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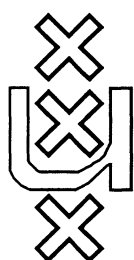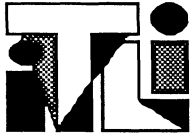
THE CONSTRUCTION OF PROPERTIES UNDER PERSPECTIVES

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Adjectives express properties, is the traditional opinion, be it properties an individual has itself (absolute properties) or properties that it has only in relation to others (relative properties or relations). I shall show in this paper that most properties are not expressed by adjectives, rather they are denoted by them in, what I call "thematic dimensions". Properties are expressed by thematic dimensions and adjectives together. Adjectives can be used in predicative, adnominal, adverbial, or adsentential position and function. Besides elaborating the notion of 'thematic dimension' and explaining the relationship between properties and these dimensions, an aim of this paper is to assign suitable semantic types to adjectives and the 'thematic dimensions' they are used in. These serve for forming conjunctions and other combinations of thematic dimensions, and for forming conjunctions of expressions in several categories. These operations form the basis for the construction of properties under perspectives, i.e. in thematic dimensions.

1. Thematic Dimensions and context dependent interpretation of adjectives

Not all adjectives express properties but there is a common semantic characterization of adjectives, namely as functions which map thematic dimensions onto properties. *Thematic dimensions* are aspects of the context in which predications of adjectives have to be understood. Adjectives indicate specifications within these dimensions. Thematic dimensions can be more or less precise in providing the perspectives which are relevant for the interpretation of adjectives. A dimension can extensionally be understood as a set of properties. Those properties that are situated within one dimension have the dimension as a common presupposed semantic marker, or in other words: contain the dimension as a presupposed perspective which makes possible the predication of these properties. But this containment of a dimension in a property is different from the way a superordinated concept is contained in a subordinated one, though also these thematic dimensions are given by explicit or implicit questions which a text is supposed to answer. Let us first consider a case of superordination.

A question like "What is this grey thing over there?" restricts the realm of answers to those

referring to grey things: the concept 'grey thing' will be presupposed in all the answers, except if a correction is made, like "it is not grey, it is brown"; but otherwise the answers like "a cat" or " a handbag", or "it is not a handbag but a cat" all presuppose the property "grey thing" as being true of all the things referred to in the answer. These may be grey cats, grey handbags, or whatever grey that may be at the place indicated. In the context of this question, the concept "grey thing" is superordinated to the concepts GREY CAT, GREY HANDBAG, etc, which are expressed by just the nouns *cat, handbag*, etc. These nouns are interpreted with respect to the domain of grey things in the answers *a cat, a handbag*, or whatever. Likewise, when we ask "How is John's health?" , the answer "bad" will be interpreted as John being in bad health. Dimensions, like HEALTH are domains of interpretation for adjectives. The answer "bad" does not simply express a property BAD, rather the property BAD WITH RESPECT TO HEALTH, which is expressed by the adjective *sick*. The relationship between the thematic dimension HEALTH and the property BAD WITH RESPECT TO HEALTH is not one of super-ordination in the sense of a hierarchy of broader and narrower concepts (which are all of the same order), but one of hierarchy in terms of different order: SICK ist a health-property, like RED is a colour-property. This means that the dimension HEALTH and the dimension COLOUR are the set of all health-properties, and the set of all colours, respectively. In the course of this paper, I shall treat all properties on a type-level that makes them to be of the same type as thematic dimensions. Within these dimensions, they will be treated as subsets consisting of just a single property, and then the relationship between a thematic dimension and such a lifted property contained in it is formally exactly like in the first example, namely one of superordination in a hierarchy between semantic 'entities' of the same order, though the whole relationship takes place on a higher level.

Not all properties are directly expressed by adjectives, but those adjectives which express properties, like *sick, 3 miles long, 5 feet tall, red*, are marked semantically for their dimension, HEALTH, LENGTH, HEIGHT, COLOUR, and are thus interpretable in a context-independent way. They can only be used in one single dimension which means that they are *stable characters* in the sense of Kaplan (1979), who formulated a theory of indexical interpretation for demonstratives. This approach can be extended to other kinds of words. Stable characters cannot be used in another dimension than the one for which they are semantically marked, except in a metaphoric way. If metaphoric use happens repeatedly for a property expressing adjective and extends over several dimensions, we get a metaphorically initiated broadening of its meaning, whereby the specific dimension is elimited from its content; and it thus becomes unstable, i.e. becomes a function from dimensions to properties. Different from concept broadening, metaphorical extension of the use of an adjective is an extension over several dimensions, which means that it becomes polysemic: For each dimension it indicates another concept (or, as I shall point out later, another equivalence class of concepts if the dimension is not fully precise with respect to the meaning of the adjective).

Those adjectives that can be used in several dimensions do not express properties, rather contents that together with a dimension make up a property. Therefore they express a property only in a context, but not by themselves. These adjectives, by themselves, are dimensionally not determined or they are underdetermined. I also call them *dimensionally weakly determined adjectives*. Examples are *good, strong, much, satisfactory, big, great* and their antonyms, and especially the Dutch adjective *flink*, which has been treated extensively in Bartsch 1986. To be able to interpret these adjectives one has to know under which perspective they are used in the respective situations: *good, well, strong, weak satisfactory, great under which aspect?* Some of them have, if no dimension is indicated, a (linguistically) 'unmarked' meaning, such as *good* as morally good, *strong* as physically strong, *big* as big in length and width; and this is the case as long as nothing in the context is contrary to this assumption. In these situations of use they express properties relative to the "unmarkedly" presupposed dimension. In all other cases they are functions from contexts to different contents, here properties, and are thus generally "characters" in the sense of Kaplan 1978[1]. I shall use the name "pre-property" for the functions from contexts to properties.

A dimension is fully precise with respect to a pre-property, if and only if the pre-property assigns in the dimension exactly one property. Otherwise, if it assigns a class containing more than one property, further specification is possible in order for the pre-property to assign a property.

Sometimes several steps of specification are necessary to get from a pre-property to a property. In the sentence *John is good in swimming*, the predicate *good in swimming* can mean different things GOOD IN SWIMMING AS FAR AS SPEED IS CONCERNED, or GOOD IN SWIMMING AS FAR AS STYLE IS CONCERNED, or GOOD IN SWIMMMING AS FAR AS ENDURANCE IS CONCERNED, or it can mean some of these or all of these together. We can interpret *good in swimming* as a property, namely as GOOD IN SWIMMING UNDER AT LEAST ONE OF THE RELEVANT ASPECTS, or if speed generally is taken to be presupposed as the most important aspect, it can mean GOOD IN SWIMMING AS FAR AS SPEED IS CONCERNED. But we also can take *good in swimming* to be a pre-property, which is more specific than the pre-property GOOD, but which has still to be applied to another thematic dimension in order to yield the property predicated about John. Thus, a pre-property can be a function from a thematic dimension to a more specific pre-property, which, in a special case can be stable, i.e. can be a property, which is a pre-property in which a maximally precise dimension is included. A pre-property can extensionally be understood as an equivalence class of properties,

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[1]Kaplan mainly deals with pronouns and other indexical expressions, which express functions from contexts to entities, but he introduces the notion 'character' in a general way as function from contexts to contents (i.e. from contexts to intensions). Those characters that give the same value for all contexts, i.e. are independent from any particular context, are called stable.

namely as the set of all the properties it assigns in all the different dimensions.

The notion of context is broad, in one way because it comprises linguistic and situational context. I refer to both. In another way it is broad, because it comprises different context properties. Here I shall restrict myself to one kind of context properties which I call 'thematic dimensions', extending the notion of 'dimension' which we know from spatial and temporal specifications of entities. Thematic dimensions can be differentiated into finer grained dimensions by additional perspectives and aspects, some of which are contained in the lexical semantics of nouns that are used to describe the entities about which the adjectives are predicated. In this way we have more general and more specific dimensions in which properties can be located. Other than space and time dimensions, thematic dimensions are intentional dimensions. An object or event can be determined with regard to its location in space and time: it can be projected onto space and time coordinates, i.e. it has its space and time projections. Likewise it can also be determined with regard to thematic dimensions: what is the situation of John, for example, from the point of view of health, financially, socially, what is his way of dressing, living, thinking, etc. ? The projections of John onto these dimensions are the health of John, the financial situation of John, etc. The nominal terms *the health of John*, *the financial situation of John* refer to subsets of the set of pre-properties of John, for example to the set of those pre-properties that designate health properties John has. If we look at an individual from different perspectives, we see it differently. The projections onto different thematic dimensions are the ways in which we single out the relevant properties an individual has, relative to the thematic interest given. These can be absolute properties (e.g. yellow) versus relative properties (e.g. long), or essential properties (e.g. human) versus accidental ones (e.g. thick, blond, healthy).

