On the Interpretation of Indefinites

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0. Introduction

This paper presents novel data from Antecedent Contained Ellipsis constructions to argue that English indefinites are interpreted through a choice function of type <et, <et,t>>. The analysis will thus provide independent support for the general approach of Winter (1997), although the semantic framework assumed here differs considerably.

The paper is organized as follows. Section 1 outlines the choice function approach to indefinites, due originally to Reinhart (1997) and Kratzer (1998). Reinhart and Kratzer both claim that indefinites are ambiguous between an interpretation using a choice function of type <et, e> and an interpretation as a generalized quantifier. Section 2 presents novel data from Antecedent Contained Ellipsis constructions. These data will suggest that indefinites are not ambiguous, but rather seem able to behave as quantifiers and choice functions simultaneously. Section 3 examines and rejects two possible explanations for this dual behaviour of indefinites, before proposing an <et, <et, t>> analysis, and demonstrating how it accounts for the interpretation of indefinites.

1. The Choice Function Approach to Indefinites

It has long been observed that the scopal properties of indefinites are not limited by the syntactic islands that characterize movement. Examples of this phenomenon (adopted from Reinhart 1997) are provided in (1) through (3). In each, *namely DP* is

* I would like to thank Kai von Fintel, Danny Fox, Irene Heim, Sabine Iatridou, Tony Kroch, Jon Nissenbaum, David Pesetsky, Yoad Winter, and the audience at an MIT LingLunch for helpful comments and discussion. This work is partially funded by SSHRC grant #752-97-2087.

Pius Tamanji, Masako Hirotani, and Nancy Hall (eds.), NELS 29: 247-260

added to favour the intended reading.

(1) *Adjunct Islands*
Most guests will be offended if we don't invite some philosopher, namely Quine.
OK: ∃>Most

(2) *Across-the-Board Constraint*
Everyone reported that that Mark and some lady disappeared, namely Carolyn.
OK: ∃>∀

(3) *Relative Clauses*
All students believe anything that several teachers say, namely Kira, Dana, and Donn.
OK: Several>∀

Strong quantifiers, on the other hand, do seem to be limited by islands, as shown in (4) through (6).

(4) *Adjunct Islands*
Some guest will be offended if we don't invite every philosopher.
*∀>∃

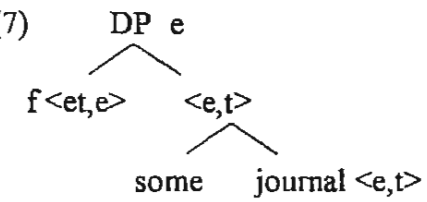
(5) *Across-the-Board Constraint*
Someone reported that Mark and every lady disappeared.
*∀>∃

(6) *Relative Clauses*
Many students believe anything that every teacher says.
*∀>Many

The choice function approach was designed to account for this disparity between the scopal freedom of strong quantifiers and indefinites. Other data that motivated the approach came from wh-constructions and from limits on distributive readings of indefinites. See Reinhart (1997) for details.

For concreteness, consider the structure in (7).

(7)



Thus, a choice function variable is generated within the DP.[1] This function takes the set denoted by the noun phrase as an argument, and returns a member of the set. The function variable is then specified outside the island by some mechanism. Given an appropriate definition for the choice function,[2] this analysis yields island-insensitive scope without movement, as shown informally in (8).

(8) *Choice Functions: Island-Insensitive Scope without Movement*
Most guests will be offended if we don't invite some philosopher, namely Quine.
'there exists a choice function f, such that for most guest x, x will be offended if we don't invite the individual chosen by f from the set of philosophers'

Several points of contention remain among proponents of the choice function approach. One I will not explicitly address is how the choice function variable should be specified. Reinhart (1997) and Winter (1997) maintain that existential closure applies to the variable at any point in the structural representation; Matthewson (1998) restricts existential closure to the highest level of the representation; while Kratzer (1998) appeals to identity with a salient choice function in the discourse. The debate is largely an empirical one, centering around the possibility for indefinites to take intermediate scope, that is scope that escapes a syntactic island while remaining within the scope of another operator. A possible example from Reinhart (1997) of an indefinite with intermediate scope is given in (9).

(9) Most linguists have looked at every analysis that solves some problem.
'for most linguist x, there exists a problem y, such that x has looked at all analyses z, such that z solves y'

This paper will have nothing additional to add to this debate, although possible examples of intermediate readings will be given when appropriate. For ease of exposition, I assume unrestricted existential closure.

