THE TEMPORAL DEGREE ADJECTIVES *FRÜH(ER)/ SPÄT(ER)* 'EARLY(ER)'/'LATE(R)' AND THE SEMANTICS OF THE POSITIVE

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1. INTRODUCTION[1]

There is a rich literature about the temporal conjunctions *before/after*, but at the time I gave the talk that underlies this paper I was not aware of any analysis of the temporal comparatives *früher/später 'earlier/later'*, which may be used to express similar states of affairs, but are constructed differently.[2] Recently I became acquainted with del Prete's thesis about It. *prima/dopo*, which analyses *prima* as a comparative and *dopo* as a preposition.[3] This is the only paper known to me that goes into the same direction as the following proposal. Del Prete's analysis is very different from mine and I must leave the discussion of his theory to another occasion.

The semantics of *before/after* is notoriously controversial and the semantics of the related adjectives is therefore interesting in itself. A study of the adjectives gains additional interest from the fact that they are constructed entirely differently from the temporal prepositions: they are degree adjectives and have a comparative, an equative and a positive variant. I will study the comparative and the positive variant.

Particular attention will be devoted to the positive forms of the adjectives because I have a novel proposal for a positive operator that solves a long standing puzzle in the semantics of degree adjectives, namely the question of how we can give a uniform treatment of the positive form of both poles of antonym pairs such as *tall/short*.

As I said, the comparative variants 'earlier'/'later' are particularly intriguing because they are temporal comparatives, and time is a dimension that has not been studied in the semantics of degree. The analysis of the two adjectives deepens our insight into the nature of degree constructions, one of the central areas of our thinking. Times play a double and perhaps confusing role in the semantics of 'early/late'. It was quite surprising to me that the roots of the two adjectives simply express the temporal relations $<$ (before) and $\geq$ (after or simultaneously), respectively. So the basic meanings are very much related to the meaning of the prepositions *before/after*, but the syntax and semantics of degree adjectives will make their behaviour entirely different.

Here are some data that illustrate that *früher/später* exhibit the relevant properties of

[1] Previous versions of this article were presented in Stuttgart on December 3, 2005, Saarbrücken on December 16, 2005, and in Frankfurt on June 1st, 2006. I want to thank the audiences for helpful comments. The original article contained sections about the interaction between *früh/spät* 'early/late' and *schon/noch/erst* 'already/still/only'. I am not sure anymore that this part was entirely correct. It is therefore left to another occasion. The German examples in the article are motivated by the earlier version. I could have made all the points with English alone. Since the German sentences are all translated and easy enough to remember, I have left them. I wish to thank Bhuvana Narasimhan for checking my English.

[2] See (Beaver and Condoravdi, 2003) and the references given there.

[3] (Del Prete, 2005)

comparative adjectives. The first two examples show that the adjectives have comparative complements.

(1-1) Alla kam früher/später zur Arbeit als Olga (kam).
Alla came earlier/later to work than Olga (came).

(1-2) Alla kam früher/später als wir dachten.
Alla came earlier/later than we thought.

As we expect, NPIs are licensed in the complement of both *früher* and *später* (as opposed to the complement of *after*).

(1-3) Alla kam früher/später zur Arbeit als **jemals** zuvor.
Alla came earlier/later to work than **ever** before.

(1-4) Alla kam früher/später als **auch nur** irgendjemand von uns gedacht hätte.
Alla went earlier/later than **anyone** of us would have thought.

(1-5) Alla gab ihre Arbeit früher/?später ab, als sie sie abzugeben **brauchte**.
Alla delivered her thesis earlier/?later than she **needed** to deliver it.

In the approach I am pursuing here, the meaning of comparative adjectives is not derived from that of positive adjectives (nor vice versa). I rather hold the view that the Positive is a particular universal quantifier, which quantifies over degrees. My semantics of the Positive will entail the following synonymy, which might be regarded as a diagnostic for the correctness of the meaning of the operator:

(1-6) a. Es ist nicht spät ↔ Es ist früh oder es ist weder früh noch spät.
it is not late ↔ it is early or it is neither early nor late
b. Es ist nicht früh ↔ Es ist spät oder es ist weder früh noch spät.
it is not early ↔ it is late or it is neither early nor late

For other degree adjectives similar equivalences should follow:

(1-7) a. Ede ist nicht groß ↔ Ede ist klein oder weder klein noch groß
Ede is not tall ↔ Ede is short or neither short nor tall
b. Ede ist nicht klein ↔ Ede ist groß oder weder klein noch groß
Ede is not short ↔ Ede is tall or neither short nor tall

My proposal for the semantics of the Positive may be regarded as a general contribution to the semantics and syntax of degree constructions.

