Arbeitspapier 110

Fachbereich Sprachwissenschaft
Universität Konstanz

Offprint

Klaus von Heusinger

Choice Functions and the Anaphoric Semantics of Definite NPs

In: Klaus von Heusinger & Ruth Kempson & Wilfried Meyer-Viol (eds.) 2002. *Proc. of the Workshop "Choice Functions and Natural Languages Semantics"* Arbeitspapier 110. FB Sprachwissenschaft, Universität Konstan, 63--83.

Proceedings of the Workshop "Choice Functions and Natural LanguageSemantics"

Arbeitspapier 110

FB Sprachwissenschaft. Universität Konstanz

Klaus von Heusinger & Ruth Kempson & Wilfried Meyer-Viol (eds.).

Table of contents

Note: All papers can be downloaded as pdf-files from the following website:

ling.uni-konstanz.de/pages/home/heusinger/publications/abstracts/ap110.html

Choice Functions and the Anaphoric Semantics of Definite NPs

KLAUS VON HEUSINGER

klaus.heusinger@uni-konstanz.de

1. Introduction*

Choice functions are commonly used for representing indefinite NPs in LF for reasons of scope behavior, while definite NPs are analyzed according to Russell's classical theory. This view, however, is restricted to sentence semantics and, therefore, assumes static meanings of definite and indefinite NPs. Once we extend our analysis to (small fragments of) discourses, the picture changes dramatically – indefinite expressions receive a context change potential, while anaphoric definite expressions must be interpreted according to the updated context. This is the approach of dynamic semantics, such as File Changes Semantics, Discourse Representation Theory, or Dynamic Predicate Logic. However, in these theories, there is no clear account of the semantics of anaphoric definite NPs, which are still analyzed as Russellian descriptions, i.e. as static terms that do not interact with the context change potential of other expressions.

Lewis (1979, 179) has already illustrated that this view cannot account for the different reference of the two occurrences of the definite NP *the cat* in (1) (indices are inserted by the author):

(1) "the cat"
i Imagine yourself with me as I write these words. In the room is **a cat**$_1$, Bruce$_1$,
ii who has been making himself$_1$ very salient by dashing madly about.
iii He$_1$ is the only cat in the room, or in sight, or in earshot.
iv I start to speak to you:
v The cat$_1$ is in the carton. **The cat**$_1$ will never meet **our other cat**$_2$,
vi because our other cat$_2$ lives in New Zealand.
vii **Our New Zealand cat**$_2$ lives with the Cresswells.
viii And there **he**$_2$'ll stay, because Miriam would be sad if **the cat**$_2$ went away.

We can account for the different references of the two occurrences of *the cat* in (1) by assuming the following context changes: The indefinite NP *a cat* in (1i) updates the context such that the subsequent term *he* in (1iii) and *the cat* in (1v) refer to that cat (namely Bruce). However, the definite term *our New Zealand cat* in (1vii) updates the context again: it makes the cat Bobby the

* I would like to thank the audiences at the workshop "Choice Functions and Natural Language Semantics" at the XIII ESSLLI in Helsinki (August 2001) and at the conference "Is meaning dynamic?" in Prague (September 2001) for enlightening feedback. In particular I appreciate the comments and questions of Johan von Benthem, Hans Kamp, Ruth Kempson, Wilfried Meyer-Viol, and Jaroslav Peregrin. The research was supported by a Heisenberg fellowship of the Deutsche Forschungsgemeinschaft (German Science Foundation).

most salient New Zealand cat, the most salient cat and the most salient (male) individual. Therefore, the definite pronoun *he* and the definite NP *the cat* in (1vii) refer to that cat Bobby.

This paper argues that anaphoric definite descriptions are crucially involved in the dynamics of context change: First, definite NPs are dependent on the updated context, and second not only indefinite NPs but also definite NPs update a given context. Context change is reconstructed as the change of a contextually given salience structure that can be represented by a global choice function. An indefinite NP *a cat* changes this structure in that it assigns its referent to the set of cats as being the most salient one. A definite NP *the cat* refers to that most salient referent and updates the context in the following way: (i) it trivially updates the set of cats with its referent (which is already the most salient one); (ii) it updates also some supersets such that its referent becomes the most salient referent of the supersets.

In order to describe the semantics of definite and indefinite NPs, I distinguish between two kinds of choice functions: *global choice functions* and *local choice functions.* A global choice function represents the salience structure of the discourse and therefore determines the reference of definite expressions. It is discourse-anchored and exhibits widest scope (like deictic information). A global choice function is updated by information of the current sentence – in this respect it is quite similar to the assignment function in File Change Semantics and Dynamic Predicate Logic, or the embedding function in Discourse Representation Theory. Local choice functions, on the other hand, are introduced by indefinite NPs and assign referents to them. They can be bound by semantic operators and exhibit different scopes depending on the scope of their binders. Thus, global choice functions are closely related to definite expressions and local choice functions to indefinite expressions.

The paper is organized as follows: In section 2, I argue that we need global choice functions for the representation and interpretation of definite NPs. Definite NPs can only interpreted according to a contextually given salience structure. A global choice functions stands for this salience structure. In section 3, I present some arguments for the use of local choice functions for indefinite NPs. In recent literature, it is assumed that indefinites are represented by choice functions, rather than by the existential quantifier. However, it can be shown that these choice functions must be "minimized" or "local", as I call them. In section 4, I present a dynamic semantics with choice functions, which was introduced by Peregrin & von Heusinger (1995, in print). I then modify this dynamic semantics in order to capture the semantics of anaphoric definite NPs.

2. Global choice functions and definite NPs

2.1 The concept of salience

The concept of salience was introduced into the discussion of the semantics of definite NPs in the seventies (Lewis 1970, 1979; Kripke 1977; McCawley 1979). Lewis (1979, 178) uses it in order to replace Russell's problematic uniqueness condition for definite descriptions.

> The proper treatment of description must be more like this: 'the F' denotes x if and only if x is the most salient F in the domain of discourse, according to some contextually determined salience ranking.

The notion of salience itself seems to be influenced by the analysis of demonstrative expressions. A demonstrative like *this man* refers to the most prominent object in the physical environment of the speaker and hearer. Salience, however, does not depend only on the physical circumstances, or any other single cause. Rather it is a bundle of different linguistic and extra-linguistic factors, as noted by Lewis (1970, 63):

> An object may be prominent because it is nearby, or pointed at, or mentioned; but none of these is a necessary condition of contextual prominence. So perhaps we need a prominent-objects coordinate, a new contextual coordinate independent of the other.

In the following, salience is understood as the property of a context. This property assigns one object to each set (or to each predicate). It is the most salient or most prominent object of this set. We also speak of the most salient *F* in the context *i.* The present approach treats salience as a primitive which will not be analyzed further. The idea of salience was often criticized because of its pragmatic nature (cf. Heim 1982), however, an explicit formal account of salience and Lewis "prominent-object coordinate" was never seriously attempted, even though there are many different approaches towards the concept of salience (e.g. Sgall 1984 or Poesio & Stevenson (to appear)).