A second difference among proponents of the choice function approach is that Reinhart (1997), Kratzer (1998) and Matthewson (1998) claim that indefinites are ambiguous between an interpretation as a generalized quantifier and an interpretation as a choice function of type <et,e>, while Winter (1997) claims that indefinites are unambiguously interpreted as a choice function of type <et, <et,t>.

A crucial point to notice about the proposal that indefinites are ambiguous is that it predicts that indefinites should exhibit two separate types of behaviour. When interpreted as a generalized quantifier, an indefinite should behave as a quantifier, potentially undergoing quantifier raising (QR), i.e. syntactic movement limited by islands. When interpreted through a choice function, yielding a DP of type <e>, indefinites should potentially exhibit island-insensitive scope *in situ*.

[1] More specifically, Reinhart (1997) argues that the choice function variable is generated in the specifier of DP, but the exact location need not concern us here.
[2] See section 3 for the choice function definition advocated in this paper.

The purpose of the following section of this paper is to show that this separation of behaviours does not obtain. An indefinite is able to behave as a generalized quantifier and a choice function simultaneously. To establish this result, the behaviour of indefinites in Antecedent Contained Ellipsis constructions will be tested.

2. Data from Antecedent Contained Ellipsis

Antecedent Contained Ellipsis constructions are characterized by the existence of an elided or downstressed VP contained within its antecedent. Consider (10).

(10) *Antecedent Contained Ellipsis (ACE)*
Donn $_{VP1}$[likes $_{DP}$[one of the books I do $_{VP2}$[e]]].

In this sentence, the elided VP2 is contained within its antecedent, VP1. This construction was first noticed as a problem by Bouton (1970). There are two analyses of this construction which can now be considered standard--PF deletion of the elided VP2 under LF parallelism, and LF copying of VP1 into VP2 at LF. Both approaches make crucial use of quantifier raising,[3] requiring QR of *one of the books I do* in (10), either in order to create parallelism between VP1 and VP2, or to avoid infinite regress when VP1 is copied into VP2 at LF. I believe there is sufficient evidence to prefer the PF deletion analysis,[4] so I will assume this approach, although nothing crucially rests on this decision. (11) illustrates the structure resulting from this movement.

(11) *ACE Resolution through QR*
Donn $_{DP}$[one of the books I do $_{VP2}$[e]]$_i$ $_{VP1}$[likes t_i]

The structure in (11) allows both VP1 and VP2 to consist of *[likes t_i]* at LF, thus satisfying parallelism.

Given the need for quantifier raising to resolve antecedent contained ellipsis, we may use this construction to test the behaviour of indefinites. If indefinites are ambiguous between a generalized quantifier and a choice function, ACE constructions should be able to distinguish between them. The quantificational indefinite should be able to undergo quantifier raising, and thus could appear in ACE constructions; however, it would not be able to obtain island-insensitive scope, since this is only accomplished through a choice function. The choice function indefinite, on the other hand, would be able to obtain island insensitive scope, but as a DP of type <e>, it should not be able to undergo quantifier raising, and thus should not be able to appear in ACE constructions. The prediction of the ambiguity hypothesis, then, is that indefinites will not be able to appear in ACE constructions *and* obtain island-insensitive scope.

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[3] Hornstein (1995) proposed an alternative approach in which ACE is resolved by object shift. See Kennedy (1997) for considerable evidence against this possibility.

[4] For example, the parallelism requirement of ACE, also found in ellipsis and phonological reduction constructions, refers to material outside of the ellided VP. This fact is naturally captured by the PF-deletion approach, while it is unclear how LF copying could account for such a condition. Furthermore, LF copying could not explain the appearance of this condition in the phonological reduction constructions; thus a separate explanation for this parallelism would likely be required. See Chomsky & Lasnik (1993), Fox (1998), Lasnik (1972), Tancredi (1992).

The data in 12(a) through (c) demonstrate that this prediction is not borne out. Island-insensitive scope is available for indefinites in ACE constructions, as demonstrated by the availability of the readings given informally under each example.

