

Textlinguistic Analysis of Events: A Paradox

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Abstract: The aim of this paper is to present and analyze a paradox which arises through the use of complex events as the denotation of causative verbs within texts. According to the majority of event-based theories, complex events consist of at least two parts of the same ontological status, namely events. The paradox appears as soon as a single complex event can be identified with arbitrarily many parts within the text. A way out of the paradoxical situation comes when one recognizes the fact that the verb denotes an event, but that its parts are not of the same status. For this analysis I use the discourse-sensitive strategy of Asher and Lascarides (2003) in order to demonstrate the advantages of using discourse entities implied by a verb, which are available for textual inference.

Keywords: Textual analysis, causative verbs, complex events, paradox, discourse inference.

1. Introduction

Davidson (1967) first argued persuasively for allowing the use of event variables as crucial logical elements in the semantic analysis of verbal predicates. Nowadays, the majority of linguistic theories in the innersentential level use the notions of causation and event in order to explain the semantics of verbs and the linguistic realization of their arguments. All of these theories follow, either explicitly or implicitly, Davidson's main proposal that events enter the semantic analysis of verbs as independent entities and that they constitute denotations of verbs.

The first part of the paper in 1.1 is devoted to the presentation of the paradox that arises when one tries to put in use event-based theories for building intersentential representations and inferences. I will then use the Segmented Discourse Representation Theory's (henceforth SDRT) perspective on the lexicon-discourse interface and particularly on events as lexically denoted variables exploited for textual analysis. Although this approach sounds more promising related to the solution of the paradox under analysis, I will present some foundational problems it faces. Thereafter, the paper unfolds a more improved analysis extending the use of the foundational concept of *discourse labels* of the theory that very naturally solves this important problem of how to semantically represent lexical causative verbs. The last part sums up the findings under the new framework and the direction for researching the interface between lexical and textual meaning.

1.1 The paradox or how to identify events in the text

Either as variables in a logical language or primitives in a conceptual framework such as that of Jackendoff's (1990), events are organized around more primitive notions, one of which is that of causation. However, although the internal complexity of verbal denotations seems to enter the discussion about how arguments of verbs are projected into syntax or how syntax organizes them in the different projections, depending on the position one might adopt regarding the lexicon-syntax debate, most of these theories do

not seem to care about how this complexity is cashed out in model-theoretic terms particularly when new sentences of the text enter the interpretation procedure.

Causation is usually seen as a relation between events. Linguistic causation appears as a factor for determining the behavior of verbs with their arguments and is clearly distinguished from the causation studied by philosophers. The majority of semantic theories stipulate that verbs or verbal constructions denote events that consist of subevents (for lexical causative verbs) or two compositionally derived events (for more complex constructions as resultatives) that are causally connected to each other (a.o. Alsina's 1993, 1999; Chierchia and ConnellGinet 2000; Dowty 1979; Hale and Kayser 1993; Higginbotham 2000; Jackendoff 1990; Kratzer 1996; Levin and Rapaport 1999, 2005; Parsons 1990; Pustejovsky 1995; Ramchand 2008).

For instance, abstracting away from the various theoretical bias of the differing analyses, the semantics of the lexical causative verb assume that lexical causative verbs of change of state such as *break* denote a causing subevent and a process subevent that includes a result state. Following Levin and Rapaport (1999), the semantic structure of these verbs can be represented schematically as in (1).

(1) 'unspecified event CAUSE BECOME specified state'

These verbs specify the exact change of state of the object, e.g., the state of *broken* for the vase in (2), but there is no single property that could describe the causing event denoted by the lexical verb. In other words, the nature of the causing subevent is determined only within a specific context and constrained only by pragmatic means.

Levin and Rapaport (1999) called the semantic unspecificity of these lexical causatives *lexical gap*, since these verbs "say nothing about the activity of the agent which brings about this change".

(2) John broke the glass

However, note that the unspecificity of the causing subevent does not imply that one cannot refer to it by using a pronoun, as shown in (3). The pronoun *it* in the second sentence refers to the *breaking* of the vase. Therefore, although the *cause of the breaking* is unspecific in the above sense, it can reasonably be thought of as part of the semantic structure of the lexical causative verb.