2.2 Syntax and semantics of Hilbert's epsilon operator

The epsilon operator corresponds to a selection function that assigns to each non-empty set one element of this set. An empty set will be assigned an arbitrary element. Thus it is guaranteed that an expression F εx (Fx) under all circumstances denotes something and that there are no cases where it has no reference as in Russell's system. Like the iota operator, the epsilon operator forms a term (constant) from a sentential form. Unlike the iota operator, it carries with it no existence or uniqueness presupposition. The main difference may be shown by the formalization and the paraphrase of the description *the island*, as given in (2) and (3):

(2) ιx [island(x)]
the **unique** x, such that x is an island

(3) εx [island(x)]
the **selected** x, such that x is an island

To introduce epsilon terms into a first-order predicate logic, we will adopt the axiom (4) by Hilbert and Bernays (1939), which they call the *epsilon formula*. From each formula of the form Fa, we can go directly to the corresponding formula F εx Fx (or F(εx [Fx]) giving all brackets; in the following I will supress brackets if the formula is non-ambiguous. The only new constant that has to be introduced is the symbol ε. This can be done equivalently by means of rules (5) and (6), which we call the first and the second Hilbert rule (Hilbert & Bernays 1939, 15):

(4) epsilon formula: $Fa \rightarrow F\,\varepsilon x\, Fx$

(5) first Hilbert rule: $x\ Fx \equiv F\ \varepsilon x\ Fx$

(6) second Hilbert rule: $x\ Fx \equiv F\ \varepsilon x \neg Fx$

The content of these two equivalences can be conceived as follows. If there is an x that has the property F, then there is also a description εx Fx that satisfies F. To look at it the other way around: if there is a description εx Fx that satisfies F, then there must be as well an x that satisfies F. The intuitions behind the second Hilbert rule are a bit more difficult: $\neg$Fx denotes the complement of the set Fx. By εx $\neg$Fx this complement is assigned one element, which either is an element of $\neg$F, if $\neg$F is non-empty, or is an arbitrary (but constant) element, if $\neg$F is empty. Precisely the latter, however, has to be the case, as εx $\neg$Fx is element of F. Therefore, $\neg$F must be empty, and thus F denotes generality or: x Fx. The second Hilbert rule can be derived from the first by replacing F by $\neg$F, and by invoking contraposition.

Hilbert and Bernays did not give a semantic interpretation of their epsilon symbol, leaving this task for others. Schröter (1956) proposed interpreting the epsilon operator by a choice function. Asser (1957) then formulated this idea with the necessary detail. Following Asser we will interpret the epsilon operator by a choice function Φ, which assigns one of its elements to each non-empty set and an arbitrary element to the empty set.

We have to extend a model m by the choice function Φ. Then we get the triple $<A, I, \Phi>$ = m with the domain of discourse A, an interpretation I of the constants and the choice function Φ. Also we have an assignment g of individuals to the variables as usual. The interpretation of an epsilon term $\varepsilon x\ \alpha$ is given by the following rule: $\|\varepsilon x\ \alpha\|^{m,g} = \Phi(s)$, where s is the set of individuals $\{a: \|\alpha\|^{m,g^{x/a}} = 1\}$.

(7) $\|\varepsilon x\ \alpha\|^{m,g} = \Phi(\{a: \|\alpha\|^{m,g^{x/a}} = 1\})$

Let us assume we have a domain of discourse, called "Lake Constance", and three objects in this domain, called "Mainau", "Reichenau", and "Lindau". All three individuals have the property of being an island. Let Φ be the choice function that assigns an arbitrary individual to the set of islands.

(8) Φ({Mainau, Reichenau, Lindau}) {Mainau, Reichenau, Lindau}

We only know that this element must be in the set of islands, but we do not know which island it is. This observation is often taken as argument for the "indefinite" character of epsilon terms, thus interpreting them as representing indefinite NPs. It is true that in the original epsilon theory, the choice of an element is arbitrary, but once the choice is done it is fixed for all subsequent expressions, which is the "definite" aspect of the classical epsilon calculus. This means that all expressions of the form *an island* get the same referent, which is counterintuitive.

This very general characterization makes epsilon terms and choice functions as their interpretations an attractive and flexible semantic tool that can reconstruct different linguistic categories. The operation of selecting one element out of a set (i.e. assigning one of its elements to a set) is common to all uses of the epsilon operator. This function very well captures the basic semantics of definite and indefinite NPs in their guise as terms. It corresponds to the assumptions of traditional grammar that the definite and indefinite article has a "individualizing" function. In order to distinguish between indefinite and definite NPs, we must modify the classical calculus.[1]

2.3 Context dependent epsilon terms

Since Hilbert applied his classical epsilon terms only to the domain of numbers, a naturally ordered set, no determined choice function was necessary. However, in natural language the objects we refer to are not naturally ordered; rather, the order depends on a particular context. Egli (1991) approaches this problem by assuming a family of choice functions for representing definite NPs. Each context *i* has its own choice function Φ_i and the definite NP *the F* is represented as the indexed epsilon term $\varepsilon_i x\ Fx$, which can be paraphrased with *the selected x in the context i such that x is F* or *the most salient x in i such that x is F*. It is interpreted as the element that results from applying the choice function Φ_i to the set of all Fs. The "uniqueness commitment" of a definite NP is not understood as the uniqueness of the associated set, but as the "unique availability" of the referent (cf. Peregrin 2000). This is warranted by the definition of the choice function, which assigns one element to a set, independently of the size of this set.

To illustrate: The property *island on Lake Constance* is common to three objects: Mainau, Reichenau, and Lindau. The description ε*x [island on Lake Constance(x)]* denotes the first element of the set of islands on Lake Constance. This expression might denote different islands according to different situations. If we hear the expression (9) from a Reichenau fisherman, he probably means the island Reichenau; if we encounter the same sentence during a guided tour through Lindau it will rather be the island Lindau that is meant; however, uttered by the Earl, owner and occasional inhabitant of Mainau, the sentence is sure to be about the island Mainau. We can assign one indexed epsilon operator to each of these situations, as given in (10):

(9)	the island on Lake Constance	
(10)	$\varepsilon_{\mathbf{fisherman}}$x [island on Lake Constance(x)]:	Reichenau
	$\varepsilon_{\mathbf{tourist\ guide}}$x [island on Lake Constance(x)]:	Lindau
	$\varepsilon_{\mathbf{earl}}$x [island on Lake Constance(x)]:	Mainau

Thus we can conclude that the most appropriate representation for a definite NP *the F* is the indexed epsilon term ε_ix Fx, which denotes that individual with the property F that is chosen first in a certain situation i, as in (11):

(11) the F: $\|\varepsilon_i x\ Fx\| = \Phi_i(\|F\|)$ with *i* contextually determined

[1] Slater (1986) uses the classical epsilon calculus in order to describe E-type pronouns. He substitutes the iota-operator by the epsilon-operator and can therefore avoid the problematic uniqueness condition of the iota-term. However, Slater does not give the full epsilon calculus. Meyer-Viol (1995) develops such full epsilon calculus and applies it to semantic problems such as E-type and Bach-Peter pronouns. A variant of Meyer-Viol's calculus is used in Dynamic Syntax (e.g. Kempson & Gabbay & Meyer-Viol 2000; Kempson & Meyer-Viol & Otsuka 2002). However, in the full epsilon calculus, Meyer-Viol has to assume some syntactic or pragmatic copy mechanism in order to fill the descriptive material into the epsilon terms.

3. Local choice functions and indefinite NPs

Recently, choice functions have been applied to represent indefinite NPs. First I present the classical representation of indefinite NPs as existential quantifiers in the following subsection . Second I give the motivation to use indexed epsilon terms for indefinite NPs, third I discuss the representation of indefinites by choice functions and fourth I list some open ends of the epsilon and choice function approach.