(12) *Indefinites in ACE with Island-Insensitive Scope*

a. *Complex NP Island*
John overheard the rumour that Chomsky$_i$ didn't write some book he$_i$ did, namely *Aspects*.
'there exists a book x, such that Chomsky wrote x, and John overheard the rumour that Chomky didn't write x'

b. *Adjunct Island*
John$_i$ would be thrilled if he$_i$ sat beside a famous hockey star I did, namely Bobby Orr.
'there exists a famous hockey star x, such that I sat beside x, and John would be thrilled if he sat beside x'

c. *Relative Clause*
John$_i$ rewarded every student who saw one of the films he$_i$ did, namely *Hamlet*.
'there exists a film x, such that John saw x, and for every student y, if y saw x, John rewarded y'

Notice that intermediate scope also seems possible for indefinites in ACE environments.

(13) *Intermediate Scope with Adjunct Islands*

a. Every student$_i$ will be happy if NELS accepts some paper of hers$_i$ that we did.
'for every student x, there exists a paper y such that we accepted y and x would be happy if NELS accepted y'

b. Every student in this class would be happy if MIT offered some course that Harvard does.
'for every student x, there exists a course y such that Harvard offers y and x would be happy if MIT offered y'

This section thus concludes with the result that indefinites in ACE constructions have the same scopal freedom as indefinites in other environments. The following section considers possible explanations for these data.

3. Analysis and Alternatives

The first possibility to be considered is that the indefinites in (12) and (13) are interpreted through a choice function of type <et, e>, the parallelism requirement of ACE motivates movement of the indefinite, and thus ACE resolution is achieved. This

possibility is unlikely to be true. To see why, we need to make a brief foray into the work of Danny Fox (see for example, Fox 1998).

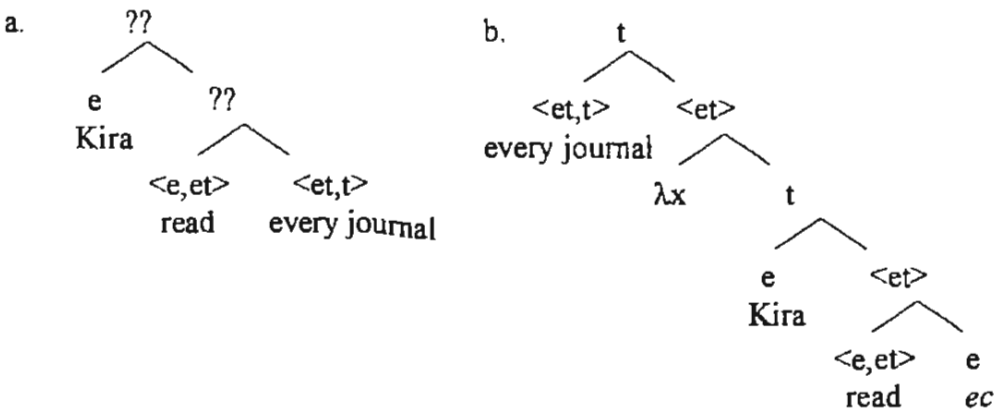
Fox has been developing an economy-based analysis of scope shifting operations (SSOs). In this approach, operations like QR are limited by Economy in two ways. First, each application of an SSO must be motivated by semantic considerations:

(14) *Scope Economy* [intuition] (Fox 1998)
SSOs which are not forced for type consideration must have a semantic effect, where "semantic effect" is defined in terms of scopal commutativity.

(15) *Scope Economy* [definition] (Fox 1998)
An SSO can move XP1 from a position in which it is interpretable only if the movement crossed XP2 and <XP1, XP2> is not scopally commutative.
<α,β> is scopally commutative, when α, β ∈D <et,t> if for all ϕ ∈ D<e,et>
$\alpha(\lambda x \beta(\lambda y\, \phi(y)(x)) = \beta(\lambda y \alpha(\lambda x\, \phi(y)(x))$

Notice that Fox assumes type mismatches must be resolved by movement, an idea anticipated by Pesetsky (1982), and assumed in Heim and Kratzer (1998). Thus, an object of type <et,t> cannot combine in situ with a predicate of type <e,et>. Instead, it must undergo movement, creating a lambda abstraction in order to be interpreted, as shown in (16). Therefore, QR of a quantificational object is always motivated, and indeed obligatory.

(16) *Obligatory QR of Quantificational Objects*



The second manner in which scope shifting operations like QR are limited by Economy, according to Fox, is in how far they may move:

(17) *Shortest Move* (Fox 1998)
QR must move a QP to the closest position in which it is interpretable.
i.e. a QP must always move to the closest clause-denoting element that c-commands it.

