

1 Event coreference in causal discourses

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Abstract

This study concerns the causal discourses which express a “direct causation”. With the help of the extended event structure for causative verbs proposed in (Pustejovsky 1995), I will show that they involve an event coreference relation when the result is expressed by a causative verb in its transitive use. Then I will define two types of event coreference, generalization and particularization. Next I will show that discourses expressing a direct causation with a resultative rhetorical relation involve a generalization relation (which explains their awkward behavior), while those discourses with an explanation rhetorical relation involve a particularization relation (which accounts for their normal behavior). Finally, I will study discourses in which the result is expressed with an unaccusative form of a causative verb. This study leads to question the extended event structure for unaccusatives proposed in (Pustejovsky 1995).

1 Direct causation and event coreference

1.1 The notion of direct causation

It is well known that causal relations can be of different kinds. Among them, the “direct” causal relation is often mentioned in the literature and among others, by (Fodor 1970) and (Schank 1975). In the line of these works, I define the notion of a direct causation on conceptual grounds as follows: the result is a physical change of state for an object Y^1 , the cause is an action performed by a human agent X , the action is the direct cause of the change of state.

On linguistic grounds, the result of a direct causation can be expressed in a sentence built around a causative verb, first studied in its transitive use. The cause can be expressed in a sentence juxtaposed to this sentence expressing the result (other means exist apart from this paratactic structure: they will be presented in Section 2.6). If the cause precedes the result, a

¹ I will leave aside psychological changes of state because psych-verbs possess specific properties

“resultative” rhetorical relation is observed, (1a); an “explanation” rhetorical relation is observed when the order of the sentences is reversed, (1b). Both (1a) and (1b) have a natural causal interpretation in which the action of hitting the carafe directly caused its crack(s).

- (1) a. Fred hit the carafe against the sink. He cracked it.
 b. Fred cracked the carafe. He hit it against the sink.

Similarly, (2a) and (2b) have a natural causal interpretation in which Fred’s jumping off the plane without a parachute directly caused his death. On the other hand, (3a) and (3b) express an indirect causation: forgetting (mental act) cannot directly cause a fatal outcome. (3a) or (3b) is an elliptical form of a longer causal chain: Fred’s jumping off a plane (without a parachute) is not explicitly expressed.

- (2) a. Fred jumped off the plane without a parachute. He killed himself.
 b. Fred killed himself. He jumped off the plane without a parachute.
- (3) a. Fred forgot his parachute. He killed himself.
 b. Fred killed himself. He forgot his parachute.

Finally, (4) and (5) do not have the interpretation of a direct causation. (4a) and (4b) have a “motivation” interpretation, and (5a) and (5b), where the agents are not coreferent, have a motivation or “narration” interpretation.

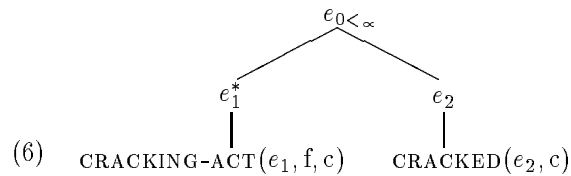
- (4) a. Fred was angry with Mary. He broke the carafe.
 b. Fred broke the carafe. He was angry with Mary.
- (5) a. Fred hit the carafe against the sink. John cracked it.
 b. John cracked the carafe. Fred hit it against the sink.

Intuitively, the notion of direct causation relies on a “small” distance between the cause and the result. However, it is well known that the distance between the cause and the result is hard to evaluate, since a causal relation can be broken down in an arbitrarily long cause-result chain. This is the reason why I am going to delimit the notion of direct causation with the help of linguistic notions. First, only causal discourses in which the result is expressed by a causative verb will be examined, in Sections 1 and 2 in its transitive use, in Section 3 in the unaccusative one². Next, adopting the extended event structure of (Pustejovsky 1995) for causative verbs, I

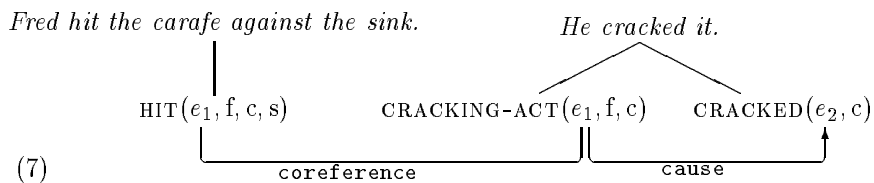
² Therefore, the discourses in which the result is expressed in a stative construction (e.g. *The carafe is cracked*) or in a periphrastic construction (e.g. *Fred made the carafe crack*) will not be examined.

am going to show that the discourses which express a direct causation differ from other causal discourses by the fact that they involve an event³ coreference relation.

Causative verbs are generally analyzed as complex predicates involving a causing sub-event (e_1) which brings about a new state (e_2), (Chierchia 1989, Dowty 1979, Levin & Rappaport 1995, Moens & Steedman 1988, among others). With Pustejovsky's extended event structure, the (informal) analysis of *Fred cracked the carafe* is given in (6): e_1 is a cracking act of Fred (f) on the carafe (c), e_2 is the cracked state of the carafe, e_1 precedes ($<_{\infty}$) e_2 , and the head (*) is on the causing sub-event e_1 .



Let us now analyze (1a). The fact that the first sentence describes the direct cause of the result described in the second sentence can be expressed in the following terms: the first sentence describes an event (Fred's hitting the carafe) which is in an event coreference relation with the causing sub-event of the result (Fred's cracking act on the carafe). This event coreference relation is made explicit in diagram (7) in which the hitting event is represented by e_1 as is the cracking act. The two occurrences of e_1 are linked by a coreference relation, the second occurrence of e_1 is linked to the resulting state e_2 by a (direct) causal relation.



Therefore, linguistic means exist to delimit the notion of direct causation involved in a resultative discourse such as (1a). These linguistic means can be used *mutatis mutandis* for the direct causal relation involved in an explanation discourse such as (1b). The analysis of (1b) is shown in diagram (8), which is based on the same principles as (7).

³ The term "event" should be read as "eventuality": it covers both static and dynamic situations and is represented by the symbol e .

1.2 Unspecified versus specified sub-causing event

It has long been noted that, among causative verbs, some specify the resulting state but leave the causing event unspecified (e.g. *crack*, *sink*, *kill*), while others such as *slice* and *wax* specify both the resulting state and something about the event leading up to it (see Levin & Rappaport 1995, Van Voorst 1995). The former are found in the S_c of a direct causation discourse, (1a) or (1b) with *crack*, while the latter are not. When one attempts to form a direct causation discourse with a causative verb which specifies its causing sub-event, e.g. *slice*, one obtains a discourse with another interpretation. For example, a discourse such as (9a) can only be understood as an “enablement”: the event described in the first sentence allows but does not cause the event described in the second sentence. Fred still has to perform some action with the knife in order to get the baguette sliced. This action can only be described in *Fred sliced / cut the baguette with a knife*. However, (9b) is a “particularizing discourse” (see next section) and not a causal one.

