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Semantics with clusters of properties

In model theoretic semantics, we represent the core of predicate-sense by intension. Another notion, clusters of characteristic properties, serving as conceptual guidelines that help us identify the denotation in each context of use, has intrigued scholars from a variety of disciplines for years. Model theoretic theories often appeal to clusters of properties / features /criteria / propositions etc. However, there is no systematic account of the role of clusters. Stipulations are made in each case separately regarding the presence of clusters and/or their various effects. I propose a detailed formal model, which incorporates two kinds of clusters into our denotational representation of Predicate meaning. For example, the interpretation of the predicate *chair* includes in each context a set of individuals (chairs), necessary properties (like *piece of furniture* or *solid*) and stereotypical characteristics of chairs (like: *has a back, four legs, is used to sit on it* etc.) In this paper, I illustrate the use of this model in semantic analysis with one case study: contextual restrictions in universal generalizations with *every, any* and generic *a*.

1. Background

Some classical cluster theories and experimental evidence

Cluster theories are found in the work of philosophers like Wittgenstein (1953) and Searle (1958); conceptualist semanticist like Fodor (1963), Katz & Postal (1964), and Jackendoff (1972); psycholinguists like Keil (1979) and cognitive psychologists like Rosch (1978), among many others (see for instance Smith (1988); Reed (1988) and references therein). In formal semantics, such theories are systematically found in the work of Renate Bartsch (1984,1986,1998).

The effects of clusters are extensively investigated in cognitive psychology, and empirical evidence from a variety of psychological experiments has been collected.

The most basic motivation for cluster theories is the fact that people tend to define or describe the content of a predicate (say, *bird*) by a list of properties. These properties, in most cases, are not necessary conditions for entities to fall under the predicate, but rather – these properties affect the typicality of entities with respect to the predicate. For instance the following properties are regarded as characterizing *bird*: *fly, build nests, sing, have feathers, perch in trees, are small, eat insects,* etc.

The number of typicality properties that an entity satisfies correlates with:

(1) Judgments on the entity's typicality (i.e. whether it is regarded as more or less typical of the concept *bird*, with respect to other entities: robin, seagull, chicken, penguin etc.);

(2) Speed of categorization of the entity (when presented as a novel stimulus);

(3) Retrieval from memory (in recall of memorized lists of entities (say - birds), people tend to reorder them by typicality);

(4) Memory encoding (typical instances first seen may look familiar. Typicality induces false memories); etc.

Typicality clusters play an important role in certain stages of language acquisition. Some neurobiological evidence displaying their importance was collected as well. For instance, it has been shown that items with different characterizing properties are stored in different brain areas: predicates that denote artifacts are identified by their use (e.g. *chair* is identified by a property like *is used to sit on*) and hence semantic information about these predicates is stored near brain areas responsible for motor control and action planning. Predicates that denote animate beings are identified by sensual (usually visual) properties, and hence semantic information about these predicates is stored in the areas in which the relevant sense is implemented (see in Susan Bookheimer 2002 and references therein).

Traditionally researchers have investigated fixed (though culture or language dependent) typicality properties. Later on research has expanded also to ad-hoc or context dependent typicality clusters.

<u>Classical objections to cluster theories</u>

Formal semanticists admit that characterizing properties are part of our world knowledge and that they play a role in the interpretation of statements like (1):

(1)a. *Birds fly.*
b. *Frenchmen eat horsemeat.*

However, cluster theories were seriously criticized by semanticists. In fact, the intensional theory of predicate meanings came into being partially as a reaction against cluster theories of meaning, for good historical reasons. The arguments for intensions (rather than clusters) as the core of meaning focus on <u>compositionality</u> and <u>aboutness</u>:

1. <u>Aboutness</u>: Cluster theories failed to represent aboutness. Aboutness concerns the relation between linguistic representations (like sentences and their constituents) and non -linguistic entities (the world, as a non-linguistic conceptual structure). The observation is that it is a core part of the native speaker's capacity to classify objects or situations with linguistic items. All human beings are capable of distinguishing situations where it rains from situations where it doesn't rain. Only competent speakers of French are able to distinguish these situations with the linguistic item *il ne pleut pas*. It is part of the semantic competence of French speakers that they can use that sentence to distinguish these situations. This classificatory semantic competence is exactly what the notion of intension models. Every expression is associated with the set of objects or events it applies to in each context.

Cluster theories only associate a predicate (or a concept- say *bird*) with a set (cluster) of other predicates or concepts, but those are linguistic items, symbols themselves. This translation only pushes the need for a semantic interpretation one level up to the level of the clusters (Lewis 1970). In other words, cluster theories fail to represent the contribution of cluster properties (and, in particular, typicality properties) to truth conditions (see for instance in Cohen 1999, page 11).

2. <u>Compositionality</u>: Cluster theories failed to be compositional (see in: Osherson and Smith 1981); Only a compositional theory can generate the meanings of infinitely many complex expressions possible in a language, using a finite set of rules. Cluster theories typically didn't address the question of the construction of meanings of complex expressions (say - *male nurse, red or white*) given the meanings of the parts (how, say, the cluster of *red or white* is constructed from the separated clusters of *red* and *white*).

3. Wrong predictions: Kripke 1972, Putnam 1975 and many others since, have demonstrated very convincingly that Cluster theories give rise to wrong predictions, mostly with regard to the semantics of predicates that stand for natural kinds, like *whale*. At some point in time, whales were thought to be fish. Presumably, at that time the cluster of concepts associated with *whale* included the concept *fish*. The discovery that whales are mammals has changed the cluster (*fish* being replaced by *mammal)* but not the denotation: the word *whale* still refers to the same objects (the absolute set of whales, à la Kripke-Putnam). No one thinks that other creatures that are fish are the actual whales. That is, the word is more strongly connected with the denotation, not the cluster of properties.

Moreover, it is incorrect to assume that before the discovery the sentence *whales are fish* was regarded as a definitional tautology, and after the discovery a meaning change has turned it into a contradiction. Its falsehood is and was an empirical matter. For the same reasons- *whales are mammals* is not regarded as a tautology today, but rather as an empirical matter. On an intensional theory, the replacement of older criteria for whalehood by new ones changes the meaning of *whale* very little (it could be that, with the new knowledge, the denotation of *whale* in dubious contexts changes).

Solutions

I argue that all three deficiencies of cluster theories just mentioned can be eliminated, provided that clusters are implemented within an intensional theory. The model I present in the following sections explains how cluster-properties relate systematically to the ontology presupposed by semantic interpretations. Thus, the problems of aboutness and compositionality are solved: we have denotations, and rules of composition of denotations, as usual. I will not directly discuss the issue of compositionality of clusters in this paper, though certain predictions regarding compositionality of clusters follow from the theory I am presenting. Partee and Kamp 1995 discuss this issue at length, arguing that it ought to be dealt with. Their paper specifically refers to criticism against Prototype theory. They propose a certain implementation of Prototype theory in a model theoretic framework, which doesn't use cluster properties, but their arguments generalize also for a cluster- implementation of this theory. In fact, they argue in the discussion that perhaps clusters may be able to do a better job.

I argue that cluster properties of the predicate *whale*, (for instance *living in the North Sea* or *mammal*) ought to be represented as context dependent characteristic properties of *whale.* In certain contexts they are taken to be presupposed by *whale,* and in others they may not be so taken. If so, it doesn't follow that *whales are mammals* is a tautology, or that *whales are fish* is a contradiction. Since cluster properties are not regarded as entailments of the predicate they characterize, the classical Kripke-Putnam arguments against them are no longer valid.

Basic motivation for the incorporation of clusters

I propose that we need clusters in our denotational theory.

Some basic motivation for a model with clusters of properties in the semantics of predicates (along with denotations) is that it allows for a fuller representation of people's knowledge of predicate meanings and the way they acquire it, and of a variety of psychological findings (typicality ordering of entities, categorization-speed, memory; language acquisition etc).

In addition, it allows a systematic account of a variety of semantic phenomena in which clusters play a crucial role. Indeed, model theoretic semantics often appeal to clusters of properties / features / criteria / propositions etc. Examples include: Lewis 1970 (features restricting modal bases); Lewis 1970, Venneman 1972, Kamp 1975 (ordering criteria and standards of precision, in the analysis of gradable predicates and comparatives); Kadmon and Landman 1993 (contextual restrictions of conditionals, quantifiers and generics); Partee and Kamp 1995, Bartsch 1986,1998 (cluster properties of adjectives and nouns); Bartsch 1984, Landman 1989 (sets of properties in the analysis of respects, and in the analysis of groups); Lasersohn 1998 (pragmatically ignorable features of words when used in loose speech, and with modification by certain adverbs); Searle 1958 (characterizing properties associated with proper names in identity sentences), and many others.

However, there is no systematic account of the role of clusters. Effects of clusters (entailed properties, contextually restricted meanings, typicality scales etc.) are usually dealt with by stipulating restrictions separately for each phenomenon: fixed and contextual restrictions on intensions, quantifiers, conditionals, and etc. case by case. This is ad-hoc as it is not a part of the representation of the Fregean sense, and it is not economical. Clusters as part of predicate interpretation, being accessible to grammatical operations, spare much of these stipulations.

In order to demonstrate this, let me quickly review some of the assumptions in the analysis of contextual restrictions.

Contextual restrictions on quantifying expressions

Domains of quantification are contextually restricted. For example, the statement in (3) is clearly not about every possible object, only about *sites in Paris,* or maybe even, only about famous or adored sites:

(3) *I lived near the Seine, near Boulevard St. Germain and Rue St. Michel, near the market and the Pantheon, near everything* (Ha'aretz, 4.1.2002, in "Positively Boris Carmi").

The statement in (4) is a free translation from Hebrew. Lisa Ben-Senior, the secretary of the linguistics department at Tel Aviv University posted it on the notice board:

(4) *No notice (of any kind) may be posted on the notice board*.

Clearly – notices that Lisa herself posts are irrelevant here. More kinds of notices might be irrelevant too – lists of grades, notices regarding changes of classrooms, etc.

Traditionally, contextual restrictions on quantifying expressions are represented by a context variable (say- X_c), whose value is a set of relevant individuals (for details see in von Fintel 1994). The truth conditions of a statement with a quantifying expression, like (5a), are represented in (5b):

(5)a. *A duck lays whitish eggs* ,

b. $\forall d \in (X_c \cap [duck]_w): d \in [lays\ whitish\ eggs]_w$

(Where X_c is a set of relevant individuals).