3.1 The classical analysis of indefinite NPs

The classical view of definite and indefinite NPs goes back to Frege and Russell which was then developed by Carnap, Quine and Montague. Frege drastically diverted from the once accepted grammatical analysis of indefinite NPs as terms (see von Heusinger 2000 for an explicit comparison between the grammatical tradition and the logical account of Frege). The indefinite NP *a man* in (12) is classically represented by an existential quantifier , binding the variable x in the predication *man(x)*, as in (12a). This notion goes back to Frege (1892), who assumes that indefinite NPs refer to a predicate, rather than to an object. Russell (1905) reformulates this to the assumption the indefinite article expresses that the intersection between the descriptive material of the indefinite NP and the matrix predicate is non-empty, as expressed in (12a). The existential quantifier can undergo quantifier raising which explains the two readings of (13) as two different quantifier configurations, as in (13a) and (13b). (14a) shows that the representation does not make a difference between the descriptive material in the NP, predicates in the relative clause, or the matrix predicate. All predicates are equal with respect to the formal representation (14a). Finally, the contrast between an indefinite NP and a definite NP is made by the uniqueness condition of the definite NP, which leads to a wide scope reading, as illustrated in (15). In (15a) the uniqueness condition is expressed by the iota-operator, which is an abbreviation for a complex quantifier, as in (15b):

(12) A man walks
(12a) x [man(x) & walk(x)]
(13) Every boy dates a girl.
(13a) x [boy(x) → y [girl(y) & date(x,y)]]
(13b) y [girl(y) x [boy(x) → & date(x,y)]]
(14) Every boy dates a girl he admires.
(14a) x [boy(x) → y [girl(y) & admire(x,y) & date(x,y)]]
(15) Every boy dates the girl with the read hair.
(15a) x [boy(x) → date(x, ιy [girl(y) & (red_hair(y))]]
(15b) x [boy(x) → y z[girl(z) & (red_hair(z)) ↔ z=y & date(x, y)]]

To summarize the classical view: (i) indefinite NPs express predicates; (ii) they can only be interpreted in the context of a sentence; (iii) they are translated into existential quantifiers; (iv) ambiguities are explained by quantifier raising; (v) the difference to definite NPs is the lack of the uniqueness condition.

However, each of the assumptions is controversial. In particular, criticisms of assumptions (i) and (iv) have led to a different representation regarding indefinite NPs as terms, rather than as quantifier phrases. There are two guises to this approach – indefinite NP as epsilon terms or as choice function terms.

3.2 Indefinite NPs as indexed epsilon terms

Egli (1991), Egli & von Heusinger (1995), Meyer-Viol (1995), von Heusinger (2000) represent indefinite NPs as epsilon terms, rather than as quantifier phrases. Epsilon terms reconstruct the assumption that the indefinite article "picks up" one element of the set which is formed by all elements that fit the description in the NP. Thus an indefinite NP is of type *e*, rather than of the quantifier type ((et)t). This assumption about "selecting one element" is reconstructed by the interpretation of the epsilon operator by a choice function, which takes a set and yields an element of this set. In the following, we use indexed epsilon terms indicating different epsilon operators (Egli & von Heusinger 1995, von Heusinger 2000). An epsilon operator ε_i is interpreted as a choice function Φ_i, i.e. a function that assigns one element to each set. The indefinite NP *a man* is interpreted as the application of the choice function to the set of men. The choice function always selects one element from a non-empty set, as expressed by the second clause in (16).[2] Definite and indefinite NPs have the same semantics, but differ in the restriction of their indices (which is a different way to express the familiarity of definites). The index for definite NPs is determined by the context – it stands for the contextually given salience. The index for an indefinite is new and free to be bound, either by semantic operators or by existential closure.[3]

(16) $||\varepsilon_i x\ man(x)|| = \Phi_i(||man]])$ and $\Phi_i(||man]])$ $||man||$
(11) the F: $||\varepsilon_i x\ Fx|| = \Phi_i(||F||)$ with *i* contextually determined
(17) an F: $||\varepsilon_i x\ Fx|| = \Phi_i(||F||)$ with *i* new (bound)

The simple indefinite NP *a man* in (12) is represented as an epsilon term $\varepsilon_i x\ man(x)$ in (12a'). The index on the epsilon is bound by existential closure (e.g. text closure). This representation distinguishes the predicate by which the indefinite is introduced from the matrix predicate (see Farkas 2000 for a similar approach in a more DRT-like framework). The interpretation of this sentence is given in (12b') which is equivalent to the interpretation of the existential sentence in (12a) if the set of men or non-empty.

(12) A man walks
(12a') i walk($\varepsilon_i x$ man(x))
(12b) || i walk($\varepsilon_i x$ man(x))||
= 1 iff there is a choice function Φ_i such that $\Phi_i(||man||)$ $||walk||$

The two readings of (13) are represented by different locations of the existential closure operation that binds the index, rather than by movement of the whole indefinite to different

[2] There are different ways to handle empty sets. See Winter (1997) and the discussion in von Stechow (2000).
[3] A difference still remains between a contextually bound epsilon for definites and an epsilon bound by a closure operation at text level: the index of an epsilon for an indefinite must be new, i.e. it cannot be identical to the contextually given salience index.

locations. Below we will see that certain movements of the whole NP are prohibited. Indefinite NPs dependent on other expressions, such as *a girl he admires* in (14) are easily translated into epsilon terms, which indicate the structure of the NP much better than the representation with the existential quantifier (or with choice functions, see (14a"). The brackets around the existential operators in (14a') indicate that there are two potential locations for the existential closure operation in: the level of the matrix predicate or at the level of the text. The difference between the two potential representations becomes clear in a situation where two boys admire the same set of girls – the one choice function at text level assigns the two boys the same girl, while existential closure at the level of the matrix predicate gives us two choice functions that possibly select different girls from the same set (compare the discussion in von Stechow 2000 and von Heusinger 2000 on Kratzer's approach). Finally, the definite NP *the girl with the read hair* is also represented by an epsilon term, yet the index is bound by the context. Thus the corresponding choice functions is determined by the salience structure of the context (see section 2) – the principle of salience replaces the uniqueness condition, as required by Lewis.

(13) Every boy dates a girl.
(13a') x [boy(x) → i date(x, ε_iy girl(y))]]
(13c') i x [boy(x) → date(x, ε_iy girl(y))]]
(14) Every boy dates a girl he admires.
(14a') (i) x [boy(x) → (i) date(x, ε_iy [girl(y) & admire(x,y)])]
(15) Every boy dates the girl with the read hair.
(15a') x [boy(x) → date(x, $\varepsilon_{context}$y [girl(y) & (red_hair(y))]]

To summarize the indexed epsilon view: (i) indefinite NPs express arguments that are "picked up" from the set described by the lexical content of the indefinite NP; (ii) the interpretation of indefinites depends on a certain choice and the descriptive material; (iii) indefinite NPs are translated into terms (indexed epsilon terms); (iv) ambiguities are explained by different binding operations of the index, e.g. existential closure, and not by movement; (v) the difference between definite and indefinite NPs is that the index of the epsilon for indefinites is new and free (to be bound), although contextually determined for definite NPs.

3.3 Indefinite NPs as LF-choice functions

An alternative representation is to use the choice function directly in LF. Thus (12) is represented as (12a") with a function *f* for the indefinite article. This function *f* must be a choice function (*ch(f)*) and is applied to the set formed by the descriptive material of the NP. The indefinite is represented by a choice function term *f(man)* (cf. Reinhart 1992, Winter 1997, Kratzer 1998, von Stechow 2000, among others). The formula is true if there is a choice function such that the selected object is in the extension of the matrix predicate. Again, this is equivalent to the classical interpretation if the set is non-empty.