Before treating the grammar of adjectives and dimension indicating expressions I shall make the notion of dimension more concrete. Thereby I extend the traditional notion of 'dimension' to all kinds of sets of properties that are grouped together and ordered under some perspective.

Dimensions in the narrower sense contain measures and values, quantitative as well as qualitative ones. Next to the evaluation and measure adjectives, which permit grading, there are non-gradable adjectives which express substantial properties as 'feline', 'human', 'male', properties of shape or form as 'circular', 'elliptic', non-gradable value properties like 'fake', 'genuine', 'true', non-gradable state properties like 'raw', 'cooked', 'boiled', 'pregnant', and disposition properties like 'breakable', 'solvable'. Some dispositional properties are also gradable, as well as some state properties, like 'ripe', 'done' ('well done', 'medium done'), 'wet', 'dry'.

Dimensions can be of lesser or greater extension: the dimensions of colour or of form are very large and open. They are not ordered, though they permit several partial orderings

from various points of view. Other dimensions are small; they exist merely of one property and its antonym, as e.g. the dimension of genuiness, which consists only of 'genuine' and 'fake', or the dimension of truth, which is {'true', 'false'}; the dimension of verification, is broader, namely: {'verified', 'confirmed', 'supported', 'uncertain', 'non-verified', 'disconfirmed', 'falsified'}. For small dimensions there is mostly no separate name. A nominalization of the adjective, or the adjective itself, sometimes in disjunction with its antonym, or the adjective followed by the question "yes, or no?" serve to name the dimension, for example: "human, yes or no?" The general pre-properties in these cases are only the two poles of a dimension, expressed by *positive* and *negative*, sometimes with a third neutral value. In linguistics, for example, adjectives are used as names for dimensions in semantic or phonetic marker analysis, together with '+' and '-' as the names for the two antonymic pre-properties (*human:* + or -, *round:* + or -), or in medical analysis, where *positive* or *negative* are used as names of pre-properties, which together with different dimensions x , defined by questions of the form "Are there antibodies of the virus x in the sample?", express a medical property of the sample (or of the person from whom the sample is taken).

Words expressing pre-properties are answers to questions for a suitable specification of an object in the dimension which is 'opened' by the question. A *Yes-No*-question divides a dimension into two parts, such that only one of the two pre-adjectives (+ or -) are a suitable answer. Those adjectives which also name the dimension express, in an unmarked case, the positive value within the dimension. The other value is expressed by negation. Antonyms can serve to name the same dimension. For example, "Wet, yes or no?" and "Dry, yes or no?" point to the same dimension, though in an opposite orientation: in the first case, 'wet' is the positive, and in the second, 'dry' is the positive value.

Note that the common colour words express stable characters, which have the dimension COLOUR encoded within their semantics, but a word like *soft* can also be used with respect to the colour dimension. It is not a property, since it does not denote a colour by itself, but it is a pre-property which, when applied to the colour dimension selects certain class of colours from that dimension. Some of these are the properties that are predicated when we say that the colours of a certain dress are soft.

The most important dimensions of physical properties are 'shape' (*round, angular, triangular, ..., pearshaped, eggshaped, ...*), 'consistency' (*fluid, pappy,viscous, solid*), 'humidity' (*wet, damp, dry*), 'spatial extension' (specified in three dimensions 'height', 'length', 'width'), 'temporal extension', and 'speed'. The first two do not have an ordering structure by grading, the other dimensions have. Such an order can be found in quantitative as well as qualitative dimensions: quantity can be ordered according to measures from big to small quantity, and quality from high to low quality . In the following drawing the vertical lines represent different dimensions and the horizontal different characters (i.e. pre-properties), whereby a character indicates at each dimension a property, namely its

intersection with the dimension. Note that a pre-property and a dimension are both sets of properties of which, extensionally speaking, the intersection is formed. The pre-properties are ordered, i.e. they are points on a 'pro-dimension', which is projected on all the other dimensions such that an orderd set of properties is determined which corresponds to the ordered set of pre-properties. The dimensions in Schema 1 are taken to be fully precise with respect to the pre-properties under consideration. This means that the intersection between a pre-property and a dimension contains exactly one element.
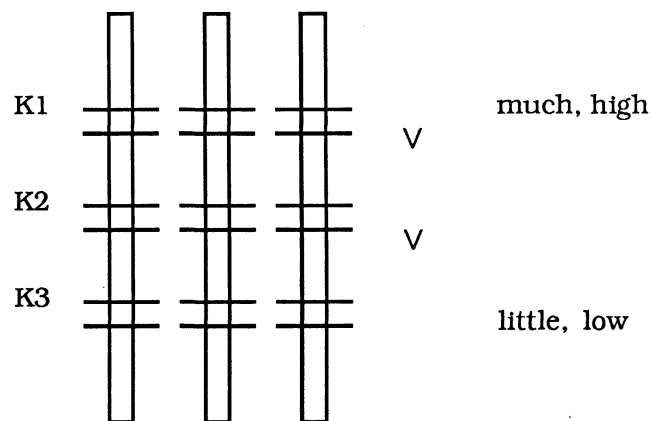
*Schema 1:* Pre-properties (characters) and dimensions

The dimensions d_i, d_j, d_k are ordered sets of properties, the pre-properties or characters K_i are functions which have for each dimension the intersection point (in the above drawing) as a value. The K_i represent the points in the general ordering structure which is projected on the various dimensions: By applying a norm of comparison to a dimension it is mapped onto a measure scale or a scale of valuation, as represented in schema 2. Measure dimensions are scaled by absolute dimensional adjectives, which are the (numeral) measures of comparison with a standard unit, for example '1 cm'. Valuation dimensions contain properties denoted by the relative adjectives, which are the valuations. A measure dimension, for example 'length in centimetres', is compatible with a valuation dimension, for example 'length of five year old children', because the ordering structure is kept intact in the mapping from the basic dimension d_i (e.g. length) to d_{ij} (e.g. length in centimetres) or d_{ik} (e.g. length of five year old children). If we apply a number just to the dimension 'length' we get something like '3 long', or '5 long', which are not properties but pre-properties, namely the equivalence classes like, for example, {3 cm long, 3 m long, 3 inches long, ...}. In order to yield a property, a measure specification is needed, for example '3 long in cm', or '5 long in cm'. These are properties in the dimension 'length in cm'. Likewise, 'long' and 'short' are pre-properties in the dimension 'length valuation' which, in order to designate a property, need the specification of a norm or value for