(3) Kelly broke the vase yesterday. It made a very loud noise on the floor

Furthermore, in (4) the *throwing-against-the-wall* in the second sentence refers back to the *breaking of the vase* in the first sentence.

(4) Kelly broke the vase. She threw it against the wall.

Levin and Rapaport (1999) add that the subevents of lexical causative verbs cannot be assigned clearly distinct temporal roles and that the denotation of these subevents should be considered independently.

(5) Moshe's piano playing woke my cat up.

(cause of the waking up = piano playing)?

| ---- act/cause of the waking up ---- || --- result-waking up --- |

| ----- piano-playing ----- |

Let us look briefly at one of their interesting examples. Following the usual aspectually-based assumptions about the internal temporal structure of the complex event denoted by lexical causative verbs, such as that of *wake up*, I provide a split representation of two temporal traces for these verbs. The one on the left indicates the cause and the other on the right represents the process along with the relevant result state.¹

If Levin and Rapaport (1999), among other theories, follow an aspectually-based analysis of the semantic structure of these verbs, there is a central inevitable question that these theories need to answer. This question can be addressed in two different ways; How do we define the causing subevent of a lexical causative verb in these cases? Or else, what kind of temporal constraint would be able to define the relation between causing and the resulting part of the denotation? The piano-playing event may occur well after the resulting event as the possible interpretation scenario in (5) indicates. Note also that the *piano-playing* event might have also started well before it has some effect on the cat. Let us concentrate on the last of these examples in order to see clearly the shortcomings of any aspectually-based framework on analyzing verbal meanings and their entailments.

Levin and Rapaport (1999) assume that two seemingly irrelevant events, the event of *piano-playing* and the *cause of the waking up* of the cat are identified and that this is a proof that the two subevents of lexical causative verbs are temporally independent. However, under any aspectual theory, time is a major factor for determining the semantic structure of lexical causative verbs that lexically entail the result state of the affected object.

Therefore, if we assume that causes precede effects in the world as we know it, it is not comprehensible how it is possible that the specific *piano playing* event causes the *waking up* as we saw in the temporal traces of (5), since the traces in this reading imply that the cause may extend well after the effect of the *waking up* took place. Following any of these aspectual representations, one is forced to conclude that it is not the *piano playing* event that causes the *waking up* but that part of its temporal trace in the above representation that corresponds to the relevant part that occurs before the *waking up*. Even though this temporal slice of the *piano playing* event can still be predicated of by the predicate *playing the piano*, it is critical to realize that in the situation illustrated in the schema under (5), it is not the same event with the bigger *piano playing* described in the sentence; or else that there is a different *piano playing* event. This means that if the *piano playing* event that actually occurred and is illustrated in (5) is e1, the *piano playing* event that corresponds to the *cause of the waking up* is an event e2. The immediate question that emerges, then, is how to identify this new event e2. Is there a spatiotemporal region with a specific property that other parts of the bigger *piano playing* event do not have and that caused the *waking up*? And if there is such property how can we trace it? Was there perhaps some part of the *piano playing* which was louder than the others and that was responsible for the waking up? The much deeper issue with the indeterminacy of event talk is also related to the talk about the subevents denoted by lexical causative verbs, since it is assumed that subevents and events belong to the same domain.

However, even if case one is able to trace a specific property of a smaller *piano playing* event, e2, that caused the *waking up*, it is still not clear how the spatiotemporal properties of the cause of the waking up may be traced in other cases. For if we add

¹ I follow the same strategy throughout the whole paper whenever temporal traces are needed.

another gerundive in the same sentence that refers to the *cause of the waking up* as in (6), it is not clear how the relevant spatiotemporal part that maps onto the cause of the waking up in the corresponding representation below could be described. Perhaps a predicate piano playing - singing in our logical language would seem more appropriate to describe it, but the location of the event that this new predicates is predicated of becomes even more complex.

(6) Moshe's piano playing and singing woke my cat up.

(piano-playing = cause/waking up-act)?