This representation has the advantage of being more compact in simple cases, but requires an additional binding structure in more complex cases like (14), which can be supplied by lambda-abstraction (or by Skolem functions, see below (21)). However, the similarities with definite NPs are totally lost since definite NPs are still represented as iota terms, as in (15a"):

(12) A man walks
(12a'') $\ f\,[ch(f)\ \&\ walk(f(man))]$
(12b'') $||\ \ f\,[ch(f)\ \&\ walk(f(man))]||$
$= 1$ iff there is a choice function f such that $f(||man||)\quad ||walk||$
(13) Every boy dates a girl.
(13a'') $\ x\,[boy(x) \rightarrow \ \ f\,[ch(f)\ \&\ date(x, f(girl))]]$
(13b'') $\ f\,[ch(f)\ \&\ \ x\,[boy(x) \rightarrow date(x, f(girl))]]$
(13b'') $\ f\,[ch(f)\ \&\ \ x\,[boy(x) \rightarrow date(x, f(girl)\ \&\ R(x,y))]]$
(14) Every boy dates a girl he admires.
(14a'') $(\ \ f)\,[ch(f)\,)\ \ x\,[boy(x) \rightarrow (\ \ f)\,[ch(f)\,)\ date(x, f(\lambda y\,[girl(y)\ \&\ admire(x,y)]))]$
(15) Every boy dates the girl with the read hair.
(15a'') $\ x\,[boy(x) \rightarrow\ date(x, \iota y\,[girl(y)\ \&\ (red\_hair(y))]]$

The assumption of the LF-choice function approach (Reinhart, Winter, von Stechow) are: (i) indefinite NPs express arguments that are “picked up” from the set that is described by the lexical content of the indefinite NP; (ii) the interpretation of indefinite NPs depends on a certain choice and the descriptive material; (iii) indefinite NPs are translated into terms (choice function terms); (iv) ambiguities are explained by different existential closure operations of the LF-choice function.[4] The indefinite NP as such does not move; (v) the difference from definite NPs is the lack of the uniqueness condition as in the classical approach.

There are slight differences between approaches: Kratzer (1998) assumes that the choice function variable *f* is bound by the context, i.e. it always has widest scope. She then accounts for narrow scope by assuming that the descriptive content of the indefinite contains a variable *x* which is bound by some other operator in the matrix sentence. An explicit case of this is (13), where the predicate *he admires* actually takes this function. In contrast to this, Winter (1997) and von Stechow (2000) allow binding of the choice function variable at any place in the sentence, indicated in (14a'') by brackets.

3.4 Indefinite NPs, choice functions and open ends

The discussion of choice functions and their application in natural language semantics has opened a very fruitful discussion. In this subsection, I only discuss four areas of effective discussion: Indefinite NPs and movement, specificity, choice functions and Skolem functions, and choice functions in dynamic semantics, which will be discussed in section 4.

Choice functions and movement

One of the most celebrated arguments for using LF-choice functions rather than existential quantifiers is based on a conflict between three principles of LF-representation: (i) scope ambiguities are reconstructed by movement, (ii) indefinite NPs are represented as existential quantifier phrases and (iii) there are scope islands such as that-clauses. Fodor & Sag (1982) observe that (specific) indefinite NPs do not obey scope islands, as illustrated in (18) and (19).

[4] As far as I have understood the literature, there is no possibility to bind the choice function variable *f* by other operators, as it is suggested for the index of the epsilon term.

Sentence (18) can receive a reading where the indefinite NP *a student* receives wide scope over *the rumor* while the universal term *each student* in (19) cannot since the that-clause constitutes a scope island for quantifier phrases.

(18) John overheard the rumor that a student of mine had been called before the dean.
(18a) the rumor > there is a student
(18b) a certain student > the rumor
(19) John overheard the rumor that each student of mine had been called before the dean.
(19a) the rumor > each student
(19b) *each student > the rumor

There have been two approaches to accommodate the problem: either one assumes that quantifier phrases for indefinite NPs have exceptional properties with respect to scope islands, or one assumes that there are different indefinite NPs. Fodor & Sag (1982) propose a lexical ambiguity of the indefinite article giving up a uniform analysis of indefinites. Indefinites have either a specific or referential reading, or they have a non-specific or existential reading. The contrast between the two readings in incommensurable. They illustrate this point by the interaction of indefinites with quantifiers as in (19). They propose that the indefinite NP is either interpreted as a referring expression or as an existential quantifier. The referring expression is scopeless like proper names and demonstratives, i.e. it behaves as if it always has widest scope, as in (18b). The quantificational interpretation, as in (18a), must observe island constraints like other quantifiers (cf. (19)) and accounts here for the non-specific reading.

Under the assumption that Fodor & Sag's observation is correct, we have two ways for implementing choice function into the semantics of indefinite NPs: Following the *lexical ambiguity theory,* Kratzer (1998) defends Fodor & Sag (1982) and assumes that an indefinite NP is either represented as an existential quantifier, which obeys island constraints, or as a choice function, which is bound by the context and, therefore, has widest scope. In the *uniform LF-choicefunctions-approach*, Winter (1997), von Stechow (2000) and others represent all indefinite NPs as choice functions. The exceptional behavior of indefinites with respect to scope islands is explained by the fact that not the indefinite itself, but only the choice function variable *f* is bound, which can freely "move" to different position in the representation Thus there is no movement of the indefinite. This approach argues that the lexical ambiguity view is not correct since it has been long observed that there are intermediate readings, such as (20) (cf. Farkas 1981). (20) has a reading (20a) according to which for each student there is one condition such that the student comes up with three arguments against the condition:

(20) Each student has to come up with three arguments that show that some condition proposed by Chomsky is wrong.
(20a) each student > some condition > three arguments

Choice functions and specificity

Kratzer (1998) assumes a lexical ambiguity of indefinite NPs in two different semantic representations, the choice function for the specific reading and the existential quantifier for the non-specific one. Other approaches, such as the classical approach to indefinites (see section

3.1) or the uniform choice functions approach (Winter 1997), allow for only one representation and reduce the specificity effect to scope interactions. However, cases of "relative specificity" (von Heusinger (to appear)), such as example (21) from Hintikka 1986 show that specificity cannot be reduced to scope:

(21) According to Freud, every man unconsciously wants to marry **a certain woman** – his mother. (Hintikka 1986)

(21a) x [Man(x) $\rightarrow$ Wants(x, marry(x, f(x))]
with f: Skolem function from men into their mothers

(21b) x [Man(x) $\rightarrow$ Wants(x, marry(x, [ε_Xy woman(y)]]

In (21a) the specific indefinite is interpreted as a "functional" reading of the indefinite and represented as a Skolem function, while in the indexed epsilon approach (see section 3.2), the index of the epsilon is bound by the variable for *man.* Thus the choice of a choice function is determined by the value for the variable *x* for man (for details see von Heusinger (to appear); Kratzer 1998 uses Skolem function over choice function instead).

Choice functions and Skolem functions

Examples like (21) and (14), repeated as (22), suggest a representation of indefinites not as choice functions, but as Skolem functions that can take arbitrarily many arguments, e.g. in (22a) one argument (cf. the discussion in Schlenker 1998, Chierchia 2001, Bende-Farkas & Kamp 2001, Winter 2002, among others). The disadvantage of Skolem functions is that the descriptive material of the indefinite disappears from the representation. It is rather integrated into the meta-language which interprets the Skolem function. The representation (22b) with indexed epsilon terms (see section 3.2) does not have this disadvantage: It states all descriptive material of the relative clause. The formalism allows for epsilon terms that contain variables that are bound from outside (see for a full account of such dependent terms in a the classical epsilon calculus Meyer-Viol 1995):

(22) Every boy dates a girl he admires.

