Causation, Event Structure and Process Specifying Adverbials

Tavs Bjerre

Based on data from Danish, this article examines various linguistic means of expressing causation. It is argued that *inchoatives, causatives* and *accomplishments* all denote situations in which one situation − subevent $_1$, is construed as causing another − subevent $_2$. *Inchoatives* and *causatives* are described as having different kinds of underspecified subevent $_1$. The bulk of the article is concerned with an analysis of prepositional phrases of a type termed *Process Specifying Adverbials*, (PSAs). It is argued that PSAs serve to specify subevent $_1$, and their behaviour is seen as corroborating the proposed analysis for *inchoatives* and *causatives*. The analysis is formalized within the framework of HPSG.

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1. INTRODUCTION

Causation is a fundamental notion to human beings. This is reflected in language by the numerous − and frequently used − means we have at our disposal to describe situations involving causation.

In this article I start out by considering what it is the Danish sentences in (1) have in common, and what sets them apart.

(1) a. Marie vågnede.
      Mary woke up
    b. Bo vækkede   Marie.
      Bo awakened   Mary
    c. Bo ruskede Marie vågen.
      Bo shook   Mary awake

In order to do that, I sketch a proposal for an event structure with sub-events, building on and further developing ideas from the work of Dowty (1979); Jackendoff (1983, 1990); Levin & Hovav (1995); Parsons (1990) and Pustejovsky (1988, 1991, 1995).

In the second part of the article the focus is on prepositional phrases like those shown in (2).

(2) a. Marie vågnede ved at Bo råbte.
         Mary woke up by that Bo shouted
     b. Marie vågnede af at Bo råbte.
         Mary woke up of that Bo shouted
     c. Bo vækkede Marie **med sin råben**.
         Bo awakened Mary with his shouting

I examine the interaction of these PPs with VPs expressing various event structures and thereby try to establish on the one hand what licenses the PPs and on the other if the proposed event structure is tenable.

2. EVENT STRUCTURE

(3) through (6) are examples of the possibilities of expressing causation in Danish:

(3) a. Marie vågnede.
         Mary   woke up

     b. Peter kom   ud i   haven.
         Peter came out in garden-the

(4) a. Bo vækkede   Marie.
         Bo awakened Mary

     b. Bo fik Peter ud i   haven.
         Bo got Peter out in garden-the

(5) a. Ane byggede et hus.
         Ane built   a   house

     b. Peter løb ud i   haven.
         Peter ran out in garden-the

(6) a. Bo spiste sin mor   ud af   huset.
         Bo ate   his mother out of house-the

     b. Bo ruskede Marie vågen.
         Bo shook   Mary awake

The verbs in (3) and (4) belong to the class of *achievement verbs*, those in (5) and (6) are *accomplishments* (Vendler 1957), my definition of these terms differs somewhat from Vendler's, though. Verbs like those in (3) are often called *inchoatives* (cf. (Levin 1993: 27–33) and references there) while those in (4) are called *causatives*. VPs like those in (6) have been much discussed recently under the name of *resultatives*

(e.g. Hoekstra (1988); Carrier & Randall (1992); Goldberg (1995); Verspoor (1997)).

It is my claim that causation is part of the semantics of all of the sentences above. They all denote complex situations in which one situation is construed as causing another. The causing situation I term *subevent$_1$*. It must be a process, as only processes may cause change.

The resulting situation is termed *subevent$_2$*. It may be a state, as in the sentences above, or it may be a process (plus possibly a state). All of the sentences above have a CONTENT-value of the type *result-psoa*.

The difference, I claim, between the semantics of the VP-types exemplified in (3) through (6) lies in the specificity of subevent$_1$. In (3), subevent$_1$ is totally underspecified, any process may satisfy the description, provided it can be construed as the cause. Figure 1 shows the representation of the semantics of inchoatives, as exemplified by (3a).

$$\text{CONTENT} \begin{bmatrix} \textit{inchoative-psoa} \\ \text{E1} \quad \textit{abs-unspec-rel} \\ \text{E2} \quad \textit{awake-rel} \\ \text{E-REL} \ \textit{cause} \end{bmatrix}$$

Figure 1. CONTENT value of *vågne* 'wake up'.

E1 and E2 take those relations as values that hold for subevent$_1$ and subevent$_2$, respectively. The value *cause* for the attribute E(vent)-REL(ation) expresses that subevent$_1$ precedes subevent$_2$, and that the former is construed as causing the latter. Furthermore, the negation of the state in E2 must hold prior to E2, i.e. for someone to be able to wake up he must have been asleep prior to the coming about of subevent$_2$. I will express this presupposition by the constraint shown in Figure 2 stating that for any sign with a CONTENT-value of type *result-psoa*, it must hold that the negation of the relation in E2 is in the set of background relations.

$$\begin{bmatrix} \textit{sign} \\ \text{SS} \mid \text{LOC} \mid \text{CONT} \ \textit{result-psoa} \end{bmatrix}$$
$$\longrightarrow$$
$$\begin{bmatrix} \text{SS} \mid \text{LOC} \begin{bmatrix} \text{CONT} \mid \text{E2} \ \boxed{1} \\ \text{CONTEXT} \mid \text{BACKGROUND} \ \{.., \ \neg\boxed{1}, \ ..\} \end{bmatrix} \end{bmatrix}$$

Figure 2. *Result-psoa* constraint.

