that arrive for Mary at some time arrive when Mary is at home.
(Consider the case of letters that are delivered repeatedly.)

• Examples like (8) are just the limiting case of this. Here only the time variable is bound, since it is the only variable around.

(8) When it rains, it usually pours.

• It is unlikely that the unselective binding approach can explain the special status of the time coordinate. After all, unselective binding is all about being unselective.¹

• In any case, what clearly would explain the asymmetry is a theory in which adverbial quantifiers always bind temporal objects, such as times, events, or situations.

Or, to make a weaker point, such a theory would account for the fact that sentences like (8) represent the simplest or default case.

1.4 Difficulties with translation into GQ theory

1. Coordination

• Under an unselective binding theory, the restriction of a quantifier is effectively a set of $n$-tuples, (hence an $n$-place relation), where $n - 1$ is the number of indefinites.

• A quantificational NP will therefore denote the property of being a set which stands in some relation to an $n$-place relation.

  – For instance "every girl who owns a dog" will denote the property of being a 2-place relation that is a superset of the 2-place relation of being a girl who owns a dog.

Notice that to be a superset of a 2-place relation, you have to have contain a bunch of ordered pairs. So in effect, when the restriction of the quantifier is an $n$-place relation, the scope also has to denote an $n$-place relation.²

¹Schubert and Pelletier (1989) simply stipulate that time variables are always bound by the governing quantifier. Kratzer (see e.g. her 1995 article) accounts for the specialness of time by claiming that: (a) that the nuclear scope of an adverbial quantifier is given by VP; (b) anything above VP contributes to the restriction of the quantifier; (c) you don’t have a constituent denoting a set of events until above VP. But this account involves several postulates that are not easily accept.

²Recall our discussion of Schwarzschild’s “select-tuplization.”
• But we can coordinate quantificational DPs whose NP contains different numbers of indefinites:

\[(9) \quad \text{Every farmer who keeps an animal in a barn and everyone who has a pet must feed it.}\]

  a. “every farmer who keeps an animal in a barn”: property of 3-place relations
  b. “everyone who has a pet”: property of 2-place relations

Coordination is generally interpreted as intersection. But when the quantifiers denote (properties of) relations of different arity, this will always result in \(\emptyset\).

• So how does coordination work??

• The only obvious ‘solution’ is this:

  – If \(\llbracket \text{DP}_1 \rrbracket\) is a property of \(n\)-place relations, and \(\llbracket \text{DP}_2 \rrbracket\) is a property of \(m\)-place relations, and \(n > m\), then \(\llbracket \text{DP}_1 \text{ and DP}_2 \rrbracket = \llbracket \text{DP}_1 \rrbracket \cap S_n(\llbracket \text{DP}_2 \rrbracket)\), where \(S_n\) is an operation which takes a set of \(m\)-tuples and outputs a set of \(n\)-tuples, \ldots [exercise: spell out the rest]

But even if it works, this ‘solution’ is ad hoc, and involves a wildly noncompositional sort of operation.

2. The select-tuplization problem

• More generally, rendering an unselective binding theory in the terms of GQT requires something like Schwarzschild’s “select-tuplization.” But this operation is unattractive, due to its noncompositional spirit.

Why should a formula in the scope of a quantifier make different semantic contributions (an \(n + l\)-place relation, instead of an \(n\)-place relation) depending on the meaning of the formula in the restriction?
2  Berman 1987

2.1 Two problems for unselective binding

1. The proportion problem.

- With proportional quantifiers like most and usually, unselective binding often yields an unavailable meaning. In these cases, the correct meaning grants the indefinite existential force, as a traditional theory would predict.

(10)  

a. Most girls who own a dog groom it regularly.

b. i. ≠ ‘For most girl-dog owning pairs \( (x, y) \), \( x \) grooms \( y \).

ii. = ‘Most dog-owning girls regularly groom their dog(s).’

And when the relevant quantifier is adverbial, it associates only with some parameter that involves time: something like occasions, situations, events, or just times themselves.

(11)  

a. If a letter arrives for me, I’m usually at home.

b. i. ≠ ‘For most letters-arrival time pairs \( (x, t) \), I’m home at \( t \).

ii. = ‘For most occasions \( o \) where there’s letters that arrive, I’m home at \( o \).’

2. The iteration problem ("Iteration problem" is Berman’s term)

- When there is more than one adverbial quantifier, they of course don’t both unselectively bind the same variable(s).