- (9) a. Fred took a knife. He sliced the baguette.
 b. Fred cut the baguette with a knife. He sliced it.

Hence, I propose the following hypothesis:

The existence of a S_a , S_c , or S_c , S_a , discourse with an interpretation of direct causation is a linguistic proof that the causative verb in S_c does not specify the causing sub-event.

In the event structure of a causative verb V_c , I represent the predicate of the causing sub-event as a variable indicated by the ? sign if left unspecified, e.g. ?-CRACKING-ACT(e_1 , x , y), and as a constant otherwise, e.g. SLICING-ACT(e_1 , x , y). When the predicate of a causing sub-event is a variable, it can be bound by the predicate of a S_a sentence: a discourse with an interpretation of direct causation is then obtained. Most of the causative verbs where the causing sub-event is unspecified detransitivize into unaccusative forms (Levin & Rappaport 1995)⁵. The variants of S_a , S_c , and S_c , S_a , discourses in which the causative verb is in an unaccusative form will be studied in Section 3.

⁵ The causing sub-event, whose predicate is a variable, is then shadowed. On the other hand, let me informally advance the hypothesis that a causing sub-event, whose predicate is a constant, cannot be shadowed. The unaccusative form would lose one part of the semantics of the verb, namely the information given by the predicate of the sub-causing event. This could explain why *slice* or *wax* cannot detransitivize into unaccusative forms.

1.3 Types of event coreference

An event coreference relation is to be found between two successive descriptions D_1 and D_2 of the same event. The description of an event can be either linguistically realized or not. When it is linguistically realized, it is as a (pro)nominal phrase or a sentence. It is not linguistically realized for a sub-event which can only get a conceptual representation, such as $?-CRACKING-ACT(e_1, x, y)$.

Event coreference has mainly been studied when D_2 is a (pro)nominal phrase which refers to an event in a coreference relation with a sentence, $D_1 = S_1$ (see, among others, (Webber 1988)). In (Danlos 1999a), I have studied event coreference between two sentences. In this paper, I concentrate on the event coreference relations observed in S_a , S_c , and S_c . S_a discourses which express a direct causation: they are coreference relations between the description of an event linguistically realized as a sentence and the description of the same event that is not linguistically realized.

Two types of event coreference, “particularization” (noted as PART) and “generalization” (noted as GEN), can be defined as follows.

Two descriptions D_1 and D_2 of the same event e are in a particularization relation with $D_2 = PART(D_1)$ if D_2 conveys some new information about e when compared to the information known from D_1 .

Two descriptions D_1 and D_2 of the same event e are in a generalization relation with $D_2 = GEN(D_1)$ if D_2 does not bring any new information about e .

To illustrate these two types of event coreference, let us consider the well known case in which D_2 is a (pro)nominal phrase and D_1 a sentence. In (10a), $D_2 = this$, $D_1 = S_1$, and $D_2 = GEN(D_1)$ since a pronoun does not bring new information. In (10b), $D_2 = this\ unforeseen\ arrival$, $D_1 = S_1$, and $D_2 = PART(D_1)$ since D_2 brings the information that Fred’s arrival was unforeseen.

- (10) a. Fred arrived at midnight. This woke up Mary.
 b. Fred arrived at midnight. This unforeseen arrival surprised Mary.

When D_1 and D_2 are both sentences, a particularization relation is observed in “particularizing discourses” such as (11), and a generalization relation is observed in “generalizing restatement discourses” such as (12). In (11a), $S_2 = PART(S_1)$ since it specifies that the damage was a stain and the garment was a shirt. In (11b), $S_2 = PART(S_1)$ because *at noon* brings new temporal information, while *X compliment Y* re-describes (without bringing new information) *X tell Y that Y is pretty*. In (12), $S_2 = GEN(S_1)$

and S_2 is introduced by *therefore* with an epistemic value (Rossari & Jayez 1996). In the next section, it will be shown that some S_a . S_c . discourses may look as causal, but are in fact particularizing or restatement discourses.

- (11) a. Fred damaged a garment yesterday. He stained a shirt.
 b. Fred told Mary that she is pretty. He complimented her at noon.
- (12) Fred stained a shirt yesterday. Therefore, he damaged a garment.

In section 2, I will put forward hypotheses which state that the event coreference relation is a generalization for S_a . S_c . discourses and a particularization for S_c . S_a . discourses. These hypotheses explain contrasts such as the one observed between (13a) with a S_a . S_c . structure and (13b) with a S_c . S_a . structure. In these discourses, S_c comprises a time adjunct (*at noon*). (13b) has a natural interpretation of direct causation, whereas (13a) does not have this interpretation.

- (13) a. ?Fred hit the carafe against the sink. He cracked it at noon.
 b. Fred cracked the carafe at noon. He hit it against the sink.

In support of this last point, let us resort to a connective such as *therefore* or *as a consequence*. Such a connective is used to explicitly indicate a resultative rhetorical relation: (14a), which is obtained from (1a) after insertion of *therefore*, is stylistically unfelicitous, but it is a paraphrase of (1a). On the other hand, (14b), which is obtained from (13a) after insertion of *therefore*, is meaningless (hence the * sign in front of it). (13a) might just possibly be understood as a “narration” (Asher 1993), although this interpretation is better expressed in *Fred hit the carafe against the sink at 11am. He cracked it at noon*. In conclusion, (13a) has no natural interpretation, hence the ? sign in front of it.

- (14) a. Fred hit the carafe against the sink. Therefore, he cracked it.
 b. *Fred hit the carafe against the sink. Therefore, he cracked it at noon.

Before presenting my hypotheses, let me examine other interpretations of S_a . S_c . discourses.

1.4 Interpretations of S_a . S_c . discourses

In (15) with a S_a . S_c . structure, the change of state (i.e. the death of the rabbit) is a new piece of information. In particular, it cannot (or should not) be inferred from S_a , since the rabbit could have been safe and sound, or simply wounded.

- (15) Fred fired a shot at the rabbit. He killed it.

It is this type of discourses I am interested in: the interpretation is a direct causation with a resultative rhetorical relation. However, discourses with a S_a . S_c . structure may have other interpretations when the change of state is not a new piece of information, either because it can be inferred from S_a or because it is “available” from S_a , or because it is known from a prior context, as shown respectively in the three following subsections. I will establish that some adjuncts may or may not be inserted in S_c depending on the interpretation of a S_a . S_c . discourse.

S_a . S_c . discourses as particularizing discourses

When the action described in S_a compulsorily implies the change of state described in S_c , a S_a . S_c . discourse without any adjunct in S_c sounds poor because it is redundant, (16a). This redundancy disappears if S_c comprises an adjunct: (16b) is natural. The point is that (16b) is not a resultative causal discourse in which S_c describes the result of S_a : it is a particularizing discourse in which both sentences describe the same event. The second sentence brings a new temporal information through *at noon*. X kill Y re-describes —without bringing new information— X cut the throat of Y ⁶. This analysis of (16b) is confirmed by the fact that it is paraphrased by (16c) with the pronominal form *did it*. (16b) is also paraphrased by (16d) in which the connective *more precisely* explicitly (although unfelicitously) indicates a particularization relation between the two sentences.