In (4), subevent$_1$ is also underspecified, but in this case the relation is constrained to being a process in which the subject plays the role of actor. The representation of the semantics of causatives is shown in Figure 3.

$$\text{CONTENT} \begin{bmatrix} \textit{causative-psoa} \\ \text{E1} \quad \textit{unspec-act-rel} \\ \text{E2} \quad \textit{awake-rel} \\ \text{E-REL} \;\; \textit{cause} \end{bmatrix}$$
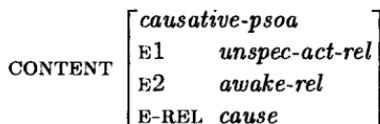
Figure 3. CONTENT value of *vække* 'awaken'.

In the accomplishments (5) and (6) on the other hand, subevent$_1$ is specified. In (5a) it was the building-process of which Ane was the actor that led to the existing of the house, in (5b) Peter ran, and this resulted in his being in the garden. In (6a) Bo ate (something) resulting in his mother being outside the house. And, finally, in (6b) Bo shook (Mary) which led to Mary's being awake. Figure 4 shows an *accomplishment-psoa*.

$$\text{CONTENT} \begin{bmatrix} \textit{accomplishment-psoa} \\ \text{E1} \quad \textit{shake-rel} \\ \text{E2} \quad \textit{awake-rel} \\ \text{E-REL} \;\; \textit{cause} \end{bmatrix}$$
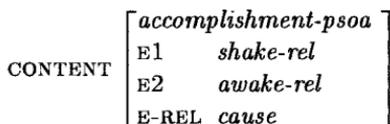
Figure 4. CONTENT value of *ruske vågen* 'shake awake'.

Figure 5 summarizes what I have said so far.
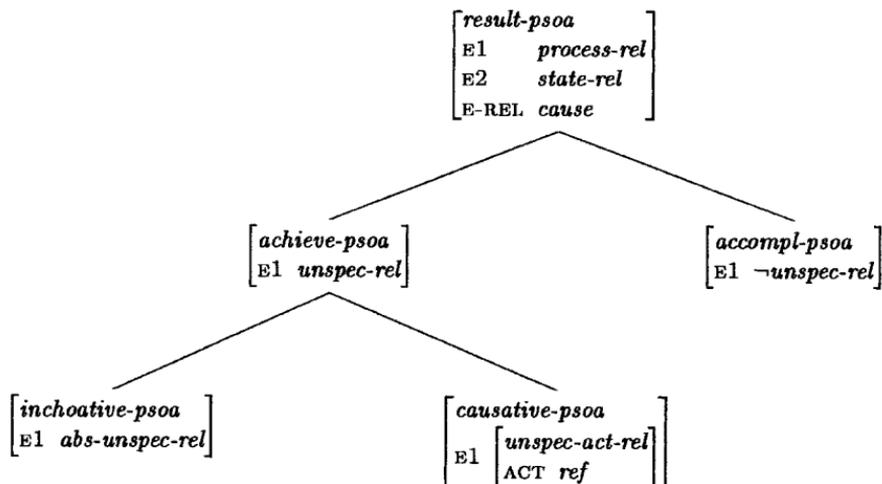
Figure 5. Complex event structures.

A *result-psoa* is a (conceptualized) complex situation consisting of a process preceding and causing (the coming about of) a state. The two subtypes of *result-psoa* are distinguished on the basis of the specificity of E1. *Achievement-psoa* has an underspecified E1 splitting into *inchoa-*

tive-psoa with an absolutely underspecified E1 and *causative-psoa* with an underspecified E1 in which the first argument must play the role of actor. *Accomplishment-psoa* has a specified E1.

The idea of causation as a relation between events is discussed and supported in Dowty (1979). Jackendoff (1990) gives the following formation rule:

$$[\text{EVENT}] \longrightarrow \begin{bmatrix} event \\ \text{CAUSE}\left(\left[\left\{\begin{matrix} \text{THING} \\ \text{EVENT} \end{matrix}\right\}\right], [\text{EVENT}]\right) \end{bmatrix}$$

Figure 6. CAUSE (Jackendoff 1990: 43).

adding that if the first argument of CAUSE is a thing, it is an agent, thus in fact saying the same as the present proposal though less precisely. The major difference between the theories of Dowty and Jackendoff and others and the present proposal is the uniform treatment of inchoatives, causatives and accomplishments, the sole difference being the specificity of subevent $_1$.

The idea of an underspecified subevent $_1$ has been advocated by for example Chierchia (1989) cited in Levin & Hovav (1995), and the event structure proposed here has much in common with the proposal in Levin & Hovav (1995). However, what they explain in terms of externally versus internally caused events I would prefer to explain in terms of processes (which are simple events) versus complex events. A discussion of this point is beyond the scope of this article, though.