(12)  

a. If I’m expecting company, I usually vacuum twice.

b. = “Most time-intervals in which I’m expecting company are such that there are two time-intervals in each of which I vacuum.” (Berman 1987: 20)

c. i. *usually\(_1\), 2): I’m expecting company at \( t_1 \): [ twice\(_{1,2} \): \( t_2 \) contained within \( t_1 \): I vacuum at \( t_2 \). ]

ii. usually\(_1\): I’m expecting company at \( t_1 \): [ twice\(_2 \): \( t_2 \) contained within \( t_1 \): I vacuum at \( t_2 \).

So here, binding must be selective.
• Notice, furthermore, the particular relation between the domains of the two quantifiers:
  – In this example, the time in the domain of the embedding quantifier contains the
time in the domain of the embedded quantifier.

Berman: This should not need to be stipulated; it should follow from the basic structure
of the model for adverbial quantification.

• Both problems can be fixed by ad hoc modifications of the unselective binding theory—
modifications which allow quantifiers to be either selective or unselective, and force them
to be selective in certain circumstances.

• Berman: A theory that needs this sort of unprincipled tailoring is unattractive. Find one that
fits right off the rack.

2.2 Berman’s theory

• Adverbial quantifiers count situations.

• Situations are ordered by a part-whole relation. Big situations can have little situations as
parts. The order is presumed to have a unique maximal element (i.e. a greatest element).
This greatest situation is a world.

\textbf{Weak Order} \quad A weak order on set $A$ is a binary relation in $A$ ($R \subseteq (A \times A)$) which is \textit{transitive}, \textit{reflexive}, and \textit{antisymmetric}. Example: $\leq$, in the set of numbers. \footnote{$R$ is transitive iff for all $\langle x, y \rangle \in R$ and all $\langle y, z \rangle \in R$: $\langle x, z \rangle \in R$. $R \subseteq (A \times A)$ is reflexive iff for every $x \in A$, $\langle x, x \rangle \in R$. $R$ is antisymmetric if whenever $\langle x, y \rangle \in R$ and $\langle y, x \rangle \in R$, then $x = y$ (i.e. the only symmetric pairs are reflexive pairs).}

\textbf{Strong/Strict Order} \quad A strong order on set $A$ is a binary relation
over $A$ which is \textit{transitive}, \textit{irreflexive}, and \textit{asymmetric}. Example: $<$, in the set of numbers.\footnote{$R$ is asymmetric if for any pair $\langle x, y \rangle \in R$, $\langle y, x \rangle \notin R$.}

\textbf{Partial Order} \quad An order, weak or strong.

\textbf{Total/Linear Order} \quad An order that is \textit{connected}.\footnote{An \textit{order} is \textit{connected} if and only if it is \textit{total}, or \textit{linear}, or \textit{dense}.

\textbf{Maximal Element} \quad Given an order $R$ in set $A$, $x \in A$ is \textit{maximal}
wrt $R$ iff there is no element $y \in A$, $y \neq x$, such that $\langle x, y \rangle \in R$.

\textbf{Greatest Element} \quad Given an order $R$ in set $A$, $x \in A$ is \textit{greatest} wrt
$R$ iff for every $y \in A$, $y \neq x$, $\langle y, x \rangle \in R$.}
• Indefinites still introduce open formulas, and not quantifiers. But they are not bound by embedding quantifiers. Instead they have existential force by virtue of the interpretation procedure:

“[F]or each situation we have to consider in evaluating a sentence, there must be some admissible value assignment to each free variable in the sentence. In effect, then, free variables are directly bound to an [implicit] existential quantifier.” (22)

• The situations quantified over must be minimal.

(13)  

a. A man sneezed exactly twice.

b.  
i. ̸= ‘There are two situations where a man sneezed.’

   E.g. The situation where sneezed in his living room, and the situation where he sneezed in his house.

ii. = ‘There are two situations where a man sneezed, which are minimal in having no man-sneezing situations as parts.’

• To evaluate the truth of the ‘main clause’ (i.e. the nuclear scope), you consider “extensions” of the minimal situations evaluated in the restriction. That is, you consider “more inclusive” situations that have the minimal situation considered in the restriction as a part.

   – Q(R, S) is true iff:

     ‘For Q-many minimal R situations s₁, there is an s₂ ≥ s₁ that is an S situation.’

• So here is the total theory:

   – Simple version:

     Q[R, S] is true iff for Q-many situations o that that satisfy description R under some assignment, there is an extension of o that satisfies description S under that same assignment.