- (16) a. ?Fred cut the throat of the rabbit. He killed it.
 b. Fred cut the throat of the rabbit. He killed it at noon.
 c. Fred cut the throat of the rabbit. He did it at noon.
 d. Fred cut the throat of the rabbit. More precisely, he killed it at noon.

It is worth underlining the contrasts of acceptability in S_a . S_c . discourses related to the possibility or impossibility to infer the change of state from S_a . (17a) (= (15)) without an adjunct in S_c is natural, whereas (16a) is redundant. (17b) with an adjunct in S_c does not have any natural interpretation, whereas (16b) is natural with a particularization interpretation. (17c) is not in a paraphrastic relation with (17b), whereas (16c) paraphrases (16b). (17d) with the connective *therefore* (unfelicitously) paraphrases

⁶ In (16b), each sentence is built around a causative verbal form. The event coreference relation between the two sentences relies on coreference and inference relations between their sub-events. Their causing sub-events are interpreted as coreferent with $CUTTING-THROAT(e_1, f, r)$ which specifies $?-KILLING-ACT(e_1, f, r)$. Their resulting states stand in an inference relation: $DEAD(e'_2, r)$ can be inferred from $CUT-THROAT(e_2, r)$.

(17a), whereas (16d) with the connective *more precisely* (unfelicitously) paraphrases (16b).

- (17) a. Fred fired a shot at the rabbit. He killed it.
 b. ?Fred fired a shot at the rabbit. He killed it at noon.
 c. Fred fired a shot at the rabbit. He did so at noon.
 d. Fred fired a shot at the rabbit. therefore, he killed it.

In conclusion, an extralinguistic factor (i.e. can the change of state be inferred from S_a ?) is crucial for the acceptabilities and interpretations of S_a . S_c . discourses. Of course, this extralinguistic factor, as any other extralinguistic factor, is subjective, depending on the speaker's vision of the world. To illustrate the consequences of this point, consider the pair in (18) with $V_c = crack$ in (18a) and $V_c = break$ in (18b). I have submitted this pair to a number of speakers. Speakers agree that (18a), which repeats (13a), is deviant. On the other hand, opinion is divided for (18b): some speakers (including me) consider that this discourse is as deviant as (18a), while other speakers consider it natural.

- (18) a. ?Fred hit the carafe against the sink. He cracked it at noon.
 b. ?Fred hit the carafe against the sink. He broke it at noon.

In (18a), the cracked state of the carafe is plausible, but nobody can infer it from the cause. The speakers who consider (18b) natural have a vision of the world in which the broken state of the carafe is an ineluctable consequence of the cause (they activate the rule: when a carafe is hit against a sink, it is broken). Therefore, they interpret (18b) as (16b), i.e. with a particularization relation between the two sentences. The speakers who do not consider that a carafe hit against a sink is a broken carafe cannot interpret (18b) with a particularization relation, and therefore judge (18b) as deviant as (18a).

S_a . S_c . discourses as “achieved-goal” discourses

Another subtle issue concerning the newness of the change of state in S_a . S_c . discourses is the fact that the S_a cause sentence describes or allows to infer a goal. For example, the S_a sentences in (19) indicate explicitly or implicitly that Fred's goal is Mary's death. In my vision of the world, (19a) should not be perceived as redundant since Fred may fire a shot at Mary inadvertently (without a goal, e.g. while cleaning his rifle) or with the goal of wounding her.

- (19) a. Fred fired a shot at Mary to kill her.
 b. Fred fired a shot at Mary carefully aiming for her heart.

It is normal to continue a S_a sentence as in (19) with a sentence which indicates whether the goal is achieved or not, as in (20). If the goal is

achieved, no connective is needed, (20a). If it is not, the use of a connective such as *however* is preferable, (20b). This contrast between (20a) and (20b) means that the default outcome of S_a is *success*.

- (20) a. Fred fired a shot at Mary to kill her. He succeeded.
 b. Fred fired a shot at Mary carefully aiming at her heart. However, he missed her.

The discourse relation in (20a) is obviously not a causal resultative relation. Let us call it an “achieved-goal” relation. Consider now the discourses in (21) and (22) which have a $S_a . S_c$ structure.

- (21) a. Fred fired a shot at Mary to kill her. He killed her at noon.
 b. Fred fired a shot at Mary carefully aiming at her heart. He killed her at noon.
- (22) a. ? Fred fired a shot at Mary to kill her. He killed her.
 b. ? Fred fired a shot at Mary carefully aiming at her heart. He killed her.

The discourses in (21) with an adjunct in S_c are natural, while the discourses in (22) without any adjunct in S_c sound poor. None of these discourses have a causal resultative interpretation (the insertion of *therefore* is totally forbidden). The discourses in (21) receive a natural achieved-goal interpretation: S_c brings the information that Fred achieved his goal and that it happened at noon. The discourses in (22) sound poor, probably because *success* is the default outcome of S_a . In (21) (or (22)), the change of state (Mary’s death) is not a brand-new piece of information since it is already “available” through the goal phrase in S_a ⁷.

When S_a does not include a goal adjunct, the ability to infer one from its content may vary from one speaker to another. Consider the pair in (23). Speakers agree that (23a) with $V_c = \textit{wound}$ is deviant. On the other hand, opinion is divided for (23b) with $V_c = \textit{kill}$ (which repeats (17b)). Some speakers (but not me) consider it natural with an achieved-goal relation. For them, the change of state (Mary’s death) is made available by S_a because they activate the rule: when somebody fire a shot at someone, it is in the purpose of killing him/her⁸.

- (23) a. ? Fred fired a shot at Mary. He wounded her at noon.
 b. ? Fred fired a shot at Mary. He killed her at noon.

⁷ On the other hand, in (i), in which S_a includes a goal adjunct, the cracked state of the carafe is a brand-new information since it has nothing to do with the goal.

(i) Fred hit the carafe against the sink to draw Mary’s attention. He cracked it.

⁸ The *cracked* and *broken* states for a carafe can be compared respectively to the *wounded* and *dead* states for an animate object.

S_a. S_c. discourses as restatement discourses

Discourse (24a) in which S_c comprises an agent-oriented adjunct is poor (the interpretations as a direct causation and as a narration are not naturally available). However, if it is inserted in a context where Mary's death is already known, the whole discourse becomes acceptable, (24b).

- (24) a. ?Fred fired a shot at Mary. He killed her deliberately.
 b. After the discovery of Mary's body, the police arrested her lover, Fred. He made a full confession. They had an argument. Fred picked up his rifle. **He fired a shot at Mary.** Therefore, **he killed her deliberately.**

In the last sentence of (24b), which is introduced by *therefore* with an epistemic value, the speaker draws her conclusions: what happened to Mary was a murder and not an accident. In other words, the speaker makes a restatement. A restatement interpretation has nothing to do with a causal one. A causal discourse stands at the informational level and both the cause and the result are new information for the hearer. On the other hand, a restatement stands at the intentional level and does not bring any new information.