3. PROCESS SPECIFYING ADVERBIALS

I now turn to a class of adverbials which I term *Process Specifying Adverbials.* Sentences like (7) have been discussed in the literature at least since McCawley (1971).

(7) a. He made the metal flat by hammering it.
    b. He flattened the metal by hammering it.
    c. He hammered the metal flat.

The problem is to show how these syntactically rather diverse sentences can be given roughly the same interpretation. Dowty (1979: 227–229) discusses the sentences in (8) and (9):

(8) a. John awakened Mary by shouting.
   b. John's shouting awakened Mary.
(9) a. John flattened the metal by hammering it.
   b. John hammered the metal flat.

He suggests treating **by**

> as an expression of category (IV/IV)/T and its translation **by'** as a
> non-logical constant restricted by the following meaning postulate:

(65) $\Lambda p \Lambda P \Lambda Q \Lambda x \Box [\mathbf{by}\text{'}(P)(\hat{y}[Q\{y\}\text{CAUSE } \breve{p}])(x) \rightarrow$
      $[P\{x\}\text{CAUSE } \breve{p}]]$

> This specifies that if by doing *P x* does something (*Q*) that causes
> some proposition *p* to obtain, then in this situation *x*'s doing *P*
> causes *p* to obtain. This postulate leaves open the question of just
> how the events involved are to be individuated; it does not require
> that the event which *P* is the property of being 'involved in' (how-
> ever this notion is to be defined) is the same as the event which *Q*
> is the property of being involved in, because it does not even
> require that *P* and *Q* be the same property. This is as it should be,
> since if John hammers the metal flat by pounding it with a pipe
> wrench, we do not wish to say that the *property* of hammering the
> metal is the same as the property of pounding it with a pipe
> wrench, though the extension of these two properties may be the
> same in the actual and/or most relatively similar worlds.

The important thing to note here is that Dowty is unable to characterize
the relation between P and Q. It is this defect I try to improve on.
    Danish has three prepositions that may function as process specifying,
ved, 'by', *af*, 'of/from', and *med*, 'with'. The next sections treat these
prepositions one at a time.

3.1. *The preposition ved*
The Danish equivalent of (8a) is shown in (10).

(10) John vækkede   Marie ved at råbe.
       John awakened Mary by   to shout

Given what I have said earlier about causatives having an underspecified
E1-value, the obvious thing to say about (10) is that the *ved*-phrase
serves to specify the E1-value. This can be formalized as in Figure 7

$$
\begin{bmatrix}
\text{PHON } \textit{ved} \\[2pt]
\text{SS} \mid \text{LOC}
\begin{bmatrix}
\text{CAT}
\begin{bmatrix}
\text{HEAD}
\begin{bmatrix}
\textit{prep} \\[2pt]
\text{MOD} \mid \text{LOC}
\begin{bmatrix}
\text{CAT} \mid \text{HEAD } \textit{verb} \\[2pt]
\text{CONT}
\begin{bmatrix}
\text{E1 } \textit{unspec-rel} \\
\text{E2 } \boxed{2}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix} \\[6pt]
\text{COMPS } \left\langle
\begin{bmatrix}
\text{LOC}
\begin{bmatrix}
\text{CAT} \mid \text{HEAD } \textit{verb} \\
\text{CONT} \mid \text{E1 } \boxed{1}
\end{bmatrix}
\end{bmatrix}
\right\rangle
\end{bmatrix} \\[10pt]
\text{CONT}
\begin{bmatrix}
\textit{result-psoa} \\
\text{E1} \quad \boxed{1} \\
\text{E2} \quad \boxed{2} \\
\text{E-REL } \textit{cause}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$
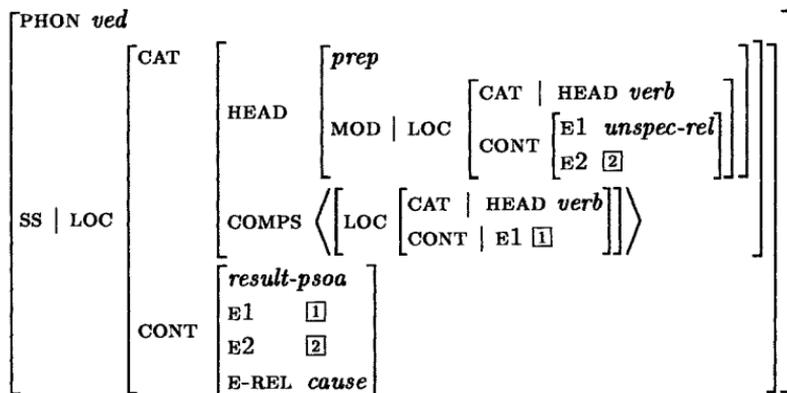
Figure 7. Part of the lexical entry for *ved*, 'by'.