The structure of the paper is this. 1. I start with the syntax/semantics of degree adjectives; I am assuming Heim's negation theory of antonymy[4] and introduce overt degree phrases. To explain cross-polar anomalies, the degree phrases have to be lifted to the quantifier level. 2. I then introduce a positive operator *Pos* that gives a unified semantics for polar opposites. *Pos* makes essential use of a contextually given function *N* that assigns each adjective *A* a neutral domain of $N(S_A)$, where S_A is the scale determined by A. *Pos* is a universal quantifier that is restricted by $N(S_A)$. 3. The next step is to introduce tense into degree constructions. 4. We are then prepared to formulate the meanings of the temporal adjectives *früh* 'early' and *spät* 'late'. We will show that the two denote the temporal relations < and ≥, respectively. 5. The next step will be to introduce the comparative. The usual analyses are transferred in a straightforward way to the temporal adjectives. The only non-trivial step is to account for the adverbial use of 'early'/'late'. I will have to introduce the Perfective

[4] (Heim, 2004)

Operator. 6. I shortly indicate where differentials ("5 minutes later") enter the picture.

2. 'NORMAL' DEGREE ADJECTIVES

In this section I will recapitulate Heim's version of the semantics of degree adjectives.[5] The basic idea for the semantics of adjectives is taken from (Cresswell, 1976). An adjective like *tall* determines a *scale* Σ_{tall} of degrees that are measured in meters in a vertical direction. The degrees themselves are abstract objects, say numbers assigned to equivalence classes of possible things that have the same height. So Σ_{tall} is more accurately a structure $\Sigma_{tall} = \langle S_{tall}, m, < \rangle$, where S_{tall} is a set of degrees that are linearly ordered by $<$ and whose distance is measured by the unit m (meter). I will assume that S_{tall} has a smallest element called 0 and has no upper bound, i.e. it contains arbitrarily high degrees. A further assumption is that the carrier set of a scale is dense, i.e., if d and d' are in a S_{tall} and $d > d'$, then there is a d'' in S_{tall} such that $d > d''$ and $d'' > d'$. The union of all carrier sets S_A is the set of degrees D_d.

The meaning of an adjective *A* is based on a measure function f_A that assigns each individual a degree on its scale S_A. Let us assume the type d for degrees together with the usual types e (individuals), i (times), v (events), s (worlds), t (truth-values). A measure function is therefore of semantic type ed. Typical measure functions are these:

(2-1) Measure functions
HEIGHT = $\lambda x \in D_e$.x's height
INTELLIGENCE = $\lambda x \in D_e$.x's intelligence
WEIGTH = $\lambda x \in D_e$.x's weight

Measure functions assign unique degrees to individuals. HEIGHT(x) is the maximal degree to which x is tall and so on for different measure functions. Since the height of a person varies with time and world, the functions also depend on time and world. We will add these parameters when we need them.

For (Cresswell, 1976), an adjective *A* relates an individual *x* to the unique degree *d* it occupies on the scale D_A, i.e., there is precisely one *d* such that *A* holds of the pair (x,d). Heim builds a monotonicity condition into the meaning of *A*: when an adjective *A* is true of the pair (x,d), then it is true also of every (x,d') where $d' < d$. If we take into account everything we have said so far, the meaning of degree adjectives can be described in the following way.

(2-2) Degree adjectives
$[\![\textbf{tall}]\!] = \lambda d: d \in S_{tall}.\lambda x \in D_e.\ HEIGHT(x) \geq d$

Following (Heim, 2004), antonym pairs such as *tall/small* are related via internal negation.[6]

(2-3) Adjective Negation (internal negation)
$[\![\neg_{(det)(det)}]\!] = \lambda R_{det} \lambda d.\lambda x.\neg R(d)(x)$

This is a sloppy definition. We will have to make sure that the negation remains within the scale of adjective under consideration. We may define the negative pole by means of the positive pole plus negation, or we may do it the other way round. The antonyms of the adjectives considered may be defined in the following way:

(2-4) a. **short** := **¬ tall**

[5] (Heim, 2004)
[6] A related, but only axiomatic, proposal has been made in (von Stechow, 1984b)

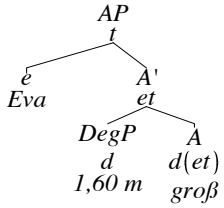
b. **stupid** := ¬**intelligent**

Degrees of adjectives can sometimes be made explicit by overt degree phrases as in the following example.

(2-5) Eva ist 1,60 m groß.
Eva is 1.60 m tall.

The most straightforward LF is the following:

(2-6) LF without tense



HEIGHT(Eva) ≥ 1, 60 m

Note that this LF contains no positive operator although the morphology of the adjective is positive. The semantics predicts the following two implications, which seems correct.

(2-7) a. Eva is not 1, 60 m tall ==> Eva is smaller than 1, 60 m.
b. Eva is 1,60 m tall ==> Eva is 1, 56 m tall

This account cannot, however, explain the oddness of the following sentence.

(2-8) #Eva is 1,56 m short.

In fact, the analysis would yield the following meaning for the sentence, obviously a wrong prediction:

(2-9) HEIGHT(Eva) < 1,56 m
"Eva is shorter than 1,56 m"

(von Stechow, 1984b) says that degree phrases play a double role: they name the top of an interval and measure the length of the interval. Negative poles don't have a length because they are unbounded at one side. Therefore measure phrases only combine with positive poles.