(22a) (f) [x [boy(x) $\rightarrow$ date(x, f(x))]

(22b) i x [boy(x) $\rightarrow$ date(x, ε_iy [girl(y) & admire(x,y)]])]

Here it also becomes obvious that the choice function for indefinites are not defined for all sets, but only for the set that is associated with the descriptive material of the indefinite, thus we speak of "minimalized" or "local" choice functions - this also holds for the indexed epsilon representation.[5]

---

[5] Bende-Farkas & Kamp (2001, 51) show in example (i) from Heim (1982) that a global choice function for indefinites cannot be correct. The scope of the indefinite *a friend of mine* must be wider than the scope of the conditional, while the scope of *a kitten* is narrower (representation (ii) according to Bende-Farkas & Kamp 2001):

(i) If a kitten likes a friend of mine, I always give it to him.

(ii) (f) (CH(f) & (t) (g) & like' (f(x |friend')(x, sp)},
g({y | kitten*(x)} t) -> give(sp, y, x, t))

4. Dynamic semantics with choice functions

4.1 The problem of coindexing

Approaches like Discourse Representation Theory (DRT) or Dynamic Predicate Logic (DPL) primarily investigate cross-sentential anaphoric pronouns. There is one problem of these approaches, which can be illustrated with our initial example (1), repeated as (23): the pronoun *he* in line (viii) has two potential antecedents or already established discourse referents: the discourse referent for the cat Bruce and the discourse referent for the New Zealand cat Bobby. DRT cannot tell which is the more appropriate one, but must rely on extra-linguistic knowledge. This is then indicated by co-indexing the anaphoric term with its antecedent. However, it is the anaphoric relation that the theory should explain and not rely on.

(23) "the cat"

i Imagine yourself with me as I write these words. In the room is **a cat**$_1$, Bruce$_1$,
ii who has been making himself$_1$ very salient by dashing madly about.
iii He$_1$ is the only cat in the room, or in sight, or in earshot.
iv I start to speak to you:
v The cat$_1$ is in the carton. **The cat**$_1$ will never meet **our other cat**$_2$,
vi because our other cat$_2$ lives in New Zealand.
vii **Our New Zealand cat**$_2$ lives with the Cresswells.
viii And there **he**$_2$'ll stay, because Miriam would be sad if **the cat**$_2$ went away.

It seems very obvious from the discourse structure that the pronoun *he* can only refer to the New Zealand cat Bobby and therefore must be linked to that discourse referent. Therefore, I assume that the anaphoric link should follow from the theory and not be part of the input.

In order to solve this problem, Peregrin & von Heusinger (1995, to appear) developed a dynamic semantics with choice functions. The context change potential of an expression is seen in its potential to change the set of possible global choice functions in the sense of section 2. The dynamic semantics with choice function is a modification of classical DPL: the information states are described as sets of possible (global) choice functions, rather than sets of possible assignment functions. The context change potential of definite and indefinite expressions updates the (global) choice function. An indefinite NP introduces a discourse referent, which then becomes then the most salient of its kind. Hence, the global choice function is updated with respect to the set described by the indefinite. This set is assigned the referent of the indefinite. A definite NP refers to the most salient of its kind.

4.2 Choice functions and dynamic interpretation

In the remainder of this section I summarize the dynamic choice functions approach of Peregrin & von Heusinger (1995, to appear): let us assume the non-empty universe U of individuals. A choice function (or "epsilon function" in Peregrin & von Heusinger) f is a partial function from the power-set of U into U such that f(s)   s for every s   U for which f is defined. This means that the class CH_U of all choice functions based on U is defined as follows (where D(f) and R(f) denote the domain and the range of f, respectively):

DEF1 CH_U = {f | D(f)   Pow(U) and R(f)   U and f(s)   s for every s   D(f)}

We further introduce update functions for choice functions, or choice function (cf-) updates in short. An cf-update is a function that takes three arguments: an choice function, an element of the universe, and a subset of the universe; it yields a new choice function.

DEF2 UPD = {f | D(f)=CHxUxPow(U) and R(f)   CH}

The basic cf-update upd_1 applied to an choice function f, an individual d, and a set s, yields the choice function f' which is identical with f except for the assignment d for the set s.

DEF3 upd_1 is the element of UPD defined as follows
upd_1(f,d,s)(s') =d if s'=s and d   s
=f(s') otherwise

We use $f'=f^s$ as an abbreviation for   d.f'=upd_1(f,d,s).[6] If $f_2=f_1{}^s$ and $f_3=f_2{}^{s'}$, then we also write $f_3=f_1{}^{s,s'}$. upd_1 can be seen as the first approximation to the salience change potential of an indefinite NP. The indefinite NP *a man* selects an arbitrary man and changes the actual choice function such that this arbitrarily chosen man becomes the current representative for the class of men. In the following, a formal fragment will be defined illustrating how choice functions act in a dynamic semantics. We do without quantifiers, since they play no role in the argument. However, for a detailed treatment of quantifiers in this framework see Peregrin & von Heusinger (1995, to appear).

DEF4a. (lexicon)
1. sentences
2. terms (constants **he, she, it**)
3. n-ary predicates for n>0 (constants **man, walk, whistles, farmer, boring, woman, thing** for n=1; **own, beat** for n=2)
4. determiners (constants **a, the**)
5. n-ary logical operators for n=1,2 (the constant ¬ for n=1; **&, v** for n=2)

DEF4b. (syntax)
1. If P is a unary predicate and D a determiner, then D(P) is a term.
2. if $T_1,\ldots,T_n$ are terms and R an n-ary predicate, then $R(T_1,\ldots,T_n)$ is a sentence.
3. If S is a sentence and o a unary logical operator, then oS is a sentence.

---

6 Here it is assumed that the referent for the indefinite is found by interpreting the indefinite as an existential operator (at least at the meta-language). This corresponds to the classical approach to indefinites, described in section 3.1. According to the indexed epsilon approach of section 3.2, we can modify this by saying that the referent is found by applying a local choice function to the set described by the descriptive material of the NP. For the argument in this section this does not make any difference, since we do not deal with scope interactions. Thus, in the remainder of the section we use the classical view. However, for a more comprehensive account one would like to follow the indexed epsilon approach.

4. If S_1 and S_2 are sentences and o a binary logical operator, then $S_1 o S_2$ is a sentence.

DEF4c. (semantics)

A model is a pair <U,|| ||>, where U is a set and || || is a function such that (i) if T is a term, then ||T|| U; (ii) if R is an n-ary predicate, then ||R|| U^n. If T is a term and f CH_U, then we define the value $||T||_f$ in the following way:

$||T||_f$ = ||T|| if T is a constant term
= f(||P||) if T is D(P) for a determiner D and a predicate P

The function || || is extended to the categories of terms and sentences so that if E is a term or a sentence, then ||E|| CHxCH:

1a. ||**a**(P)|| = {<f,f'>| f'=$f^{||P||}$}
1b. ||**the**(P)|| = {<f,f'>| f'=f and f'(||P||) is defined}
1c. ||**he**|| = ||**the(man)**||
1d. ||**she**|| = ||**the(woman)**||
1e. ||**it**|| = ||**the(thing)**||
2. $||P(T_1,\ldots,T_n)||$ = {<f,f'>| there exist $f_0,\ldots,f_n$ so that f=f_0 and f'=f_n and $<f_0,f_1>$ $||T_1||$ and ... and $<f_{n-1},f_n>$ $||T_n||$ and $<||T_1||_{f1},\ldots,||T_n||_{fn}>$ ||P||}
3. ||¬S|| = {<f,f'>| f=f' and there is no f'' such that <f,f''> ||S||}
4a. $||S_1\&S_2||$ = {<f,f'>| there is an f'' such that <f,f''> $||S_1||$ and <f'',f'> $||S_2||$} (= $||S_1;S_2||$)
4b. $||S_1 v S_2||$ = {<f,f'>| f=f' and there is an f'' such that <f,f''> $||S_1||$ or <f,f''> $||S_2||$}

An indefinite NP *a P* is taken to express an cf-update, i.e. its function is taken to be the updating of the actual choice function f to a new choice function f'. f' then differs from f at most in the representative of the set of P; the NP refers to this representative. We write $f^{||P||}$ for an f' resulting from the evaluation of *a P* with the input f. A definite NP *the P* denotes the representative of the set of P's according to the current choice function; it is taken to express the trivial cf-update. Further, it is required that there be at least one P — this expresses the existential presupposition of definite NPs. There is no uniqueness condition, since it is replaced by the condition that there exists the representative of the set of P's. A pronoun is defined to be semantically equivalent to the impoverished definite NP expressing merely the corresponding gender.