comparison, like 'average or expected length of five year old children'.
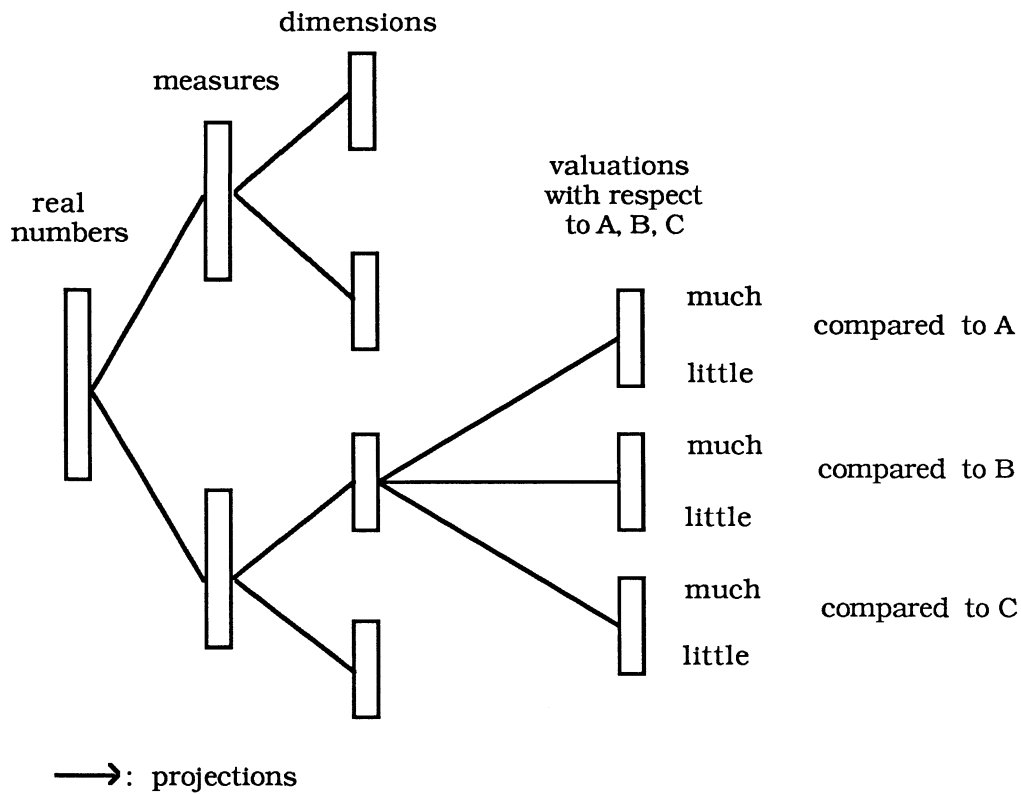
Schema 2: Measures and valuations

Measure and valuation is possible in quantitative as well as in qualitative respect. The pair (dimension, measure) is a measurewise specified dimension, in which an object can be determined, for example, according to its length in inches. The number 30 in the property '30 cm long' is a character, i.e. a pre-property. It lies located on a pro-dimension, namely on the ordered set of real numbers. The number indicates a property on each measure-specific dimension, which can be predicated of an object, as, for example '30 cm long'.
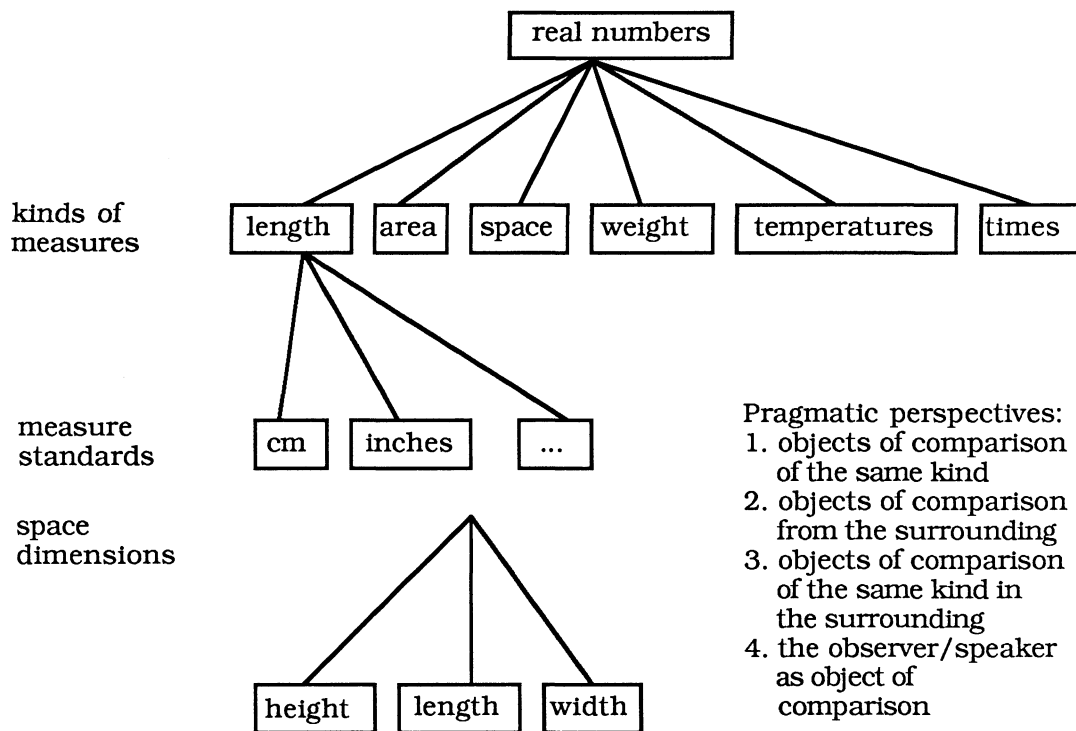
Schema 3: Kinds of measures and perspectives of valuation

Likewise the pair (dimension, pragmatic perspective) is a perspectively specified dimension, on which, for example, properties are situated which are expressed by relative adjectives like *tall, long, short, narrow* in the dimensions of space extension. The pragmatic perspectives, which I have taken over from Ehrich 1976, differentiate dimensions into dimensions which incorporate a norm of valuation. This means, a norm of comparison or a middle-value has been specified on the dimension. These norms or middle-values of comparison can be based on:

1. compared objects of the same kind, e. g. This mouse is big compared to other mice.
2. compared objects in the surrounding, e.g. This baby-elephant is big compared to the children standing around.
3. compared objects of the same kind in the surrounding, e.g. This house is big here in Muiden, in Amsterdam the same house would be small.
4. the speaker or observer as the object of comparison, e.g. "Daddy is big" the small child thinks, and generally for childeren, adults are the big people".

In this way, a dimension, e.g. the dimension of body-size, is differentiated into various dimensions $d_{ij} = (d_i, p_j)$, whereby p_j stands for pragmatic perspectives. These perspectives are context-properties. They are functions p_j which map dimensions d_i on perspectively

specified dimensions d_{ij}, $d_{ij} = d_j(d_i)$, which come about by installing on the respective dimension a norm of comparison which is defined by the perspective p_i. This means that one of the properties on the dimension is fixed as the norm, or that a group of properties form the centre of the dimension with which all the others are compared as being more or less, for example, the size of a small child in the surrounding or the average size of small children generally, whereby a small child can be big.

With respect to *absolute dimensional adjectives,* we thus have as their dimensions pairs consisting of dimension and measure $d_{ij} = (d_i, d_j)$. Hereby we can take the measure to be a function which maps the respective dimension on a measure-determined dimension $m_j(d_i)$ by marking properties on the dimension according to the measure, e.g. a certain length property as being the property "30 inches long". And with respect to *relative dimensional adjectives,* we have as their dimensions pairs consisting of dimension and pragmatic perspective $d_{ij} = (d_i, d_j)$, or the value-determined dimension $p_j(d_i)$, which comes about by marking one or a cluster of properties on the dimension as the norm and marking the other properties on the dimension according to their position with respect to the norm. If the dimension is "size" and the pragmatic perspective of comparison is the average size of small children in the respective surrounding, then every small child the size of which is a property way out to the positive end of the dimension is a small child that is big when seen under the perspective given. Therefore, *This small child is big* is not a contradiction if *small child* is interpreted with respect to older children, and *big* is interpreted with respect to its own younger age group: *this [small child]$_{d: i,n}$ is [big]$_{d: i,m}$*.

The distinction between measure-determined and value-determined dimensions is not identical with the one between quantitative and qualitative dimension. A quantitative dimension can be determined according to measure as well as according to valuation. This is, for example, the case with respect to the dimension of body length ('180 cm long' versus 'tall') or the dimension of temperature ('30 degrees Celsius' versus 'hot'). This means, there are acts of quantitative measurement and acts of quantitative evaluation. The same is partly true for qualitative dimensions: intelligence can be measured (according to psychologists), and it can also be evaluated as high or low. The measurement in these cases is done in order to establish a scale which can be used in evaluation relative to the established average or norm.

The difference between qualitative and quantitative dimensions is the following:

Quantities are determined by how many times they contain a standard quantity, for example an inch in length, which is the measure. Thus we get the quantity properties of length on a rod, ordered according to the ordering structure of real numbers, which is the general pro-dimension of measurement. Or quantities are determined by how they are situated in terms of more or less with respect to a quantity which is the standard or norm. The general

ordering structure ('< ' on an ordered set) is the pro-dimension of evaluation by comparison.