(2-10)

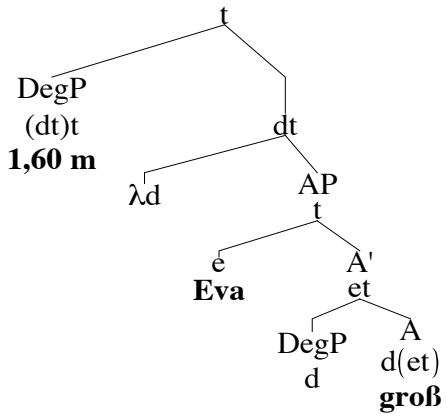
[.....Eva 1,56 m tall.....](.....#Eva 1,56 m short.....>
|++++++++++++++++++1,56----------> ∞

This explanation has been accepted by a number of researchers, e.g. (Kennedy, 2001) and (Meier, 2003b), and I will assume that it is correct. In order to implement the idea, we have to type-lift degree phrases to the quantifier level:

(2-11) Measure phrases are of type (dt)t.
$[\![\textbf{1,56 m}]\!] = \lambda I_{dt}$: I has a finite length. LENGTH(I) ≥ 1,56 m.

The LF of (2-5) is now:

(2-12) Eva is 1,60 m tall



LENGTH(λd.HEIGHT(Eva) ≥ d) ≥ 1,60 m

The set λd.HEIGHT(Eva) ≥ d may be regarded as the interval which corresponds precisely to Eva's height.[7] Clearly this interval has a finite length, though it contains infinitely many degrees (as any dense interval does).

The revised semantics makes (2-8) undefined because the interval **λd.Eva (is) d-short** has no finite length. For different proposals, see (Klein, 1980), (Bierwisch, 1987), (Schwarzschild, 2004) among others.

The reader may verify for himself that the inferences in (2-7) are preserved under the revision. Furthermore, negated sentences are correctly analysed:

(2-13) a. Eva ist keine 1,60 m groß.
Eva is not 1,60 m tall
b. **not [1,60 m [λd. Eva d tall]]**
= LENGTH(λd.HEIGHT(Eva) ≥ d) < 1,60 m

LENGTH(D) is defined as MAX(D) – MIN(D). If D has no maximal or minimal element, the difference is not defined.

Note that sentences with overt degree phrase are morphologically positive, but they do not contain the Positive Operator, which is introduced in the following section. The Positive Operator will make the denotation of APs context dependent. The denotation of APs with overt degree phrases is not context dependent but absolute.

3. A NEW POSITIVE OPERATOR

The positive operator I propose is based on the assumption that a degree scale *S* like that for *tall* is divided into three parts, a part that contains the short things under consideration, a part that contains the tall things under consideration, and a neutral part *N(S)* that contains the things that are neither short nor tall.

(3-1) S |--------[-------------------]--> ∞
short Neutral **tall**

This picture has been popular in the semantics of polar adjectives for decades, but it has never been exploited for the semantics of the Positive Operator, which is defined in the

[7] (Kennedy, 2001) calls these sets degrees and takes them as basic units for the semantics.

following way:

(3-2) The Positive Operator
$[\![\mathbf{Pos}_N]\!]^g = \lambda A_{dt}.(\forall d \in g(N)(S_A))\ A(d)$

N is a contextually determined function that gives the neutral segment of the scale in a particular context, I assume that the scale is provided by the adjective modified. In other words, the **Pos**-operator is a universal quantifier over degrees, which is restricted by the contextually neutral degrees of the relevant scale. Note that the scale S_A is uniquely determined by the adjective A, but the neutral segment $g(N)(S_A)$ varies with the contextual assignment function g.[8] Recall Cresswell's (1976) observation, which makes the point:

(3-3) Fifi is a big flea but a small animal.

The two Positive Operators that figure in the LF of this sentence are relativized to two different neutral functions. The first gives us the sizes of fleas that are neither small nor big, the second gives us the sizes of animals that are neither small nor big.

Here is the LF for a simple positive sentence.

(3-4) Ede is tall.
$[\![\mathbf{Pos}_N\ \lambda d.\mathbf{tall(d)(Ede)}]\!]$ iff $(\forall d \in N(S_{tall}))$ HEIGHT(Ede) $\geq$ d
|--------[------------------]----x-----------------> ∞

In the picture, x stands for the height of Ede. There is a glitch here. In the limiting case, the height of Ede might coincide with the right border of the neutral interval. Then (3-4) should be true in a scenario where Ede belongs to the things that are neither tall nor short. In order to avoid this unwelcome consequence, we have to add the stipulation that the right border of the neutral interval counts as positive tallness. I will assume this henceforth.

Consider the interaction of **Pos** with negation. Recall that we want to deduce the equivalences in (1-7). Syntactic negation has the standard meaning, viz. reversal of truth-value.

(3-5) Ede is not tall.
$[\![$ **not** $\mathbf{Pos}_N\ \lambda d.\mathbf{tall(d)(Ede)}]\!]$ iff $\neg(\forall d \in N(S_{tall}))$ HEIGHT(Ede) $\geq$ d
|--------[---------x----------]----------------> ∞
or
|-----x--[------------------]----------------> ∞

Syntactic negation always has wide scope with respect to **Pos**. A negation that has narrow scope with respect to **Pos** is morphologically realised as the negative pole of the antonym pair. I leave it to the reader to draw diagrams for the examples involving the adjective *short*.