Summary

A discourse with a S_a . S_c . structure can receive (at least) four interpretations:

- a causal resultative interpretation when the change of state is a brand-new piece of information,
- a particularization interpretation when the change of state can be inferred from S_a ,
- a achieved-goal interpretation when the change of state is made available by S_a ,
- a restatement interpretation when the change of state is known from a prior context.

I have shown that some adjuncts may or may not be inserted in S_c depending on the interpretation that can be given to a S_a . S_c . discourse. If one wants to say anything relevant about the insertion of adjuncts in S_c , it is thus crucial to stick to a given interpretation. In the rest of this paper, only S_a . S_c . discourses in which the change of state is (interpreted as) a brand-new piece of information will be examined. These discourses should receive a causal resultative interpretation. The question is to determine under which conditions they receive this interpretation. For example, how can the contrast between (1a) without adjunct in S_c and (13a) with a

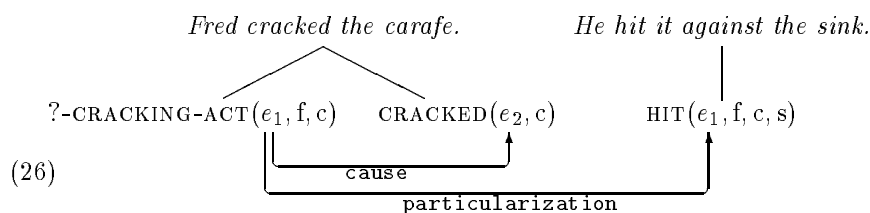
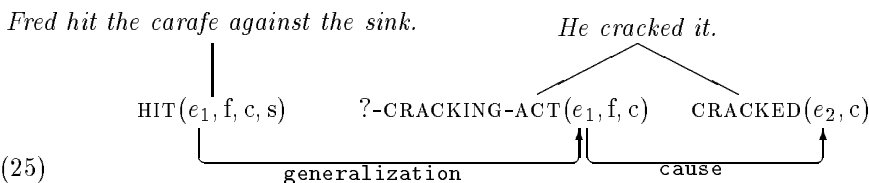
time adjunct in S_c be explained? My answer to this question is the (H1) hypothesis presented below.

**2 (H1) generalization hypothesis for S_a . S_c discourses and
(H2) particularization hypothesis for S_c . S_a discourses**

I am going to defend the following hypothesis:

- (H1) *A S_a . S_c . discourse, in which the change of state is a brand-new information, has a natural interpretation of direct causation if and only if the description of the causing sub-event in S_c is a **generalization** of the description of the event in S_a .*
- (H2) *A S_c . S_a . discourse has a natural interpretation of direct causation if and only if the description of the event in S_a is a **particularization** of the description of the causing sub-event in S_c .*

Let us briefly show that (H1) is valid when S_c does not comprise any adjunct. The description of the causing sub-event in S_c is an unspecified act achieved by X on Y. Hence, it does not bring any new information compared to the description of that event in S_a in which this act is lexically specified. By the inverse principle, the S_c . S_a . discourses illustrated so far involve a particularization relation. In other words, the diagrams in (7) and (8), in which the coreference relation is non-typed (so non-oriented), ought to be replaced respectively by the diagrams in (25) and (26), in which the coreference relation is typed (and oriented).



In all this section, a S_a . S_c . or S_c . S_a . discourse which has a natural interpretation of direct causation will be qualified as “acceptable”. It will be qualified as “unacceptable” otherwise, and will be annotated by the # sign.

2.1 Method

To show the validity of (H1), it must be shown that a S_a . S_c . discourse is acceptable only if the description of the causing sub-event in S_c generalizes S_a , i.e. it does not bring new information compared to what is known from S_a . The following method will be used. Starting with an acceptable S_a . S_c . discourse without any adjunct in S_c , different types of adjuncts are inserted in S_c ⁹. Surprisingly, differences of acceptabilities are then observed. They correlate with the differences of scope of the adjuncts modifying the causative verb. More precisely, if an adjunct modifies the causing sub-event, the discourse is unacceptable. Otherwise, it is acceptable. Now, if an adjunct modifies the causing sub-event, the description of the causing sub-event in S_c does not generalize S_a . Otherwise, it does. This method is illustrated in the following paragraph with time and “quantifier” adjuncts inserted in (1a).

Keep in mind that the interpretation of direct causation is lost when a time adjunct is inserted in S_c , as in (13a) repeated in (27a). On the other hand, when a quantifier adjunct is inserted in S_c , the interpretation of direct causation is maintained, (27b).

- (27) a. #Fred hit the carafe against the sink. He cracked it at noon.
 b. Fred hit the carafe against the sink. He cracked it badly.

This contrast between (27a) and (27b) correlates with the difference of scope between time and quantifier adjuncts (modifying a causative verb). A time adjunct modifies the causing sub-event (and the final state¹⁰) while a quantifier adjunct modifies only the final state. Therefore, the description of the causing sub-event in (27a) is $?-CRACKING-ACT(e_1, f, c) \wedge at-noon(e_1)$. This description does not generalize S_a : it brings new temporal information which is not available in S_a , since S_a does not include a time adjunct¹¹. The description of the final state in (27b) is $CRACKED(e_2, c) \wedge badly(e_2)$. The description of the causing sub-event is $?-CRACKING-ACT(e_1, f, c)$ and it does generalize S_a .

In other words, (H1) predicts that any S_a . S_c . discourse in which S_c comprises an adjunct which modifies the causing sub-event has no natural

⁹ Only adjuncts which can be inserted in S_c in isolation will be examined.

¹⁰ Although (Pustejovsky & Busa 1995) state that a time adjunct modifies only the headed event, here the causing sub-event, the inappropriateness of (i) shows that a time adjunct modifies also the final state. In *Fred killed Mary at noon*, both Fred’s killing act and Mary’s death occur around noon.

(i) *Fred killed Mary at noon and she died at 2 pm.

¹¹ The discourses in which both S_a and S_c comprise a time adjunct will be examined in the next section.

interpretation of direct causation (i.e. is unacceptable). In the next sections, this prediction will be confirmed, as well as other predictions made by (H1) or (H2).

2.2 Adjuncts which modify the causing sub-event

More about time adjuncts

Three cases are going to be examined: discourses with (i) only one time adjunct either in S_a or S_c , (ii) one time adjunct in S_a and another one in S_c which refers to a posterior time, (iii) one time adjunct in S_a and a more specific one in S_c .

It has just been shown that a S_a . S_c . discourse in which S_c (but not S_a) comprises a time adjunct is unacceptable, (27a). This unacceptability is explained by (H1). On the other hand, a time adjunct can be inserted in S_a : (28) is acceptable, which is explained by (H1) since the description of the causing sub-event in S_c generalizes S_a . More generally, as the reader can check it, any adjunct which can be inserted in S_a in isolation can be inserted in S_a in the context of a S_a . S_c . discourse, while maintaining an interpretation of direct causation. The description of the sub-causing event in S_c remains a generalization of S_a . Therefore, in the rest of this paper, only the insertion of adjuncts in S_c will be examined for S_a . S_c . discourses.