One effect of this condition is that QR motivated by type considerations may only move a quantificational object to adjoin to the closest node where it may be interpreted, i.e. the verb phrase. In order for the object to move higher, this second movement must have semantic effects, as required by the Scope Economy principle in (15).

Given these tools, we may now reconstruct Fox's arguments that the parallelism requirement of ACE doesn't motivate movement. Consider (18) and (19).

(18) A boy admires every teacher.
  a. a boy $_{VP}$[[every teacher]$_i$ [admires t_i]] OK: ∃>∀
  b. $_{TP}$[[every teacher]$_i$ [a boy $_{VP}$[t_i [admires t_i]] OK: ∀>∃

(19) Mary admires every teacher.
  a. Mary $_{VP}$[[every teacher]$_i$ [admires t_i]]
  b. *$_{TP}$[[every teacher]$_i$ [Mary $_{VP}$[t_i [admires t_i]]

The short QR of *every teacher* in (18a) is motivated by the need to resolve the type mismatch between the verb and its object. The resulting structure in (18a) is unambiguous, with the existential taking wide scope over the universal. After the additional instance of QR in (18b), the structure receives a different interpretation, with the universal taking wide scope over the existential. Thus, the additional instance of QR in (18b) is licensed by scopal considerations. Now consider (19). In (19a), as in (18a), the short QR of *every teacher* is motivated by a type mismatch between the verb and its object. The additional instance of QR in (19b), however, is ruled out by Scope Economy, since the resulting interpretation in (19b) is identical to that (19a) without the additional movement.

Now, consider what happens if (18) and (19) are combined in an ellipsis construction. If the parallelism requirement cannot motivate QR, the resulting structure should be unambiguous, with (18) only allowing narrow scope for the universal. This is because the universal *every teacher* in (18) must undergo an additional instance of QR in order to obtain wide scope, as shown in (18b), and yet *every teacher* in (19) cannot undergo this additional instance of QR, as shown in (19b). Therefore, the parallelism requirement will prevent the additional QR of (18b), and eliminate the wide scope interpretation. If, however, the parallelism requirement of ellipsis can motivate movement, the additional QR of *every teacher* in (19b) will be allowed, and the sentence will be ambiguous. As we see in (20), the resulting construction is unambiguous, indicating that parallelism cannot motivate QR.

(20) *Parallelism does not Motivate QR*
A boy admires every teacher. Mary does too.
  a. OK: *∃> ∀--parallelism requirement met*
  $_{IP}$[a boy $_{VP}$[[every teacher]$_i$ $_{VP}$[admires t_i]]]
  $_{IP}$[Mary $_{VP}$[[every teacher]$_i$ $_{VP}$[admires t_i]]]

b. * ∀>∃--*parallelism requirement not met*
$_{IP}$[[every teacher]$_i$ $_{IP}$[a boy $_{VP}$[t_i [admires t_i]]]
$_{IP}$[Mary $_{VP}$[[every teacher]$_i$ [admires t_i]]]

This disambiguation phenomenon was observed and analysed by Sag (1976) and Williams (1977), however both assumed that it always obtains in ellipsis constructions. The contrast between (20) and the minimally different (21), however, provides striking evidence for Fox's analysis. In (21), the additional instance of QR to IP is independently motivated in both clauses, since both objects are quantificational and scopally non-commutative with the subject. The reappearance of the wide-scope reading for the universal in (21) is thus predicted by Fox.

(21) A boy admires every teacher. A girl does too.
a. OK: ∃> ∀--*parallelism requirement met*
$_{IP}$[a boy $_{VP}$[[every teacher]$_i$ $_{VP}$[admires t_i]]]
$_{IP}$[a girl $_{VP}$[[every teacher]$_i$ $_{VP}$[admires t_i]]]

b. OK: ∀>∃--*parallelism requirement met*
$_{IP}$[[every teacher]$_i$ $_{IP}$[a boy $_{VP}$[t_i [admires t_i]]]
$_{IP}$[[every teacher]$_i$ $_{IP}$[a girl $_{VP}$[t_i [admires t_i]]]

Additional examples and tests can be found in Fox (1998), however I take the point as established. The disambiguation in (20), and the lack of disambiguation in (21), demonstrate that the parallelism requirement on ellipsis cannot motivate QR. The movement necessary to achieve parallelism must be independently motivated by scopal considerations in each clause.