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| --- cause/waking up-act --- | | --- result-woke up-state --- |
| ----- piano-playing ----- |
| --- singing ----- |
| - piano-playing/singing --- |
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Let us examine some of the questions that any aspectual theory would have to face in order to provide a compositional semantics and an account for the entailments of the sentence in (6). How could one say which parts of these two events are responsible for the causing? How did both of them interact in bringing about the waking up process? What is the temporal relation between the two relevant smaller piano playing and singing events? Or to put it differently: Did Moshe sing and play the piano at the same time and how would the temporal borders be defined in relation to each other and in relation to the resulting event?

2. Toward a textual-sensitive solution

Notice that the two predicates, *singing* and *playing the piano*, do not necessarily have to be in the same sentence with that of waking up in order to get the interpretation that spatiotemporal parts of them caused the waking up. In (7), the second sentence includes the two predicates and still allows us to infer that the two events they denote refer back to the cause of the waking up. The interpretation of the two-sentence discourse is coherent, although there is no natural language conjunction that would indicate the kind of semantic connection between the sentences. Therefore, the inference that the two events in the second sentence are related to the causing part of the denotation of the lexical causative verb in the first one is based exclusively on the lexical semantic information and structure of the verbs.

(7) Moshe woke my cat up. He sang and played the piano the whole afternoon.

In other words, the interpretation of the discourse in (7) is that the second sentence elaborates on the cause of the waking up expressed by the predicate break. On the other hand, if one considers the above difficulty of identifying events and if the cause of the waking up should not be viewed as a subevent, an event-like entity, then what kind of entity is it?

The status of the causing part of the denotation is determined by the role it plays in the inference process. The causing part of the denotation has a conceptual status and is determined only contextually. As we saw, the cause-wakeup cannot be identified by a single predicate. Following the examples above, it functions as a label for a spatiotemporal region that involves parts of events denoted by other predicates in the context. So, the cause-wakeup can only be understood in a contextually defined way. In this context and as long as no other event is mentioned that “reveals” some other part of the cause-wakeup, the causing part of the denotation is elaborated on by these two

events. These two events in this specific context “elaborate” on some aspect of the causing subevent; and the context is also defined either inside the sentence (as in (6)) expressed here by a gerund) or outside of it via verbal predications.

The different detail in the granularity of information seems to be also the reason why the sentences in (8) can be put side by side in the same text. The second sentence states that the vase did not only break, but that it also broke into several pieces. The second utterance provides a more detailed description of the change and the speaker is able to reveal a different aspect of the same situation with a different predicate. Naturally, then, the denotation of predicates like *break* is simply unspecific to the extent that a different predicate or proposition in the context may describe further the state of affairs that it describes.

(8) Kelly broke the vase. She smashed it against the wall.

Additionally, assuming that the two-sentence text of (8) is coherent and that, therefore, the two utterances should be semantically and pragmatically connected, it is necessary to find the relevant discourse or rhetorical relation between them. In the absence of any linguistic conjunction or any other linguistic clue, (8) obtains one reading; namely that the denotation of the predicate *smash* in the second sentence *elaborates* on the *breaking* in the first sentence and consequently that the second sentence elaborates on the content of the first. Note, however, that unlike the previous examples, the elaboration on the content of the first sentence in (8) is on the kind of change that took place and not on the causing part of the denotation. These facts suggest that the breaking and the smashing action should be identified in the specific context. The identification of the two events in (8) should then be ascribed to context-sensitive factors. That means that in this case, one has reasons to identify the *smashing* and the *breaking* due to discourse coherence and semantic specificity.

Natural language events resemble other discourse entities in that they are denoted by the linguistic forms in which we speak and are essential to discourse coherence. Verbs and other event denoting expressions refer to them, but as we just saw, subeventual structures make even more complicated the question of how to identify these subevents in the context. The semantic structure of the discourse is a prominent factor for determining the lexical semantic representation that is relevant for inference and interpretation. On the other hand, lexical semantic information is valuable for cases similar to those above, namely when there is a lack of explicit cue phrases that indicate clearly the kind of connection between two bits of information in the discourse. Therefore, any study of the lexical meaning that participates in discourse semantic processes should not ignore the structure of the discourse and its semantic and pragmatic entailments.