(28) Fred hit the carafe against the sink at noon. He cracked it.

For S_c . S_a . discourses, a time adjunct can be inserted either in S_c , (29a), or in S_a , (29b). The acceptabilities of these discourses conform to (H2) since S_a particularizes the description of the causing sub-event in S_c : it brings new information by specifying the cracking act which is left unspecified in S_a .

(29) a. Fred cracked the carafe at noon. He hit it against the sink.
b. Fred cracked the carafe. He hit it against the sink at noon.

Let us now examine the discourses obtained with a time adjunct in S_a and another one in S_c which refers to a posterior time. Both S_a . S_c . and S_c . S_a . discourses are unacceptable, (30a) and (30b).

(30) a. #Fred fired a shot at Mary on Sunday. He killed her on Monday.
b. #Fred killed Mary on Monday. He (had) fired a shot at her on Sunday.

The reader can be reminded here of the famous example in (Fodor 1970): **Fred killed Mary on Monday by shooting her on Sunday*¹². From the observation that this example is almost meaningless, Fodor (and most linguists

¹² Fodor's example does not have a paratactic structure contrarily to (30). However, it

after him) claims: a causative verb in its transitive form cannot be used to express an indirect causation. My own point of view is that this claim does not correspond to the right analysis of the data. (30) and Fodor's example do not involve a direct causation just because the causing sub-event in S_c does not corefer to the event described in S_a since they do not occur at the same time¹³. This is not because a transitive verb cannot be used when an indirect causation is expressed. Indeed, a transitive causative verb can be used when an indirect causation is involved, (31) with an indirect causation between Fred's shooting and Mary's death. (31), in which it is impossible to modify *kill* by a time adjunct specifying the day, will be discussed again in Section 3 on unaccusatives.

- (31) Fred killed Mary. He fired a shot at her on Sunday. She had an hemorrhage. She died on Monday.

The last case to be examined deals with one time adjunct in S_a (*yesterday*) and a more specific one in S_c (*at noon*). Only S_a . S_c . discourses will be examined. A contrast is then observed depending whether S_a describes a single action, (32a), or an iteration of actions, (32b) in which *bomb* means *send a bunch of bombs at* with a durative aspect.

- (32) a. #Yesterday, the enemy sent a bomb at the boat. They sank it at noon.
b. Yesterday, the enemy bombed the boat. They sank it at noon.

(32a) is not acceptable, which is explained by (H1): *at noon* brings a new piece of information on the causing event. On the other hand, (32b) is natural. Does it falsify (H1)? Let us check whether (32b) does have an interpretation of direct causation. Strictly speaking, the bombing of the boat does not cause its sinking. It is the fact that at least one of the bombs hit the boat, let's say at time t , before noon. Before t , all the

will be shown in Section 2.6 that there is no difference between paratactic and non paratactic structures for the data examined here. Another difference between Fodor's example and (30) is the use of *fire a shot at* instead of *shoot*. This is because *Fred shot Mary* implies compulsorily Mary's death, a case which has been put aside in Section 1.4

¹³ There is no difference of acceptability between (30a) with a S_a . S_c . structure and (30b) with a S_c . S_a . structure. This is because what is at stake is the lack of an event coreference relation. The type of event coreference relation involved, generalization or particularization, which accounts for differences between S_a . S_c . and S_c . S_a . discourses, is therefore irrelevant. The unacceptability of (30) should be compared to that of (i) with *two seconds later* or (ii) with *two seconds before*. (i) and (ii) are unacceptable because the causing sub-event in S_c does not corefer to the event described in S_a since they do not occur at the same time.

(i) # Fred fired a shot at Mary. Two seconds later, he killed her.

(ii) # Fred killed Mary. Two seconds before, he (had) fired a shot at her.

sending of bombs which did not hit the boat are not in a causal relation with the sinking. It is thus impossible to postulate a coreference relation between the bombing and the causing sub-event of the sinking. Moreover, the interpretation of (32b) involves an achieved-goal relation (Section 1.4), as shown in (33) which glosses (32b).

- (33) Yesterday, the enemy started to bomb the boat and they continued to bomb it until they reach their goal, sinking it. They achieved their goal at noon.

This gloss calls for comments on extralinguistic grounds. A human being may perform a single action without having any specific goal. It does not seem to be the case for an iteration of actions: a (normal) human being is not expected to perform the same action several times without having a goal. On linguistic grounds, this goal may be inferable from a sentence describing the type of action achieved and repeated. For example, in (32b), the goal of the enemy is inferable from S_a . In S_c , it is indicated that the enemy achieved their goal and that it happened at noon. In conclusion, this interpretation of (32b), in which the bombing does not corefer to the sinking act (see above), does not exhibit a direct causation. Therefore, (32b) does not falsify (H1).

In the rest of this paper, the S_a . S_c . or S_c . S_a discourses in which S_a describes an iteration of actions or a durative action will be put aside¹⁴.

Let us now examine (more quickly) the other adjuncts which modify the causing event. The S_c . S_a . discourses will not be systematically presented. They behave as expected: each adjunct which is licensed in S_c in isolation (or in S_a) is licensed in S_c . S_a . discourses while maintaining an interpretation of direct causation. This normal behavior is explained by the (H2) particularization hypothesis.

Locative adjuncts

In the carafe example, the agent and the patient are in the same place. It is impossible to specify this place in S_c , (34). In the boat example, the agent and the patient are not in the same place. It is impossible to specify in S_c either the place of the agent, (35a), or that of the patient, (35b).

¹⁴ Let me just add however that a frame adjunct can be inserted in S_c when S_a describes an iteration of actions, (i), while this is not possible when S_a describes a single action, (ii). The unacceptability of (ii) is explained by (H1). A frame adjunct indicates the temporal distance between the onset of the causing sub-event and the occurrence of the resulting state (Pustejovsky 1991). It brings thus information on the duration of the causing sub-event.

(i) The enemy bombed the boat. They sank it in two hours.

(ii) # The enemy sent a bomb at the boat. They sank it in a fraction of a second.

- (34) #Fred hit the carafe against the sink. He cracked it at Mary's.
- (35) a. #The enemy sent a bomb at the boat. They sank it from Buru.
 b. #The enemy sent a bomb at the boat. They sank it near Brest.¹⁵

These data on S_a . S_c . discourses conform to (H1). The reader will check the validity of (H1) and (H2) when there are two locative adjuncts, one in S_a , another one in S_c , these two locative adjuncts referring either to two different places or to one place included in the other one.

Agent-oriented adjuncts

A sentence with an agent admits adverbial phrases (adverbs, prepositional phrases or subordinate clauses) directed towards the agent, (36). The verb *break* is used instead of *crack* because a sentence such as *Fred cracked the carafe in a spirit of vengeance.* sounds poor, because of the basically unintentional nature of *crack*.

- (36) Fred broke the carafe (casually + in a casual way + in a spirit of vengeance + while dreaming of his fiancée + while washing it + to draw Mary's attention).