Figure 7 says that the preposition *ved* modifies a verbal sign with an underspecified subevent $_1$. The E2-value of this sign is identical to the E2-value of the whole phrase ($\boxed{2}$). *Ved* takes a verbal complement the E1-value of which is identical to the E1-value of the whole phrase ($\boxed{1}$). The CONTENT-value of the *ved*-phrase is a *result-psoa* which constrains the E1-value to a *process-rel* and the E-REL-value to *cause*.

In accordance with usual practice in HPSG, the adjunct-daughter is considered the semantic head of the phrase, which means that the content-value of a *head-adjunct-phrase* is identical to that of the adjunct-daughter, while the CAT-value is identical to that of the head-daughter. This is shown in Figure 8.

$$
\textit{head-adjunct-phr} \longrightarrow
\begin{bmatrix}
\text{SYNSEM} \mid \text{LOCAL}
\begin{bmatrix}
\text{CAT} \quad \boxed{1} \\
\text{CONT} \quad \boxed{2}
\end{bmatrix} \\[6pt]
\text{HEAD-DTR} \mid \text{SS } \boxed{3} \mid \text{LOC} \mid \text{CAT } \boxed{1} \\[6pt]
\text{ADJUNCT-DTR} \mid \text{SS} \mid \text{LOC}
\begin{bmatrix}
\text{CAT}
\begin{bmatrix}
\text{HEAD} \mid \text{MOD } \boxed{3} \\
\text{COMPS } \langle \rangle
\end{bmatrix} \\[6pt]
\text{CONT} \quad \boxed{2}
\end{bmatrix}
\end{bmatrix}
$$
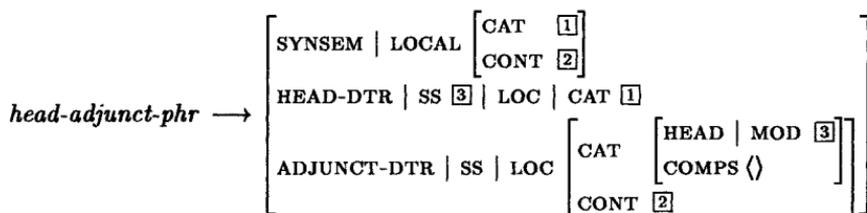
Figure 8. *Head-adjunct-phr* constraint.

Furthermore, the verbal complement must be *marked*, i.e. the phrase must be introduced by *at*, 'to'/'that' (for the sake of simplicity, I here collapse these two clearly distinct items). However, this constraint seems to be common to all prepositions taking verbal complements, and I thus express it in the constraint shown in Figure 9.

$$\begin{bmatrix} word \\ \text{SS} \mid \text{LOC} \mid \text{CAT} \begin{bmatrix} \text{HEAD} & prep \\ \text{COMPS} \ \langle[\text{LOC} \mid \text{CAT} \mid \text{HEAD} \ verb]\rangle \end{bmatrix} \end{bmatrix}$$

$$\longrightarrow$$

$$\begin{bmatrix} \text{SS} \mid \text{LOC} \mid \text{CAT} \mid \text{COMPS} \ \langle[\text{LOC} \mid \text{CAT} \mid \text{MARKING} \ marked]\rangle \end{bmatrix}$$
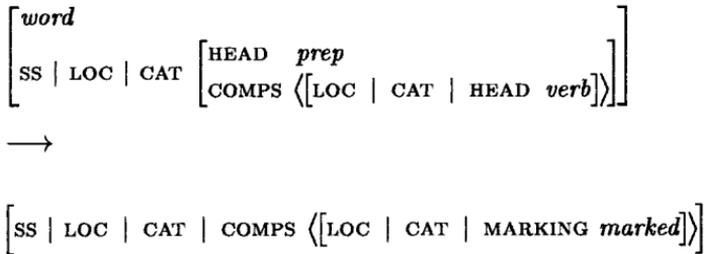
Figure 9. Clause complement preposition constraint.

Figure 10 shows perhaps a bit more perspicuously how the meaning of (10) is composed.
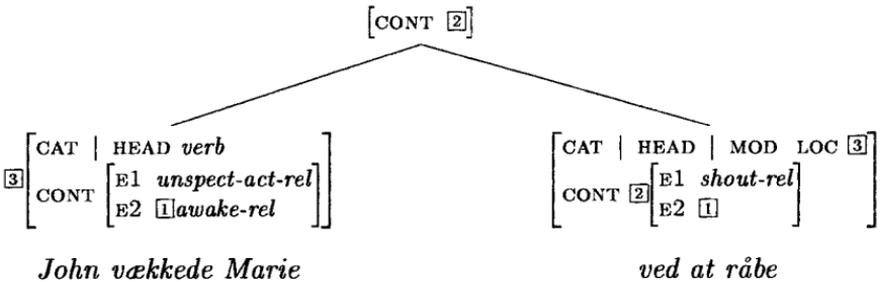
Figure 10. Composition of the meaning of (10).

The sentences in (11) show that *ved*-phrases are not restricted to modifying causative VPs.