(3-6) Ede is short.
$[\![\mathbf{Pos}_N\ \lambda d.\mathbf{short(d)(Ede)}]\!]$ iff $(\forall d \in N(S_{tall}))$ HEIGHT(Ede) < d

(3-7) Ede is not short.
$[\![$ **not** $\mathbf{Pos}_N\ \lambda d.\mathbf{short(d)(Ede)}]\!]$ iff $\neg(\forall d \in N(S_{tall}))$ HEIGHT(Ede) < d

And, of course, we can express the idea that Ede's height is in the neutral area of the scale.

(3-8) Ede is neither short nor tall:

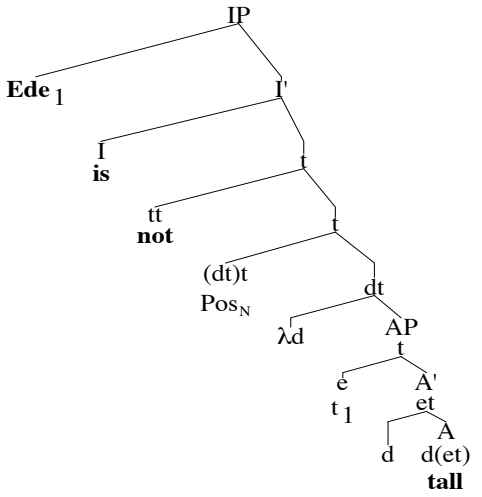
[8] It is tedious to write g in the semantics. Therefore I will omit it henceforth, but it should be there.

⟦not Pos_N λd.short(d)(Ede) & not Pos_N λd.tall(d)(Ede)⟧
iff ¬(∀d ∈ N(S_{tall})) HEIGHT(Ede) < d & ¬(∀d ∈ N(S_{tall})) HEIGHT(Ede) ≥ d

It is obvious from these examples that the equivalences in (1-7) are valid.

A remark on the relation between LF and s-structure might be helpful at this point. Here is the s-structure for (3-5):

(3-9) Ede is not tall (SS)



Since we have ignored tense, the copula may be assumed to be semantically empty. It is therefore deleted at LF by Chomsky's Principle of Full Interpretation (FI), which says that an interface (LF or PF) contains only material interpretable at the interface. The subject is reconstructed to its base position. That gives us the formula in (3-5).[9]

The positive operator gives a unified semantics for the positive and the negative pole of an antonym pair. Let us compare this with earlier treatments of the positive. The approaches known to me may be characterized as follows:

1. The positive is the basic notion. The comparative is derived from the positive via universal quantification over contextually given delineations ((Lewis, 1972), (Kamp, 1975), (Klein, 1980)). A delineation s^+_c for 'tall' separates the tall objects from the not-tall objects. We can define tall(c) as the set of objects that are at least s^+_c-tall. Obviously, we need a different delineation s^-_c for the polar opposition 'short'. Given the two delineations, the comparative can be defined as an appropriate quantification over contexts. For example, the comparative would be this:

Ede is taller/shorter than Mary iff
(∀c)[Mary ∈ tall/short(c) → Ede ∈ tall/short(c)]
& (∃c)[Ede ∈ tall/short(c) & Mary ∉ tall/short(c)]

A theory of this kind is possible, but it requires "monstrous" quantification over contexts and is conceptually complicated. The concept 'monster' is understood in the sense of (Kaplan, 1979).

2. The positive and the comparative apply to the AP and are in complementary distribution: (Cresswell, 1976), (von Stechow, 1984b), (Bierwisch, 1987), (Kennedy, 2001),

[9] (Chomsky, 1986)

among others. (von Stechow, 1984a: p. 60) assumes for each degree adjective a contextually given comparison class C, and states the truth-condition for a simple positive statement as follows:

Pos_C λd.Ede is d-tall iff (∃d)[Ede is d-tall & d > average(C)]

Suppose C is the set of men. Then *average(C)* is the size of the average man, whatever that may be. It is clear that this approach can work only for the positive pole of the adjective. The negative pole requires a different operator, which gives us a degree *below* the average:

Neg_C λd.Ede is d-short iff (∃d)[Ede is d-short & d < average(C)]

So no unified account of the meaning of the positive is possible in this theory.

A simpler account of these kinds of theories assumes a contextually given standard s for tallness.[10] The sentence "Ede is tall" may then be analysed as:

∃d[Ede is d-tall & d ≥ s]

So Pos_s := λA.∃d[A(d) & d ≥ s]. Again, this only works for the positive pole. The negative pole needs a second standard s' and a second operator $Neg_{s'}$ = λA.∃d[A(d) & d < s].

All these approaches must therefore have access to an ordering relation > and its converse <. The degree semantics given here doesn't have access to either of these relations for compositionality. Our operator fits the architecture of the semantics of antonyms very naturally.