However, in S_a . S_c . discourses, these adverbial phrases cannot appear within S_c : (37) cannot be interpreted as causal discourses (the insertion of *therefore* is totally forbidden). On the other hand, some speakers interpret (37) as particularizing discourses (Section 1.4) because they consider that the broken state of the carafe can be inferred from S_a .

- (37) #Fred hit the carafe against the sink. He broke it (casually + in a casual way + in a spirit of vengeance + while dreaming of his fiancée + while washing it + to draw Mary's attention).

An agent-oriented adjunct modifying a causative verb brings new information about either the causing sub-event e_1 or the agent while achieving e_1 . For example, in *Fred broke the carafe casually*, *casually* modifies the manner in which e_1 was achieved (Pustejovsky 1991), while in *Fred broke the carafe in a spirit of vengeance*, the adjunct indicates the state of mind of Fred while achieving e_1 . Therefore, the unacceptability of (37) is explained by (H1)¹⁶.

¹⁵ This discourse becomes acceptable if S_a describes an iteration of actions, see (i), which seems to imply that the boat was sailing.

(i) The enemy bombed the boat. They sank it near Brest.

¹⁶ Instrumental adjuncts are considered as agent-oriented adjuncts: (i) cannot be given a causal interpretation (the insertion of *therefore* is forbidden). Some speakers give (i) an achieved-goal interpretation because they activate the following rule: if someone fires a shot at a rabbit (an animate object), it is with the goal of killing it.

(i)# Fred fired a shot at the rabbit. He killed it with a rifle.

Adjuncts which indicate the speaker's judgment on the agent cannot be inserted in S_c , (38). The unacceptability of (38) is explained by the fact that the presence of *cruelly* implies that Fred wanted the rabbit to be dead (Molinier 1990), information which is not brought by S_a . See a similar argumentation for (41b) in Section 2.4.

(38) #Fred fired a shot at the rabbit. Cruelly, he killed it.

Having examined all the types of adjuncts which modify the causing sub-events, we will now ponder over the adjuncts which do not modify the causing sub-event.

2.3 Adjuncts which do not modify the causing sub-event

For S_a . S_c . discourses, keep in mind (see Section 2.1) that a quantifier adjunct which modifies the final state can be inserted in S_c , (27b).

Among temporal adjuncts, the only ones left aside so far are the durative adjuncts like *for two hours* or *forever*. When they are admitted in S_c in isolation, they indicate the duration of the final state (Pustejovsky 1995). In S_a . S_c . discourses, they can be inserted in S_c , (39). For a permanent state as *sunk*, only a durative adjunct like *forever* can be inserted.

- (39) a. Fred delivered a punch straight to Mary's stomach. He knocked her out for two minutes.
b. The enemy sent a bomb at the boat. They sank it forever.

A speaker-oriented adjunct such as *unfortunately* or *naturally* can be inserted in S_c , (40a). It indicates the speaker's judgment on the whole event, as shown in (40c) which paraphrases (40b). Therefore, it does not bring new information on the causing sub-event.

- (40) a. Fred hit the carafe against the sink. Unfortunately, he cracked it.
b. Unfortunately, Fred cracked the carafe.
c. Fred cracked the carafe and (I think) it is unfortunate.

All the types of adjuncts which can modify a sentence built around a causative verb have now been examined and this study has shown that the (H1) generalization hypothesis is valid for S_a . S_c . discourses and the (H2) particularization hypothesis is valid for S_c . S_a . discourses. The last issues to be examined are the nature of the causative verb in respect to the intentionality of the agent, and the presence and nature of the arguments.

2.4 Nature of the causative verb in S_c

In S_a . S_c . discourses, S_c cannot be built around a causative verb which intrinsically contains the notion of a goal. Contrast (41a) with *kill* and

(41b) with *murder*. Only (41a) is acceptable when Mary's death is not known from a prior context (see Section 1.4 and (Danlos 1987))¹⁷.

- (41) a. Fred fired a shot at Mary. He killed her.
b. #Fred fired a shot at Mary. He murdered her.

The semantics of *X murder Y* is roughly “X kill Y by deliberately acting with the goal of Y being dead”¹⁸. In (41b), S_c brings thus a new information on the causing event: it was goal-oriented and the goal was the death of Mary. This information is not given in S_a since Fred may have fired a shot at Mary inadvertently (without a goal) or with the goal of wounding her. So the (H1) hypothesis explains the unacceptability of (41b). On the other hand, when S_a conveys the information that the action was performed in the purpose of killing Y, Y's death is made available by S_a and an achieved-goal discourse can be built with *murder* or *kill*, (42) ((42b) repeats (21b)).

- (42) a. Fred fired a shot at Mary carefully aiming at her heart. He murdered her at noon.
b. Fred fired a shot at Mary carefully aiming at her heart. He killed her at noon.

In S_c . S_a . discourses, S_c can be built around a causative verb which intrinsically contains the notion of a goal, (43). The acceptability of (43) conforms to (H2).

- (43) Fred murdered Mary. He fired a shot at her.

2.5 Arguments

So far, we have examined only S_a . S_c . discourses in which (i) the agent and the patient in S_c are expressed by pronominal anaphora of the NPs expressing the agent and the patient in S_a , (ii) both S_a and S_c are in the active. Let us first examine S_a . S_c . discourses in which the agent in S_c is expressed by a definite NP in an anaphoric relation with the NP expressing the agent in S_a , (44).

- (44) a. Fred fired a shot at the rabbit. The hunter, who had a rifle, killed it.

¹⁷ A discourse such as (i) is a particularizing discourse, see Section 1.4

(i) Fred stabbed Mary. He murdered her at noon.

¹⁸ In the line of note 5, this semantics of *murder* could explain why this verb does not detransitivize into an unaccusative. Its causing sub-event, i.e. ?-KILLING-ACT(e_1, x, y) \wedge GOAL(e_1, e_2) with DEAD(e_2, y), cannot be shadowed. The unaccusative form would lose the information given in GOAL(e_1, e_2).

- b. Fred fired a shot at the rabbit. The hunter, who is blue eyed, killed it.
- c. Fred hit the carafe against the sink. This idiot cracked it.

The discourses in (44) are acceptable, and so appear to be counter-examples to (H1) since the subject in S_c brings new information on X. However, this new information concerns X in itself and not X as being a participant in the causing sub-event. This claim may sound *ad hoc*, especially for (44a). However, it is supported by data observed in particularizing discourses (see (Danlos 1999a) and Section 1.3). The discourses in (45) are all particularizing discourses: in each of these discourses, both sentences refer to the same event and *at noon* brings new temporal information on the event involved. Yet, the presence of *at noon* is mandatory: the discourses in (46) are meaningless.

- (45) a. Fred killed the rabbit. The hunter, who had a rifle, killed it at noon.
 - b. Fred killed the rabbit. The hunter, who is blue eyed, killed it at noon.
 - c. Fred cracked the carafe. This idiot cracked it at noon.
- (46) a. *Fred killed the rabbit. The hunter, who had a rifle, killed it.
 - b. *Fred killed the rabbit. The hunter, who is blue eyed, killed it.
 - c. *Fred cracked the carafe. This idiot cracked it.