   – Real version:

     (11) For all g and all s ∈ S, [A : α : β]s,g is true iff for A minimal s’ such that s’ ≤ s and there is a g’ ≈ g such that [α]s’g’ is true, then there is an s” ∈ S such that s’ ≤ s” and [β]s”,g’ is true.

5A relation R in A is connected iff for every two distinct elements x and y in A, either (x, y) ∈ R or (y, x) ∈ R or both. Example: ≤ and <, in the set of numbers.
We’ll discuss what’s going on with the assignment function later. For now, suffice it to say that anaphora is not the important part of this paper.

• Example:

(14)  

a. A film critic who dislikes a movie he sees always pans it.

b. Logical form:
   Always: $x$ is a film critic, $y$ is a movie, $x$ sees and dislikes $y$: $x$ pans $y$.

c. Interpretation:
   i. Simply:
      For every situation in which some film critic sees and dislikes some movie, there is a larger situation in which that film critic pans that movie.
   ii. Fancily:
      For all $g$ and all $s \in S$, $[(14a)]^* g$ is true iff: for all minimal $s' \in S$ such that: $s' \leq s$ and there is a $g' \approx g$ where $[(x \text{ is a film critic, } y \text{ is a movie, } x \text{ sees and dislikes } y)]^* g'$ is true: there is an $s'' \leq s'$ and $[(x \text{ pans } y)]^* g'$ is true.

2.3 Question

• Why is the scope predicated of extensions of the situation described in the restrictor? Why not just say: ‘Q-many R situations are S situations’?\footnote{This is generally how de Swart 1995 talks about it—although the idea that $S$ is predicated of extensions of the $R$ situation does occasionally appear after page 325, though without without being explicitly introduced. Blame van der Does and van Eijk for not forcing de Swart to make this clear.}
2.4 Berman’s account of proportion and iteration

• Proportion

(15) a. If a letter arrives for me, I’m usually home.

b. = Most minimal situations where there’s a letter that arrives for me are included in situations where I’m home.

What is a minimal situation in which a letter arrives for me?

Berman assumes that the individuation of minimal letter-arrivals is vague. One possibility is that a single minimal arrival can involve many letters. In that case, the proportion problem is solved.

This may seem like a weak explanation, since it relies on indeterminateness.

But notice, unlike the stipulative fix available within the unselective binding theory, this does connect to something real: vagueness about event individuation (read Kratzer 1989, L&P 12).

In the UB approach, no explanation was offered at all of why the contexts where the proportion problem arises require the indefinite to have existential force.

• Iteration

Berman says nothing about how relative scopes of multiple adverbial quantifiers are chosen, and leaves this question to another discussion. Fine.

What he says about the vacuuming sentence is this:

(16) “Each of most minimal situations in which I’m expecting company can be extended to two minimal situations . . . both of which in turn can be extended . . . to a situation in which I vacuum.” (26)

The relation between the two types of situations is given by the extension relation between them.
2.5 Berman’s problem with donkey anaphora

• In this paper, Berman is not immediately concerned with anaphora. But he recognizes the problem:

"First we determine the truth of the restrictive clause for however many situations the AQ specifies, by looking for some value assignment that satisfies the conditions on the free variables of the restrictive clause; next, we determine the truth of the main clause by, for each situation we considered in evaluating the restrictive clause, considering some extension of that situation that is satisfied by the same assignment of values to the free variables in the main clause. The problem arises if there is more than one satisfying value assignment—we must somehow guarantee that we use the same assignment for evaluating the extension [i.e. the broader situation described by the ‘main clause’] of given situation as we did for evaluating the situation itself.

When Berman writes "we must somehow guarantee that we use the same assignment . . .,” he’s just writing a blank check for a solution to donkey anaphora roughly in the spirit of Heim’s (1983) file-change semantics. You could say that the check was soon cashed by Groenendijk and Stokhof, with their dynamic semantics.

• The problem of holding on to provisional assignments gets even worse with multiple quantifiers:

(17) When a postman brings good news, he always rings twice.

a. Always, when a postman $x$ brings good news: twice, $T$: $x$ rings.