3. A semantics for the Positive that comes close to my proposal is found in (Kennedy, 2001). Kennedy's approach to the semantics of degrees is, however, different. His degrees are intervals. Positive degrees are finite initial segments of a scale, and negative degrees are proper final segments of a scale. Adjectives are measure functions that assign individuals a unique degree. Positive poles assign positive degrees and negative poles assign negative degrees. Thus **tall(Ede)** is a unique degree that corresponds to the height of Ede.[11] **short(Ede)** is the complement of this interval. The Positive Operator converts this degree into a truth-value. $\mathbf{Pos_s}$ **tall(Ede)** is true iff **tall(Ede)** ≥ s and $\mathbf{Pos_{s'}}$ **short(Ede)** is true if **short(Ede)** ≥ s', where s and s' are the contextually given standards for tallness and shortness respectively. s' and s correspond exactly to the left and the right border of my neutral interval. So this approach seems equivalent with mine. Kennedy has to add, however, the stipulation that the positive standard s is always higher on the scale than the negative standard s'. If the neutral zone is an interval, we don't need this stipulation.

My semantics for the Positive Operator encounters none of the difficulties mentioned. It is a unified account and empirically adequate.

Monika Rathert asked me how *sehr* 'very' is treated in this approach. The 'very' interval must be a superinterval of the neutral interval of *N(S)* that symmetrically includes both bounds of *N(S*). *very* stands in complementary distribution with the **Pos**-operator.[12]

[10] For a semantics of this kind, see (Meier, 2003a), among others.

[11] It is our interval LENGTH(λd.HEIGHT(Ede) ≥ d).

[12] As it stands, the semantics for very is not compatible with the iteration *very very*… . Intuitively, there is a scale of nested intervals *Pos*, *very*, *extremely*. Extremely can be expressed by *very very* or *very very very*. So there remains work to be done to get the facts right.

(3-10) **very$_N$ λd.short(d)(Eva)**

The following lexical entry states the meaning of **very**:

(3-11) $[\![\textbf{very}_N]\!]^c$ = λA_{dt}:c specifies an Interval I that symmetrically includes $N(S_A)$ and is considerably bigger than $N(S_A)$. $(\forall d \in I)A(d)$.

The reader may check for himself that this semantics gives the correct readings for **not very short**, **not very tall** and **neither very short nor very tall** as well. The fact that we can express the meaning of **very** so easily supports the present approach to the Positive.

4. INTRODUCING TENSE

Up to now we have been neglecting tense. The adjectives **früh** 'early' and **spät** 'late' obviously have to do with time. Let us therefore introduce time dependency. I will assume that the temporal argument of a predicate is the last one that is saturated by Functional Application. As I said earlier, the logical type of times is i. Therefore the logical type of degree adjectives e(dt) is changed into the more complicated type e(d(it)), and the semantics for the tensed version of degree adjectives is this:

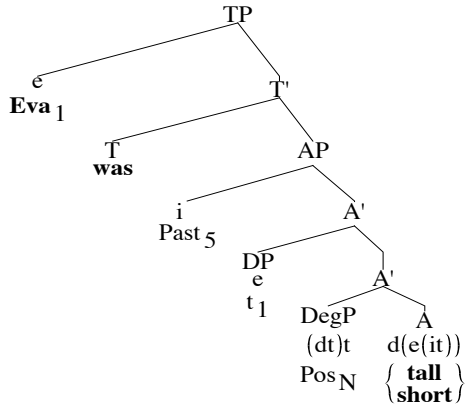
(4-1) Tensed degree adjectives, type d(e(it))
$[\![\textbf{tall}]\!] = \lambda d.d \in S_{tall}.\lambda x \in D_e.\ \lambda i \in D_i.\ HEIGHT_i(x) \geq d$
$[\![\textbf{short}]\!] = \lambda d.\ d \in S_{tall}.\lambda x \in D_e.\ \lambda i \in D_i.\ HEIGHT_i(x) < d$
$HEIGHT_i(x)$ = the height of x at time i

I will assume a referential theory of tense; cf. (Heim, 1994), (Kratzer, 1998), but the choice is not really important. Most other theories of tense that are on the market would do as well.

(4-2) $[\![\textbf{Pres}]\!]^c = t_c$ (the speech time)
$[\![\textbf{Past}]\!]^c = \lambda i:i < t_c.i$

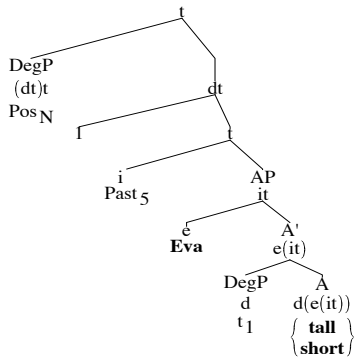
In other words, $[\![\textbf{Past}]\!]^c$ is a functor that restricts the denotation of its argument, a temporal variable i; i has to be before the speech time; cf. (Heim, 1994). The argument of **Past** will be represented as a free temporal variable, whose value is determined by the contextually given assignment function g. If **n** is a variable of type i, we will mostly write **Past$_n$** for **Past(n)**. Here is a tensed LF for a simple sentence:

(4-3) Eva was tall/short (SS)



The copula **was** is semantically empty and is therefore deleted at LF by Chomsky's Principle of Full Interpretation. The Positive Operator has to be QR-ed for type reasons. The subject **Eva** is reconstructed to its base position. This construal gives us the following transparent LF:

(4-4) Eva was tall/short (LF)



$(\forall d \in N(S_{tall}))\ HEIGHT_{i5}(Eva) \geq d$ (or "< d" if the adjective is **short**)

We are now prepared to introduce the temporal adjectives *früh* 'early' and *spät* 'late'.