(5b) is saying that every individual, which is in the set of the relevant individuals and is a duck, is in the denotation of *lays whitish eggs*.

In Kadmon and Landman 1989 and 1993 we find a different representation of contextual restrictions, specific for generics and conditionals: a set of restricting properties. For example, the truth conditions of (5a) are represented in (6):

(6). $\forall w$: $\forall d \in [duck]_w$ such that d has the properties in X_{duck}: $d \in [lays\ whitish\ eggs]_w$
(Where X_{duck} is a set of properties that determine what is relevant: *water bird, of the family Anatidae, with webbed feet and flattened beaks, female,* etc).

(6) is saying that every individual that is a duck and that has the properties in X_{duck}, is in the denotation of *lays whitish eggs.* X_{duck} is a set of properties that accompanies generics and conditionals, and determines what is relevant. It may include properties like *water bird, of the family Anatidae, with webbed feet and flattened beaks*, -they usually characterize ducks. But it may also include properties like *female.* When we speak of ducks' reproduction habits, being a *female* is a necessary condition for relevance, because if male ducks were relevant, the statement would be judged false, and it is not.

Note that certain properties, like *small,* or *has an ink stain on its forehead* may be known to be non-necessary for duckhood in the context. They are regarded as non-restrictions.
The important observation of Kadmon and Landman is that X_{duck} is typically vague, and therefore the domain is vague. In order to represent that we need to specify two sets: restrictions and non-restrictions. If a property, say *healthy,* is not <u>specified</u> in any of these sets, the domain of the generic quantifier is vague. We cannot say whether sick entities are relevant ducks, (that is, are practically regarded as ducks in the context), until the property *healthy* will be specified as either necessary (a restriction) or not (a non-restriction).
Kadmon and Landman's analysis of Free Choice *any* crucially depends on this cluster of properties: *any* widens the domain by the elimination of restricting properties.

We also find sets of restricting properties in most recent theories of conditionals:

(7)a. *If John subscribes to a newspaper, he gets well informed.*
b. $\forall e$ such that e has the properties in $X_{\text{John subscribes to a newspaper}}$:
[John subscribes to a newspaper in e $\Rightarrow$ he gets well informed in e].
(8)a. *If there is sugar in the tea, the tea tastes good.*
b. $\forall e$ such that e has the properties in $X_{\text{there is sugar in the tea}}$:
[There is sugar in the tea in e $\Rightarrow$ the tea tastes good in e].

The conditional in (7a) is restricted via $X_{\text{John subscribes to a newspaper}}$, to be only about subscriptions to a newspaper that John can read, and so on. (8a) is restricted to eventualities in which there is no oil in the tea., and so on. This is crucial in the account for certain facts. For instance, the fact that, intuitively, (8) fails to entail (9):

(9) *If there is sugar and oil in the tea, the tea tastes good.*

The Problem with the presented theories is that the presence of the restriction in, say - generic statements, is an ad-hoc stipulation. It is not related to restrictions found with other expressions: *every, some, necessarily, if-then,* etc.
Moreover, intuitively, the source of the contextual restriction is not the quantifying expression but the predicate, be it a simple predicate like *duck* or even a proposition, taken to be a property of events, like *John subscribes to a newspaper.* Before the occurrence of a predicate the addressee has no idea what the contextual restrictions would be.

Finally, an additional and at least as common kind of restricting properties plays a crucial role in contexts: stereotypicality properties. For example, even if being *healthy*, or *adult*, is not necessary for duckhood in the context, healthy adult birds may well be more relevant in a discourse on reproduction behavior of ducks, than sick or very young and very old birds. In such a case, the properties *healthy* and *adult* are contextually stereotypical of ducks: they raise ducks' relevance in the context. I delay the discussion of the significance of such properties in the analysis of generic statements, and *any,* to section 3.

The cluster properties added to our model ought to directly represent the fact that there is no absolute set of whales that is always a-priori referred to by a contextual use of the predicate *whale*. Contextual information determines whether the relevant objects in each and every contextual use are all the whales that ever existed, the set of whales that are alive now (the year 2002), the whales that were alive last decade or will be alive next 50 years, the set of whales in a certain sea, nature reserve, or zoo, males or females etc.

Consider the examples in (10):

(10)a. *whales are gray*
b. *We feed the whales in the mornings*
c. *Every whale chooses a territory*
d. *A whale suckles her offspring.*

Sentences with the predicate *whale*, like those in (10), are interpreted in relation to the information given in a certain context and to certain contextual presuppositions, i.e. in relation to a contextually restricted set of relevant whales, and what is known about them. Hence, a property like *living in the North Sea, mammal* or *female* is not necessarily just part of our world knowledge, but may also be a possible part of our linguistic knowledge: it helps us determine the relevant set of whales referred to by the predicate. A representation of those contextual restrictions is required in order to represent the actual denotation of *whales* and the actual quantification domains in *every whale* and *a whale*.

Note, that stipulating both an extension and a cluster of characteristic properties is not redundant in contexts of partial information:

On the one hand, the information in the cluster is not given by the information in the denotation. Thus, the individuals in the denotation of *whale* may have lots of known properties, but one can not deduce from this whether they are obligatory or not to all the denotation members. For example, even if all the known whales are healthy, it is not clear whether the dimension *healthy* is obligatory or not for every potential member of *whale*.

On the other hand, the information in the cluster doesn't give the information that the denotation gives: in some context one may know that the relevant whales ought to be, say, *nocturnal*, *adult, males*, but the question whether an arbitrary nocturnal adult male whale is relevant in that context, may still be open (if for instance it is not healthy).

Therefore, in a state of partial information one may know some property to be obligatory for (or stereotypical of) whales without knowing a single whale. On the other hand one may know that some individual is in the denotation of the predicate without knowing all the predicate's obligatory or non-obligatory properties. Thus postulating clusters of characteristic properties as part of the basic interpretation of a predicate P (in addition to the denotation), allows for a better representation of the actual content of the partial information a discourse participant may have regarding that predicate.

As demonstrated above, in the absence of clusters, contextual criteria for, say, whalehood, are added to our models externally, by lists of stipulations. The same criteria are stipulated again when linguistic items that make use of them are analysed (quantifiers, *any,* conditionals etc). So the cluster content is indeed represented in our theories, but not in an economic way.

In the following section I propose a detailed formal model, which incorporates clusters in addition to denotations.

2. The dimension model

As noted, when asked to describe the content of a word, say *chair,* people may either point at individuals that satisfy this property (and from all available chairs, they are likely to start pointing at relatively typical chairs, and only then point at worse examples), or utter a list of characterizing properties of chairs. For instance, properties necessary for membership in the contextual extension like: *solid* or *piece of furniture,* and, mostly, properties affecting stereotypicality like *has a back, four legs, is used to sit on,* etc. Similarly, children in acquisition, and adults while disambiguating or acquiring predicate meaning in specific contextual uses, are exposed both to instances that fall (or don't fall) under a predicate, and to characteristic (or non-characteristic) properties.

The core of the Fregean sense is commonly represented by intension. The intension of a predicate P is a function that associates with P a set of individuals (an extension), $[P]_w$, per world (or per situation, time, etc.) w in W (the set of possible worlds, or alternatives of reality). Our information regarding the real world is partial, i.e. we do not know which w in W it is. The partial information that speakers have about the denotation of a predicate P in the real world is often represented by a partial specification of the positive and the negative extensions of P in the real world: $<[P]^+_c,[P]^-_c>$. These are the set of entities that fall, or don't fall, under P given the information in context c. Let us call these sets the partial extensions of P in c. My proposal is that the interpretation of a predicate P in a context c, includes both partial extensions: $<[P]^+_c,[P]^-_c>$ (as in standard vagueness models) and partial sets of characteristic properties, as follows:

Proposal:

The interpretation of a predicate P in a context c, includes a partial specification of**:**

The positive extension in the real world +	**Clusters of characteristic properties** ↙	↘
↓	**Membership dimensions**	**Ordering dimensions**
(predicate instances)	(necessary properties)	(properties affecting stereotypicality)
{h,h,h,…}	{*solid, piece of furniture,…*}	{*has a back, four legs, is used to sit on,*}
= $\mathbf{[chair]^+_c}$	= $\mathbf{MS^+_{(chair,c)}}$	= $\mathbf{OS^+_{(chair,c)}}$

We may also know some negative instances, i.e. we have a partial specification of:

The negative extension in the real world	**Non-membership dimensions**	**Non-ordering dimensions**
	(Non-necessary properties)	(properties that don't affect stereotypicality)
(Non-chairs)	{ *has a back ,brown,…*}	{*brown, small,…*}
= $\mathbf{[chair]^-_c}$	= $\mathbf{MS^-_{(chair,c)}}$	= $\mathbf{OS^-_{(chair,c)}}$

Of the rest of the individuals/ properties, we still don't know in c in which set they belong, the negative or the positive one. They form the gaps:

$\mathbf{[chair]^?_c}$	$\mathbf{MS^?_{(chair,c)}}$	$\mathbf{OS^?_{(chair,c)}}$
(Unspecified entities)	(Unspecified dimensions)	(Unspecified dimensions)

Finally, we have scales, i.e. ordering of individuals by stereotypicality or relevance in a context. A scale is represented by a set, $\mathbf{[\leq_{chair}]^+_c}$, of pairs of individuals $<d_1,d_2>$, such that d_2 is at least as good example of *chair* as d_1. The negative set $\mathbf{[\leq_{chair}]^-_c}$, consists of the pairs in which d_2 is <u>not</u> at least as good example of *chair* as d_1, i.e. those pairs in which d_1 is a better example. (= $\mathbf{[>_{chair}]^+_c}$). The gap $\mathbf{[\leq_{chair}]^?_c}$ contains pairs of individuals about which we don't yet know if they belong in the negative set or in the positive one.

The dimension-model is a standard vagueness model, with the addition of clusters (for formal definitions see appendix 1). Information growth is represented by an ordered set $<C,\leq_A>$ of partial information states c, called contexts, starting with a minimal context c-zero and extending gradually into all possible different contexts t of total information.

Information growth from contexts to their extensions is represented by a monotonic growth of the positive and negative denotations or clusters. Monotonicity requires of every context c_2 extending another context c_1, that the denotations and clusters in c_2 be supersets of those in c_1.

Denotations of predicates in the minimal information context are completely empty, while in total information contexts, t, predicates have no gaps (i.e. every individual is either in the positive or in the negative denotation of every predicate, and every predicate (i.e. dimension) is either in the positive or in the negative cluster of every predicate).

The interpretation constraints postulate the requirements on cluster properties and scales.