Thus, the first possible explanation for the indefinite data in (12) and (13) has been excluded. The movement of the indefinite in these sentences is not motivated by the parallelism requirement of ellipsis.

The second possibility to be considered is that indefinites under the choice function interpretation can undergo QR. Given the model of scope Economy presented above, this would be highly surprising, since neither scopal considerations nor type mismatch would motivate this movement. The scope of the indefinite is determined by the location of the existential closure over the choice function variable, and the indefinite, being of type <e>, can combine with the verb in situ. This would thus be an instance of free QR in a system that otherwise requires motivation for this operation. However, one would also like empirical evidence to support the conclusion that elements of type <e> cannot undergo QR. Evidence bearing on the issue is very difficult to find, but the type of tests employed above can provide us with some relevant data. The examples require use of pseudogapping constructions, which is unfortunate in that pseudogapping constructions are always slightly marginal, making the judgements more difficult. It should not affect the argument, though, since pseudogapping constructions are also subject to the parallelism requirement on ellipsis.

Consider (22).

(22) *DPs of Type* e *Fail to Undergo QR*

a. Kira gave a sleeping bag to every camper, and Carolyn did to every counsellor.
OK: ∀>∃ (#∃>∀)

b. Kira gave a sleeping bag to every camper, and Carolyn did to Mark.
*∀>∃ (#∃>∀)

c. Kira gave a sleeping bag to every camper and Carolyn did to either John or Mark.
OK:∀>∃ (#∃>∀)

In (22a), the universal in both conjuncts undergoes QR, motivated both by type mismatch, and by scopal considerations. This allows the only plausible reading under which each person got their own sleeping bag. In (22b), on the other hand, this plausible reading is no longer available. Although QR of the indirect object *every camper* in the first conjunct is still motivated by both type mismatch and scopal considerations in (22b), movement of the indirect object *Mark* in the second conjunct is motivated by neither. Being a proper name, *Mark* is scopally commutative with the existential, and being of type <e>, it can combine with the verb in situ. Thus, it does not move, and parallelism between the two conjuncts fails. If short QR could freely apply to all objects, the proper name should be able to move and obtain the relevant reading.[5]

The datum in (22c) supports this interpretation. In this sentence, the plausible reading on which each person got their own sleeping bag reappears. Here, the indirect object in the second conjunct is a quantifier that is scopally commutative with the existential. Thus, although movement of the indirect object is still not motivated by scope considerations, it is motivated by type mismatch. The indirect object can therefore undergo QR, satisfying parallelism with the first conjunct.

The contrast between (22a) and (22b), and between (22b) and (22c), suggests that proper names, being elements of type <e>, do not undergo quantifier raising. These data, combined with the general implausibility of unmotivated movement in an Economy-based system, lead to the conclusion that elements of type <e> cannot optionally undergo short QR. Therefore, the movement of the indefinites in (12) and (13) is not due to a free operation of QR.

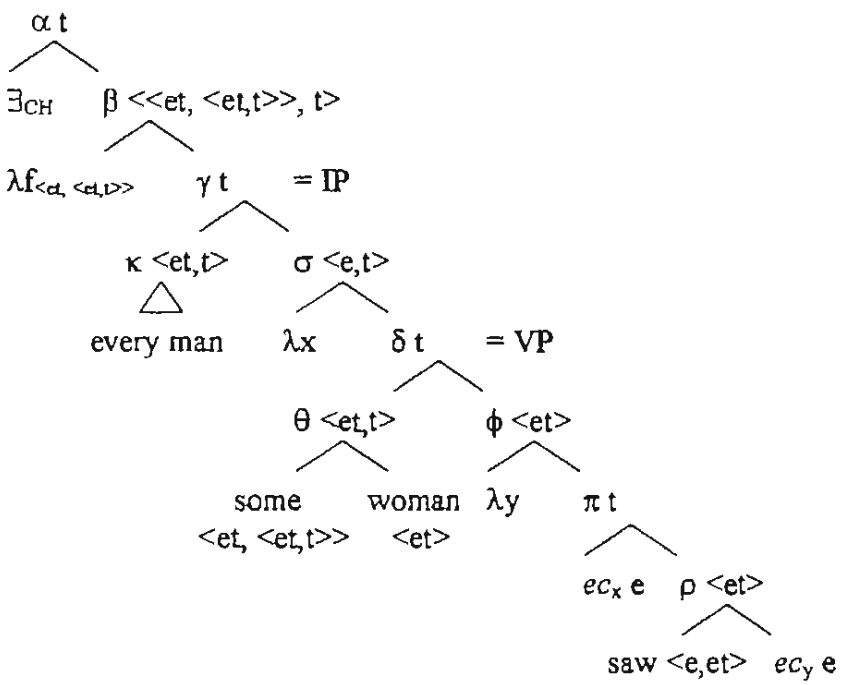
I conclude that neither possible analysis considered of why indefinites are able to undergo quantifier raising *and* exhibit island-insensitive scope simultaneously is adequate. Recall, however, that the difficulty only arose when adopting the hypothesis