(11) a. Han døde ved at få en mursten i hovedet.
      He   died by to   get a brick in   head-the

    b. Marie vågnede ved at John råbte.
       Mary woke up by that John shouted

The verbs in (11) are inchoatives, but since the value for E1 is *abs-unspec-rel* in the case of inchoatives, and *abs-unspec-rel* is a subtype of *unspec-rel*, the entry in Figure 7 already makes allowance for this. However, there is an important difference between the two cases.

Ved-phrases modifying causatives (and less frequently, accomplishments) only accept as complements infinitives where the unrealized subject is identical to the subject of the verb, or, to a lesser extent, a finite clause the subject of which must be co-referential with the subject of the main clause.

In contrast, in the case of *ved*-phrases modifying inchoatives, the

complement of *ved* may also be a finite clause without any restrictions on the subject (11b).

I consider this a corroboration of the claim that the subject of active causative verbs must have the role of actor in the underspecified process. To handle these differences we add some information to the lexical entry for *ved*.

$$
\begin{bmatrix}
\text{PHON } \textbf{\textit{ved}} \\
\text{SS} \mid \text{LOC}
\begin{bmatrix}
\text{CAT}
\begin{bmatrix}
\text{HEAD}
\begin{bmatrix}
\textbf{\textit{prep}} \\
\text{MOD} \mid \text{LOC}
\begin{bmatrix}
\text{CAT}
\begin{bmatrix}
\text{HEAD} & \textbf{\textit{verb}} \\
\text{SUBJ} & \langle \boxed{3} \rangle
\end{bmatrix} \\
\text{CONT}
\begin{bmatrix}
\text{E1} & \textbf{\textit{unspec-rel}} \\
\text{E2} & \boxed{2}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix} \\
\text{COMPS}
\left\langle
\begin{bmatrix}
\text{LOC}
\begin{bmatrix}
\text{CAT}
\begin{bmatrix}
\text{HEAD} & \textbf{\textit{verb}} \\
\text{SUBJ} & \langle \boxed{3} \rangle \vee \langle \rangle
\end{bmatrix} \\
\text{CONT} \mid \text{E1} \ \boxed{1}
\end{bmatrix}
\end{bmatrix}
\right\rangle
\end{bmatrix} \\
\text{CONT}
\begin{bmatrix}
\textbf{\textit{result-psoa}} \\
\text{E1} & \boxed{1} \\
\text{E2} & \boxed{2} \\
\text{E-REL} & \textbf{\textit{cause}}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$
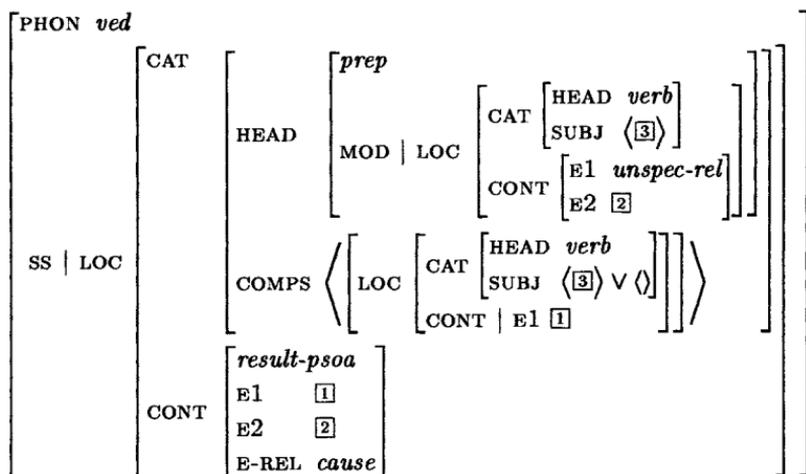
Figure 11. Lexical entry for *ved*, 'by'.

Figure 11 is identical to Figure 7 except for the following: The SUBJ-list of the complement must either be empty or else contain the same element that is on the SUBJ-list of the modified VP. This handles the fact that the unrealized subject of an infinitive is identical to the subject of the verb, and allows for finite complement clauses. What remains is to make sure that sentences like (12) are ruled out.

(12) * John vækkede   Marie ved at   Ole råbte.
        John awakened Mary   by that Ole shouted

Recall that causatives are characterized by an *unspec-act-rel* as value for E1. This means that John must have the role of actor in the E1-relation, but in (12) that role is already taken by Ole and hence the sentence is not well formed. I shall not try to spell out the technical details here.

3.2. *The preposition af*

As (13) demonstrates, also a phrase headed by the preposition *af*, 'of', may function as process specifying adverbial.

(13) Ole døde af at løbe / overanstrenge sig / feste / læse etc.
      Ole died of to run   over-exert   himself party read

The main difference between *af* and *ved* is that *af* may also take a noun complement, as shown in (14).