Qualities, on the other hand, are determined with respect to ideals, purposes, aims and goals, which people have with respect to other beings, tools, events and actions. The general pro-dimension here is 'appropriateness with respect to whatever ideal, aim or goal', and it consists of the pre-properties 'good', 'bad', 'satisfactory', and grades in between. As it happens, people also try to develop measurements of qualities by singling out a cluster of properties that are relevant for reaching the respective ideals or goals, and then devising a mapping into a set of numbers, for example according to the number of times each of the properties has been shown in a standard test, and possibly according to the weight that has been fixed for each property to begin with, in order to represent importance of a property to the goal involved. However, the use of numbers in these contexts is quite different from the use of numbers in measuring quantities: with respect to qualities, numbers are attached to certain characteristics (i.e. the relevant properties) in a purely conventional mannner; likewise the use of an algebraic operation on these numbers is merely conventional, and there is no way back from the final result of measurement to the distribution of occurences of properties on which it was based. Certain arithmetric operations make no sense on such qualitative measurements: What does it mean to divide the quality measure of an apple or of the intelligence of a person by half? Which property is the result of such an operation? We cannot tell. But note that the same question can always be answered with respect to quantities.

Which dimensions of quality are relevant for judging objects depends on the kinds of objects. There are discriptive ones like shape, colour, position, financial state, social state, and normative ones like health, success, moral conduct, an others, whereby the descriptive ones are often also marked normatively.

We can make a basic distinction between kinds of dimensions of valuation from the points of view of norms of ideal for objects and courses of events, including persons and actions, on the one hand, and of norms of purpose and aim concerning objects, and of norms of result concerning telic processes and especially actions. The norms of ideal with respect to objects and courses of events concern the esthetic aspects of 'gestalt' (form, substance, colour, movement), and for humans and living beings generally also aspects of well-being (health, situational conditions), and especially with respect to people there are aspects of their social, economical, occupational situation, as well as aspects of moral obligation and emotional states and dispositions. The norms of purpose and result are differentiated by all kinds of relevant goals and results. All these norms with their respective specifications provide perspectives under which qualitative dimensions are defined, in which the respective qualitative properties are located, as there are, for example, the various properties of a person's character. The pre-properties are then functions which indicate properties within these dimensions. These kinds of dimensions are the themes of

conversations with respect to those objects that are topic, and the properties predicated about a topic under such a thematic dimension are in focus. For example, the pre-property 'strong' indicates the property 'enduring' if it is used with respect to a person as the topic, and with respect to the fairly specific thematic dimension 'capacity, yes or no, to persist in trying to overcome adversities'.

A language has no names for most properties: they are constructed from a small set of pre-properties and a set of thematic dimensions, and accordingly most properties are expressed not by single words but by a text. Thematic dimensions together with pre-properties establish in a text, as I shall show in 2.4, the properties predicated of individuals. - The introduction of thematic dimensions within a conversation or text provides a basis for text coherence. Next to being introduced by questions they are also introduced by expectations the speaker has about the thematic interest the hearer might have.

2. The grammar of dimension indicating expressions.

Dimensions can be indicated by adjectives, e.g. by *long* in *30 inches long* or by nominalizations of adjectives, e.g. *length*. In order to express that a predication is restricted to a certain dimension, dimension indicators can be used in the form of prepositional phrases, morphologically modified forms of the respective adjectives, or adjectives without any special modification. The dimension indicators appear syntactically as adsentential, adverbial or adterminal phrases:

1. as adsententials combinable with sentences, whereby the result is again a sentence; example: *With respect to health, John is fine.*
2. as adverbials combinable with adjectives or verbs, whereby the result is again an adjective or verb; example: *John is fine healthwise.*
3. as adterminals combinable with terms (i.e. quantified noun phrases, also called 'generalized quantifiers'), whereby the result is again a term; example: *John's health is fine.*

In these different ways they are, from a grammatical point of view, functions which restrict a predication to a specific dimension or perspective[2]. The sentence *John is fine* by itself is vague as long as no thematic dimension is specified. In everyday conversation, some relevant perspectives are presupposed, and the sentence is understood to be meant with respect to all or most of them. Often, hearers are not interested in which are exactly the

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[2] Compare the class of predicate limiting adverbials in Bartsch 1972/76 and the treatment of dimensional indicators in a Montague-Kaplan grammar in Bartsch 1986.

dimensions referred to. In this way, sentences can be vague.[3]

Expressions which indicate dimensions can be iterated, whereby they are used in different categories:

> *John exceeds Paul in swimming (, but not in running)*
> *With respect to speed (,but not with respect to style), John exceeds Paul in swimming,*
> *In swimming (, but not in running), John's speed exceeds Paul's.*

This iteration amounts to a stepwise precisification of the dimension such that the relational pre-property EXCEED first maps the dimension 'in swimming' on the pre-property EXCEED IN SWIMMING, and then, by applying this to the dimension 'speed', finally results in the stable relation EXCEED IN SWIMMING WITH RESPECT TO SPEED. This can be done in one step by constructing a fully precise thematic dimension 'speed of swimming' and interpret *exceed* with respect to it:

> *With respect to speed of swimming (,but not with respect to style), John exceeds Paul.*

The "intentional structure" is different, i.e. the way of getting at a fact differs, but the fact is the same. The way of getting at a fact is a matter of focussing. Note that although the order of specifying the dimension is in principle arbitrary, it makes a difference in the way a text can be continued:

> *With respect to swimming, John's speed exceeds Paul's, and so does his style*
> *With respect to speed, John's swimming exceeds Paul's, * and so does his style*
> *With respect to speed of swimming, John exceeds Paul, * and so does his style*

In the first sentence, the focus frame is the thematic dimension of swimming, and within this dimension two facts are in focus by referring to speed and to style and by comparing John and Paul under these respects. In the second sentence the focus frame is speed, and within this thematic dimension John's and Paul's swimming can be considered, but style does not fit under this dimension: there is a speed of swimming but no 'speed of style'.

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[3]Pinkal (1981) has treated the semantics of this kind of vagueness and introduced the notion of precicification, which amounts to specifying the dimension until it is is fully precise. The vague predicate interpreted with respect to the fully precise dimension denotes a property, i.e. the sentence is true or false with respect to this precification. With this notion in mind, we can say that the sentence is somewhat true if there is at least one relevant precisification under which the sentence is true, and the sentence is strongly true if it is true under all relevant precicifications. And there are degrees to which a sentence can be true according to how many relevant precisifications the sentence is true.

The following semantic operations correspond with the three syntactic structures listed above:

1. (Dimension, Perspective) + Truth evaluation = Relative Truth evaluation, i.e. the sentence is claimed not simply true, but true with respect to a certain dimension and under a certain perspective. This means that truth evaluation is restricted to a dimension and/or perspective.

2. (Dimension, Perspective) + Pre-property = (Pre-)property.

3. (Dimension, Perspective) + (intentional) Object = Partial Object.

In what follows I am going to describe how this limitation of the interpretation of a sentence is performed in the adsentential, adverbial, and adterminal manner. With each of these constructions I shall investigate the combinability of dimensional indicators. First some remarks about semantic types are necesssary:

In a Fregian semantics, the interpretation of an indicative sentence has as its result a truth value, its denotation. Hereby the interpretation is dependent on several parameters, called indices: world (: w), time (: z), and context (: c).[4] A sentence-concept then is a function that maps a triple $<c,w,z>$ onto a truthvalue (: t) 'true' or 'false'. The semantic type of an indicative sentence is accordingly $<c,z,w,t>$, its denotation type with respect to the triple $<c,z,w>$ is t. Such a sentential concept is the context-, time- and world-undetermined content of the sentence. This means that these parameters are not specified, i.e. the interpretation of a clause that expresses such a sentential concept still depends on information about the context, the time, and the world, which have to be provided separately. A merely world-undetermined sentential content is called a 'proposition', which is a function from possible worlds to truth values, i.e. of type $<w,t>$: A sentence expresses a proposition, i.e. its semantic type is $<w,t>$, and it denotes (with respect to a world) a truth value, i.e. its denotation type there is t. Likewise we can speak of time-undetermined or context-undetermined sentential contents, which are of type $<c,t>$ and $<z,t>$, respectively. Only when context- and time-specifications are provided, the truth of sentential contents can be considered and judged with respect to the thematic interest involved, and with respect to time. The relationship between the triple $<c,w,z>$ and the truth value can be looked at in different functional ways, for example as $<c,<z,<w,t>>>$. By this type, it is determined that first the interpretation has to be fixed according to the context, then according to the time, and finally according to the world to which the sentence is related.