“When the embedded AQ-sentence is evaluated [viz. twice: he rings], a new assignment function is introduced; however, it must be constrained to assign the same values to the free variable $x$ in the embedded AQ-sentence as were assigned to the same variable by the distinct assignment function in the immediately dominating sentence.” (27)

That is, in the simplest case, $Q(R, S)$, you just carry over assignments from $R$ to $S$. But given $Q_1(R_1, Q_2(R_2, S_2))$, you’ve got to carry over assignments from $R_1$ to $R_2$ and $S_2$, even though $Q_2$ itself introduces a new assignment variant..

2.6 Berman on sage plants

• Heim 1982 gave (18) as a problem for an account of donkey anaphors as covert definite descriptions:

(18) If someone buys a sage plant here he usually buys eight others along with it.
Like Heim 1982, Berman lets indefinites contribute free variables. He describes the interpretation of (18) like this:

“[W]e consider minimal situations in which a person buys a sage plant, and look for some value assignment satisfying this; then we look for an extension of such minimal situations in which eight other sage plants are bought; since the assignment function remains the same in both cases [i.e. since Berman has stipulated that they do], and in the restrictive clause we considered an arbitrary sage plant (whatever value satisfied the conditions on the free variable), the pronoun in the main clause is not interpreted as referring to a specific sage plant.”

Berman presents this discussion as support for a nonquantificational analysis of indefinites, since he assumes that a quantificational analysis would impose a uniqueness presupposition on the donkey pronoun.

Here it should be pointed out that Dynamic Logics give a principled account of cross-sentential binding by indefinites, while still assuming that the quantificational force of indefinites is always existential.

2.7 Observations on the analogy with nominals

The situation approach seems to allow a very close parallel with nominal quantification:

- in both cases you just have two sets of things: situations or normal individuals.

Differences mostly just follow from differences in the nature of situations and other things, and in what sorts of expressions denote in these domains.

But is the analogy perfect?

Does the **minimality** and **extension** conditions have an analog in the nominal case?

(19) a. Most professors smoke.
     b. ?= Most minimal professors can be extended to smokers.

Discuss what applying these conditions in the nominal domain would mean.
3 Heim 1990

- Main point of this paper:

A traditional quantificational analysis of indefinites can be made to work at least as well as a DRT analysis, given two things:

1. An analysis of donkey anaphors as e-type pronouns.

Most interesting for us is Heim’s discussion of how the e-type analysis of pronouns is enabled by the situation-based analysis of adverbial quantification.

- Recall from Heim 1982 that the main problem besetting the e-type pronoun analysis was the absence of uniqueness presuppositions in donkey anaphors:

  (20) If a girl who owns a dog, she always grooms it.  
       (“it” ≠ ‘the unique dog each girl owns’; sentence true even for girls who own multiple dogs, if they groom each of them.)

  (21) If a man is in Athens, he is not in Rhodes.  
       (“he” ≠ ‘the unique man in Athens’) 

  (22) If someone buys a sage plant here, she always buys eight others along with it.  
       (“it” ≠ ‘the unique sage plant that each person bought.’)

- But in nearly all cases, it is clear that:

  “Letting QAdverbs quantify over minimal situations has made it possible to maintain an analysis of pronouns that is committed to uniqueness presuppositions, because it ensures that these uniqueness conditions will come out weak enough to be harmless.” (Heim 1990: 147)

Let’s see why.

- Heim’s situation-based analysis is basically Berman’s, except that it is stated in a GQT perspective: quantifiers are relations between sets.

The two relevant sets are constructed from the sets of situations that satisfy (1) the restriction and (2) the scope of the adverbial quantifier at logical form:
1. A set of minimal situations which satisfy the formula contributed by the restriction:

\[ \text{MIN}(S) = \{ s : s \in S \land \neg \exists s' [s \in S \land s' \leq s \land s' \neq s] \} \]

2. and a set of extensions of those minimal situations which satisfy the formula contributed by the scope:

\[ \{ s_1 : \exists s_2 : s_1 \leq s_2 : \ldots \} \]

"Always," for example, contributes the subset relation. Thus,\(^7\)

\[ \llbracket \llbracket \text{always}_{\sigma_1 \alpha} \sigma_2 \beta \rrbracket \rrbracket^g = 1 \text{ iff :} \]

\[ \text{MIN} \{ \{ s_1 := \llbracket \alpha \rrbracket^g_{\sigma_1/s_1} = 1 \} \} \subseteq \{ s_1 : \exists s_2 : s_1 \leq s_2 : \llbracket \beta \rrbracket^g_{\sigma_1/s_1, \sigma_2/s_2} = 1 \} \]

That is, the set of minimal situations in which \( \alpha \) is true is a subset of the set of larger situations in which \( \beta \) is true.