(14) Ole døde af druk /   overanstrengelse / arsenikforgiftning.
      Ole died of drinking over-exertion   arsenic poisoning

The noun complement must be a predicative noun, i.e. a noun denoting a situation, or, in technical terms, a noun with a *psoa*-object on its RESTRICTION-list. The noun denotes the causing event, the E1-process, parallel to what verbal complements do. A noun complement denoting the actor of the E1-process is not possible:

(15) * Ole vågnede af ringeklokken.
         Ole woke up of doorbell_the

Figure 12 shows how this can be formalized.
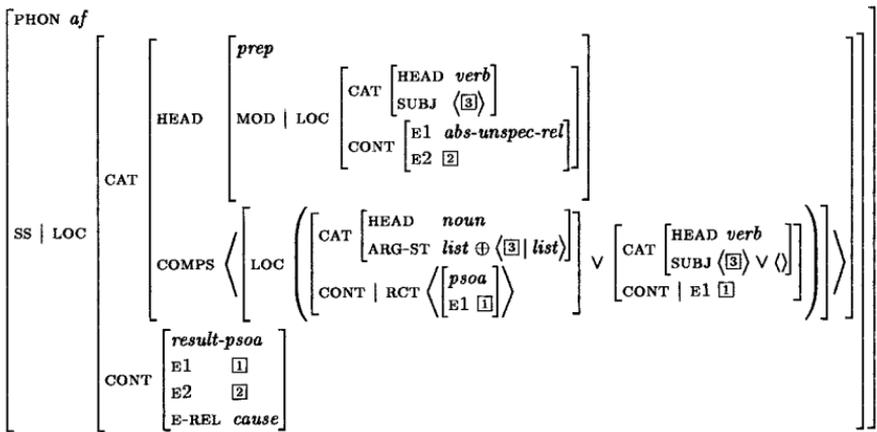
Figure 12. Lexical entry for *af (spec)*, 'of'.

The lexical entry for the Process Specifying af_{spec} in Figure 12 resembles that of *ved* with the addition that *af* may take a noun complement. This noun must have a *psoa*-element on its RESTRICTION-list, and the E1-value of this element must be identical to the E1-value of the phrase. An element on the ARG-ST-list of the noun is structure-shared with the subject of the modified verb. Furthermore, as (16) shows, af_{spec} may only

modify *inchoatives* and so the E1-value of the modified VP is constrained to being an *abs-unspec-rel*.

(16) a. * Søren dræbte Ole af druk / overanstrengelse.
        Søren killed Ole of drinking over-exertion
   b. * Søren dræbte Ole af at drikke / overanstrenge sig.
        Søren killed Ole of to drink over-exert himself

While the entry in Figure 12 works fine for (14), there still remain a number of problematic cases.

The problem with the sentences in (17) is that the nouns apparently denote states, the state of Ole having pneumonia or being old or injured, and thus cannot be said to directly denote the causing event (recall that the E1-relation in *result-psoas* is constrained to being a process-relation).

(17) a. Ole døde af lungebetændelse.
        Ole died of pneumonia
   b. Ole døde af alderdom / sine kvæstelser.
        Ole died of old age his injuries

I claim that in both cases the states are inherently connected to processes. *Lungebetændelse* in (17a) denotes a complex, dynamic situation, consisting of a number of underspecified and possibly unknown relations. Some of these relations are processes and it is eventually one or more of these processes that cause death. In (17b) the states denoted by *alderdom* and *kvæstelser* are inherently connected to the processes that brought them about, and it is those processes that cause death as well.

This is modelled by letting for example *pneumonia-rel* be a subtype of *dyn(amic)-rel*. Part of the type hierarchy for dynamic relations is shown in Figure 13.
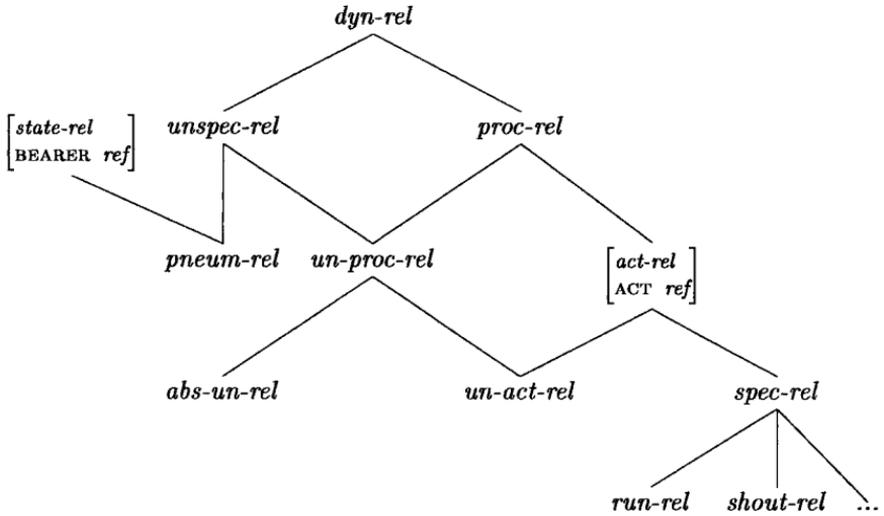
Figure 13. Part of the type hierarchy for dynamic relations.