From this perspective, the denotation of natural language predicates is one of events, but the internal complexity is not of subevents. Given the above data, I believe that the internal semantic structure of verbs consists of conceptual construals or labels that are constructed for the convenience of inference. Under my proposal, the causing part of the denotation serves as a tag or label with conceptual status and is assigned to lexical items by people in order to help them infer what led to the achievement of the woken up resulting state, for the verb *wake up* for instance, in a specific context. In this way, one provides a contextually dependent answer to a much deeper question about what criterion is more adequate to event identity. Events with their internal structure can be identified only given a specific context. And this context is organized around the

rhetorical structure of the discourse. Therefore, the major criterion for identifying these events is discourse or textual coherence.

3. Refining SDRT's lexicon-discourse interface

3.1 A very short crash course on SDRT

SDRT is a theory that lies in the borders between semantics and pragmatics and its ambition is to represent reliably the semantics and pragmatics of discourses and texts. Departing from theories of dynamic semantics it differs from them by claiming that the connections between the sentences can be encoded in terms of rhetorical relations and that underspecification does not only underlie the resolution of scope ambiguities but any part of textual inference and interpretation. The most common rhetorical relations used within SDRT are: *Background*, *Contrast*, *Elaboration*, *Explanation*, *Narration*, *Commentary*, *Parallel*, *Alternation* and *Correction*. Rhetorical relations are basic representational devices that incarnate the pragmatic component of SDRT and establish the semantic-pragmatic interface.

3.2 Improving existing approaches to the lexicon-discourse interface

Recently, problems in lexical semantics have been addressed by discourse semantics. A new view on lexical causative verbs has arisen based on the idea that lexically entailed causation can also influence the connectedness of units bigger than sentences. (Asher and Lascarides 1995, 2003) and Danlos (2001a,b) conceive lexical causation as potentially available for discourse inference within SDRT. Their account of lexical semantics is driven by discourse semantic purposes and should, therefore, be very different from the usual lexical semantic approaches. However, they assume analyses almost isomorphic to the usual lexical semantic ones, the only difference being that they deploy the machinery of the discourse semantic theory SDRT in order to allow lexical knowledge to interact with discourse structure. For example, the typical causative verb *sink*, according to Asher and Lascarides' (2003) theory is analyzed in terms of an entry with a rhetorical relation, *Result*, between utterances that involve two events; the *causing* and the *resulting* one as in Figure 1. Essentially, the analysis of lexical semantic theories for causative verbs is conveyed to SDR Structures that assume a close correspondence between events and utterance labels (the π s in the figure below).² The semantics of *Result* entails the causal relation between the two events expressed in π_1 and π_2 and, essentially, this entry does not differ in any important aspect from others' views on the matter.

² SDR Structures (SDRSs) are the boxes in fig. 1.

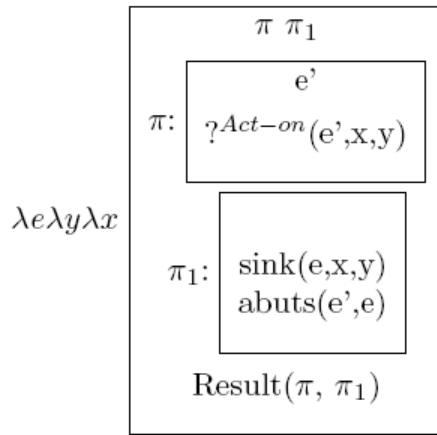


Figure 1: The discourse-sensitive lexical representation of *sink* by Asher and Lascarides (2003)

The event variable e is lambda bound as the other two arguments of the verb and is available for the semantic composition within the sentence, while the *causing* subevent is not bound within the sentence. Also, π_1 of the representation of *sink* in Figure 1, includes the temporal constraint *abuts* between the two subevents, e and e' . The *abuts* relation is a relation between any two events, one of which initiates just after the other reaches its culmination point. In other words, only when the causing subevent culminates, the resulting sinking subevent initiates. The causing event, labeled by π , is predicated of by a questioned predicate, which represents underspecified information. Additionally, the questioned predication is assigned a type (the superscript *Act-on*) from a rich type system provided within the framework of the Generative Lexicon of Pustejovsky (1995). This means that it is the context of the utterance that provides event descriptions and resolves the underspecification implied by such questioned predications. Event descriptions labeled by utterance tokens of the accessible discourse may contribute information via some predicate assigned the same type with that of the causing event of *sink* (see (9) below).