The atomic sentence is semantically characterized in 2 via its potential to change the current choice function f to the updated function f' by way of the subsequent application of the updates expressed by its terms. Thus, f and f' must be connected by a sequence of choice functions such that the adjacent pairs of the sequence fall into the respective updates expressed by the terms; and the referents of the terms must fall into the extension of the predicate. Here we differ essentially from usual dynamic logic in that we consider atomic sentences internally and externally dynamic.[7] The logical operators ¬ and v are static (they act as tests) – they are in fact

[7] Since each of the arguments of an atomic sentence potentially updates the given choice function, we have to account for different interpretations of one sentence depending on the order of its arguments.

the classical operators only formally dynamized. & is the dynamic conjunction suitable for conjoining subsequent sentences.

Let us illustrate this mechanism by analyzing a simple atomic sentence with an indefinite NP. Sentence (24) is assigned the formula (24a) which is then interpreted as (24b) according to the definitions given above. As we have noted, a pair of choice functions <f,f'> falls into the update expressed by an atomic sentence iff f and f' are connected by a sequence of choice functions such that the adjacent pairs of the sequence fall into the respective updates expressed by the terms and the referents of the terms fall into the extension of the predicate. Since we have only one term in (24), it is reduced to the condition that <f,f'> falls into the update expressed by *a(man)* and that the referent of *a(man)* falls into the extension of walk. This yields $f'=f^{||man||}$ and f'(||man||) ||walk||. The resulting set of pairs is clearly non-empty just in case d.d ||man|| & d ||walk|| (i.e. if the intersection of ||man|| and ||walk|| is non-empty) and our formula (24b) is thus in this sense equivalent to the classical formula x(man(x)&walk(x)).

(24) A man walks
(24a) walk(a(man))
(24b) ||walk(a(man))|| = {<f,f'>| <f,f'> ||a(man)|| and $||a(man)||_{f'}$ ||walk||}
= {<f,f'>| $f'=f^{||man||}$ and f'(||man||) ||walk||}

Sentence (25) with the definite NP *the man* is represented and interpreted similarly to (24). The only difference is the condition on the choice function – the interpretation of the definite NP is static (in the formalism developed so far). The only condition is that the referent of the NP, determined by the current choice function, falls within the extension of the predicate. The difference between the definite and the indefinite NP thus lies in their different behaviors with respect to the choice function — the indefinite NP updates it, whereas the definite NP acts merely as a test.[8] In both cases, the referent of the NP is yielded by the actual epsilon function.

(25) The man whistles
(25a) whistle(the(man))
(25b) ||whistle(the(man))||
= {<f,f'>| <f,f'> ||the(man)|| and $||the(man)||_{f'}$ ||whistle||}
= {<f,f'>| f=f' & f'(||man||) ||whistle||}

The analysis of the conjunction (26) of (24) and (25) shows how the referent of the anaphoric NP *the man* gets identified with that of its antecedent *a man.*

(26) A man walks. And the man whistles
(26a) walk(a(man))&whistle(the(man))
(26b) ||walk(a(man))&whistle(the(man))||
= {<f,f'>| there is an f'' such that <f,f''> ||walk(a(man))|| and
<f'',f'> ||whistle(the(man))||}

---

[8] At this stage a context change potential of a definite NP would trivially update the given choice function – it would make the most salient referent most salient. See, however, section 4.3 for a revision of this position.

= {<f,f'>| there is an f'' such that <f,f''> {<f,f'>| f'=$f^{||man||}$ and f'(||man||) ||walk||} and <f'',f'> {<f,f'>| f=f' and f'(||man||) ||whistle||}}
= {<f,f'>| there is an f'' such that f''=$f^{||man||}$ and f''(||man||) ||walk|| and f''=f' and f'(||man||) ||whistle||}
= {<f,f'>| f'=$f^{||man||}$ and f'(||man||) ||walk|| and f'(||man||) ||whistle||}

<f,f'> falls into the update expressed by (26b) if and only if there is an choice function f'' such that <f,f''> falls into the update expressed by (24b) and <f'',f'> falls into the update expressed by (25b). Using the results of the above analyses and eliminating redundancies, we reach the result that <f,f'> falls into the update expressed by (26b) iff f' differs from f at most in the representative of the class of men and this representative is a walker and a whistler.

Using this formalism, we can give a first analysis of the variety of anaphoric relations in (23). The meaning of the first sentence in (23i) - (23v) consists of the pairs of choice functions f and f' such that f' is like f with the single possible exception that f' chooses a new representative for the class of cats, namely Bruce. Furthermore, the chosen representative must be in the extension of the predicate *be in the room*. The definite expression *the cat* in (23v) then refers to this chosen individual, namely Bruce. Thus, the anaphoric relation is not explained in terms of binding or by means of a Russellian description, but rather in the interaction of the context change potential of the antecedent together with the context dependent interpretation of the anaphoric term. However, this basic picture can only account for the anaphoric link between *a cat* and *the cat*, but not for the anaphoric link between *a cat* and *he* in (23iii) or the anaphoric link between *our New Zealand cat* in (vii) and *the cat* in (viii):

(23) “the cat”
i Imagine yourself with me as I write these words. In the room is **a cat$_1$**, Bruce$_1$,
ii who has been making himself$_1$ very salient by dashing madly about.
iii He$_1$ is the only cat in the room, or in sight, or in earshot.
iv I start to speak to you:
v The cat$_1$ is in the carton. **The cat$_1$** will never meet **our other cat$_2$**,
vi because our other cat$_2$ lives in New Zealand.
vii **Our New Zealand cat$_2$** lives with the Cresswells.
viii And there **he$_2$**’ll stay, because Miriam would be sad if **the cat$_2$** went away.

In order to account for an anaphoric relation between the indefinite NP *a cat* and the pronoun *he*, Peregrin & von Heusinger (1995, to appear) modify definition DEF 3 to DEF 3'. An indefinite NP *an F* does not only change the representative of the class of Fs, but also the representative of (certain) supersets. Hence, the anaphoric expressions *he* (as short for *the (male) object*) refers back to the mentioned representative.

DEF3' upd$_1$ is the element of UPD defined as follows
upd$_1$(f,d,s)(s') =d if s' s and d s
=f(s') otherwise

Still, this modification does not explain the anaphoric link between the definite NP *our New Zealandcat* and the definite NP *the cat.* An even more flexible account of salience change potential is necessary.