• Now consider the cases that challenged the e-type analysis. Uniqueness is no problem, so long as the minimal situations are those with single participants.

(23) If a girl owns a dog, she always grooms it.
   a. ‘Every minimal situation \( s_1 \) in which a girl grooms a dog extends to a situation in which \( \text{the unique girl who owns the dog in } s_1 \text{ grooms the unique dog who is owned in } s_1 \).’

(24) If a man is in Athens, he is not in Rhodes.
   a. ‘Every minimal situation \( s_1 \) of a man being in Athens extends to a situation in which \( \text{the unique man in Athens in } s_1 \text{ is not in Rhodes} \).’

(25) If someone buys a sage plant here, she always buys eight others along with it.
   a. ‘Every minimal situation \( s_1 \) of a person buy a sage plant here extends to a situation in which \( \text{the unique person buying in } s_1 \text{ also buys eight other sage plants along with the unique sage plant bought in } s_1 \).’

• Under this approach, the proportion problem can be handled as suggested in Berman 1987: what counts as a minimal situation wrt a situation-description can vary with contextual assumptions.

For some reason, the default context for (26) counts one minimal situation per girl-dog pairs, while the default context for (27) counts one per girl.

---

\(^7\)For now don’t worry too much about the indexes and assignments. Concentrate on the basic idea: Q-many minimal R situations can be extended to S situations.
Here Heim makes an interesting suggestion. If donkey-anaphors are e-type pronouns with uniqueness presuppositions, the presence of a donkey anaphor will force situations to be counted in such a way that uniqueness is satisfied. This might help explain the intuitive contrast between (26) and (27).

But this help only goes so far. We’ll come back to this when we talk about von Fintel 1995/2005.

• “Yet,” laments Heim, “there is one type of example which seriously challenges the empirical correctness of even these seemingly innocuous uniqueness conditions [associated with the situation-based theory].” Namely this type:

(28) If a man shares an apartment with another man, he shares the housework with him.
    a. ‘Every minimal situation $s_1$ in which a man shares an apartment with another
       man extends to a situation in which:
       ?the unique man who shares an apartment in $s_1$ . . .’

(29) If a bishop meets another man, he blesses him.
    a. ‘Every minimal situation $s_1$ in which a bishop meets a man extends to a situation
       in which:
       ?the unique bishop who meets a man in $s_1$ . . .’
       (What if the met man is also a bishop?!)

Heim calls this “the problem of indistinguishable participants,” and considers it a grave problem for a situation-based theory.

DISCUSS.

• We’ll talk about donkey-sentences with relative clauses another time.

• Another main strand of this paper is Heim’s defense of the idea that the descriptive content of the e-type pronoun is determined pragmatically (or, in a broad sense, semantically).

Formally: some function is made salient by preceding discourse.
• There are some problems for a purely semantic/pragmatic account of e-type anaphora:

1. Why does salience depend on form, and not just meaning?

   (30) (Evans 1977: 147)
   a. # John is married, and she hates him.
   b. John has a wife, and she hates him.

2. There are cases where interpretation of a seemingly unbound anaphor is *forced* grammatically. Here ‘salient description’ seems too weak:

   (31) Every chess set comes with a spare pawn, which [i.e. the pawn, not the chess set] is taped to the top of the box.

Worse, how do you get number agreement, if there is no purely formal relation between anaphor and notional antecedent?

   (32) a. Most people who own a gun never use it.
   b. Most people who own guns never use them.
   c. ?? Most people who own a gun never use them.
   d. * Most people who own guns never use it.

• Because of such problems, Evans and Parsons construct the content of e-type pronouns syntactically, out the clauses containing their coindexed antecedents. This promises to solvet the various problems mentioned above.

But there are problems for the syntactic e-type approach:

1. The switch-speaker contradiction problem:

   (33) a. A man jumped off a cliff.
   b. He didn’t jump, he was pushed.

   This comes out contradictory under the syntactic approach. But on the looser, semantic approach, there is no problem. “He” can just be taken as: the guy you think jumped.

2. You have to *block* syntactic construction of the description in a variety of semantically defined conditions—as it happens, exactly those where the preceding sentence doesn’t entail the existence of any unique thingee to refer to.

   This seems ad hoc in comparison to a theory which assumes that what is referred to is a discourse referent, hence something that must have been entailed (relative to the local context anyway) by the preceding sentence.