<u>The interpretation constraint</u>:

The interpretation constraint puts the following three constraints on membership in and ordering of denotations of predicates in every total context t. Because of monotonicity, the facts in every partial context c are necessarily consistent with these constraints.

$\forall t \in T$ (the set of contexts of total information), $\forall P \in A$ (the set of predicates):

1. A Membership dimension is known to be <u>necessary</u> for P-hood.
Non-membership dimensions are known to be non-necessary for P-hood:

$$\mathbf{[P]^+_t = \{d \mid \forall Q \in MS^+_{(P,t)}: d \in [Q]^+_t\}}$$

It follows that the positive denotation of P consists of (all and only) the individuals that satisfy every membership dimension. In addition, it follows that the negative denotation of P, which is the complement of the positive denotation, consists of (all and only) the individuals that don't satisfy some membership dimension.

Moreover, <u>P-entities need not satisfy P's non-membership dimensions</u>. They are only required to satisfy MS^+ properties. This is important: only violation of necessary properties determines non-P-hood. It means that exceptions to generalizations on P can not be regarded as irrelevant (non-Ps) on the basis that they violate some non-membership property.

Now, because of monotonicity, the facts in every context c in our structure are necessarily consistent with constraint (1). For example, consider a partial context c_i, in which $MS^{+}_{(duck,ci)}$ consists of the property *bird*; and $MS^{-}_{(duck,ci)}$ consists of the property *small* (i.e. $MS^{+}_{(duck,ci)} = \{bird\}$ & $MS^{-}_{(duck,ci)} = \{small\}$). If c_i were total, being a *bird* would be a necessary and sufficient condition for duckhood. But since c is partial, being a bird is just necessary (and there are additional potentially necessary conditions for membership). We now know (in c_i and its extensions) that only birds may be ducks, but not only small ones.

This model captures the fact that directly given denotations in partial states like c_i are extendable on the basis of the clusters. It is a fact that we may know that objects are *ducks,* or *tables* or so on, even if they were never directly given to us as such:

The indirectly extended denotation of P in c, $\mathbf{[P]_c}$, is the set of individuals that are P in every possible way of extending from c monotonically to a total information context. For instance, in c_i, every individual that differs from directly given ducks only along non-necessary dimensions (say *small*) must be regarded as a duck too. There can not be a total state t above c_i with properties that such an individual violates specified as necessary for ducks (some known ducks already violate them so they can not be regarded necessary). The negative denotation is extendable in the same way. For instance, every non-bird is in it (i.e. in $\mathbf{[\neg P]_c}$), even if it was not directly given as such. Only individuals that can be either P or not-P, because they violate some unspecified (potentially necessary) property, are in the (indirectly reduced) gap.

Note that it may, accidentally, be the case that there are only small birds in D (and thus all ducks are small). But it is an arbitrary empirical fact: it isn't required by the contextual semantic definition of *duck* in c_i.

2. The order of relevance / stereotypicality relative to P in t, $\leq_{(P,t)}$, is the order in which individuals are learned to be P:

$$\mathbf{[\leq P]^{+}_{t} = \{\langle d_1,d_2\rangle \mid \forall c\in C, c\leq t: (\text{if } d_1\in[P]^{+}_{c} \text{ then } d_2\in[P]^{+}_{c}) \text{ and } (\text{if } d_2\in[P]^{-}_{c} \text{ then } d_1\in[P]^{-}_{c})\}}$$

Note that I use the notion 'stereotypicality' (rather than the familiar theoretical concept 'typicality') because I intend to refer also to completely context dependent ad hoc scales.

Constraint (2) is saying that an individual d_2 is at least as relevant P as d_1 iff:

- whenever d_1 is P, d_2 is definitely P (i.e. d_2 is possibly a better example of P),
- and whenever d_2 is not P, d_1 is definitely not P (i.e. d_1 is possibly a worse example of P).

I have borrowed the notion of gradability as related to vagueness from theories of comparatives by Kamp 1975, and Landman 1991. But my theory has the advantage that a comparative relation may be partial. In Kamp and in Landman the ordering relation is total. It is defined for a whole information structure. In my theory, it is defined for branches in the structure, and hence the relation relative to P between two individuals is context dependent, and it is unknown if information doesn't have to extend to just one particular relation in every branch.

Equally relevant ducks ($[=_{duck}]_c$) are ducks in a symmetric relevance relation: $[\geq_{duck}]_c \cap [\leq_{duck}]_c$. It follows from constraint (2) that equally relevant entities d_1 and d_2 are always taken to be ducks (or non-ducks) together (in all contexts c under t: ($d_1\in[P]^{+}_{c}$ iff $d_2\in[P]^{+}_{c}$) and ($d_2\in[P]^{-}_{c}$ iff $d_1\in[P]^{-}$

$_c$)). In contrast, d_1 is *more relevant* than d_2 ($[>_{duck}]_c$) if the relevance relation is not symmetrical: it is only the case that d_1 is at least as relevant as d_2, but not vice versa. It also follows from constraint (2) that d_1 is classified as a duck before, or without d_2 being so classified, or d_2 is classified as a non-duck before, or without d_1 being so classified. I.e. for all c under t: (if $d_2 \in [P]^+_c$ then $d_1 \in [P]^+_c$) and (if $d_1 \in [P]^-_c$ then $d_2 \in [P]^-_c$) but in some c': ($d_1 \in [P]^+_c$ and $d_2 \notin [P]^+_c$) or ($d_2 \in [P]^-_c$ and $d_1 \notin [P]^-_c$).

Constraint (2) assumes that because of the partial nature of information, we can associate a contextual scale (an ordering relation), $\leq_{(P,c)}$, with every predicate. Why do we need this at all? Let's return to c_i. Suppose that only d_1 is a directly given duck in c_i. It is the only member in $[duck]^+_c$, the positive denotation. Therefore we must regard d_1 as the best example of *duck* in c_i, as our knowledge prevents certainty in the duckhood of any object deviating from this example: any such object may violate necessary conditions. Thus, we see that even so-called 'sharp' predicates are ordered by the order in which we learn that individuals fall under them. We can refer to this order by saying: *at least as relevant duck*; *at least as stereotypical relative to duck; at least as good an example of a duck,* etc. These scales of relevance or stereotypicality play a role in contexts, by telling us which entities are more relevant to generalizations or requests about ducks.

3. An ordering dimension Q (unlike a non-ordering dimension) helps order individuals on the P scale: of every two individuals equal in all other respects: the more stereotypical / relevant Q is also the more stereotypical / relevant P. I.e.:

a. Every pair in the relation "at least as good" relative to all the ordering dimensions is in the relation "at least as good" relative to P:

$$[\leq P]^+_t \supseteq \{\langle d_1,d_2\rangle \mid \forall Q \in OS^+_{(P,t)}, \langle d_1,d_2\rangle \in [\leq Q]^+_t\}.$$

First, constraint (3a) says that for every two entities d_1,d_2: if d_2 is at least as relevant as d_1, relative to every potential ordering property of P, then d_2 is necessarily at least as relevant as d_1, relative to P.

For instance, suppose that the properties *adult* and *healthy* order ducks. If one duck is *more adult* than another duck (which is good), but it is also *less healthy* (which is not good), then we cannot automatically determine which duck is more relevant. Only if one duck is healthier, more adult, and so on (no inverse relations relative to different ordering properties), we necessarily see it as more relevant or contextually stereotypical. This is a ceteris paribus correlation: all other things being equal, if a duck is (for example) healthier – it is more relevant.

Second, if two ducks are equally relevant relative to all potential ordering properties (they are equally healthy, of the same age, etc.), then they are necessarily *equally relevant ducks*.

b. Being in the relation "better" relative to an ordering dimension is necessary for being in the relation "better" relative to P:

$$[<P]^+_t \supseteq \{\langle d_1,d_2\rangle \mid \forall Q \in OS^+_{(P,t)}, \langle d_1,d_2\rangle \in [\leq Q]^+_t \text{ and } \exists Q \in OS^+_{(P,t)}, \langle d_1,d_2\rangle \in [<Q]^+_t\}.$$

Constraint (3b) says that for every two entities d_1,d_2, if d_2 is at least as relevant as d_1, relative to every potential ordering property of P, and d_2 is also actually better along some ordering property of *duck*, we regard it as *more relevant*.

Constraints (3a)-(3b) do not specify how to determine the relations between individuals in inverse relations relative to different ordering properties (for instance, the relation between d_1 and d_2 if d_1 is, say, more adult but less healthy). I believe that we do not in fact have a systematic mechanism that completely determines these relations. We may assume that age is more important (and this assumption would make d_1 a better example of *duck*), just as well as we may assume the opposite. (Actually, the relative importance of ordering properties depends (on my proposal) on the order in which they are learned to be in OS^+, but I will not elaborate on this in our current paper).

It does follow from (3a)-(3b) that non-ordering dimensions cannot influence the status of individuals relative to P. They don't <u>help order entities on the P scale</u>. It also follows that if we don't know the ordering properties, we may not know the ordering relations.

In addition, it follows that the individual, which makes the best example of all the duck potential ordering properties, would also be regarded as the best example of *duck* (that is, the <u>Prototype</u>, or the prototypical duck). And vice versa: the first directly given duck, d_1, which by constraint (2) is the best duck, ought to rank best relative to all the ordering properties (otherwise, (3b) is violated: some individual which is better relative to the ordering properties is not a better duck).

Denotations are further extendable on the basis of the ordering cluster: if one learns that some individuals are not as good as directly given ducks <u>only</u> along <u>non</u>-ordering requirements, one will regard them too as ducks. This is because constraint (3a) states that if two individuals are equally relevant relative to every potential ordering property, then they are necessarily equally relevant ducks, and constraint (2) states that all equally relevant ducks must become ducks together.

Finally, note that one may learn in a later stage that one's language community regards another object d_2, identical to d_1 except <u>healthier</u>, as a duck. Since one knows *healthy* to be an ordering property, d_2 must be a better duck-example than d_1. In such a case one will have to <u>accommodate</u> one's previous assumptions: one moves non-monotonically in the information structure, to a state c_j, in which both d_2 and d_1 are ducks, but d_2 is the better (best) duck-example.

<u>3. Universal generalizations</u>:

First note that in the dimension-model, where clusters of characterizing properties are part of predicate interpretation, the interpretation function already does the work of domain selection. There is no need to further restrict denotations to their contextually relevant subsets: the values of $[\ ]^+_c$ are the contextually relevant sets of individuals, those that the predicate is used to refer to in the context. This design reflects the intuition that the source of the contextual restriction is the predicate.