In other words, for (46a) and (46b), whatever the information conveyed by the relative clause may be, it cannot be interpreted as information on the agent X as a participant in the killing event: it is interpreted as information on X in itself. As there is no reason that the interpretation conveyed by a relative clause changes between causal and particularizing discourses, it can be stated that, in (44a) or (44b), the relative clause brings new information on X in itself but not on X as being a participant in the causing sub-event. Therefore, these discourses are not counter-examples to (H1). The same is true of (44c).

Let us now look at variations on diathesis in S_a . S_c . discourses. When S_c is in the active, S_a can be in the passive with an agent, (47a), but cannot be in the passive without an agent, (47b). When S_c is in the passive with an agent¹⁹, the paradigm is given in (48).

¹⁹ The cases where S_c is in the passive without an agent, (i), are left aside since the sentence *It was cracked.* is better understood with a stative reading, which gives a motivation interpretation to (i).

(i) Fred hit the carafe against the sink. It was cracked.

However, when translating a simple past as a *passé composé*, the French translation of (i) has an interpretation of direct causation which conforms to (H1), (ii).

- (47) a. The carafe was hit against the sink by Fred. He cracked it.
 b. #The carafe was hit against the sink. Fred cracked it.
- (48) a. Fred hit the carafe against the sink. It was cracked by this idiot.
 b. The carafe was hit against the sink by Fred. It was cracked by this idiot.
 c. #The carafe was hit against the sink. It was cracked by Fred.

The unacceptabilities of (47a) and (48c) are explained by (H1): the agent is not mentioned in S_a , but it is in S_c . So S_c brings new information on the causing sub-event (who is the agent).

2.6 Concluding remarks on S_a . S_c . and S_c . S_a . discourses

In S_a . S_c discourses, all the parameters in S_c (adjuncts, verb and arguments) have been examined, and this exhaustive study leads to the following conclusion: the (H1) generalization hypothesis is valid. This hypothesis accounts for the awkward behavior of these discourses. The S_c . S_a . discourses have not been examined in such an exhaustive way, but the reader can check that the (H2) particularization hypothesis explains their normal behavior.

In addition, only the S_a . S_c . and S_c . S_a . discourses with a parataxic structure have been examined. However, other structures made up of a single sentence can express a direct causation. For example, a present participle, (49a), a coordination, (49b), or a “narrative relative”, (49c), can express a direct causation with a rhetorical resultative relation.

- (49) a. Fred hit the carafe against the sink, cracking it.
 b. Fred fired a shot at Mary and (he) killed her.
 c. The carafe was hit against the sink by Fred who cracked it.

These structures are not always appropriate, but this topic will not be discussed here (Danlos 1988, Bouayad 1997). When they are, they behave exactly as S_a . S_c . discourses, as shown in (50).

- (50) a. #Fred hit the carafe against the sink, cracking it at noon.
 b. Fred hit the carafe against the sink, cracking it badly.
 c. #The carafe was hit against the sink by Fred who broke it to draw Mary’s attention.

(ii) Fred a heurté la carafe contre l’évier. Elle a été fêlée.

In (iii), the agent is not mentioned in any sentence, but it is understood that it is the same person in S_a and in S_c .

(iii) La carafe a été heurtée contre l’évier. Elle a été fêlée.

(The carafe was hit against the sink. It was cracked.)

d. #Fred fired a shot at Mary and (he) murdered her.

A direct causation can also be expressed in a single sentence with an explanation rhetorical relation, (51). These discourses behave normally, as S_c . S_a . discourses do.

- (51) a. Fred cracked the carafe by hitting it against the sink.
 b. The carafe was cracked by Fred who hit it against the sink.

3 Causal discourses with an unaccusative form

If the unaccusative form of V_c is substituted to its transitive form in an acceptable S_a . S_c . discourse, a natural discourse is obtained with (apparently) the same interpretation, (52).

- (52) a. Fred hit the carafe against the sink. It cracked (badly).
 b. Fred fired a shot at the rabbit. It died (unfortunately).²⁰
 c. The enemy sent a bomb at the boat. It sunk (for ever).

In extended event structures (Pustejovsky 1995), unaccusatives are differentiated from transitives only by the fact that the former are right headed while the latter are left headed. Therefore, (52) could be analyzed as the equivalent S_a . S_c . discourses, i.e. with a generalization relation between the first sentence and the causing sub-event in the second one. However, neither Pustejovsky's event structure for unaccusatives nor the analysis of (52) as involving a generalization relation are satisfactory.

Although Pustejovsky considers that the causing sub-event is the same in a transitive and unaccusative form, namely an action performed by an agent on the patient²¹, it has long been noted in the literature²² that an unaccusative is better understood as an eventuality that occurs "spontaneously", "without the intervention of an animate agent", "under a natural force", "with the unique control of the patient engaged in the change of state". In other words, the causing sub-event for an unaccusative should be an (unspecified) internal process in the patient, and not an (unspecified) external action performed by an agent. This position is confirmed by three phenomena observed with causal discourses.

a) If the unaccusative form of V_c is substituted to its transitive form in an acceptable S_c . S_a . discourse, a non-natural discourse is obtained, (53). The inappropriateness of (53) can be explained as follows: the first unaccusative

²⁰ Although *die* is not morphologically related to *kill*, I consider, for the sake of simplification, that *die* is the unaccusative form of *kill*.

²¹ The agent is unknown for an unaccusative.

²² See among others Boons et al. 1975, Labelle 1990 and 1992, Ruwet 1972 for French, Haspelmath 1993, Levin & Rappaport 1995, Smith 1970 for English.

sentence leads the reader to infer that the eventuality described occurs “by itself”, whereas the second sentence invalidates this inference in describing the intervention of an agent.

- (53) a. ?The carafe cracked. Fred hit it against the sink.
 b. ?The rabbit died. Fred fired a shot at it.
 c. ?The boat sunk. The enemy sent a bomb at it.

b) A S_a . S_c . discourse is unacceptable when it includes two different time adjuncts, (30a) repeated in (54a). On the other hand, the equivalent of (54a) with an unaccusative is natural with a causal interpretation, (54b).

- (54) a. #Fred fired a shot at Mary on Sunday. He killed her on Monday.
 b. Fred fired a shot at Mary on Sunday. She died on Monday.

(54b) expresses an indirect causation. Fred’s shooting triggered off an internal process within Mary (e.g. an hemorrhage) which led to her death. This internal process can be explicitly expressed as in (55). It is this internal process which can be considered as the direct cause of Mary’s death, i.e. interpreted as coreferent to the sub-causing event of the unaccusative.

- (55) a. Fred fired a shot at Mary on Sunday. She had an hemorrhage. She died on Monday.
 b. Fred fired a shot at Mary on Sunday. She died from an hemorrhage on Monday.

c) A S_a . S_c . discourse with $X=Y$ is acceptable if X is proto-agent (Dowty 1991) in S_a , (56a)–(56c), and unacceptable if X is proto-patient, (56d)–(56f) (see (Danlos 1999b) for more details on this paradigm). On the other hand, the equivalents of (56) with an unaccusative form are all natural with a causal meaning, (57).