[5] Tony Kroch (pc) pointed out that the plausible reading also reappears when the indirect object can obtain a distributive reading (e.g. Kira gave a sleeping bag to every referee, and Carolyn did to AC Milan). This follows from my analysis if we assume, following Heim, Lasnik, & May (1991), that a distributivity operator applies to the DP, raising it to type <et, t>.

that indefinites are ambiguous between an interpretation as a generalized quantifier and an interpretation as a choice function of type <et, e>. Suppose, therefore, we reject this hypothesis, and instead adopt Winter's proposal that indefinites are unambiguously interpreted through a choice function of type <et, <et,t>>. Under this proposal we no longer expect indefinites to exhibit two separate types of behaviours. Instead, indefinites are of the same type as quantifiers, and are thus able to undergo QR; however, they also contain a choice function variable, and are thus able to receive island-insensitive scope.

(23) illustrates the proposed structure for a simple sentence in which the indefinite receives wide scope over the subject.

(23) Every man saw some woman. ∃>∀



This structure illustrates the short QR of the indefinite object to adjoin to VP, the A-movement of the subject to [spec, IP], and the existential closure of the choice function variable above the subject. I have represented the choice function as within the meaning of *some* purely for ease of exposition. The meaning of this structure is provided in (24):

(24) there is a function $f \in D_{<et, <et,t>>}$ such that $\forall P \in D_{<et>}$ [$P \neq \varnothing \rightarrow \exists x \in D_e$ ($P(x) \wedge f(P)$
= $\lambda A \in D_{<et>}.A(x)] \wedge f(\varnothing \in D_{<et>}) = \varnothing \in D_{<et, <et,t>>} \wedge \forall z$ (z a man) (z saw *a*)
$\Rightarrow$ where *a* is the individual picked by the choice function from the set of women
'there is a function *f* such that *f* is a choice function and for all z, z a man, z saw the individual chosen by *f* from the set of women'

The definitions and derivation that produced this meaning are provided in the Appendix.

4. Conclusion

In this paper, I have demonstrated that indefinites must have an interpretation as a choice function of type <et, <et,t>>, based on novel data from Antecedent Contained Ellipsis constructions. In addition, I have shown that the island-insensitive scope of indefinites is not created by an element of type <e>, be it the referential indefinite proposed by Fodor & Sag (1982), or the choice function indefinite proposed by Kratzer (1998) and Reinhart (1997). I have not, however, addressed the possibility that indefinites do have two interpretations, one as quantifier created by a choice function variable, and the other as a simple generalized quantifier. Indeed, if Kratzer (1998) and Matthewson (1998) are correct that the choice function variable cannot be existentially closed at any level of the structure, then this ambiguity will be required to capture the narrow scope of indefinites. The question of the possible ambiguity of indefinites must therefore be left to further research.

Appendix

Definitions:

$[[\text{some}_{\langle 1, \langle et, \langle et,t\rangle\rangle\rangle}]]^g$	=	$g(1, \langle et, \langle et,t\rangle\rangle)$
$[[\exists_{CH}]]$	=	$\lambda\zeta \in D_{\langle\langle et, \langle et,t\rangle\rangle, t\rangle}$. there is a function f of type <et, <et,t>> such that CH(f) and $\zeta(f) = 1$
[[CH]]	=	$\lambda f \in D_{\langle et, \langle et,t\rangle\rangle}$. $\forall P \in D_{\langle et\rangle}$ [$P \neq \varnothing \rightarrow \exists x \in De$ [$P(x) \wedge f(P) = \lambda A \in D_{\langle et\rangle}.A(x)] \wedge f(\varnothing \in D_{\langle et\rangle}) = \varnothing \in D_{\langle et,t\rangle}$] (Winter 1997)