4.3 The dynamics of definite descriptions

Lewis' example "the cat" illustrates that different occurrences of the definite NP *the cat* can refer to different referents, contrary to the classical assumption of Russell, which are also held in contemporary theories. The example rather shows that the context can change in a way that the second occurrence of the cat refers to a different object. The question I address in this subsection is what the contribution of other definite NPs to this context change is – we have already seen that an indefinite changes or updates an input choice function. Before we analyze the context change potential of a definite NP, I'd like to present another text in which we have more than one occurrence of one definite NP with different referents. The fragment is from the short novel "A clean, well-lighted place" from Ernest Hemingway (1925, see the continuous fragment in the appendix):

(24) **A clean, well-lighted place**
It was late and everyone had left the café except an old man who sat in the shadow the leaves of the tree made against the electric light. [...] **The two waiters** inside the café knew that the old man was a little drunk [...]. "Last week he tried to commit suicide," **one waiter** said. "Why?" [...] **The younger waiter** went over to him. [...] The old man looked at **him**. ***The waiter*** went away. [...]
The waiter who was in hurry came over. "Finished," **he** said [...].
"Another", said the old man. "No, finished." ***The waiter*** wiped the edge of the table with a towel and shook **his** head. The old man stood up [...]. "Why didn't you let him stay and drink?" **the unhurried waiter** asked.

In this fragment the two occurrences of the definite NP *the waiter* refer to different waiters – both refer to the last mentioned one. We can then extract the following anaphoric chains from this example:

(25) Anaphoric chains of definite NPs in (24)
the younger waiter ... him ... the waiter
the waiter who was in hurry ... he ... the waiter

It is obvious that the definite NP *the younger waiter* changes the context in a way that its referent is not only the most salient younger waiter (trivially), but also that its referent is the most salient waiter (at all). In order to implement this, we change the interpretation rule for the definite NP (1b) to (1b') by accommodating it to the one of indefinite NPs (1a) – the original rules are repeated below:

1a. $||\mathbf{a}(P)|| = \{<f,f'>|\ f'=f^{||P||}\}$
1b. $||\mathbf{the}(P)|| = \{<f,f'>|\ f'=f \text{ and } f'(||P||) \text{ is defined}\}$

1b' $\|\mathbf{the}(P)\| = \{\langle f,f' \rangle \mid f'=f^{\|P\|}\}$

In the original rule (1b), the definite character of the NP was warranted by its static (i.e. non-updating) behavior, while in the new interpretation rule the definite NPs is also assigned an update function. However, this update function can also change the context if we allow for the more flexible updating function DEF3', otherwise it would trivially update the given global choice function only for the set associated with the descriptive material. The difference between an indefinite and a definite NP is not the dynamic vs. static behavior, but the way they find their referents. An indefinite NP refers to an arbitrarily selected element (by way of an existential quantifier or by a local choice functions), while a definite NP refers to its referents due to the global choice function (standing for the salience structure of a discourse). With these two modifications of the original dynamic semantics with choice functions, we can account for the example (23) of Lewis, the fragment from Hemingway (24) and many more natural language discourses with more than one occurrence of one and the same definite NP.

5. Summary

It was shown that definite descriptions exhibit two functions: (i) they are interpreted depending on the context and establish in this way anaphoric links, (ii) they change the context by raising new referents to the most salient ones for the set they describe as well as some supersets. Furthermore, it was argued that the most appropriate representation for definite descriptions are context dependent global choice function terms. These terms refer to the most salient object of the class of objects that fall under the descriptions and the referent of the term becomes the most salient element of the set, as well as some supersets. Indefinites are represented by local choice functions. Both NPs change the context by updating the global choice function, which represents the salience structure of the discourse.

Appendix 1 “A clean, well-lighted place" from Ernest Hemingway 1925

It was late and every one had left the café except **an old man** who sat in the shadow the leaves of the tree made against the electric light. In the day time the street was dusty, but at night the dew settled the dust and the old man liked to sit late because he was deaf and now at night it was quiet and he felt the difference. The **two waiters** inside the café knew that **the old man** was a little drunk, and while he was a good client they knew that if he became too drunk he would leave without paying, so they kept watch on him.
"Last week he tried to commit suicide," **one waiter** said.
"Why?"
"He was in despair."
"What about?"
"Nothing."
"How do you know it was nothing?"
"He has plenty of money."
They sat together at a table that was close against the wall near the door of the café and looked at the terrace where the tables were all empty except where the old man sat in the shadow of the leaves of the tree that moved slightly in the wind. A girl and a soldier went by in the street. The street light shone on the brass number on his collar. The girl wore no head covering and hurried beside him.
"The guard will pick him up," one waiter said.
"What does it matter if he gets what he's after?"
"He had better get off the street now. The guard will get him. They went by five minutes ago."
The old man sitting in the shadow rapped on his saucer with his glass. The **younger waiter** went over to him.
"What do you want?"
The old man looked at him. "Another brandy," he said.
"You'll be drunk," the waiter said. **The old man** looked at **him**. **The waiter** went away.
"He'll stay all night," he said to his colleague. "I'm sleepy now. I never get into bed before three o'clock. He should have killed himself last week."
The waiter took the brandy bottle and another saucer from the counter inside the café and marched out to **the old man**'s table. He put down the saucer and poured the glass full of brandy.
"You should have killed yourself last week," he said to the deaf man. The old man motioned with his finger. "A little more," he said. The waiter poured on into the glass so that the brandy slopped over and ran down the stem into the top saucer of the pile. **The waiter** took the bottle back inside the café. **He** sat down at the table with **his colleague** again.

"He's drunk now," **he** said.
"He's drunk every night."
"What did he want to kill himself for?"
"How should I know."
"How did he do it?"
"He hung himself with a rope."
"Who cut him down?"
"His niece."
"Why did they do it?"
"Fear for his soul."
"How much money has he got?"
"He's got plenty."
"He must be eighty years old."
"Anyway I should say he was eighty."
"I wish he would go home. I never get to bed before three o'clock. What kind of hour is that to go to bed?"
"He stays up because he likes it."
"He's lonely. I'm not lonely. I have a wife waiting in bed for me."
"He had a wife once too."
"A wife would be no good to him now."
"You can't tell. He might be better with a wife."
"His niece looks after him. You said she cut him down."
"I know."
"I wouldn't want to be that old. An old man is a nasty thing."
"Not always. This old man is clean. He drinks without spilling. Even now, drunk. Look at him."
"I don't want to look at him. I wish he would go home. He has no regard for those who must work."
The old man looked from his glass across the square, then over at **the waiters.**
"Another brandy," he said, pointing to his glass. **The waiter who was in hurry** came over.
"Finished," **he** said, speaking with that omission of syntax stupid people employ when talking to drunken people or foreigners. "No more tonight. Close now."
"Another", said the old man.
"No, finished." **The waiter** wiped the edge of the table with a towel and shook **his** head.
The old man stood up, slowly counted the saucers, took a leather coin purse from his pocket and paid for the drinks. leaving half a peseta tip.
The waiter watched him go down the street, a very old man walking unsteadily but with dignity.
"Why didn't you let him stay and drink?" **the unhurried waiter** asked.

References

Bende-Farkas, Ágnes & Kamp, Hans 2001. *Indefinites and Binding: From Specificity to Incorporation*. Lecture Notes, revised version. XIII ESSLLI, Helsinki 2001.

Bosch, Peter 1988. Representing and Accessing Focussed Referents. *Language and Cognitive Processes* 3, 3, 207-231.

Chierchia, Gennaro 2001. A Puzzle about Indefinites. In: C. Checchetto & G. Chierchia & M.-T. Guasti (eds.). *Semantic Interfaces: Reference, Anaphora and Aspect.* Stanford: CSLI Publications.

