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Disambiguating propositions: How to clear the confusion in linguistics and psychology about this notion

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Abstract: Discourse psychology has used propositions to answer both functional and structural questions regarding mental representations that best reflect the result from bottom-up and top-down processes in language comprehension. But propositions as used in discourse psychology are not the same as the traditional use of the term in fields like linguistics and philosophy. Moreover, propositions in discourse psychology do not operate at the desired language level and lack important representational features. It will be claimed that entities like eventualities and thematic roles are more appropriate to be used in psycholinguistics and computational linguistics and that the use of these entities can solve the problems that arise in propositionalizing texts in the traditional way.

Key Words: Propositions, psycholinguistics, computational linguistics, discourse psychology.

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Desambiguación de proposiciones: Cómo aclarar la confusión en lingüística y psicología acerca de esta noción

Resumen: La psicología del discurso ha usado las proposiciones para responder preguntas funcionales y estructurales, respecto de las representaciones mentales que mejor reflejan el resultado de los procesos asecendentes y descendentes en la comprensión lingüística. Sin embargo, la manera en que las proposiciones han sido utilizadas en la psicología del discurso, no es la misma que la utilizada en el sentido tradicional del término, en campos como la lingüística y la filosofía. Más aun, las proposiciones en la psicología del discurso no operan en el nivel lingüístico deseado y carecen de rasgos representacionales importantes. Sostendremos que entidades como las eventualidades y los roles temáticos son más apropiados para ser utilizados en psicolingüística y en lingüística computacional y que el uso de estas entidades puede resolver el problema que emerge en la proposicionalización de textos a la manera tradicional.

Palabras Clave: Proposiciones, psicolingüística, lingüística computacional, psicología del discurso.

INTRODUCTION

Language processing requires the translation of visual or auditory perception into a mental representation. Generally speaking, bottom-up processes translate the sensory input into a mental representation and top-down processes support the coherence of the mental representation. For text comprehension it is important to make a distinction between what is in the text and what is in the mind of the comprehender. Elsewhere (Louwerse, 2002a; Louwerse & Graesser, 2004), I have called the cues in the text 'cohesion' and the coherent mental representation formed by the comprehender 'coherence'. Cohesion in the text can cue the comprehender how to build a coherent mental representation of the information in the text. At the same time, however, the absence of these cues does not necessarily prevent such a coherent representation. Take for instance the sentence "He was exhausted, [because] he ran ten flights of stairs." The cohesion device 'because' cues comprehenders to make a causal relation, but without this cue their world knowledge still enables them to determine that the second clause is a cause for the first. In fact, several studies have examined interactions between text cohesion and comprehenders' prior knowledge (McNamara, 2001; McNamara & Kintsch, 1996) showing the interaction between cohesion and coherence. Low-cohesion texts turn out to be particularly detrimental for low-knowledge comprehenders, while high-knowledge comprehenders show greater comprehension and learning gains from less cohesive texts (i.e., a reverse-cohesion effect). In other words, bottom-up processes cue comprehenders how to build a coherent mental representation, but without these explicit cohesive cues top-down processes can establish the same effect or sometimes even the reverse effect.

Given that language symbolizes the physical world by using text-based and memory-based information, a model is needed that represents this symbolization for studies concerning the comprehension of discourse. This model could serve two purposes:

1. It can give a notion of what the representation of language may look like in the mind of the comprehender (mental representation).
2. It offers a useful tool in describing the comprehension process (semantic representation).

It is important to distinguish these two purposes. The mental representation purpose answers a structural question, the semantic representation a functional question. The current study will primarily be concerned with the functional question, that is, what the semantic representation should be like. The representation should standardize the surface structure of the text in such a way that all information necessary for comprehension is included. The representation should enable one to infer the relation between the text and the world. Traditionally, propositions are used for these representations.

Propositions

Linguistics and Philosophy

In linguistic and philosophical terms, propositions are objects of belief. They can be either true or false, can be asserted, denied, known, believed or doubted. Propositions can be defined as the information about situations that can truly be described by the sentence and what is expressed by a declarative sentence (Cann, 1993; Lyons, 1977). This means that the translation from one language into another does not affect propositions. The proposition expressed by a declarative sentence is true on some particular occasion if that proposition corresponds to some state-of-affairs that obtains on that occasion. Consider the following examples:

1a. Bart tells the truth.

1b. Does Bart tell the truth?

1c. Bart, tell the truth!

1d. May Bart tell the truth.