Derivation of (24):

Let *a* be the individual picked by the choice function from the set of women

$[[\alpha]] = 1$

iff $[[\exists_{CH}]]\ ([[\beta]]) = 1$

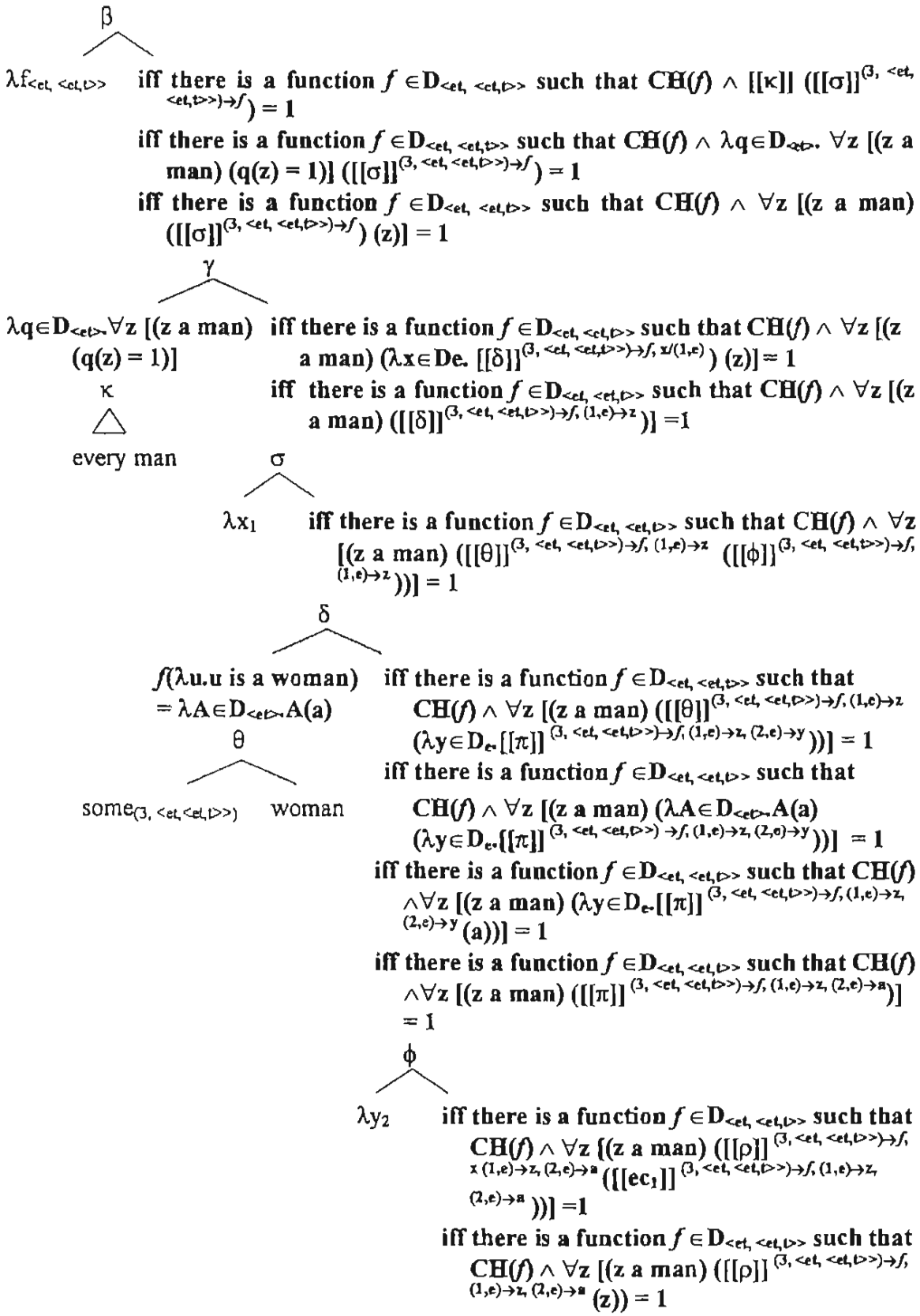
iff $\lambda\zeta \in D_{\langle\langle et, \langle et,t\rangle, t\rangle}$. there is a function f of type <et, <et,t>> such that CH(f) and $\zeta(f) = 1\ ([[\beta]]) = 1$