A predicate in the position of the first argument of a quantifying expression, then, plays a crucial role in the construction of a domain of quantification, as it brings about sets of relevant individuals and criteria for relevance in the context. But though crucial, its role is not sufficient.

When an English speaker wants to express a universal generalization she/he must choose one of several possible quantifying expressions, for instance: *every, all*, *any,* generic *a,* bare plurals*, each, always,* conditionals etc. The choice of some of these expressions over others, can be, and often is, meaningful. Different determiners with a universal force have different imports in terms of the domain they presuppose.

For instance, *every* is often regarded as "non-vague", in contrast to the vagueness of generic *a*. The intuitive notion is that *a* is used when the speaker wants to allow the existence of certain exceptions, whereas *every* is used when the speaker is committed to the idea that there are no exceptions at all (i.e. *every* is a marker of a precise quantification).

(11)a. *Birds fly* (≠ *every bird flies*)
b. *An owl hunts mice* (≠ *every owl hunts mice*)
c. *A poodle gives live birth* (≠ *every poodle gives live birth*), (Carlson 1977)
d. *A (#every, #any) duck has colorful feathers and lays whitish eggs* (Kadmon & Landman 1993)
e. *I don't think that a photographer who has no culture sees things the same way a cultured photographer does. A cultured photographer is more sensitive to things and therefore he sees more.* (*Ha'aretz,* Friday 4.1.02, in "Positively Boris Carmi")

The determiners in (11) are not associated with precise (totally known) domains. Therefore, exceptions are tolerated, because it is always possible to regard the exceptions as irrelevant (not in the domain). Those generalizations only mean: generally, typically, normally a - e. They are law-like. (11b), for instance, would usually be taken to mean: "if you are an owl – you hunt mice". These counterfactual entailments are usually represented by quantification over possible alternatives of reality w: ∀w:∀d…

The expressions in (12) are assumed to have precise meanings:

(12)a. *Every student who had ever read anything about phrenology attended the lectures.* (Ladusaw 1979)
b. *The townspeople are awake* (Lasersohn 1998).
c. *There are two types of photographers", he says, "those who photograph only what they can sell, and those who photograph everything. I photograph everything. All kinds of nonsensical things that I know I will never use, but I just can't help myself.* (*Ha'aretz,* Friday 4.1.02, in *"Positively Boris Carmi"*)
d. *...He joined the Hagana...Everything was terribly secret...*(*Ha'aretz,* Friday 4.1.02, in *"Positively Boris Carmi*")
e. *Take television for example. There is no sparkle of happiness, everything is bad.* (*Ha'aretz,* Friday 4.1.02, in *"Positively Boris Carmi*")
f. *Materna Premium contains all* the essential ingredients in mother's milk necessary for proper development. You just have to add a hug... (* Permitted for use). (Ha'aretz,* Friday 4.1.02)

The generalizations in (12) have a stricter interpretation: if there are exceptions, these generalizations are strictly false (like the *every* versions of (11)). Since the advertisers of (12f) do not want to be accused of lying, they explicitly mention the exceptions (in *). Note that we can sometimes express such generalizations in the presence of exceptions, in what is referred to as loose speech. In these cases we would still know that they were, strictly speaking, false, unlike the generalizations in (11), which may be potentially true even in the presence of exceptions. We use false generalizations when they are close enough to the truth, or violate from it only in pragmatic ignorable ways (Lasersohn 1998). It is likely that (12c)-(12e) are false, but the intention of the speaker was precisely to make a very strong statement, so *every* was the preferred quantifier.

Any is more complex, as its use combines both strictness and tolerance to exceptions (Kadmon and Landman 1989, 1993):

(13) *You say that a healthy owl hunts mice? any owl hunts mice* (≠ *an / every owl hunts mice*).

(13) is similar to the generalizations in (11), in being interpreted such that only "normal" owls are strictly required to hunt mice. Each owl may be regarded as a legitimate exception on some basis. The domain is vague. In addition, like the generalizations in (11), (13) enables counterfactual entailments.

However, (13) is similar to the generalizations in (12) in one respect: An exception cannot be ignored on the basis that it is not healthy. No exceptions are allowed <u>along the dimension *healthy / sick*</u>. *Any* receives here a free choice nature: whichever owl you choose - healthy or sick – will hunt mice.

Kadmon and Landman 1989,1993 argue that the function of *any* is to create <u>widening of the domain</u> by the <u>elimination of a restriction</u>: one property (*healthy*) that is initially regarded as necessary for membership in the domain (or for owlhood, in this context) is specified as non-necessary. As a result, the generalization strengthens: it applies to sick items too.

Kadmon and Landman also argue that the distribution of *any* is limited only to contexts in which widening along a dimension strengthens the statement. For instance, consider the examples in (14):

(14)a. *I am not reading any book.*
b. * *I am reading any book.*

In (14a) every relevant book ought to be in the set of things that I don't read, and so widening the set of relevant books strengthens the requirements: more books ought to satisfy the generalization. Because strengthening occurs, *any* is licensed. In (14b) only one relevant book ought to be in the set of things that I read, so widening the set of relevant books weakens the requirements: more books may satisfy the generalization. Since there is no strengthening, *any* is not licensed.

This theory predicts many of the cases in which *any* is or is not licensed.

Conclusions

A possible conclusion from the above observations is that <u>*every* requires the domain to be precise, whereas generic indefinites require it to be vague</u>. More precisely, *every* requires the domain to be precise in every respect (the speaker should have full information: every property should be either known to be necessary or known to be non-necessary for membership in the domain, so that the set of individuals that ought to satisfy the generalization, would be totally determined), whereas *any* requires the domain to be non-vague only in one respect (some specific, contextually marked property, *healthy* in (13), should be specified as non-necessary, meaning that violation of that property is not a basis for the exclusion of objects from the domain. If such objects are exceptions to the generalization they falsify it, unless there is another property, which forms a legitimate basis for their exclusion from the domain).

But, is *a* (or *any*) indeed used in contexts where the denotation of the 1st argument is more partial than in those where *every* is used? I don't think so. They may occur in the very same contexts. The point is that contexts are rarely total (i.e. denotations are rarely precise). There are infinitely many properties (potential restrictions), whose status as necessary or unnecessary is not known. The effort of specifying the status of each of them as either necessary or not, one by one, is never worthwhile. It is precisely because of the vagueness in predicates' contextual interpretation that we may construct the domain in several possible ways, and we need several linguistic items in order to mark the option that we choose. I believe that *every, any,* and generic *a* may operate upon the same cluster of restrictions of the same predicate in the same context. However, they treat the unspecified dimensions and entities in different ways.

Predicates (as 1st arguments of quantifiers) help us construct the domain by bringing about <u>partial</u> sets of relevant entities and criteria for relevance. A choice of one of several possible expressions – like *every, any* or the generic indefinite - <u>determines how one should treat the unspecified criteria and entities</u>. Thus, I propose that these expressions denote <u>operations upon the dimension-cluster</u> of their first argument. They shift contexts, systematically, rendering the cluster – and hence the denotation – more or less partial, and through this they weaken or strengthen the universal statements.

On this analysis, restrictions are stipulated just once: in the predicate interpretation, and not with every quantifier's contextual occurrence. The rest is determined by the semantics of the quantifying expression. In addition to being economic, this illuminates the relations between the meanings of different quantifying expressions, given a specific context.

For instance, consider the following examples:

(15)a. *Apparently, if you believe that <u>any aspect of an organism</u> has a function, you absolutely must believe that <u>every aspect of an organism</u> has a function* (Pinker, 1999, *How the mind works*).

b. *<u>Every match</u> I strike lights. Not <u>any match</u>, of course, a wet one doesn't* (Kadmon and Landman 1993).

In both (15a) and (15b), *any* (which is supposed to modify a predicate with a vague denotation and cluster), and *every* (which is supposed to modify a predicate with a non-vague denotation and cluster), operate on the same predicate in the same context.

The Adaptionists' view, which Pinker introduces and rejects using the phrase in (15a), is as follows: if one is committed to the idea that <u>any</u> aspect of an organism has a function, regardless whether it is, say, a *physiological* or a *behavioral* aspect, but with possible exceptions on some other basis, then one must also be committed to the idea that <u>every</u> aspect of an organism has a function, - that is - without exceptions on any basis at all: *physiological, behavioral, complex, not complex,…*

With *any*, the properties *physiological or behavioral* are treated as non-restrictions. With *every,* everything that was not initially treated as clearly necessary in the context, is treated as non-necessary (non-restriction). No further restrictions can be presupposed and be the basis for disregarding exceptions, if these exist. The Adaptionists, à la Pinker, simply didn't think of important distinctions like *complex* or *not complex,* while in fact only complex aspects have functions.

The same kind of switch in interpretation happens also in (15b), but this time it's the other way around: it is *any* that yields a stronger statement. With *every,* no 'new' property can be treated as necessary for membership in $[\text{match}]_c$. Only properties that were clearly treated as necessary for membership in $[\text{match}]_c$ in the first place are so regarded, and *dry* is naturally one of those necessary conditions for relevance in c. However, with *any* the properties *wet* and *dry* are treated as non-restrictions. The domain is widened along *dry* to include wet matches too. Because of this, the generalization *any match I strike lights* becomes false.

To sum up, the analysis presented predicts that *every, any* and generic *a* can appear in the very same contexts, but the use of *every* is always stronger (i.e. induces wider domains) than the use of *any* along every dimension, except for the dimension that *any* eliminates. Generic *a* and *any* are weaker (i.e. induce narrower, or more partially specified domains) than *every* along every dimension, except for the dimension that *any* eliminates. *Any* may induce widening of the domain (with respect to the domain of both *every* or *a*) along the eliminated dimension.

Operations upon clusters

The truth conditions of the universal statements in (16), given in (17), require that every potential duck (i.e. everything that is not yet known as a non-duck, but rather is either in $[duck]^+_c$ or in $[duck]^?_c$) lays eggs.

(16)a. *Every duck lays eggs*
b. *A duck lays eggs*
c. *Any duck lays eggs*

(17)a. $[16a]_c = 1$ iff: $\forall d \notin [\neg \text{duck}]_{\text{every(duck,c)}}$: $d \in [\text{lays eggs}]_{\text{every(duck,c)}}$
b. $[16b]_c = 1$ iff: $\forall d \notin [\neg \text{duck}]_{\text{a(duck,c)}}$: $d \in [\text{lays eggs}]_{\text{a(duck,c)}}$
c. $[16c]_c = 1$ iff: $\forall d \notin [\neg \text{duck}]_{\text{any(duck,c,Q)}}$: $d \in [\text{lays eggs}]_{\text{any(duck,c,Q)}}$

The sets [lays eggs] and [¬duck] are already restricted to <u>contextually</u> <u>relevant</u> entities.