5. FRÜH '*EARLY*'/SPÄT '*LATE*'

Let us transfer the semantics of degrees to the temporal adjectives *spät/früh* 'late/early'. The analytic idea is that *spät* 'late' is the positive and *früh* 'early' is the negative pole. This is obvious from the fact that German temporal questions use the adjective 'late' and not

'early':

(5-1) a. Wie spät ist es?
how late is it
'What is the time?'
b. #Wie früh ist es?
how early is it

Times play a double role: since they are ordered, they may play the role of a temporal degree: t > t' if t is later than t'. On the other hand, qua location on the time axis, a time may also play the role of the subject of the adjective. So, what does 'late' mean?

Suppose this adjective did relate an event e to the degrees with respect to which e is late. The first difficulty we meet is that the semantics for polar adjectives requires a scale with a beginning, but the time stretch has no beginning (or one in a remote past which is not relevant for the meaning of the adjectives). So we must assume a contextually given final segment I of the time scale T. The relevant degrees are obviously the time points in the interval I. Analogous to a degree adjective like "tall", the lexical entry for 'late' is expected to be the following:

(5-2) $[\![\textbf{spät}_I]\!]$ = λd:d ∈ I & I is a proper final segment of T.λe ∈ D_v.λi ∈ T. TIME(e)(i) ≥ d.
(first attempt)

TIME is a measure function that assigns each event e its temporal degree. What is that? It couldn't be the duration of e. If we say of two events e_1 and e_2 that e_2 is later than e_1, we don't mean that e_2 has a longer duration than e_1. We rather mean that e_2 occurs at a later time than e_1. We obtain this result if we say that the running time of e_2 is after the running time of e_1. The standard notation for the running time of an event e is τ(e).[13] Therefore, we can rewrite the rule in the following way:

(5-3) $[\![\textbf{spät}_I]\!]$ = λd: d ∈ I & I is a proper final segment of T.λe ∈ D_v.λi ∈ T. τ(e)(i) ≥ d.
(TIME = τ)

Since the running time of e is the same for each time, we can omit the time argument of the τ-function. Recall further that degrees of lateness are times. Therefore we can replace the degree argument by a time argument and rewrite the rule in a simpler way as:

(5-4) $[\![\textbf{spät}_I]\!]$ = λi: i ∈ I & I is a proper final segment of T.λe ∈ D_v. τ(e) ≥ i.
(simplification)

A problem with this rule is that it is not clear how to hook up the event time to the reference time, which is given by the tense of the sentence. We are assuming a framework in which an aspectual operator like Perfective (PF) maps the event time into a reference time (see below). In other words, the temporal localisation of the event is not performed by the adjective 'late' but by an aspectual operator. But then 'late' can simply denote a two-place relation that applies to the reference time and its temporal degrees of lateness. Hence our entry for the adjective 'late' is the following.

(5-5) 'late' :type i(it) (official rule)
$[\![\textbf{spät}_I]\!]$ = λi: i ∈ I & I is a proper final segment of T.λi' ∈ I.i ≥ i'.

The first time argument – the object – plays the role of the degree of lateness, the second time argument – the subject of the adjective – is the reference time of the sentence. We are now in a position to analyse the following sentence (which has kept puzzling me for a long

[13] Cf. (Krifka, 1989) among many others.

time):

(5-6) Es war spät 'It was late'
Pos_N λ_2 [$Past_5$ t_2 $late_I$]
($\forall$t $\in$ N(I)) $Past_5 \geq$ t
I: |.....(.....)....$Past_5$.....> ∞
early N(I) late

This means that the reference time is in a contextually determined time span *I* but after the neutral time interval *N(I)*, which counts as neither early nor late.

The negative pole *früh* 'early' is of course defined in terms of internal negation, i.e., $[\![\textbf{früh}_I]\!] = \neg[\![\textbf{spät}_I]\!]$. Therefore the sentence

(5-7) Es war früh 'It was early'

means that the reference time is before the neutral time *N(I)*. I leave it to the reader to check for himself that the sentences involving negation all get the correct reading:

(5-8) a. Es war nicht spät. 'It was not late'
b. Es war nicht früh. 'It was not early'
c. Es war weder früh noch spät. 'It was neither early nor late'

The surface syntax of (5-6) might be something like this:

(5-9) $[_{TP}$ **es** $[_{T'}$ **war** $[_{AP}$ $Past_5$ $[_{A'}$ Pos_N **$spät_I$**$]]]]$

The semantically empty expletive **es** and the copula **war** are deleted by the Principle of Full Interpretation, Pos_N is QR-ed for type reasons. This yields the transparent LF.

6. *Temporal Adjectives as Adverbs*

In comparative constructions our temporal adjectives are used as adverbs. So we have to say something about the interpretation of the adverbial construction. The default interpretation for modification is set-theoretical intersection. *Cecile is a charming woman* means that Cecile has the property of being a woman and of being charming. Similarly, *Alla came late* means that a particular past time has the property of being late and of being the time containing a coming of Alla. This sounds simple but is somewhat tedious to spell out.