In what follows I shall neglect time and world in order to avoid denotation types that are too long for easy writing and reading. We can suppose that z and w have been fixed once and for all; then only the context c is of interest. And among the context properties, I merely focus on thematic dimensions. A context-undetermined sentential content is then a

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[4] I disregard place in this paper.

function of type <c,t>, i.e. it maps contexts on truth values. Its denotation with respect to a fully precise context is of type t. A context is fully precise with respect to a sentence, if and only if it gives all the information necessary for determining the reference of pro-nouns and for determining properties as the denotations of the predicates of the sentence. Here, we only deal with full precision of a context with respect to the assignment of properties to predicates, i.e. with full precision of thematic dimensions with respect to pre-properties.

A context-specifying adsentential denotes a function of type <<c,t>,t>, i.e. it maps at a certain context index a context-undetermined sentence content on a contextually (here: dimensionally) determined one, i.e. a stable sentence content, which amounts, in our simplified semantics (without time and world indices), just to the truth value at this context index. Many thematic adsentials are not fully precise by themselves. Either a thematic dimension from the context or thematic modifiers within the clause contribute to precision. Consider the following text.

> *Let us compare how the boys do in swimming. With respect to style, John is best, with respect to speed, Paul.*

The second sentence is of semantic type <c,t>; it has to be interpreted with respect to the contextually given thematic dimension 'in swimming'. The adsentials *with respect to style* and *with respect to speed* must be of semantic type <c,<<c,t>,t>>, and of denotation type <<c,t>, t> at the contextually provided thematic dimension . In Montague Grammar, (modal) adsentials have the syntactic category t/t, and in the translation into intensional logic the translation of the sentence d within the scope of the translation of the adsentential g appears under the intensionality sign: g'(^d'). This means that the corresponding semantic type of g is <s,<<s,t>,t>> and the denotation type at a world index is <<s,t>,t>. This corresponds with the denotation type assignment <<c,t>,t> for thematic adsentials. The difference between possible worlds and thematic dimensions (and contexts generally) is that the latter are constructed and introduced by the text under consideration, while possible worlds are, once and for all, fixed in the model. The semantic type of all thematic adsentials is taken to be <c,<<c,t>,t>>, and the fully precise ones are special cases among these, namely those that, when applied to a sentential content provide a stable sentential content. A thematic adsentential is fully precise relative to a clause, if it maps an unstable sentential content (which is the meaning of the caluse) on a stable one, i.e. if the sentential content merely misses that extra thematic information to become stable. In this case a contextually provided thematic dimension (i.e. the context index) has no influence on the interpretation. A thematic adsentential is precise relative to a clause if and only if it maps the meaning of the clause on a function that yields a stable result (i.e. a truth-value) when applied to the contextually provided thematic dimension.

In this paper I shall skip the whole component of translation into intensional logic[5]. I assign semantic types directly to natural language expressions, and this depending on their syntactic surroundings in the respective sentence.

2.1. The adsentential use of thematic dimension indicators

Examples of the adsential use of dimension indicating expressions are:

> *As far as health is concerned, John is doing well.*
> *Healthwise and financially it holds: John is doing well.*
> *As far as length is concerned, this board is sufficient; but not with respect to width.*
> *With respect to length, John exceeds Peter.*
> *Lengthwise, John exceeds Peter.*

The adsententials have the semantic type $<c,<<c,t>,t>>$ and the denotation type $<<c,t>,t>$, and the embedded sentence has its semantic type $<c,t>$ as denotation type. The predications *is doing well, is sufficient, exceeds Peter* have the semantic type $<c,<e,t>>$ and the denotation type $<e,t>$. In the above examples, the proper names can be of type e ('entity'), but since they can be replaced by noun phrases like *a man, every man, no man,* etc. we use the type of generalized quantifiers for all (quantified) noun phrases or terms, as it is done in Montague grammar: nominal terms denote functions that map properties onto truth values.[6] They are thus two type levels higher than the basic entity level. But in the above examples, they are not sets of full-blown properties, rather sets of pre-properties, which, when predicated of an object do not make up a full sentence content, but a contextually undetermined sentence content, which acquires a truth value only when it becomes related to a thematic dimension and/or a perspective. The semantic type for nominal terms therefore is in these sentences $<c,<<c,<e,t>>,t>>$, which means that their denotation type is $<<c,<e,t>>,t>$. The basic type for thematic dimensions f, g, etc. is c. Thematic adsententials F^1 and G^1 express thematic dimensions on a level that is two steps higher[7] than the basic type, namely of denotation type $<<c,t>,t>$.

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[5] It has been elaborated for the kind of constructions we are concerned with in Bartsch 1986, where the syntactic rules, the translation into (intensional)logic, and the interpretation in a model are formulated.

[6] Another way of expressing this is: terms designate sets of properties, i.e. are of type $<<e,t>,t>$, or, with intensionality included, $<<s,<e,t>>,t>$.

[7] I use superscripts to distinguish expressions of different type, but the number used as a superscript does not really correspond with the height of the level referred to. Properties have no superscript, and pre-properties have superscript '0'. Correspondingly the conjunction is of different types, which is indicated by a superscript.

A <u>conjunction of thematic adsententials</u> is formally possible: if a function is of a type $\langle x,t \rangle$, whereby x is whatever type, a conjunction can be defined on the basis of the conjunction defined for truth value denoting expressions.

If p is a sentence of type $\langle c,t \rangle$ and F^{1} and G^{1} are thematic adsentials, then $F^{1}(p)$ and $G^{1}(p)$ are sentences, and also their conjunction is a sentence of denotation type t. On the basis of such a conjunction we can define the conjunction of thematic adsententials by abstraction from the specific sentence p:

$$F^{1} \,\&^{1}\, G^{1} =_{def} \lambda p\,(F^{1}(p) \,\&\, G^{1}(p))$$

An example is:

As far as health and financial affairs are concerned: John is doing well.

This sentence is of the form:

(healthwise & financially)(John is doing well)

or more explicitly:

((health$_{AS}$ & financial$_{AS}$)$_{AS}$ (John is doing well)$_{S}$)$_{S}$

According to the above definition of conjunction, this has the same interpretation as:

Healthwise, John is doing well, and financially, John is doing well.

Formally, i.e. qua type, the conjunction of two dimensions or perspectives is always possible, but contentwise there are restrictions: Two dimensions or perspectives f and g can be put into conjunction if and only if there is a pre-property P such that $P(f)$ and $P(g)$ are two compatible properties, i.e. if there is an entity of which both are possibly true.

2.2. The adverbial use of dimension indicators

Examples are:

John is fine healthwise
John does well in his business and financially
The beam is 2 meters long

John exceeds Paul in length not in weight
John exceeds Paul lengthwise and in width.

The combination of a dimension adverbial with a dimensionally weakly determined or undetermined adjective results into a dimensionally stronger determined, or even fully determined, adjective. On the semantic level a pre-property is applied as a function to a dimension, whereby the result is a (pre-)property. The pre-property is of semantic type <c,<e,t>>.

We can take the dimension indicator *long* in *The beam is 3 metres long* as being of type c, the basic type for dimensions, and construct the types of the dimension indicating expressions *in length* or *with respect to length* as being of a type that is two levels higher, a type we need anyhow for forming the conjunction, like *in length and with respect to weight* or *in length but not in weight*. The semantic type for adverbial dimension indicators is <c,<<c,<e,t>>,<e,t>>>, and its denotation type at a certain thematic dimension is <<c,<e,t>>,<e,t>>. This expresses that, with respect to a contextually given thematic dimension, they are functions from pre-properties to (pre-)properties.

Thematic adverbials, as well as thematic adsententials are thematically opaque operators, i.e. an expression under their scope gets as denotation type its semantic type, i.e. if an expression with denotation type x is used under such an operator, it is lifted to denotation type <c,x>.