1e. If Bart does not tell the truth, Lisa will.

All these sentences share a component of meaning, namely that they all make reference to a situation in which somebody called Bart engages in an activity of telling the truth. The propositional content “that Bart tells the truth” are the truth conditions associated with the declarative sentence. The propositional content is declared in (1a), questioned in (1b), encouraged in (1c), wished for in (1d) and conditioned in (1e). The speaker expresses

the same proposition and the propositional act is the same, but the speaker performs very different illocutionary acts (Searle, 1971).

The main characteristic of propositions is that the predicates 'true' and false' apply. So what does it mean that a proposition is true or false? It has to be kept in mind that true and false values cannot be assigned to sentences or word groups, but only to what is expressed by these sentences or word groups (Kneale & Kneale, 1962). Thus, it may be tempting to say that the sentence "Bart is writing the second page of his homework" is true at one time and not true while Bart was writing the first page of his homework or when Bart will be writing the third, but this 'true or false' ('having been true', 'becoming true') is different from the true/false predicate of propositions. The proposition of the sentence "Bart is writing the second page of his homework" is true if and only if Bart is writing the second page of his homework. This does not mean that the proposition is only true while Bart is writing the second page of his homework now, but every time that there is a reference to a situation in which somebody, called Bart, engages in an activity of writing a second page of his homework in the present.

In sum, at least three aspects of meaning cannot be explained in terms of truth-conditional semantics. One concerns the illocutionary force of the utterance. The sentences presented in (1a-e) have different meanings in particular circumstances, despite the fact that their abstract sentence meaning (propositional content) is the same. This extra-linguistic information is not captured by propositions. Secondly, implicatures cannot be accounted for in truth-conditional semantics. For instance, in case of a customer asking whether the barman has any white wine, this concerns a request rather than an informative question. The barman will infer that the customer would like to have a glass of wine, whereas a simple answer "I do" (without any subsequent actions) will not have the desired effect. Or take the following sentences:

> 2a. My neighbor played saxophone. I didn't like it, although he practiced every day.
>
> 2b. I cannot stand neighbors who practice on their musical instruments every day. My neighbor played saxophone. I didn't like it, although he practiced every day.
>
> 2c. I do not like it when neighbors play their musical instruments badly. But if they practice every day, I sometimes enjoy it. My neighbor played saxophone. I didn't like it, although he practiced every day.

The two-clause sentence in (2a), tells us that "if somebody practises saxophone playing every day, I tend to like it". However, truth-conditional semantics is not concerned with these implicatures. For text comprehension, however, they are essential. Text (2b) sounds odd, because the implicature in the final clause is contradicted by the contextual information of the first clause. This contextual information cannot be captured in propositions.

Finally, predicate logic allows us to determine the truth value for propositions connected by conjunction, disjunction, implication and equivalence. Strictly speaking, it does not allow us to calculate the truth-value of causally or temporally related propositional contents, because propositions are a-temporal, they exist outside time and space.

Propositions in discourse psychology

The notion of propositions in linguistics and philosophy is very different from the propositions used in psychology. There, propositions are defined as basic language units, a semantic configuration of the surface structure of the text (e.g. van Dijk & Kintsch, 1983; Fletcher, 1994; Kintsch, 1998). To distinguish the notion of propositions in linguistics and philosophy from the notion in psychology, I will call the former *λ-propositions*, the latter *ψ-propositions*.

A ψ-proposition contains a predicator and a variable number of arguments. The predicator can be a verb, noun, adjective or connective. The argument can be any lexical item and even (embedded) propositions. Van Dijk and Kintsch (1983) and Bovair and Kieras (1985) provide useful guides to propositional analysis that has served the psychological community as a first guide to propositionalizing text. Examples (3-7) give instances of a propositional representation.

3a. Bart thinks.
3b. P1 (THINK, BART)

4a. Bart tells the truth.
4b. P1 (TELL, BART, TRUTH)

5a. Why does Bart tell the truth?
5b. P1 (WHY, P2)
5c. P2 (TELL, BART, TRUTH)

6a. Lisa believes Bart is an honest boy.
6b. P1 (BELIEVE, LISA, P2)
6c. P2 (ISA, BART, HONEST-BOY)

7a. Because Lisa plays saxophone, Bart watches television.
7b. P1 (BECAUSE P2, P3)
7c. P2 (PLAY, LISA, SAXOPHONE)
7d. P3 (WATCH, BART, TELEVISION)

As can be seen in the above examples, each sentence is parsed into a predicate and one or more arguments. If more than one predicate can be determined, like in a two-clause sentence as (7), a meta-proposition is used that structures the two propositions. Arguments in follow the predicate, usually in the order of the thematic roles Agent, Experiencer, Instrument, Object, Source, Goal.