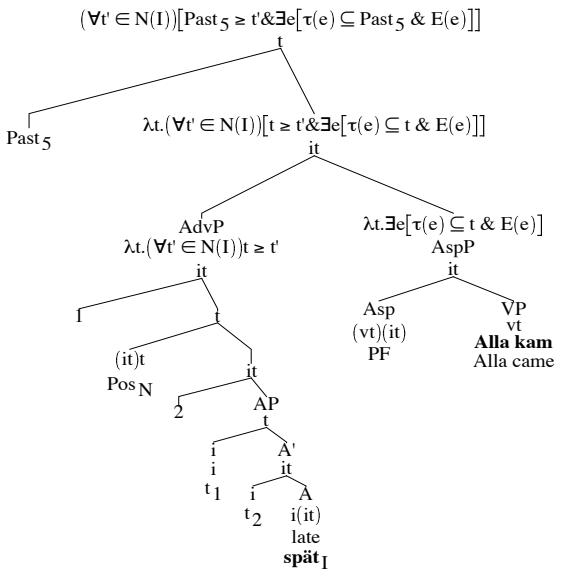
Here is first what the Perfective Aspect does: it says that the event time is included in the reference time[14]:

(6-1) Perfective Aspect :type (vt)(it)
$[\![PF]\!] = \lambda E.\lambda i.\exists e[E(e) \,\&\, \tau(e) \subseteq i]$.

The sentence *Alla kam spät* 'Alla arrived late' would then have the following LF, where "E" stands for Alla's coming:

(6-2) 'Alla came late' (LF)

[14] This is the standard meaning for the Perfective. See (Krifka, 1989) and (Klein, 1994) among many others.



This can be paraphrased as "The time of an arrival of Alla is at least as late as every time in the neutral interval." Note that the AdvP and the AspP are combined via the intersection rule, i.e., by what (Heim and Kratzer, 1998) call Predicate Modification.

(6-3) I |----------[//////////]----[--e--]---------->

N(I) $Past_5$

In this picture, "e" stands for the event of Alla's coming. The surrounding bracket denotes the reference time, i.e., the denotation of $Past_5$.

7. FRÜHER '*EARLIER*'/SPÄTER '*LATER*'

The application of the usual comparative semantics to our temporal degree adjectives is straightforward now. I will adopt Heim's (2001) formulation of the comparative and equative, which is inclusion between sets of degrees. Consider first the analysis of *John was taller than Mary*. The LF is this:

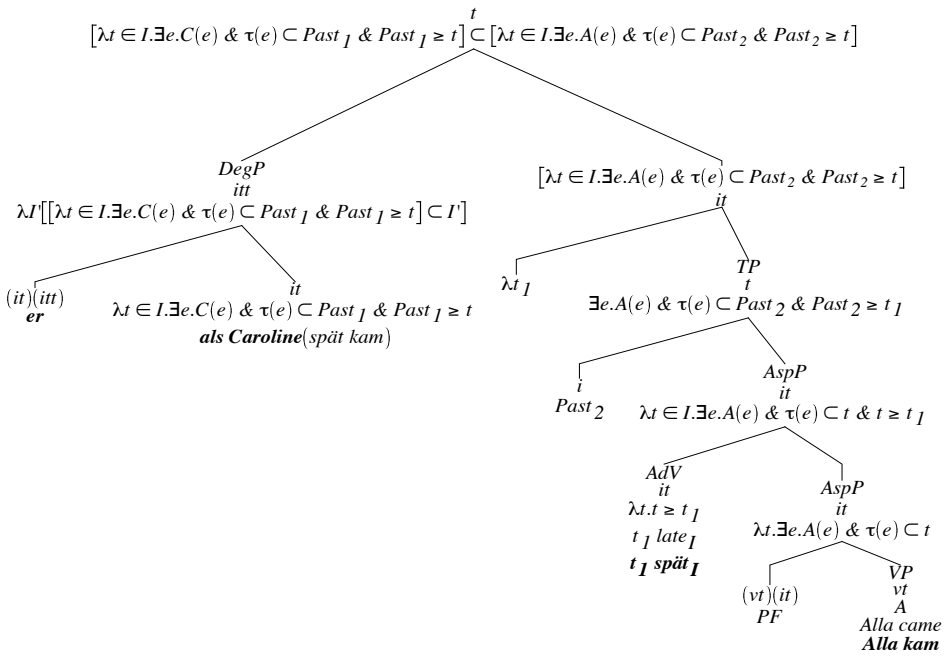
(7-1) John was taller than Mary.
-er [λd. Mary d-tall at $Past_5$] ⊂ [λd. John d-tall at $Past_5$]

The LF is constructed in the usual way. For convenience I give the meaning rule for the Comparative.

(7-2) Comparative morpheme
[[**-er**]] = $\lambda P_{dt}.\lambda Q_{dt}.P \subset Q$.