In recent work about type shifting[8] it is investigated when and under what conditions it is necessary to assume different semantic types for a syntactic construction or phrase in different grammatical combinations and contexts. The simplest example is that we can use the type e for a simple nominal term like *John* in a sentence like *John drinks*, but *every man* or *John and Paul* need a type that is two levels higher, namely <<e,t>,t>, as in Montague Grammar. Montague assumed this higher type for all nominal terms, in order to have a one-one correspondence between syntactic categories and semantic types, i.e. that there exists an injective mapping from syntactic categories into types. In the literature on type shifting and flexible categorial grammar in general, it has been shown, that we cannot assign one single semantic type, namely the highest necessary, to a single syntactic category in all its contexts. Some inferences are only available on a lower type level, and others are only available on a higher level. And this may be so for one single grammatical category (cf. Groenendijk and Stokhof 1986). These various type levels which may correspond to a single syntactic category are necessary if we want to take into account inference properties between questions and not simply between indicative sentences. In this paper we restrict ourselves to indicative sentences, and here the lifted type <<c,<e,t>>,<e,t>> is sufficient for thematic adverbials, next to the basic type c, which we

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[8] Partee and Rooth 1983, Partee 1986, and Groenendijk and Stokhof 1986.

need for building up the types, but which we do not need as a type of certain linguistic expressions.

The conjunction between two thematic dimension adverbials is defined via the conjunction between property expressions: Let F and G be two property expressions , i.e. of denotation type $<e,t>$. Their conjunction is defined as

$$F \; \&^2 \, G =_{def} \lambda x \; (F(x) \; \& \; G(x)).$$

Then the conjunction between two thematic adverbials F^2 and G^2 is:

$$F^2 \; \&^3 \, G^2 =_{def} \lambda F \; (F^2(F^0) \; \&^2 \; G^2(F^0)).$$

Hereby, F^0 is of denotation type $<c,<e,t>>$, i.e. a pre-property, and F^2 and G^2 are of denotation type $<<c,<e,t>>,<e,t>>$.

2.3. The adterminal use of dimension indicators

Examples are:

> *John, with respect to health, is fine.*
> *John, from the financial and economical point of view, is doing well .*
> *John, as far as intelligence goes, exceeds Paul.*
> *Every man, from a moral point of view, is responsible, even if he, from a psychological point of view, is not in control.*
> *John, as a teacher, is excellent.*

In Montague grammar and in the theory of generalized quantifiers, the denotation of a nominal term is a set of properties. The combination of such a nominal term with a predicate means that the predicated property belongs to the set of properties which is the denotation of the nominal term. In our examples, there is not a property predicated, rather a pre-property. Accordingly, the whole nominal term, including the adterminal dimension indicator, has as its denotation at a certain context index, i.e. at a certain contextually provided thematic dimension, a set of pre-properties, to which the predicated pre-property belongs in case the sentence is true at that context index. Therefore, as expressed in the formula below, the denotation of the adterminal dimension indicator is a function (F^3) which maps a set of pre-properties (A), including stable ones, i.e. properties, on a set of pre-properties (A'), namely precisely those pre-properties (P^0) which, when applied to the

indicated dimension or perspective (f) have (pre-)properties (P) as the result which are elements of the denotation (A) of the nominal term without the dimensional indicator:

Let A be the set of (pre-)properties, which is the denotation of a nominal term a. Then A is of denotation type $<<c,<e,t>>,t>$. Let F^3 be the denotation of an adterminal dimension indicator, which is of denotation type $<<c,<<c,<e,t>>,t>>,<<c,<e,t>>,t>>$, i.e. a function of sets of pre-properties on sets of pre-properties. The denotation A' of the whole nominal term, let us call it "perspective- or dimension-term", is a set of pre-properties, i.e. of type $<<c,<e,t>>,t>$ which is a selection from the first. According to the dimension indicator, this set A' contains merely those pre-properties which belong to the indicated dimension or perspective. This is expressed by:

$$F^3 (A) = A', \text{ and } A' = \{P' \mid \text{there is P with } P'(f) = P \text{ and } A(P) = 1\}$$

Such a set of pre-properties is a partial object, namely an object viewed under a certain perspective, or, with other words, under consideration as far as it is determinable within a certain dimension. This is comparable with the partial objects Evening star and Morning star, which are Venus as it appears in the light of its morning star properties, and Venus as it appears in the light of its evening star properties, respectively.

There is a whole class of nouns that can have these kind of partial objects as denotations. These are the nomina agentis, like *eater, drinker, runner, speaker, teacher* etc. A dimension or perspective of possible predications is included in these denotations. This means the nominal terms constructed from these nouns, like *a teacher, every drinker*, etc. are essentially of type $<<c,<e,t>>,t>$. I call these nouns "perspective- or dimension nouns". The typical predications are pre-properties which provide specifications within the perspectives and dimensions which are given by the respective verbs *teach, drink* etc. This means, the pre-properties select (pre-)properties from these dimensions, as in *This teacher is good* or *This runner is slow* or *John, as a teacher, is good, but as a runner, he is bad.*[9] It is possible that stable pre-properties, i.e. properties, are selected (or constructed) in more than one step by interation of thematic dimensions, as in the sentence *As far as keeping order in class is concerned, this teacher is good.*

Also complex nouns like *size of John, width of this car, health of Fred* belong to the class of perspective- or dimension nomina. This means that the dimension indicators *size, width, health*, etc. are relative dimension- and perspective-nomina. These nouns themselves can be modified adnominally, like in *good health, extreme size, etc.*, and likewise *good teacher, slow runner, moderate drinker, bad dancer, inspiring speaker*. The nomina agentis are basically of denotation type $<e,t>$, as in *John is a teacher*. But there is

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[9] These nouns and phrases like *John as a teacher* are treated in Bartsch 1986 in a Montague-Kaplan grammar.

also a type <e,<<c,<e,t>>,t>>, which is the lowest denotation type of phrases like *as a teacher*. Their denotations map individuals (or two levels higher: sets of (pre-)properties) on sets of pre-properties, as in *John, as a teacher*. Such a set consists of all pre-properties which assign, in the perspective or dimension expressed by the nomen (agentis), properties of an individual. For the noun *teacher* these are all the teacher properties of the individual, i.e. all his properties which are comprised by the dimensions and perspectives of an individual's teaching. The adnominal adjectives are of the type <<c,<e,t>>,<e,t>>, as in *blond teacher*, or in *good teacher*. They map the dimension noun onto a noun of property-type, namely <e,t> at a context-index. When we consider iteration of thematic dimensions in a sentence, further specification is possible as in *good teacher as far as keeping order in class is concerned:* Here *good teacher* has its semantic type <c,<e,t>> as its denotation type under the scope of the adterminal operator *as far as keeping order in class is concerned.*

The semantics of adnominals which are based on pre-properties is derivable from their predicative use in accordance with the following meaning postulate: *somebody is a good teacher if and only if he is a teacher, and as a teacher he is good.* We can represent the conjunction by treating individuals on the generalized quantifier level: With an individual variable x of denotation type e there corresponds two levels higher a variable X which has sets of properties as its denotation type.

For all X: X(GOOD TEACHER) =1 if and only if X(TEACHER) =1 and X AS A TEACHER(GOOD) = 1. Hereby, X AS A TEACHER = { P' | there are P with $P'(d_{TEACHER})$ = P and X(P) = 1}.

The property GOOD TEACHER, thus, is a conjunction of the property TEACHER and the property GOOD AS A TEACHER, which is expressed by saying that the pre-property GOOD belongs to the set of pre-properties which have as values properties of x under the teacher perspective. X AS A TEACHER is, according to this semantics, a partial object, like the denotation of *John, from a financial point of view* and others listed above. The dimension and perspective indicator *as a teacher* can also be used adverbially, as in *John is good as a teacher*. This does not mean, that John is a teacher; it merely indicates the dimension or perspective under which the pre-property GOOD is predicated. This dimension is designated by the index $d_{TEACHER}$ in the semantic model, whereby the adverbial is, as explained above, of a denotational type which is two levels higher. It is evident[10] that in this way the sentences *John, as a teacher, is good* and *John is good as a teacher* (and also *Under the perspective of teaching, John is good*), though of different

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[10] See for details Bartsch 1986, where also terms like *the length of John* are treated as dimension- or perspective-terms, as in sentences like *The length of John is enormous,* where *enormous* denotes a pre-property. The interpretation of this sentence has the same result as the one of the sentence *John is enormously long* or *John is enormous in length.*

syntactic form, receive the same interpretation.