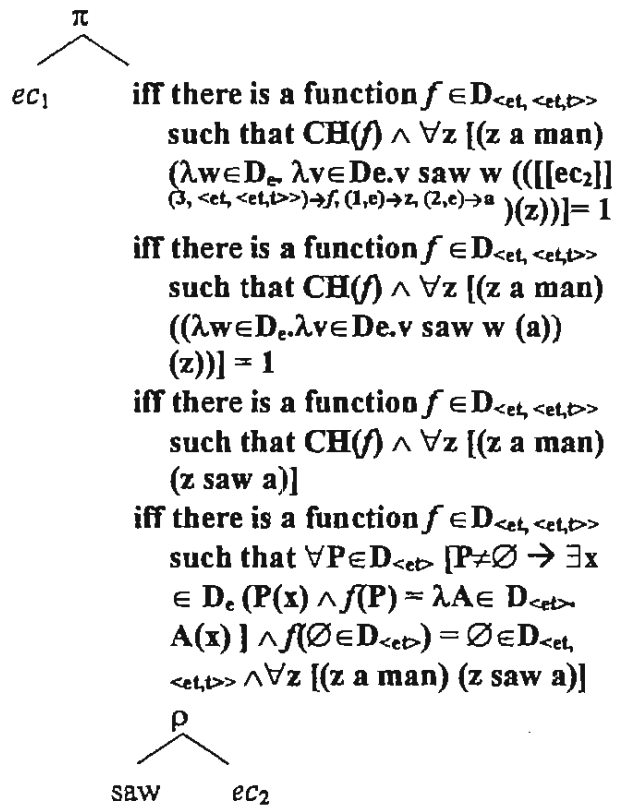
iff there is a function $f \in D_{\langle et, \langle et,t\rangle\rangle}$ such that CH(f) $\wedge$ $[[\beta]]\ (f) = 1$

α

$\exists_{CH}$ **iff there is a function $f \in D_{\langle et, \langle et,t\rangle\rangle}$ such that CH(f) $\wedge$ $\lambda g \in D_{\langle et, \langle et,t\rangle\rangle}$.$[[\gamma]]^{g/\langle 3, \langle et, \langle et,t\rangle\rangle\rangle}\ (f) = 1$**

iff there is a function $f \in D_{\langle et, \langle et,t\rangle\rangle}$ such that CH(f) $\wedge$ $[[\gamma]]^{\langle 3, \langle et, \langle et,t\rangle\rangle\rangle \rightarrow f} = 1$


β
λf<et, <et,t>> iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ [[κ]] ([[σ]]^(3, <et, <et,t>>)→f) = 1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ λq∈D<et>. ∀z [(z a man) (q(z) = 1)] ([[σ]]^(3, <et, <et,t>>)→f) = 1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[σ]]^(3, <et, <et,t>>)→f) (z)] = 1
γ
λq∈D<et>.∀z [(z a man) (q(z) = 1)]
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) (λx∈De. [[δ]]^(3, <et, <et,t>>)→f, x/(1,e)) (z)] = 1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[δ]]^(3, <et, <et,t>>)→f, (1,e)→z)] =1
κ
every man
σ
λx1 iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[θ]]^(3, <et, <et,t>>)→f, (1,e)→z ([[ϕ]]^(3, <et, <et,t>>)→f, (1,e)→z))] = 1
δ
f(λu.u is a woman) = λA∈D<et>.A(a)
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[θ]]^(3, <et, <et,t>>)→f, (1,e)→z (λy∈De.[[π]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→y))] = 1
θ
some(3, <et,<et,t>>) woman
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) (λA∈D<et>.A(a) (λy∈De.[[π]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→y))] = 1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧∀z [(z a man) (λy∈De.[[π]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→y (a))] = 1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧∀z [(z a man) ([[π]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→a)] = 1
ϕ
λy2 iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[ρ]]^(3, <et, <et,t>>)→f, x (1,e)→z, (2,e)→a ([[ec1]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→a))] =1
iff there is a function f ∈D<et, <et,t>> such that CH(f) ∧ ∀z [(z a man) ([[ρ]]^(3, <et, <et,t>>)→f, (1,e)→z, (2,e)→a (z)) = 1



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