To facilitate the reading, I give the LF for a temporal comparative in greater detail:

(7-3) Alla kam später als Caroline 'Alla came later than Caroline'



Note that it is essential that the two semantic tenses in the construction are different. One indicates the time of Alla's coming, the other that of Caroline's coming. The two tenses are the upper limits of the intervals that are compared. Here is a picture, which illustrates that the truth-condition given by the LF is correct.

(7-4) I: |.....[Past1].....[Past2].....> ∞
++++++++++++++ times up to Caroline's coming
++++++++++++++++++++++++++ times up to Alla's coming

Früher 'earlier' is, of course, analysed in exactly the same way as APs that have ¬ **spät** as their head. The reader may check for himself that the following equivalences are predicted by our semantics.

(7-5) Caroline kam früher als Alla ↔ Alla kam später als Caroline
Caroline came earlier than Alla ↔ Alla came later than Caroline

If we now assume Ladusaw's (1980) theory of NPI-licensing, the occurrence of NPIs in the complements of *früher/später* is explained because the comparative induces a downward entailing context. It doesn't matter whether we consider the positive or the negative pole of the pair.

8. DIFFERENTIALS

It is always important to ask whether differentials can be integrated into a semantics of comparison. Here are two examples.

(8-1) a. Alla ist (um) 5 cm größer als Ede.

Alla is (by) 5 cm taller than Ede

b. Alla kam 5 Minuten später als Caroline.
Alla came 5 minutes later than Caroline

It is pretty obvious what these mean: subtract the interval that corresponds to Ede's height from the interval that corresponds to Alla's height. The result must be an interval of length 5 cm. This is the meaning of sentence (a). Similarly for (b): subtract the times up to Caroline's coming from the times up to Alla's coming. The result should be an interval of length 5 minutes.

The differential phrase is presumably best analysed as a PP that modifies the comparative morpheme. For sentence (8-1a), the following meaning rule would do:

(8-2) $[\![[_{PP}$ **by 5 cm**$]]\!] = \lambda R_{(dt)((dt)t)}$: R = $[\![$ **-er** $]\!].\lambda D_{dt}.\lambda D'_{dt}.R(D)(D')$ & LENGTH(D' - D) = 5 cm

The LF for (8-1a) is the following formula:

(8-3) **[by 5 cm er] [λd. tall(d)(Ede)(Pres)][λd. tall(d)(Alla)(Pres)]]**
$= \lambda d.HEIGHT_{Pres}(Ede) \geq d \subset \lambda d.HEIGHT_{Pres}(Alla) \geq d$
& $LENGTH(\lambda d.HEIGHT_{Pres}(Alla) \geq d - \lambda d.HEIGHT_{Pres}(Ede) \geq d) = 5$ cm

The analysis of for (8-1b) proceeds in a parallel manner and is left to the reader.

8.1.Summary

I have interpreted the temporal adjectives 'early' and 'late' as degree adjectives and I have shown that the analysis accounts for some hitherto puzzling phenomena. I started with the observation that 'earlier'/'later' require a comparative analysis. Both comparative adjectives license NPIs in their complements. The adjectives engender two puzzles in connection with phase adverbs, which I dubbed the Type-1 Puzzle and the Type-2 puzzle.

The particular ingredients of my analysis are these.

1. Every scale of degrees is contextually restricted to an interval *S* that might be called the frame of the adjective. The context determines a function *N* that gives us the neutral degrees within *S*.
2. I have introduced a new positive operator *Pos*, which is a universal quantifier over degrees that is restricted by *N(S)*. This operator works equally well for the positive and the negative pole of an antonym pair.
3. I gave a semantics for the temporal adjectives 'early' and 'late' in terms of times as degrees. Times play a double conceptual role here. Qua subjects of the adjectives, they are locations on the time axis, qua objects they are degrees. 'early' expresses the temporal relation <, 'late' expresses the relation ≥.
4. I analysed the comparative adjectives 'earlier'/'later' in the standard way and showed that NPIs are licensed in the complement. The analysis is not entirely trivial, because we have to consider adverbial uses of the two adjectives. This necessitates the introduction of the perfective operator.

As a final remark I have to add some caveats. The semantics of adjectives on which my proposal is based is rather conservative. It works for the purposes discussed in this paper, but it cannot explain the scope puzzles arising with quantifiers in comparative clauses, which have been discussed in (Schwarzschild and Wilkinson, 2002), (Heim, 2001, Heim, 2003) among others. For instance, why does the quantifier *everyone of us* in *Irene is more intelligent*

than everyone of us is have wide scope with respect to the comparative operator? For equatives, the present semantics can't even express the correct truth-condition for a sentence like *Eva is as pretty as no one of us is* (= Eva is prettier than everyone of us). A treatment of these requires more elaborate methods. I think that the perspective opened in (Schwarzschild and Wilkinson, 2002) will ultimately turn out to be the most promising one: the adjective 'tall' doesn't relate Ede to the degrees d to which Ede is tall, but to the sets D of degrees that contain Ede's height. Such an account will complicate the issues considerably and will lead to a revision of the semantic rules presented here. I think that the main results obtained in this paper for the positive and the comparative can be conserved under revisions of the approach, but we will have to say something different about the equative. These issues are topics for another paper.

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