Dekker, Paul 1998. Speaker's Reference, Descriptions, and Information Structure. *Journal of Semantics* 15, 305-334.

van der Does, Jaap & de Hoop, Helen 1998. Type-Shifting and Scrambled Definites. *Journal of Semantics* 15, 393-416.

Egli, Urs 1991. *(In)definite Nominalphrase und Typentheorie.* In: U. Egli & K. von Heusinger (eds.). Zwei Aufsätze zur definiten Kennzeichnung. Arbeitspapier 27. Fachgruppe Sprachwissenschaft Universität Konstanz.

Egli, Urs & von Heusinger, Klaus 1995. The Epsilon Operator and E-Type Pronouns. In: U. Egli et al. (eds.). *Lexical Knowledge in the Organization of Language*. Amsterdam: Benjamins, 121-141.

van Eijck, Jan 1993. The Dynamics of Description. *Journal of Semantics* 10, 239-267.

Farkas, Donka 1981. Quantifier Scope and Syntactic Islands. In: R. Hendrik et al. (eds.). *Papers from the Seventeenth Regional Meeting (CLS 17)*. Chicago Linguistics Society: University of Chicago, 59-66.

Farkas, Donka 2000. Scope Matters. In: K. von Heusinger & U. Egli (eds.). *Reference and Anaphoric Relations*. Dordrecht: Kluwer, 79-108.

Frege, Gottlob [1892] 1980. Über Begriff und Gegenstand. In: *Funktion, Begriff, Bedeutung. Fünf logische Studien*. Hrsg. u. eingeleitet v. Günther Patzig. 5. Aufl. Göttingen: Vandenhoek & Ruprecht, 66-80. [Zuerst erschienen: Vjschr. f. wissensch. Philosphie 16, 1892, 192-205]

Groenendijk, Jeroen & Stokhof, Martin 1991. Dynamic Predicate Logic. *Linguistics and Philosophy* 14, 39-100.

Hajicová, Eva & Hoskovec, Tomás & Sgall, Petr 1995. Discourse Modelling Based on Hierarchy of Salience. *The Prague Bulletin of Mathematical Linguistics* 64, 4-24.

Heim, Irene 1982. *The Semantics of Definite and Indefinite Noun Phrases.* Ph.D. Dissertation. University of Massachusetts, Amherst. Ann Arbor: University Microfilms.

Hemingway, Ernest [1925] 1966. A clean, well-ligthed place. In: *The short stories of E. Hemingway*. New York: C. Scribner, 379-383.

von Heusinger, Klaus 1997. Salienz und Referenz. *Der Epsilonoperator in der Semantik der Nominalphrase und anaphorischer Pronomen.* Studia grammatica 43. Berlin: Akademie Verlag.

von Heusinger, Klaus 2000. The Reference of Indefinites. In: K. von Heusinger & U. Egli (eds.). *Referenceand Anaphoric Relations.* Dordrecht: Kluwer, 247-265.

von Heusinger, Klaus (to appear). Specificity and Definiteness in Sentence and Discourse Structure. *Journal of Semantics.*

Hilbert, David & Bernays, Paul [1939] 1970. *Grundlagen der Mathematik.* Vol. II. 2. ed. Berlin; Heidelberg; New York: Springer.

Hintikka, Jaakko 1986. The Semantics of ‘a certain’. *Linguistic Inquiry* 17, 331-336.

Kamp, Hans [1981] 1984. A Theory of Truth and Semantic Interpretation. In: J. Groenendijk & T. M. V. Janssen & M. Stokhof (eds.). *Truth, Interpretation and Information*. Dordrecht: Foris, 1-41.

Kamp, Hans & Reyle, Uwe 1993. *From Discourse to Logic. Introduction to Modeltheoretic Semantics of Natural Language, Formal Logic and Discourse Representation Theory*. Dordrecht: Kluwer.

Kempson, Ruth & Gabbay, Dov & Meyer-Viol, Wilfried 2000. *Dynamic Syntax. The Flow of Language Understanding.* London: Blackwell.

Kempson & Meyer-Viol & Otsuka 2002. Anaphoric Processes of Interpetation: Growth of Logical Form. *Proceedings of the Workshop "Choice Functions and Natural Languages Semantics"* Arbeitspapier 110. FB Sprachwissenschaft, Universität Konstanz.

Krahmer, Emiel & van Deemter, Kees 1998. On the Interpretation of Anaphoric Noun Phrases: Towards a Full Understanding of Partial Matches. *Journal of Semantics* 15, 355-392.

Kratzer, Angelika 1998. Scope or Pseudoscope? Are there Wide-Scope Indefinites? In: S. Rothstein (ed.). *Events and Grammar.* Dordrecht: Kluwer, 163-196.

Lewis, David 1979. Scorekeeping in a Language Game. In: R. Bäuerle & U. Egli & A. von Stechow (eds.). *Semantics from Different Points of View*. Berlin; Heidelberg; New York: Springer, 172-187.

Meyer-Viol, Wilfried 1995. Instantial Logic. *An Investigation into Reasoning with Instances*. Amsterdam: ILLC Dissertation Series 1995-11.

Peregrin, Jaroslav 2000. Reference and Inference: The Case of Anaphora. In: K. von Heusinger & U. Egli (eds.). *Reference and Anaphoric Relations*. Dordrecht: Kluwer, 269-286

Peregrin, Jaroslav & von Heusinger, Klaus 1995. Dynamic Semantics with Choice Functions. In: U. Egli & K. von Heusinger (eds.). *Choice Functions in Natural Language Semantics*. Arbeitspapier 71. Fachgruppe Sprachwissenschaft Universität Konstanz, 41-67.

Peregrin, Jaroslav & von Heusinger, Klaus (to appear). Dynamic Semantics with Choice Functions. In: H. Kamp & B. Partee (eds.). *Context Dependence in the Analysis of Linguistic Meaning*. Amsterdam: Elsevier Science.

Poesio, Massimo & Stevenson, Rosemary (to appear). *Salience: Computational Models and Psychological Evidence.* Cambridge: Cambridge University Press

Reinhart, Tanya 1992. Wh-in-situ: An Apparent Paradox. In: P. Dekker & M. Stokhof (eds.). *Proceedings of the Eighth Amsterdam Colloquium*. ILLC. University of Amsterdam, 483-491.

Russell, Bertrand 1905. On Denoting. *Mind* 14, 479-493.

Schenkler, Phillipe 1998.A Note on Skolem functions and the Scope of Indefinites. Poster, *NELS* 1998.

Schröter, Karl 1956. Theorie des bestimmten Artikels. *Zeitschrift für Mathematische Logik und Grundlagen der Mathematik* 2, 37-56.

Sgall, Petr 1984. Remarks on Text, Language and Communication. In: P. Sgall (ed.). *Contributions to Functional Syntax, Semantics, and Language Comprehension*. Amsterdem; Philadelphia: Benjamins, 123-144. (Linguistic & Literary Studies in Eastern Europe 16)

Slater, B. H. 1986. E-Type Pronouns and Epsilon-Terms. *Canadian Journal of Philosophy* 16, 27-38.

von Stechow, Arnim 2000. Some Remarks on Choice Functions and LF-Movements. In: K. von Heusinger & U. Egli (eds.). *Reference and Anaphoric Relations*. Dordrecht: Kluwer, 193-228.

Winter, Yoad 1997. Choice Functions and the Scopal Semantics of Indefinites. *Linguistics and Philosophy* 20, 399-467.

Winter, Yoad 2002. Functional Quantification. *Proceedings of the Workshop "Choice Functions and Natural Languages Semantics"* Arbeitspapier 110. FB Sprachwissenschaft, Universität Konstanz.