> The <u>conjunction of thematic dimension adterminals</u> takes place on the type level <<c<c,<e,t>,t>>,<<c,<e,t>>,t>>. For the sentences

John, from the financial and economical point of view, is successful.
John, as a teacher and director, acts responsible.

we have the following forms:

(from the financial and economincal point of view(John))(is successful)
(as a teacher and as a director(John))(acts responsible)

The conjunction of adterminal dimension indicators is defined on the basis of the conjunction of the dimension-and perspective terms. This conjunction is for two such terms X' and Y':

> X' &^{4} Y' $=_{def} \lambda P^0(X'$ (P^0) & Y' $(P^0))$, whereby P^0 is a variable for expressions of pre-properties.

An example of such a conjunction is:

The length of Fred and the width of Fred is enormous.

The conjunction of two adterminal dimension indicators F^3 and G^3 is then:

$$F^3 \ \&^5 \ G^3 \ =_{def} \lambda X \ (F^3(X) \ \&^4 \ G^3(X)).$$

Hereby, X is a variable for terms and the complex expressions $F^3(X)$ and $G^3(X)$ are dimension- or perspective terms. In the above form *((as a teacher and as a director(John))(acts responsible))*, the predication *acts responsible* is a pre-property. In the grammar presented here, this sentence has the same interpretation as the sentence *John as a teacher and John as a director acts responsible*. The property which is assigned by the pre-property in the dimension $d_{Teacher\ and\ Director}$ is the property TO ACT RESPONSIBLE AS A TEACHER AND AS A DIRECTOR. In the same way the sentence *The length and the width of John is enormous* can be treated.

If a conjunction of pre-properties and properties is predicated, we have to assign to the conjunction the higher type, i.e. the one of pre-properties, namely <c,<e,t>>, which means that all adjectives have to be treated as pre-properties, the properties just being stable pre-properties. From this it follows that the term that is constructed from the nomen agentis, e.g. *the runner*, has to be treated as a set of pre-properties. Although it is

possible to define a different type for *runner* in *blond runner* and in *fast runner*, and likewise for the nominal term in *the runner is blond*, and in *the runner is fast*, we take the highest type that takes care of all combinations and interpret *blond* just as stable with respect to the thematic dimension 'in running': the stable pre-property 'blond' just yields the property, i.e. itself, when applied to the dimension of 'run'-properties. It might count against this option that sentences like *This runner is fast and blond* appear somewhat strange[11] because a dimensional specification seems to be forced upon a property that has nothing to do with it. But this dimensional specification has no effect, because the property BLOND is stable. Note that *This runner is fast and weighs 250 pounds* is not strange at all, probably because weight is relevant for the possibility of runners being fast, and here the high weight makes it surprising that the runner is fast. The sentence would even be better with an adversative conjunction: *This runner is fast, but weighs 250 pounds*.

We can also form the conjunction between *John* and *this runner* as in sentences like *John and this runner both are slow*. The two nominal terms are of the same type. This is equivalent to 'John is slow and this runner is slow' where the first conjunct is not yet stable but needs a specification of the thematic dimension, the second conjunct is stable because the thematic dimension was specified in the meaning of the nominal term.

2.4. Iteration of thematic dimension indicators

The iteration of the application of pre-properties to dimensions, whereby the result of one application is again a pre-property that can be applied to another dimension to yield a (stable) pre-property is the basis of property-construction. If such a process of repeated application results in a stable pre-property, we have constructed a property. In texts this iteration is reflected in the repeated application of dimension indicators. Examples of iterations of thematic dimension indicators are:

With respect to speed John is excellent in swimming
As far as swimming is concerned John is excellent with regard to speed
Regarding speed of swimming, John is excellent
As far as swimming is concerned John's style is excellent
As a teacher John is excellent as far as mathematics is concerned

The type assignment discussed in the sections before is such that these iterations are possible: if x is a denotation type of an expression then a thematic dimension modifier on

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[11] This sentence with *but* is not strange at all in the following context: We are looking for somebody who is a fast runner and who is dark. Then someone points at a runner, but concludes *This runner is fast, but blond.*

this expression is of denotation type $<<c,x>,x>$, i.e. the semantic type of an expression is taken as its donation type under a thematic dimension modifier. In principle there is no limit to the number of these iterations, but the moment the pre-property involved becomes stable, iterations of these kinds of modifiers are semantically vacuous. Therefore the sentence

As far as style is concerned, John's speed of swimming is excellent

just amounts to

John's speed of swimming is excellent.

The meaning of this sentence is stable with respect to whatever dimension. But the first sentence is unacceptable because it does not make sense to indicate explicitly that a stable expression should be interpreted relative to a thematic dimension.

With respect to style, John is excellent in swimming

is acceptable, because *excellent in swimming* has as its meaning an unstable pre-property, which can be applied with respect to the thematic dimension 'style' with as a result the stable (pre-)property EXCELLENT IN SWIMMING WITH RESPECT TO STYLE.

Let us consider what happens in iteration semantically. Thematic dimensions are sets of (pre-) properties, including stable ones, i.e. properties. This means that they are basically second order properties, like 'colour' or 'geometric shape'. In iteration, the second order properties are put in conjunctions as conditions on the properties that can be the interpretation of an expression of a pre-property, e.g. an adjective. The property P assigned by the pre-property P^0 with respect to the iteration XY of dimensions X and Y has to be an X-property and a Y-property. Thus, 'excellent' in the above sentence assignes a property to John which is a property of swimming , i.e. a 'swim'-property, and a property of style, i.e. a 'style'-property. 'Excellent in style' is a pre-property, which can be applied to all or some activities, and so "John is excellent with regard to style" means vaguely that his style is excellent in several kinds of activities, if it is not interpreted relative to a contextually given kind of activity. But in order to make a precise statement it has to be applied to specific thematic dimensions, for example to swimming, or to a certain selection of activities.

Let us consider the above examples in detail:

Within the set of swim-properties a person can have properties concerning the style of swimming, the speed of swimming, the endurance in swimming, etc. Likewise, within the

set of style-properties a person can have properties of style of clothing, style of talking, style of walking, style of swimming, etc. The pre-property 'excellent' designates a class of properties on the swim-dimension which all contain 'excellent' as a pre-property. It is an equivalence class within the class of swim-properties. It consists of all those properties that express an excellency in the respective subdimensions 'style of swimming', 'speed of swimming', 'endurance of swimming'. A pre-property applied to a dimension designates an equivalence class in this dimension. This equivalence class here is the pre-property 'excellent in swimming'. Likewise, we form the equivalence class 'excellent in style' on the style-dimension. This equivalence class consists of the properties that express an excellency in the respective subdimensions 'style of walking', style of talking', style of swimming', etc.

If we now apply the pre-property 'excellent in swimming' to the thematic dimension 'style', it picks out a property of excellency from the subdimension 'style of swimming'. What actually happens is that we form the intersection between the equivalence class 'excellent in swimming' from the swim-dimension and the equivalence class 'excellent in style' from the style dimension. This intersection is a class which is the pre-property 'excellent in style of swimming'. It contains just one element which means that it contains the property 'excellent in style of swimming'.
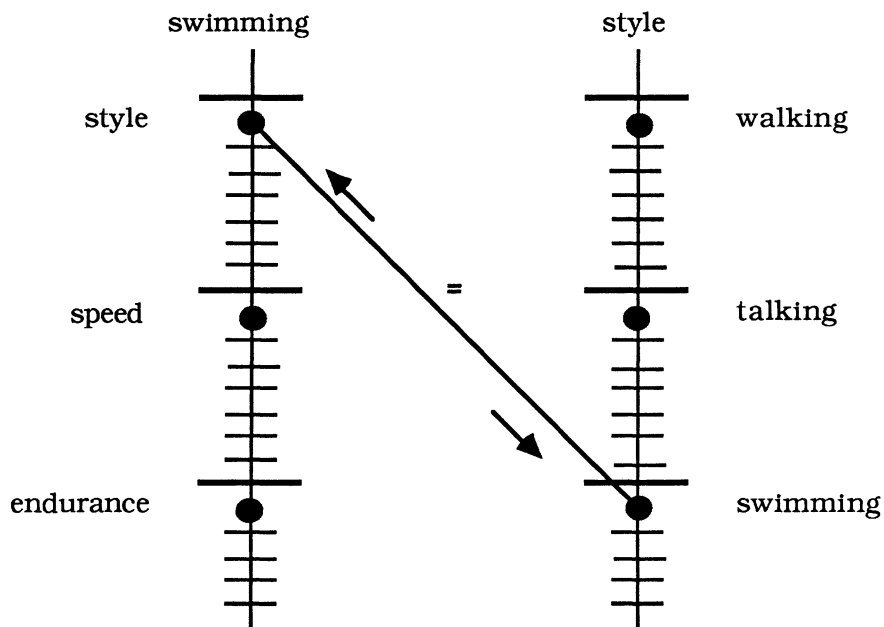
Schema 4: Iteration of thematic dimensions