In addition, these sets are not the directly given denotations ($[\text{lays eggs}]^+_c$ and $[\text{duck}]^-_c$, respectively), but rather the denotations indirectly extended on the basis of the clusters. The indirectly extended denotations are the sets of entities that belong in $[\text{lays eggs}]^+_t$ or $[\text{duck}]^-_t$ respectively, in every total extension t of c. The information in c allows no extension t in which these entities are added to $[\text{lays eggs}]^-_t$ or $[\text{duck}]^+_t$, respectively, i.e. these entities must be regarded as egg-layers or non-duck, respectively.

The additional, more interesting non-standard feature in (17), is that the use of a certain determiner moves the interpretation from the context of evaluation c to another context:

In (a), *every* is used, so we move from c to a context called $\text{every}_{(\text{duck,c})}$.

In (b), with the generic indefinite, we move to a context $\text{a}_{(\text{duck,c})}$.

In (c), *any* moves us to the context $\text{any}_{(\text{duck,c,Q})}$. Q is the dimension which *any* eliminates.

<u>What happens in each context?</u>

Consider context c_i. Let us assume that it is the context of evaluation. In $\mathbf{c_i}$, the property *bird* is necessary for duckhood, *healthy* is ordering ducks, and *small* is neither necessary nor ordering:

$MS^{+}_{(c,duck)} = \{bird\}$; $MS^{-}_{(c,duck)} = \{small\}$; $OS^{+}_{(c,duck)} = \{healthy\}$; $OS^{-}_{(c,duck)} = \{small\}$.

The crucial point is that some dimensions, for instance - *female,* are <u>unspecified</u> in the *duck* clusters. That means that *female* is still potentially necessary or stereotypical of ducks. Thus, duckhood of male birds is undetermined: if they don't lay eggs the statement $\forall d \notin [\neg duck]_{ci}$: $d \in [lays\ eggs]_{ci}$ <u>isn't necessarily false</u>. Maybe these males are not ducks.

<u>The use of *every*</u>

Now let us look at context $\mathbf{every_{(ci,duck)}}$ (= c_e). It is identical to c_i, except that <u>all unspecified properties become non- necessary</u>: all the predicates that can be generated in the language and are not in the positive clusters are added to the negative clusters. The negative cluster simply becomes the complement set of the positive one:

$MS^{-}_{(duck,ce)} = (A - MS^{+}_{(duck,ce)})$; $OS^{-}_{(duck,ce)} = (A - OS^{+}_{(duck,ce)})$.

Returning to our example, the property *female* is now specified in the negative clusters. Thus - male or female birds (that satisfy all necessary properties), become ducks. The unique membership dimension in c_i is *bird,* and since all male or female birds satisfy it, all of them become ducks. We cannot add more requirements in the context $every_{(ci,duck)}$. If some birds don't lay eggs, e.g. male birds, the statement $\forall d \notin [\neg duck]_{ce}$: $d \in [lays\ eggs]_{ce}$ is false, and hence the statement *every duck lays eggs* is <u>false</u> in c_i. No exception is tolerated. That is why this *every* statement is intuitively judged false.

Consider example (18), taken from the Kinneret Covenant:

(18) *<u>Every citizen</u> is a free person* (*Ha'aretz,* Friday 4.1.02, in the translation of "*The Kinneret Covenant*").

A relevant *citizen* in the context of the Kinneret Covenant is a *citizen of Israel*, not a citizen of the world, of USA, or so on. (18) may also be true for such citizens, or false for everyone, but that is irrelevant. The Kinneret Covenant is specifically <u>about</u> Israelis. Like other expressions, *every* refers to a contextually relevant set.

Now, if a property was not regarded as a necessary dimension of *citizen* in the context (like the properties: *female, male, Jewish, Muslim, old, young,* and so on), it clearly cannot be regarded as such after the use of *every.* The use of *every* implies that we refer to the largest denotation possible in the context.

In (12f), repeated below as (19), only *nutritional ingredients* are relevant. Thus, a hug is a not a relevant ingredient.

(19) *Materna Premium contains* <u>*all*</u>** the essential ingredients in mother's milk necessary for proper development. You just have to add a hug… (*Permitted for use).*

However, all the edible ingredients existing in mother's milk indeed are relevant, and if some of those constitute exceptions to the generalization they must be mentioned. Again, we see that the expected interpretation is such that the set of relevant *essential ingredients* is the largest possible, relative to the existing contextual restrictions.

In the following section I will argue exactly the opposite for context $\mathbf{a_{(ci,duck)}}$.

<u>The use of the indefinite determiner</u>

What happens in context $\mathbf{a_{(ci,duck)}}$ ($= c_a$)? One possible hypothesis is that the context $a_{(ci,duck)}$ is simply identical to context c_i, which is usually partial, and thus the clusters and denotations of *duck* are vague. This possibility makes sense, but let me suggest a stronger, more controversial hypothesis, and demonstrate its advantages.

The strong hypothesis is that context $\mathbf{a_{(ci,duck)}}$ is identical to c_i, except that <u>even non-necessary properties</u>, like say- *small* <u>become unspecified (i.e. potentially necessary</u>). Context $a_{(duck,ci)}$ is identical to c_i in every respect except that it is changed minimally, so as to allow every property be possibly necessary or stereotypical for duckhood. Thus, the negative clusters are emptied.

$MS^-_{(duck,ca)} = \varnothing$; $OS^-_{(duck,ca)} = \varnothing$.

As a result, even the non-membership dimension *small* becomes potentially necessary. Birds become potentially irrelevant, on the basis that they are not small, not female, and so on. If some of them do not lay eggs the statement $\forall d \notin [\neg duck]_{ca}: d \in [lays\ eggs]_{ca}$ is not necessarily false, and hence the statement *a duck lays eggs* is <u>not necessarily false</u> in c_i. So, basically, almost every exception can be tolerated (e.g. male birds).

Let me explain the idea with example (20):

(20)a. *Dogs bark.*
b. *A dog barks.*

Yael Greenberg (personal communication), argues that <u>Pragmatics</u> may specify some non-restrictions, i.e. properties that do <u>not</u> form a basis for regarding an exception as irrelevant (MS^- dimensions). (Greenberg is speaking in terms of restrictions on modal bases, but that doesn't matter for our purposes here). However, these non-restrictions are <u>highly context-dependent</u>, and easily <u>cancelable</u>. For instance, it is quite likely that genetic problems in leg function are not a basis for regarding exceptions (things that don't bark) as irrelevant to *dogs* in the context of utterance of (20). But of course, one could easily imagine the possibility that genetic problems in leg function might somehow be related to genetic problems in the vocal chords. In such a context, genetic problems in leg function would in fact form a basis for regarding a dog that doesn't bark as irrelevant.

Hence, we want the semantics to allow exceptions on every basis. Implications regarding certain things being non-restrictions are but a pragmatic enrichment, and are easily defeasible.

Even in definitional contexts like (21a) we don't have to assume that the semantics of *a bachelor* determines that every property is not-necessary (except for the property *never married* which is necessary), i.e. that all bachelors are relevant:

(21)a. *A bachelor is unmarried / Bachelors are unmarried.*
b. *Bachelors are happy.*

All bachelors are only potentially relevant. (21a) would be regarded as true even if all bachelors were relevant, simply because we all have the property *never married* specified in $MS^{+}_{(bachelor,c)}$ in every normal (literal) context. But discourse can extend to (21b) with more restrictions, and, it seems to me, without corrections. Bachelors that, say- are dying, are irrelevant. On the proposed analysis, we don't have to assume that they were initially regarded as relevant, and that discourse advances in a non-monotonic way such that they are removed from the denotation afterwards.

Note that, even if $[duck]^{+}_{ci}$ is not empty, it becomes empty in $a_{(duck,c)}$ (i.e. $[duck]^{+}_{a(duck,c)} = \emptyset$), so as to allow every property to be potentially necessary or stereotypical of ducks (*female, male, adult, not-adult,* etc.). In fact, intuitively, it is impossible to define the domain of the generic statement by pointing, without rendering the interpretation of the statement episodic. Even if an entity is directly given as a duck for previous purposes in the discourse, it is not necessarily relevant to a generic statement on ducks. It may well form an exception and be regarded as irrelevant for some reason or another (say, because it is too young a duck).

Note that if the domain is empty ($[P]^{+}_{c} = \emptyset$), the truth of a statement "*a P is Q"* is undetermined. Yet, intuitively, statements like *a duck lays eggs* are true, while statements like *a cow lays eggs* are false. Why? We do know that relevant cows or ducks may exist (these predicates are not inherently contradictory). In such total contexts the latter statement *a cow lays eggs* is false. Given that, nowadays, dimensions like *mammal* and *gives live birth* are likely to be specified in $MS^{+}_{(cow,c)}$ in most literal contexts, there is no way to settle the clusters of *cow* with *lays eggs,* without making the predicate *cow* contradictory. However, there *are* many ways to settle the clusters of *ducks* with *lays eggs*.

The last section relates to a more general idea that often appears in the literature about generic statements: the property *lays eggs* has to be "inherent" to *ducks*. In my theory, the cluster properties can yield a certain property "inherent", or at least very probable, given the cluster.

It is no wonder under the strong hypothesis, that a generic reading shows up with indefinites, and not with *every*. A generalization is likely to hold in every alternative of reality, only if exceptions are ignored. We know that in some easily imaginable alternatives there are sick exceptions, in others - young exceptions, etc. When *every* is used, none of these properties forms a basis for ignoring exceptions, and hence - the statement is false. Since universal quantification over alternatives is implicit, it simply doesn't appear when it induces false statements.

The contribution of Gen

Genericity is often represented by an implicit generic quantifier, Gen, which quantifies over alternatives of reality. The hard task is to determine the modal base relative to which a generic statement is interpreted, and the individuals that are relevant in each alternative of reality in the modal base. On the analysis proposed here, the idea would be that a generic generalization ought to hold only in those alternatives of reality that obey the linguistic definitions in c, i.e. the constraints on predicate denotations put by the cluster-properties in c. The clusters express the contextual content of the word, e.g. the relevant presuppositions in the intended meaning of *duck* in c_i. Intuitively, the generic statement *a duck lays eggs* is about the states of affairs in every alternative of reality in which the property *duck* refers to *females, water birds, of the family Anatidae,* and probably to *healthy adult* ones, and so on. The arbitrary facts, i.e. which individuals are members in these sets, may vary from one alternative to the other (and that is the source of the conditional entailments), but some inherent facts (the contextual linguistic content of *duck,* i.e. the positive cluster) ought to remain steady. This is hard to express unless clusters are explicitly assumed.