The idea is that while pneumonia is normally conceived of as a state, it may at the same time be conceived of as being dynamic. Furthermore, the constraint on *result-psoa* must be revised to allow E1 to take a *dynamic relation* as value.

(18) exemplifies another potential problem.

(18) Ole døde af jalousi.
      Ole died of jealousy

Jalousi does not denote a dynamic situation. When interpreting (18) we are forced to understand *jalousi* as the motivation or explanation for whatever it was Ole did, which eventually caused his death. Further arguments in favour of a distinction between specifying and motivating *af* are found in the sentences (19) through (21).

(19) Ole dræbte hende af jalousi / kærlighed.
      Ole killed   her of   jealousy love

(20) Ole løb / sang / græd af glæde / jalousi / smerte etc.
      Ole ran   sang cried of joy   jealousy pain

(21) a. * Ole hostede af   lungebetændelse.
              Ole coughed of pneumonia

b. * Ole løb / sang / græd af druk / lungebetændelse etc.
    Ole ran   sang   cried of drinking pneumonia

(19) shows that af_{mot} as opposed to af_{spec} may modify causatives, cf. (16). Af_{mot} may modify processes, (20), while af_{spec} may not, (21).

This means that we must distinguish between static situations that *motivate* some action and processes − possibly contained within dynamic situations − that *cause* some change of state. In order to be able to represent this distinction, I introduce a new attribute, MOTIVATION, for the type *psoa*, the value of which cannot be a *dynamic-rel*. The lexical entry for the Motivation Preposition *af* is shown in Figure 14.
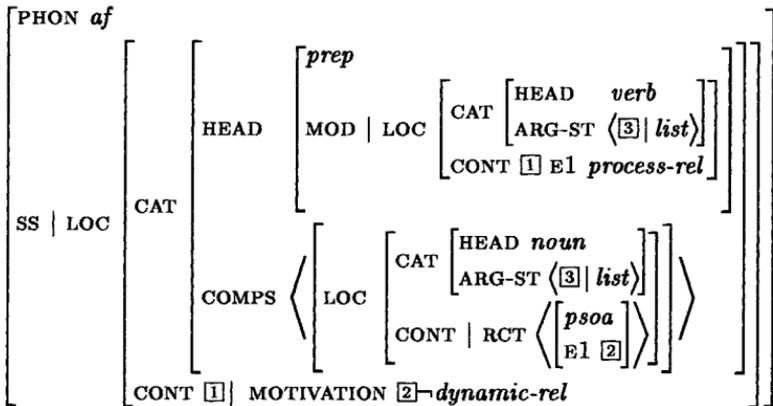
Figure 14. Lexical entry for *af (mot)*, 'of'.

Af_{mot} may modify any VP. The CONTENT-value of the modified VP is structure-shared with that of the phrase, and the E1-value of the noun complement is structure-shared with the value for the MOTIVATION-attribute within the CONTENT-value.

In both the active sentence (22a) and the passive (22b) it is unambiguously Søren who is jealous.

(22) a. Søren dræbte Ole af jalousi.
       Søren killed   Ole of jealousy

    b. Ole blev dræbt af Søren af jalousi.
       Ole was killed by Søren of jealousy

This fact is expressed in Figure 14 by the structure-sharing of the first

element on the ARG-ST-list of the modified verb and that of the comple-
ment noun. This element is realized as subject in active and as the com-
plement of *af* in passive clauses.

Even though the complement nouns in (23) denote complex situations
more or less in parallel to (17a), the sentence is not well formed.

(23) * Ole døde af sejlads / fest.
        Ole died of   sailing   party(ing)

A tentative solution is to impose a constraint on this construction to the
effect that the subject of the clause must have an explicit role in the rela-
tion introduced by the complement noun. While in (17a) it is clear what
Ole's role was, i.e. that he was the one that suffered from pneumonia, this
is not the case in (23). One way of modelling this would be to let
pneumonia-rel but not *party-rel* inherit from *state-rel*, as shown in Figure
15.
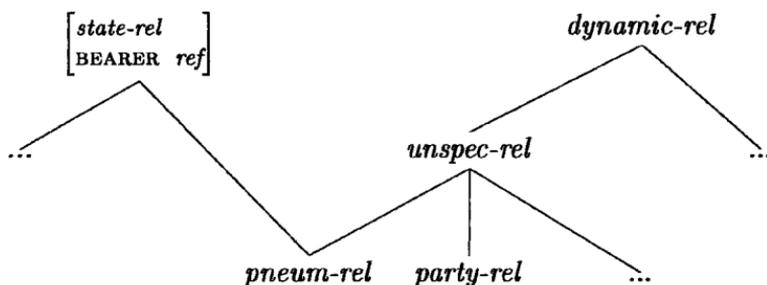
Figure 15. Part of the type hierarchy for dynamic and state-relations.

This means that while *pneumonia-rel* has a semantic role, the BEARER of
the property, for Ole to fulfil, *party-rel* does not.