- (56) a. Fred took an overdose of cocaine. He killed himself.
 b. Fred fell in a ravine. He killed himself.
 c. Fred threw himself in a ravine. He killed himself.
 d. #Fred was thrown in a ravine. He killed himself.
 e. #Fred got hit by a begonia pot. He killed himself.
 f. #Fred got pneumonia. He killed himself.

- (57) a. Fred took an overdose of cocaine. He died.
 b. Fred fell in a ravine. He died.
 c. Fred threw himself in a ravine. He died.
 d. Fred was thrown in a ravine. He died.
 e. Fred got hit by a begonia pot. He died.
 f. Fred got pneumonia. He died.

The lack of event coreference in (56d)–(56f) explains the unacceptability of these discourses: the event described in S_a , in which X is not a (proto)agent, cannot corefer to the causing sub-event in S_c , in which X is (proto)agent. For (57d)–(57f), it would be awkward to state that the sub-causing event is an action performed by an agent since there is no agent involved. On the other hand, if it is stated that the sub-causing event is an internal process in the patient, the (indirect) causal meaning of (57d)–(57f) is explained as follows: the first sentence describes an eventuality that X underwent as a patient; this eventuality triggered off an internal process within X (e.g. X had pneumonia in (57e)), which led to a fatal outcome.

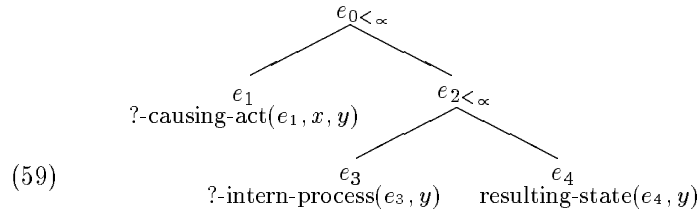
Discourses such as (52) (or (57a)–(57c)) should now be reconsidered. Do they have really the same interpretation as the equivalent S_a . S_c . discourses? For example, do (58a) and (58b) have the same interpretation?

- (58) a. Fred fired a shot at Mary (on Sunday). He killed her.
 b. Fred fired a shot at Mary (on Sunday). She died.

(58b) can be viewed in two ways. The first one consists in stating that (58b) has the same interpretation as (58a), the only difference being a pragmatic factor, i.e. namely emphasis on Fred's agentivity in (58a) but not in (58b). The second one consists in stating that (58b) is an under-specified variant of a discourse such as (54b). (58b) can be used to describe the same situation as that described in (54b) or a similar discourse: it just leaves the temporal information unspecified. The first interpretation involves a direct causation as in (58a). It implies that one considers (as Pustejovsky does) that the sub-causing event is an action performed by an agent on the patient. It is the only case which supports this position. The second interpretation involves an indirect causation as in (54b). It implies that one considers that the sub-causing event is an internal process within the patient. This position is supported by numerous linguistic works on unaccusatives (see note 22) and by the three phenomena specific to causal discourses which have just been described. The conclusion is imperative: the second interpretation is more linguistically justified than the first one. In other words, the sub-causing event in an unaccusative is an internal process within the patient, and (58b) does not involve a direct causation with an event coreference between S_a and the sub-causing event in the unaccusative.

This conclusion, however, is not totally satisfying. First, with two different types of causing sub-event for transitives and unaccusatives, one of the important features of Pustejovsky's proposal is lost, namely the fact that transitives and unaccusatives have the same representation *modulo* headedness. One way to keep the same representation for transitives and unaccusatives while differentiating the nature of the causing sub-event is to use a complex event structure as shown in (59). The realization of a

transitive occurs by heading e_1 , that of an unaccusative by heading e_2 ²³.



I cannot start here a discussion about this complex event structure, and examine how to project syntax from it. However, the following points are worth mentioning. With this complex event structure, the event representation of (31) is given in (60)²⁴.

- (60) Fred killed Mary.
 kill($\mathbf{e}_0, \mathbf{f}, \mathbf{m}$) \wedge **dead**(\mathbf{e}_4, \mathbf{m})
 He fired at her on Sunday.
 firing-a-shot($\mathbf{e}_1, \mathbf{f}, \mathbf{m}$) \wedge **on-Sunday**(\mathbf{e}_1)
 She had an hemorrhage.
 hemorrhage(\mathbf{e}_3, \mathbf{m})
 She died on Monday.
 on-Monday(\mathbf{e}_2)

In (59), it is understood that a time adjunct takes scope over both e_1 and e_2 in the transitive form (see note 10), and only over e_2 in the unaccusative form. This scope explains why it is not possible to insert a time adjunct specifying the day in the first sentence of (60): e_1 and e_2 did not occur on the same day. It also explains why (54a) is not acceptable while (54b) is.

Finally, this complex event structure explains why (58b) can be given both an interpretation close to (58a) (with just a change of head) and an

²³ The topology and the non terminal nodes of the event structure in (59) are identical to those of the event structure proposed in (Pustejovsky 1995, (93) p220) for periphrastic causative constructions, (i).

(i) Fred's shooting Mary on Sunday caused her to die on Monday.

Pustejovsky argues that a verb which encodes lexically causation does not have the same behavior as the periphrastic causative construction, therefore that their event representation should be differentiated. I agree: the leaves in my (59) and his (93) are different.

²⁴ With the usual two leave tree structure for transitives and unaccusatives, the event representation of (31) leads to the stupid following question: does Mary die from Fred's shooting or from an hemorrhage? This question does not arise in (60). However, even with my complex event structure, the following question arises: what is the event representation of a discourse longer than (31), in which several eventualities between the sentences expressing Mary's hemorrhage and her death on Monday would be described (e.g. *She got a surgery. The surgeon tried to...*).

interpretation close to (54b) (with just a lacking temporal adjunct). This is more satisfactory than making a decision in favor of the second interpretation, as one is led to make it with the usual two leave tree structure for causative verbs (see above).

Conclusion

Any study on causality is inevitably dangerous: causality implies dealing with extralinguistic knowledge which is hard to formalize. Nevertheless, this paper has presented a rigorous linguistic study of some causal discourses. Rigour has been possible thanks to the use of linguistic notions, i.e. event coreference and type of event coreference²⁵. This discourse study relies on lexical semantic works (concerned mainly with sentences in isolation). Conversely, it has shown that discourse considerations can shed a light on lexical semantics.

I would like to conclude by saying that the data have been presented for English, but that they are also valid for French (Danlos 1996), Korean (Pak 1997), Italian (Fiammetta Namer, personal communication), and very likely for many other languages²⁶.

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²⁵ Rigour has also been obtained thanks to the help of some extralinguistic precautions, e.g. the result is not an ineluctable consequence of the cause (Section 1.4), and the cause describes a single (non durative) action and not an iteration of actions (Section 2.2).

²⁶ Some graduate students are looking at the data in Arabic, Hebrew, Russian, Chinese and Japanese. Their research has not falsified the present hypotheses up to now. However further and more careful work is still necessary. I thank them for their feedback which was essential.

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