How do we formalize these intuitions? First note that total contexts in our information structure correspond to alternatives of reality, so we can make do with quantification over alternative total contexts t in T (T being the set of all possible contexts of total information), instead of quantification over worlds in W (the set of all possible worlds or alternatives of reality). Second, we are only interested in total contexts in which the positive clusters of predicates are identical to the positive clusters in c ($MS^{+}_{(P,c)}$, $OS^{+}_{(P,c)}$ for all P). Thus, we can express the contribution of Gen to the truth conditions of (16b) in the following way:

$[\text{Gen } \textit{a duck lays eggs}\ ]_c = 1$ iff:
$\forall t \in T$, such that : $(\forall P\text{: } MS^{+}_{(P,t)} = MS^{+}_{(P,c)} \text{ and } OS^{+}_{(P,t)} = OS^{+}_{(P,c)})$:
$\quad \forall d \notin [\neg \text{duck}]_{a(\text{duck},t)}\text{: } d \in [\text{lays eggs}]_{a(\text{duck},t)}$.

$[P]_{a(\text{duck},t)}$ is a partial specification of the denotation of P in t, just as $[P]_{a(\text{duck},c)}$ is a partial specification of the denotation of P in the real world w. $[P]_{a(\text{duck},t)}$ is the partial extension of P in context $a_{(\text{duck},t)}$ which is identical to t in every respect except that it is changed minimally, so as to allow every property be possibly necessary or stereotypical for P-hood (the directly given denotations and the negative clusters are empty).

These truth conditions require that every possible duck, in every extension in which being a *duck* presupposes whatever it presupposes in c (i.e. being *healthy*, a *water bird*, etc.), and *healthy* presupposes whatever it presupposes in c, and so on, - lays eggs.

These seem to be the desired truth conditions: the facts may vary to the extent that the relevant linguistic content (the clusters) allows. However, this is possibly reducible to the simple definition with which we started, particularly since the indirectly extended denotations of, say, *duck,* are usually empty anyway when almost every property is potentially necessary and stereotypical of *duck*. We only have to make it the case for every predicate P:

$[\textit{A duck lays eggs}\ ]_c = 1$ iff: $\forall d \notin [\neg \text{duck}]_{a(\text{duck},c)}\text{: } d \in [\text{lays eggs}]_{a(\text{duck},c)}$
(where $a_{(\text{duck},c)}$ is identical to c except in that it is changed minimally, so as to allow every property be possibly necessary or stereotypical: $MS^{-}_{(P,c)} = OS^{-}_{(P,c)} = \varnothing$, for all Ps).

Since predicate denotations are empty in $a_{(\text{duck},c)}$, every denotation that satisfies the positive membership constraints of a predicate is in fact the denotation of this predicate in some total context above c. The statement *a duck lays eggs* is necessarily true in c iff it is true in all the total extensions of c (i.e. iff information can not coherently extend in such a way that this statement would be found false). Thus, the effect contributed by quantification on the relevant worlds (or total states) is already achieved. The truth conditions require that every possible duck, in every extension in which being a *duck* presupposes being a *healthy*, *water bird*, etc., and *healthy* presupposes whatever it presupposes in c, and so on, lay eggs.

I, therefore, have to assume that $a_{(duck,c)}$ is identical to c in every respect except that it is changed minimally, so as to allow every property be possibly necessary or stereotypical for P-hood, for <u>all Ps</u> (all the directly given denotations and all the negative clusters are empty). This assumption is supported by the fact that, as demonstrated, the interpretation of every predicate influences the interpretation of *duck* (since every predicate is a potential dimension of *duck*).

Note, finally, that a generic statement *a P is Q* may be interpreted relative to a context of evaluation which is more specified than $a_{(c,P)}$, if some (potentially cancelable) pragmatic enrichment is given. I.e. an addressee, trying to determine the truth of a generic statement, may accommodate his or her information in such a way that the truth of the generic statement will be examined only in a subset of the total contexts described above. For example, being a cooperative addressee, he or she will try to accommodate the information in a way that will make the generic statement true. But not every accommodation is possible. I elaborate on this in the last sub-section of this paper.

<u>The indefinite determiner in existential statements</u>

Prince 1979 observes that the indefinite article, in examples like (22a), helps <u>present a new entity</u> – a girl – to the discourse.

(22)a. *A girl came in*
b. *She said…/ The girl said…*

In the context of utterance of (22a), we don't expect to hear what girls can or cannot be (i.e. which properties are contextually presupposed to be non-necessary or non- stereotypical of girls). We need to know just what girls must be or stereotypically are. Only that helps us identify the new discourse entity. So, practically, only the positive clusters (MS^+, OS^+) matter.

Moreover, we may want to be able to restrict the set of girls so as to make this girl the unique relevant girl like in (22b), i.e. such that some accidental properties identifying that girl are necessary. For this purpose, we need to start with an empty MS^-, with which everything is potentially necessary.

That is just what the indefinite determiner gives us. (22a) is an introduction of a discourse entity, by means that presuppose that bringing about the positive cluster of properties of *girl* is the most effective practical way to describe this entity. In order to see whether this idea is correct it has to be formulated within a dynamic theory. I leave this for future research.

<u>Some more arguments</u>

The data in (23) demonstrates the fact that the use of the adverb <u>*almost*</u> is not felicitous with the indefinite article:

(23)a. *Almost every owl hunts mice.*
b. *Almost any owl hunts mice.*
c. * *Almost an owl hunts mice.*

This is directly accounted for because *almost,* as a mean of weakening universal statements, is superfluous when every exception, along every dimension, is already allowed (for more details see Kadmon and Landman 1993).

The data in (24) demonstrates the fact that the use of <u>unrestricted predicates</u> like *one, body, thing* and so on, is not felicitous with the indefinite article:

(24)a. *everyone, everywhere, anybody, anything …*
b. ** a one, *a where, *a body…*

These predicates have almost every property specified in their negative clusters (MS-,OS-). As such, naturally, they don't combine well with the indefinite, that eliminates every property from these sets.

In statement (25) the indefinite is felicitous with the unrestricted predicate *thing,* only because it receives a free-choice interpretation, like free choice *any*, which assumes that some properties are specified in the negative clusters (as demonstrated in the following section).

(25) *I didn't see a thing*

<u>The use of *any*</u>

Kadmon and Landman 1993 have argued that ***any*** is similar to the generic indefinite in being vague. However, *any* <u>widens the domain</u>, by the <u>elimination of some specific contextually determined restriction</u> (which becomes a non-restriction), and hence the statement strengthens. *Any* occurs only when <u>widening induces strengthening</u>.

For instance, in (13) repeated below as (26), *any* eliminates the restriction *healthy,* which was initially regarded as necessary for owlhood:

(26) *You say that a healthy owl hunts mice? <u>any</u> owl hunts mice.*

The property *healthy* is now specified as non-necessary (in $MS^{-}_{(owl,any(c,owl,healthy))}$). As a result, the domain <u>widens</u>: the generalization applies to both sick and healthy entities. This generalization is <u>stronger</u>. It is harder to satisfy (more facts need to hold).

However, widening won't do when the domain is pre-determined, and thus cannot be widened, like in the examples in (27):

(27)a. *Just hand me any (one) of <u>those ten bottles</u>*
b. *You didn't take a picture of any of <u>your ducks</u>*
c. *Any of the videos <u>in my store</u> will please you.*
d. *I can easily recite any of <u>exactly 15</u> poems.*
e. *I can easily recite any of <u>only 15</u> poems.*

In (27a) the domain includes ten items; in (27b) with polarity sensitive *any,* the domain is predetermined by an ownership relation, which is explicitly expressed by the term *your ducks,* and the same occurs in (27c) with free choice *any.* We refer here to very specific finite sets of objects. Widening cannot work. In (27d)-(27e) we see that *any* can even occur with a phrase modified by *exactly* and *only*.

Furthermore, widening can't exhaust the contribution of *any* to meaning of statements. For instance, sometimes *any* eliminates ordering, rather than creates widening.

Consider the examples in (28):

(28)a. A: *Do you have some socks to lend me?*
B: *Yes, do you prefer socks like those you usually wear?* (say: warmer socks)
A: *No, any socks (you have) will do.*
b. *Do you have some socks to lend me? any sock would help. (dry/wet)*

A sock that is more dry, or appropriate to the weather, or fashionable, or clean, or so on, is a more relevant sock to lend. Such properties order socks on a scale of relevance. *Any* here may simply eliminate this ordering. The natural interpretation of *any* in these statements is: forget about the usual preferences of more stereotypical socks; all socks are equally good for me at the moment.

Hence, in my analysis, ***any*** may also treat some dimension as non-ordering (for instance, in the *duck* example given in (27b) *any* may eliminate *healthy* from $OS^+_{(duck,c)}$ and specify it in $OS^-_{(duck,\ any(c,duck,healthy))}$. In (28) *any* eliminates *dry* from $OS^+_{(sock\ to\ lend,c)}$ and specifies it in $OS^-_{(sock\ to\ lend,\ any(c,sock\ to\ lend,dry))}$).

What is the effect of such elimination?

Usually, more stereotypical items are more highly expected to satisfy generalizations or requests. If sickness doesn't reduce stereotypicality, then sick exceptions become more stereotypical, and hence more serious exceptions. I.e. if some sick duck doesn't lay eggs it cannot be regarded less relevant (and hence be ignored 'pragmatically'), on the basis of being sick.

Formally, if sick and healthy ducks are regarded as equally relevant ducks, then (it follows from section 2 in the model that) they become ducks together (on the same partial extension), or in other words, healthy ones do not become ducks first. The *duck* denotation in **any$_{(ci,duck,healthy)}$ homogenizes** (rather than widens) along *healthy*.

In my MA thesis I give detailed illustrations of the way homogenizing induces strengthening. In general, widening occurs, but somewhere above or under the context of evaluation, not necessarily in the context of evaluation. Strengthening is defined after Kadmon & Landman 1993 (see detailed explanations therein):

Strengthening: a statement with *any* (S_{any}) is stronger than without *any* (S) iff:

For every model M and context c: 1. If $[S_{any}]_{c,M} = 1$ then $[S]_{c,M} = 1$ and

2. If $[S]_{c,M} = 0$ then $[S_{any}]_{c,M} = 0$

But not vice versa: for some model M and context c: $[S]_{c,M} = 1$ and $[S_{any}]_{c,M} = 0$.