On the basis of what I have said so far (24) should be alright, but it is
only marginally acceptable.

(24) ? Ole døde af svømning.
        Ole died   of swimming

The explanation may be that if some meaning is expressible by means of
an infinitive, af_{spec} prefers the infinitive as complement. But then it must
be explained why (14), here repeated as (25a), is preferred to (25b).

(25) a. Ole døde af druk /   overanstrengelse.
          Ole died   of drinking over-exertion

b. Ole døde af at drikke / at overanstrenge sig.
   Ole died of   to drink to   over-exert   himself

In the case of *druk* we could say that it has a conventionalized meaning which is not expressible with the infinitive, *druk* meaning an excessive consumption of alcohol. On the other hand, in the case of *overanstrengelse* and *at overanstrenge sig* there does not seem to be any (substantial) difference. I shall leave the question for further research.

3.3. *The preposition med*

A third preposition that should be mentioned in this connection is *med*, 'with'. The use of *med* with a process specifying meaning is severely restricted compared to that of *af* and *ved*. As the sentences in (26) demonstrate, *med* as a specifying preposition takes only noun complements and modifies only causative VPs.

(26) a. John vækkede   Marie med (sit) råb / (sin) råben.
        John awakened Mary with his   shout his   shouting

   b. * John vækkede   Marie med at råbe.
        John awakened Mary with to shout

   c. * Marie vågnede med Johns råb /   råben.
        Mary woke up with John's shout shouting

   d. * Marie vågnede med at   John råbte.
        Mary woke up with that John shouted

The noun complement must denote the process directly and the complement of *med* is thus the nominal counterpart of the verbal complement of *ved*, compare (26a) with (10).

Figure 16 gives the lexical entry for *med*.

Table 1. Overview of process specifying prepositions.

| Modified VP Complement	inchoative			causative		
	noun	verb		noun	verb	
		inf	fin		inf	fin
ved	(+)	(+)	+	−	+	−
af	+	+	+	−	−	−
med	−	−	−	+	−	−
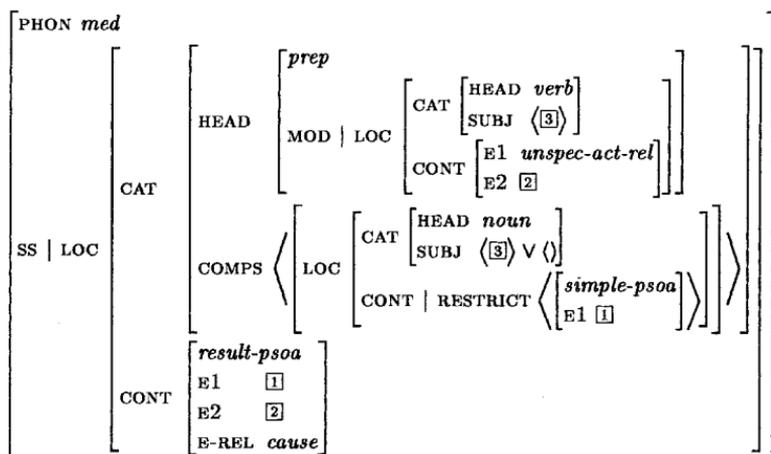
Figure 16. Lexical entry for *med*, 'with'.

Note that the sentence in (27) exemplifies another use of *med*. In this case the screaming is not the causing event, but rather an accompanying circumstance.

(27) Marie vågnede med et skrig.
      Mary woke up   with a   cry

4. SUMMARY

In this article various linguistic means of expressing causation have been examined. I have argued that *inchoatives, causatives* and *accomplishments* all denote situations in which a process, *subevent₁*, is construed as causing a state or a process, *subevent₂*. *Inchoatives* and *causatives* are

described as having different kinds of underspecified *subevent₁*, *inchoatives* having an absolutely underspecified process as *subevent₁* – an *absunspec-rel*, while causatives have an *unspec-act-rel* with an actor as argument.

The analysis of prepositional phrases of a type termed *Process Specifying Adverbials* seems to corroborate this analysis of event structure. I have argued that PSAs serve to specify *subevent₁*, and this is why they normally modify *inchoatives* and *causatives* but not *accomplishments* or simple *processes* or *states*, which already have a specified *subevent₁*. There is a constraint on PSAs modifying *causatives* to the effect that the first argument of the relation expressed by the complement of the preposition and the first argument of the causative must be structure-shared, thus underpinning the claim that the first argument of causatives must be an actor.

Table 1 gives an overview of Process Specifying Prepositions. It shows that both *ved* and *med* but not *af* may modify *causatives, ved* taking infinitival complements and *med* noun complements. *Af* modifies inchoatives taking noun complements as well as verbal complements. *Ved* may also modify inchoatives, though to a lesser extent than *af*.

Furthermore, I have argued for the existence of another type of adverbial termed *Motivation Adverbials*. These differ from PSAs in taking a complement denoting a state, not a process, and serve to express the motivating state for some process.

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