The second sentence in (9) is considered the *cause-of-the-sinking* and the correct interpretation is that the *torpedoing* had as a *Result* the *sinking* process. Such inferences are based solely on the lexical semantic knowledge brought in by *sink*. Following the ideas of SDRT about resolving the underspecified predication of *sink*, the label that tags the *cause-of-the-sinking* is identified with the *torpedoing* and the lexically triggered complex SDRSs is smoothly integrated in the rhetorical structure of the text in a process that is reminiscent of anaphora resolution.

(9) The enemy sank the boat. He torpedoed it.

Although SDRT's existing lexicon-discourse provides us with the right toolkit in order to avoid the complexity of the discussion about event identity within textual segments, as Tantos (2008) notes, the paradoxes of resolving eventual inference described in 1.1 are transferred in the labeling schema of SDRT. Therefore, although Asher and Lascarides (2003) distinguish π s as labeling segmented information and event terms as describing happenings described by predicates, they still base the interface between lexicon and discourse on event descriptions and not on the labeling scheme of SDRT.

Going a bit further, if one admits utterance tokens as the driving force for inference, then the relevant problems of resolving underspecified predicates or the complexity

associated with building event coreference relations explicated above evaporate. The solution I propose is simple in its conception but powerful enough to dissolve the enigmas of the simple cases of causative verbs that denote direct causation.³

The first step is to assume that there is not any kind of anaphora resolution of an underspecified predicate in the lexically specified SDRS involved in the inference of discourse connections. It has been assumed in SDRT in various places that the level of utterance tokens is the right place to seek the relevant connection between two segments. Then, following the main argumentation of SDRT and, given the context of our discussion about lexically specified π is being part of discourse structure, it is logically and empirically unjustified to not base inference in the discourse level on π is. Lexical information participates in the process of inferring the rhetorical structure of the discourse, but rhetorical underspecification at the discourse level is resolved based on the labeling scheme within SDRT and not on the underspecified nature of the labeled information. I suggest that the causing denotation of the causative verb is labeled as discourse prominent information and is related to other explicitly marked segments of the discourse in the usual way. By this, I mean that it is the segmentation task of the theory of π is that drives the inference and not the descriptions over events.

The task of segmenting and rhetorically relating the information in the discourse is part of the human conceptual strategy to handle the information in a pragmatically and contextually appropriate way. Linguistic event variables differ from labels mainly in that they are irreducible terms of the full dynamic SDRSs' logical forms that receive a modeltheoretic interpretation. On the other hand, labels do not refer to the happenings of the world but to logical formulas that describe events that are relevant for inferring the rhetorical structure. Therefore, there is no one-to-one correspondence between events and π is.

Another point is that although the identification of events in the discourse is a difficult and intriguing issue, the identification of utterance tokens in the discourse is possible, if the relatedness between segmented information demands it. In this process it is not the information that refers to objects and events that is identified, but the need to express the judgement of interpreters that information in the discourse is described in more than one ways or is connected in more than one ways with more than one segments in the discourse. Labels tag information and they are conceptual construals that refer to logical forms of the full-fledged SDRS dynamic logic, but not to the denotation of these logical forms.⁴

4. Conclusion

This paper has focused on one main question: namely how events denoted by lexical causative verbs are coherently interpreted within discourse. The description of events in the discourse is clearly influenced by, and influences, the rhetorical structure of the discourse. A serious paradox that arises when one uses any Neo-Davidsonian event-based theory off the shelf for textual analysis' purposes can be resolved as soon as one accepts that discourse semantics plays an important role. Starting with the framework of SDRT and defining further the character of discourse or textual labels the lexically-triggered paradox is resolved as a byproduct of resolving rhetorical underspecification.

³ Tantos (2008) has shown that simple answers can be given not only for the semantics of lexical causative verbs, but also of the complicated case of complex predicates.

⁴ Due to space limits it is not possible to demonstrate the technical part of the abstraction of the eventual structure. For a detailed analysis of the changes applied in the fundamental principles of the machinery of SDRT on the basis of the ideas explicated here, see Tantos (2008).

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