How does homogenizing induce strengthening?

Assume that the property *healthy* orders ducks in c_i (i.e. *healthy*$\in OS^+_{(duck,ci)}$). That means that healthy entities are better ducks than similar sick ones. Thus, in some context c* under or above c_i sick entities are not yet ducks but similar healthy ones are already ducks, and that is crucial.

For example, assume that d_1 and d_2 are equal in all other respects except that only d_1 is healthy and lays eggs. Thus, d_1 is a better example of *duck* in c_i. In some context c* under or above c_i d_1 is already in $[\text{duck}]^{+}_{c*}$, but d_2 is still in the gap $[\text{duck}]^{?}_{c*}$. In some extension t* of c* d_2 and similar ducks are specified in $[\text{duck}]^{-}_{t*}$. The statement without *any* $\forall d\notin[\neg\text{duck}]_{t*}$: $d\in[\text{lays eggs}]_{t*}$ is true in t* even if some sick entity like d_2 doesn't lay eggs (it is not relevant). But *any* cancels this ordering along *healthy*. *Any* moves us to the context of evaluation $\text{any}_{(\text{duck},t^*,\text{healthy})}$ in which *healthy* doesn't order ducks. Sick and healthy entities are equally good ducks. Both d_1 and d_2 are ducks. Since d_2 doesn't lay eggs the statement with *any* $\forall d\notin[\neg\text{duck}]_{\text{any}(t^*,\text{duck},\text{healthy})}$: $d\in[\text{lays eggs}]_{\text{any}(t^*,\text{duck},\text{healthy})}$ is necessarily false, and hence the statement *any ducks lays eggs* is necessarily false in t^*.

We have a context t* in which: $[S]_{t*,M} = 1$ and $[S_{\text{any}}]_{t*,M} = 0$, and not vice versa (for every c, if $[S_{any}] = 1$ in c, then sick and healthy ducks lay eggs. Hence: necessarily: $[S]_c = 1$ too). Thus S_{any} is actually stronger.

Widening occurred in contexts t^* and c* (the latter being under or above the context of evaluation). It does not have to occur in the context of evaluation itself. Widening is less extensional than assumed by Kadmon and Landman.

I would like to present additional evidence in favor of my analysis. On this analysis *any* is predominantly a dimension eliminator, so that *homogenizing* rather than *widening* may occur. When *homogenizing* occurs ordering is removed by *any*. If this in fact occurs, we should expect that adding the ordering back would be incoherent. This in fact seems to be the case, as demonstrated in examples (29b)-(31b):

(29)a. *I rarely watch movies. Especially (not) long ones.* (Ordering along *long*: √)
b. *I rarely watch <u>any</u> movies. # Especially (not) long ones.* (Ordering along *long*: #)
(30)a. *Could you take a picture of one of those ducks? Try to pick a healthy one.*
(Ordering along *healthy*: √)
b. *Could you take a picture of <u>any</u> (one) of those ducks? # Try to pick a healthy one.*
(Ordering along *healthy*: #)
(31)a. *Could you hand me one of those bottles? Try to make it a small one.*
(Ordering along *small*: √)
b. *Could you hand me <u>any</u> (one) of those bottles? # Try to make it a small one.*
(Ordering along *small*: #)

As seen, with *any* the speaker cannot assume ordering along the dimension that is being eliminated. With the indefinite determiner, on the other hand, the speaker can assume ordering almost along every dimension.

Yet another effect may occur when *any* eliminates <u>unspecified</u> dimensions. In such a case the elimination induced by *any* just **clarifies** what the domain is. For instance in the context of the utterance of (32) it is reasonable to assume that the properties *large* and *small* were not specified in the clusters of *bottle.* The use of *any* implies, as always, that these properties ought to be regarded as non-restrictions (specified in MS^- and OS^- of *bottle*):

(32)A: *Hand me a bottle.*
B: *A large one or a small one?*
A: *Just hand me any (one) of those ten bottles.*

In conclusion, **elimination of dimensions**, rather than widening, is *any*'s basic function in all its occurrences. The effects of dimension elimination include **widening**, **homogenizing** and **clarifying**, depending on whether the eliminated dimension was initially treated as necessary for membership in the denotation of the predicate forming the first argument of *any*, stereotypical of the entities falling under this predicate, or unspecified in its clusters, respectively.

Ordering dimensions and Judgments of truth values

I have argued that a cooperative addressee may try to accommodate his or her information in a way that will make a generic statement *a P is Q* end up true. This addressee would try to imagine $a_{(c,P)}$ with some pragmatic enrichment, i.e. an extension of $a_{(c,P)}$ above which all relevant Ps are always Qs. The analysis presented here predicts that this is possible (i.e. one can imagine that all relevant Ps are Qs) only if Q may be taken to be stereotypical of P. Why? If Q is stereotypical of P, then the following facts follow from constraints (2)-(3) in the dimension model:

1. If some non-Q entity is regarded as P, then entities that are equal to it in all other respects except that they are Qs are definitely regarded as Ps.
2. If some Q entity is regarded as non-P, then entities that are equal to it in all other respects except that they are non-Qs are definitely regarded as non-Ps.

In such states of affairs the cooperative addressee can easily accommodate the interpretation of P such that only the most typical entities are regarded as relevant. Given this accommodation, the generalization Q applies.

If Q is not stereotypical of P this becomes impossible to do, since in every context under and above the context of evaluation, Q and non-Q entities, similar in all other respects, are in or out of the denotation of P together.

This stands for speakers' intuitions that statements like (22a) are true and statements like (22b) are false (Cohen 1999):

(22)a. *The Frenchmen eat horsemeat*
b. *Bees are sexually sterile*

Statement (22a) is regarded as true because eating horsemeat can be taken to be stereotypical of Frenchmen. If we ignore atypical entities (that is, if we regard them as contextually irrelevant Frenchmen) (22a) would be true. The statement may be judged true even if very few perfectly stereotypical entities (i.e. entities that eat horsemeat) exist. It is only crucial that these entities are taken to be more stereotypical than identical individuals that do not eat horsemeat.

Statement (22b) is regarded as false because only workers are sexually sterile, and being a worker is not taken as a property that raises the stereotypicality of bees. At least out of the blue, workers and non-workers are taken to be equally stereotypical.

Returning to our duck example, the proclamation is usually regarded as true, since when ducks' reproduction habits are under discussion, one can easily take adult female ducks to be more relevant than male ducks, or than very young or very old female ducks. In other words, it is easy to take ducks that lay eggs as more stereotypical than similar ducks that do not lay eggs. Only if Q is necessarily taken to be a non-ordering property does the accommodation become impossible. This is why certain researchers (as described in Cohen 1999) have argued that a true generic sentence corresponds to a cultural convention, i.e. a stereotype. However, note that the truth of the Q generalization can sometimes be due to empirical reasons. Sometimes Q is not a membership or an ordering dimension of P (though it could have been), but it so happens that only Qs can satisfy all the properties in $MS^{+}_{(P,c)}$.

This is but one illustration of the role of stereotypes in semantic analysis. I hope to have shown that the idea of clusters in predicate interpretation is needed and fruitful.

I have added two appendices, one with a complete formal representation of the dimension-model, and another with a simple example of a dimension-model with four predicates and three individuals, with which the interested reader can further check how things work.

Appendix 1: The dimension model, formal representation

Let A be a set of predicates in the object language, and A* the closure of A (i.e. the set of predicates that can be generated from the predicates in A by the linguistic operations). Let D be the domain of possible individuals.

A **dimension model** for A is a tuple $M = \langle C, \leq_A, c_0, T, I_A \rangle$ such that:

1. M is an **information structure** for A, i.e.:

1. C is a set of information states (contexts)
2. $\leq_A$ is a partial order on C (a meet semi lattice)
3. c_0 is the minimal element and T is the set of maximal elements of C under $\leq_A$
4. Every context c in C has some maximal extension: $\forall c \in C, \exists t \in T: c \leq_A t$.

2. I_A is an **interpretation function** for A, a function which maps every $P \in A$ and $c \in C$ onto a tuple $\langle [P]^+_c, [P]^-_c, MS^+_{(P,c)}, MS^-_{(P,c)}, OS^+_{(P,c)}, OS^-_{(P,c)} \rangle$ satisfying the conditions below:

1. Coherence:

$$\forall P \in A, \forall c \in C: ([P]^+_c \cap [P]^-_c = \varnothing) \text{ and } (MS^+_{(P,c)} \cap MS^-_{(P,c)} = \varnothing) \text{ and } (OS^+_{(P,c)} \cap OS^-_{(P,c)} = \varnothing)$$
$$([P]^+_c, [P]^-_c \subseteq D) \text{ and } (MS^+_{(P,c)}, MS^-_{(P,c)} \subseteq A^*) \text{ and } (OS^+_{(P,c)}, OS^-_{(P,c)} \subseteq A^*)$$

2. Monotonic growth of information:

$\forall c_1, c_2 \in C$: If $(c_1 \leq_A c_2)$

$$\text{Then: } \forall P \in A: ([P]^+_{c1} \subseteq [P]^+_{c2}) \text{ and } (MS^+_{(P,c1)} \subseteq MS^+_{(P,c2)}) \text{ and } (OS^+_{(P,c1)} \subseteq OS^+_{(P,c2)}).$$
$$([P]^-_{c1} \subseteq [P]^-_{c2}) \text{ and } (MS^-_{(P,c1)} \subseteq MS^-_{(P,c2)}) \text{ and } (OS^-_{(P,c1)} \subseteq OS^-_{(P,c2)}).$$

3. Minimal information:

$$\forall P \in A: [P]^+_{c0} = [P]^-_{c0} = MS^+_{(P,c0)} = MS^-_{(P,c0)} = OS^+_{(P,c0)} = OS^-_{(P,c0)} = \varnothing$$

4. Total information:

Every $t \in T$ is total in M (i.e. is totally complete relative to A), i.e.:

$$\forall t \in T, \forall P \in A: ([P]^+_t \cup [P]^-_t = D) \text{ and } (MS^+_{(P,t)} \cup MS^-_{(P,t)} = A^*) \text{ and } (OS^+_{(P,t)} \cup OS^-_{(P,t)} = A^*)$$

3. The interpretation constraint (constraints on membership and ordering):

$\forall t \in T, \forall P \in A$:

1. $[P]^+_t = \{d \mid \forall Q \in MS^+_{(P,t)}: d \in [Q]^+_t\}$ (membership dimensions are necessary for P-hood)

2.a. $[\leq P]^+_t = \{\langle d_1, d_2 \rangle \mid \forall c \in C, c \leq t$: (if $d_1 \in [P]^+_c$ then $d_2 \in [P]^+_c$) and (if $d_2 \in [P]^-_c$ then $d_1 \in [P]^-_c$) $\}$

(an ordering relation relative to P, $\leq_{(P,c)}$, is the order in which individuals are learned to be P).

b. $[=P]^+_t = \{\langle d_1, d_2 \rangle \mid \langle d_2, d_1 \rangle, \langle d_1, d_2 \rangle \in [\leq P]^+_t\}$.