In Schema 4 we see that the dimension 'swimming' is the union of properties from the subdimensions 'style of swimming', 'speed of swimming', etc. For a dimension d_i to be

determined further by a perspective or dimension d_j means that d_i is mapped on a subset (subdimension) d_{ij}. The same is possible the other way around, i.e. that d_j is dermined by d_i.

We can also think of the pre-property 'excellent in style of swimming' as containing a whole set of properties ordered in subdimensions according to different kinds of swimming. Then we can have a third iteration, for example 'excellent in style of swimming as far as butterfly stroke is concerned'. Considering this third step of refinement of precision of the thematic dimension, we must say that the pre-property expression *excellent in style of swimming* designates the property 'excellent in style of swimming with regard to several kinds of swim strokes', if it is not used with respect to a certain kind of swim stroke, referred to in the context or in the situation.

In terms of composition of a property, the procedure just described amounts to a composition of properties from pre-properties:

Let d_1: = 'swimming', d_2: = 'style', P^0: = 'excellent'. We then have two constructed pre-properties $P' = P^0(d_1)$ = 'excellent(swimming)', and $P'' = P^0(d_2)$ = 'excellent(style)'. There is a combination '@' of two pre-properties into a single pre-property, $P''' = P' \text{ @ } P''$, which is the intersection of both. If this intersection is a singleton, i.e. $P''' = \{P\}$, we say the property P is combined out of the pre-properties P' and P''. In our example, this property is P = 'excellent (style + swimming)', which is expressed by either *excellent in style of swimming* or by *excellent in swimming as far as style is concerned*. This can be expressed by the following schema of property construction:

$$P^0(d_i) \text{ @ } P^0(d_j) = P^0(d_i + d_j) = P^0(d_{ij}) =$$
$$\{ P \mid \text{there are } P', P'' \text{ with } P' = P^0(d_1) \text{ \& } P'' = P^0(d_2) \text{ \& } P \in P''(d_1) \text{ \& } P \in P'(d_2)\}$$

If this construction results in a set with exactly one element, we have constructed a stable pre-property, namely a property. In our example this set (i.e. the resulting pre-property) just contains a single P (i.e. the property) whereby $\{P\} = P''(d_1) = P'(d_2)$. In this case P is constructed from the pre-properties P' and P'' which are constructed from the two dimensions d_i and d_j and the pre-property P^0.

In the light of this construction of (pre-)properties from pre-properties and thematic dimensions with or without iteration it follows that the operators in iteration are commutative, as is the combination '+' between dimensions themselves:

If P^0 is a pre-property, then the dimension operators D' and D" and their semantic bases, the dimensions d' and d", satisfy the formulas:

$D'(D''(P^0)) = D''(D'(P^0))$ on the higher type level,

and

$P^0(d' + d'') = P^0(d'' + d')$ on the basic type level.

Because of this, we have the possibility to apply thematic dimensions in different, and as far as semantics is concerned, in deliberate order. An order is, of course, relevant in the course of text construction, which requires a build up of dimensions such that the thematic dimension given in the context is presupposed and not expressed again in the sentence that stands within this context.

3. Conclusions

This paper has been an investigation in the context dependent type assignment for adjectives at the one hand and dimension and perspective indicating expressions on the other. The type assignments to these kinds of expressions had consequences in the area of nominal terms, where a new type was introduced, the type of the dimension- and perspective terms. Special attention was paid to combinations between thematic dimension expressions, those where a combination results in two properties (i.e. conjunctions of thematic dimensions) and those in which the combination results on one single property (i.e. iterations of thematic dimensions). For the treatment of these combinations, operations had to be performed on higher type levels, especially on the level of second order properties.

Pre-properties are sets of properties. For type shifting the difference between properties and pre-properties has complicating consequences in the area of type-assignment to other categories of expressions. Therefore, I have treated properties as stable pre-properties. This amounts to lifting a property on the level of singletons, i.e. sets consisting of just this one property. Properties and pre-properties are expressed by the same class of expressions, namely by adjectives (and some verbs of comparison), which can be used in the predicative and in the adnominal category. Without this general lifting of properties to pre-properties, we would have two categories and four semantic types for one class of expressions , namely two predicative and two adnominal types, which each are based either on the type for properties or on the type for pre-properties. At the same time there would be type differences within the category of nouns : the nomina agentis require a more complex type than other nomina, that basically denote sets of individuals. Likewise, there are type differences between nominal terms (sets of properties) and dimension- and perspective terms (sets of pre-properties). Here we would have, for one category, two different types which are not distinguished by a two level difference, but by the kind of their context-

dependence. This is avoided by lifting properties to pre-properties.

The dimension- and perspective-indicators appear each in three categories of use, in the adsentential, adverbial, and adterminal category. The relationship between these became apparent on the semantic level, where the alternative constructions result in the same interpretations.

Another interesting aspect is that the pre-properties, like *good, successful, enormous* are of a relational basic type, namele <e,c,t>. Pre-properties are, apparently, functions from pairs consisting of an entity and a dimension (and/or perspective) onto truth values. This means they are relationships between entities and thematic dimensions (including: perspectives, themes). This reflects the fact that properties of individuals get constituted in combining perspectival and thematic information in the light of which the individual is viewed by predicating about it very general pre-properties, which are the result of comparing individuals with each other under the perspectives given, and then abstracting from these dimensions. This construction of properties is different from the kind of construction which consists in forming conjunctions of properties on the first order level. There, intersections between sets consiting of zero order entities are formed, i.e. operations are formed on first order sets. But the construction considered here involves second order conjunction, as has been spelled out in detail in the section on iteration. Here, intersections between sets of first order entities are formed, i.e. the operations are performed on second order sets. Both constructions are formally of the same kind, but they take place on different levels. The construction treated in this paper has not been taken into account formally in lexical decomposition up to now. But this can be done along the lines of construction spelled out under 2.4. To be aware of this kind of construction of concepts is very important in order to understand how predication and the build up of properties works, and herewith, how 'interpretation' is achieved in texts. 'Parts' of a property can be spread over a text as a distribution of thematic dimension indicators and a pre-property expression, or it can be spread partly over a conceptualized, i.e. 'interpreted' situation, if the described situation is present at the speech situation. It is obvious that the dependence of the interpretation of pre-property expressions (especially adjectives) on thematic information is one of the important connections that establish text coherence. Properties are expressed by texts which provide for their construction by specifying thematic dimensions and pre-properties. Generally, they are not simply expressed by adjectives, except for a small class of dimensionally fully determined adjectives.

Basically, pre-properties are relations which are predicated of pairs of entities and thematic dimensions. This is what all amounts to in the end. But assuming this view to be grammatically adequate, keeps out of sight why there are grammatical differences between adsententials, adverbials and adterminals after all. With these grammatical distinctions,

obviously, different routes of interpretation correspond, which may make a difference in the result of interpretation at the moment we deal with scope relevant phenomena, like quantifiers, time, modality and negation. Scope-phenomena make a functional build up necessary instead of a relational one, at least if one uses always the same basic subject-predicate sentence pattern, as the natural language considered here does: the method is such that a relation is split up in steps of successive application of functional expressions and these steps constitute parts the meanings of which can be referred to anaphorically, can be in the scope of several modal, time, and negation operators, and can play a role in the topic-focus division of a sentence.

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