3.a. $[\leq P]^+_t \supseteq \{\langle d_1, d_2 \rangle \mid \forall Q \in OS^+_{(P,t)}, \langle d_1, d_2 \rangle \in [\leq Q]^+_t\}$.

b. $[<P]^+_t \supseteq \{\langle d_1, d_2 \rangle \mid \forall Q \in OS^+_{(P,t)}, \langle d_1, d_2 \rangle \in [\leq Q]^+_t$ and $\exists Q \in OS^+_{(P,t)}, \langle d_1, d_2 \rangle \in [<Q]^+_t\}$.

(ordering relative to the ordering dimensions is necessary for ordering relative to P)

(Because of monotonicity, the facts in every c in C are necessarily consistent with 1-3).

4. Indirectly extended information:

$\forall P \in A^*, \forall c \in C$: 1. $[P]_c = \cap\{[P]^+_t \mid t \in T \;\&\; t \geq c\}$ (an indirectly extended positive denotation).

2. $[\neg P]_c = \cap\{[P]^-_t \mid t \in T \;\&\; t \geq c\}$ (an indirectly extended negative denotation).

3. $[P]^?_c = D - ([P]_c \cup [\neg P]_c)$ (an indirectly reduced gap).

(The semantics is three-valued. See Van Fraassen 1969, Landman 1991).

Appendix 2: A detailed example

Let us assume the following:

1. A = {*duck, healthy, adult, lays eggs*} and D = $\{d_1,d_2,d_3\}$.
2. It is contextually given that: d_1 is a healthy adult, d_2 an unhealthy adult, and d_3 a healthy non-adult. d_1 and d_2 are on the same age.
   I.e. $[healthy]^{+}_{c}=\{d_1,d_3\}$; $[healthy]^{-}_{c}=\{d_2\}$;
   $[adult]^{+}_{c}=\{d_1,d_2\}$; $[adult]^{-}_{c}=\{d_3\}$; $d_2 =_{(adult,c)} d_1$).
3. $MS^{+}_{(duck,c)} = \{\}$;
   $MS^{-}_{(duck,c)}$ = {*healthy, not healthy, not adult, lays eggs, not: lays eggs*}
   (*adult* is unspecified)
   $OS^{+}_{(duck,c)}$ = {*healthy, adult*};
   $OS^{-}_{(duck,c)}$ = {*not healthy, not adult, lays eggs, not: lays eggs*}.

Facts (indirectly extended information):

1. $[duck]_c = \{d_1,d_2\}$ (there is no way to complete the information in c such that d_1,d_2 are not ducks. There is no potential MS^{+} dimension that they violate).
2. $d_2 \leq_{(duck,c)} d_1$ (d_1 is a better example of a duck than d_2, since d_1 is healthier).
3. $[duck]_{every(c,duck)} = \{d_1,d_2,d_3\}$ (*adult* is added (with all A*) to $MS^{-}_{(duck,ec)}$, so d_3 is necessarily a duck).
4. $[duck]_{a(c,duck)} = \{\}$ ($MS^{-}_{(duck,ac)}$ is empty, so no individual is necessarily a duck. However, since *healthy* and *adult* are ordering the ducks, d_1 is still the best on the *duck* scale. It is a duck in every extension with ducks, and of the ducks in those extensions that don't lay eggs, it is the most serious exception).
5. $[duck]_{any(c,duck,healthy)} = \{d_1,d_2\}$ (*healthy* is added to $MS^{-}_{(duck,anyc)}$; *non-adult* can not be in $MS^{+}_{(duck,anyc)}$, (it is not consistent with *adult* being in $OS^{+}_{(duck,anyc)}$). *lay eggs* and *not*: *lay eggs* are regarded as non-restrictions, in order not to beg the question (i.e. not to make *lays eggs* true of *duck* "by definition", but rather – a possible empirical fact). So only d_1,d_2 must be ducks).
6. $d_2 =_{(duck,anyc)} d_1$ (d_1,d_2 are equally good examples of ducks, since *healthy* is added to $OS^{-}_{(anyc,duck)}$).
7. If *healthy* is in $MS^{+}_{(duck,c)}$ in the first place, $[duck]_c = \{d_1\}$, and $[duck]_{any(c,duck,healthy)} = \{d_1,d_2\}$.
8. If *adult* is in $MS^{-}_{(duck,c)}$ in the first place and $[duck]^{+}_{c} = \{d_1,d_2,d_3\}$, *any* only induces homogenization of the domain.

References

Bartsch, Renate (1986) "Context dependent interpretations of lexical items" in Jeroen Groenendijk, Dick de Jongh, Martin Stokhof (eds.), (1986), *Foundations of Pragmatics and Lexical semantics*, GRASS 7, Foris, Dordrecht.

Bartsch, Renate (1984) "The structure of word meanings: Polysemy, Metaphor, Metonymy" in Landman Fred and Veltman Frank (Eds.), (1984), *Varieties of Formal semantics*, GRASS 3, Foris, Dordrecht.

Bartsch, Renate, (1998), *Dynamic Conceptual Semantics*, CSLI publications, Leland Stanford Junior University, U.S.A.

Bookheimer, Susan, (2002), "Functional MRI of Language: new approaches to understanding the cortical organization of semantic processing", in: Annual review of Neuroscience 25, pp. 88-151.

Carlso, Gregory, (1977), Reference to kinds in English, Doctoral dissertation, University of Massachusetts, Amherst (also published in 1980, New York, Garland).

Cohen Ariel, 1999, *Think Generic!,* CSLI-publications, Stanford, California.

Dayal, Veneeta, (1998), "Any as inherently modal" in *Linguistics and Philosophy* 21, PP. 433-476.

Fodor, Jerry A. & Jerrold J. Katz, (1963), "The structure of a semantic theory", in: *Language,* Vol. 39 (april-june 1963), PP. 170-210. Reprinted in: Fodor, Jerry A. & Jerrold J. Katz, (1964), *The Structure of Language,* Prentice-Hall, Englewood Cliffs, New Jersey.

Jackendoff, Ray S., (1972), *Semantic Interpretation in Generative Grammar,* MIT Press, Cambridge, Massachusetts.

Kadmon, Nirit, and Fred Landman, (1993), 'Any', in *Linguistics and Philosophy* 16, PP 353-422.

Kadmon, Nirit and Fred Landman, (1989), 'Polarity sensitive *any* and Free choice *any'*, in Stokhof and Torenvliet (Eds.), *Proceedings of the Seventh Amsterdam Colloquium*, ITLI publication, University of Amsterdam.

Kamp, Hans, (1975), "Two theories about adjectives", in: E.L.Keenan (Ed.), *Formal Semantics of Natural Language,* PP. 123-55. Cambridge University Press, Cambridge.

Katz, Jerrold J. & Paul M. Postal, (1964), *An Integrated Theory of Linguistic Description,* PP. 12-29, The MIT Press, Cambridge.

Keil Frank, (1979), *Semantic and Conceptual Development – An Ontological Perspective,* Harvard University Press, Cambridge, MA.

Kripke, S.A., (1972), "Naming and necessity", in G.Harman and D.Davidson (Eds.), *Semantics of Natural Language,* Kluwer, Dordrecht.

Ladusaw, William Allen, (1979), *Polarity Sensitivity as Inherent Scope Relations*, Ph.D. Dissertation, University of Texas, Garland, New York.

Landman, Fred, (1989), "Groups II" in *Linguistics and Philosophy* 12, (1989), PP. 723-744, Netherlands.

Lasersohn, Peter, (1998), "Pragmatic Halos", ms, University of Illinois.

Lewis, David, (1970), "General Semantics" in *Synthese* 22, PP. 18-67. Reprinted in D.K. Lewis, (1983), *Philosophical Papers*, Vol. 1, PP. 189-229, Oxford University Press, New York.

Lewis, David, (1979), "Scorekeeping in a Language Game" in *Journal of Philosophical Logic* 8, PP. 339-59. Reprinted in D.K. Lewis, (1983), *Philosophical Papers,* Vol. 1, PP. 233-49, Oxford University Press, New York.

Osherson, D.N. and E.E. Smith, (1981) On the adequacy of prototype theory as a theory of concepts, in *cognition* 11, pp. 237-262.

Partee, Barbara and Hans Kamp, (1995), "Prototype Theory and Compositionality" in *Cognition* 57, (1995), PP. 129-191.

Prince, Ellen F., (1979), "On the given/ new distinction", University of Pennsylvania, in *CLS,* Vol. 15.

Putnam, H., (1975), "The meaning of 'meaning'", in Keith Gunerson (Ed.), *Minnesota Studies in the Philosophy of Science,* Vol. VII, University of Minnesota Press, Minneapolis.

Reed, Stephen K., (1988), *Cognition, Theory and Applications,* Second edition, Brooks/Cole, Pacific Grove.

Rosch Eleanor, (1978) "Principles of categorization", in Rosch & B.B.Lloyd (Eds.), *Cognition and Categorization*, N.J. Erlbaum, Hillsdale.

Searle, John R., (1958), "Proper names", *Mind* 67, PP. 166-73.

Smith, Edward E., (1988), "Concepts and thought" in *The Psychology of Human Thought,* Cambridge University Press.

Veltman Frank, (1984), "Data semantics" in Jeroen Groenendijk & Theo M.V.Janssen & Martin Stokhof, (Eds.), *Truth, interpretation and information* Proceedings of the third Amsterdam colloquium, PP. 43-63.

Venneman, Theo & R. Bartsch, (1972), *Semantic Structures*, PP. 47-86, Anthenäum Verlag, Frankfurt.

Wittgenstein, Ludwig, (1953), *Philosophical Investigations,* translated by G.E.M Anscombe, third edition, (1968), B.Blackwell, Oxford.

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