Using this formal representation, one is able to analyze summarization and recall data in which differences in structure usually are not important, but differences in meaning are (e.g. Trabasso & van den Broek, 1985). Propositions are also frequently used in computational algorithms that use elements of the meaning of the input text for calculations (e.g. Kintsch, 1988; van den Broek, Risden, Fletcher & Thurlow, 1996). Other proposals of a propositional representation are very similar to this notion of propositions, except that they use graphic notations (Norman & Rumelhart, 1975), or consider them to be binary units, configurations of elements with truth values, structured according to rules of formation (Anderson & Bower, 1973). Propositions have for long been the answer to the functional question (propositions being a useful tool in describing the comprehension process), but in fact have also been used to answer the structural question (propositions as the mental representation in of a text in the mind of the comprehender).

The question is whether ψ-propositions are adequate answers to the functional question of providing a semantic representation that can be used for a variety of applications, and eventually the structural question of whether they are a good model as mental representations (see also Moore, 1995). Is the concept of ψ-propositions similar to λ-propositions, or is the use of another concept in fact more adequate. An alternative concept is presented next.

Situations

An alternative to ψ-propositions is the concept of situations, or events, a concept frequently used in computational linguistics (Kamp & Reyle, 1993; Jurafsky & Martin, 2000). Situations are not true or false, they cannot be believed, asserted, denied, known, believed or doubted. Instead, they hold or do not hold of a happening and can be caused, prevented and perceived: they are occurrences in a world. Situations consist of eventualities and participants (see Parsons, 1990; Lyons, 1995). One situation can encompass one or more eventualities. Four kinds of eventualities (States, Processes, Event Accomplishments and Event Achievements) are generally distinguished, each denoted by a verb, with thematic roles related to the eventuality. A minimal set of thematic roles consists of an Agent, Object, Instrument, Source and Goal, although other fine-grained distinctions have also been made. These eventualities and thematic roles are illustrated in Table 1.

Table 1. Eventualities and thematic roles.

Eventualities		
state:	located in space, are perceivable, individual and last through time	Bart is happy
process:	activities or happenings without finishing points	Bart ran
event (accomplishment):	happenings with finishing points taking a certain amount of time	Bart ran to school
event (achievement):	instantaneous happenings	Bart reached the second floor
Thematic roles		
agent:	instigator (performer) of an eventuality	*Bart* ran
object:	someone / something affected by (undergoing) an eventuality	Bart kicked *the door*
instrument:	someone / something by means of which an eventuality is carried out	Bart kicked the door with *his foot*
source:	someone / something from which some/something moves	Bart ran *from home*
goal:	someone / something towards which some/something moves	Bart ran to *school*
temporality:	time when the eventuality takes place	*Early in the morning* Bart ran to office 317
locality:	place where the eventuality takes place	Bart waited in the Principal's office

How can these situations (eventualities and thematic roles) be distinguished? Lyons (1977, 1995) categorizes two types of situations: static and dynamic situations. Static situations are those that exist rather than happen and are homogeneous and continuous. They do not change throughout their duration. Dynamic situations do change throughout time. States differ from events in that the former involve a continuation, whereas the latter involve a termination. At the same time, processes do not have finishing points and hence show similarities with states (Kamp & Reyle, 1993). To facilitate the task of classifying eventualities, the following rules of thumb can be used (Parsons, 1990).

1. Pseudo-clefts can distinguish states from the other eventualities.

State:
8a. Bart is happy.
8b. *What Bart did was be happy

Process:
9a. Bart ran.
9b. What Bart did was run.

Events (accomplishment):
10a. Bart ran to school.
10b. What Bart did was run to school.

Events (Achievement):
11a. Bart reached the second floor.
11b. What Bart did was reach the second floor.

2. V-ing so (not) V-ed distinguishes events from processes. For Events (accomplishments/ achievements) one can say:

If x is V-ing then x has not V-ed.

Thus:

12a. If I am running to the third floor, I have not run to the third floor (accomplishment).
12b. If I am reaching the third floor, I have not reached the third floor (achievement).

For processes this rule does not apply. There, one can say:

If x is V-ing then x has V-ed.

13. If I am running, I have run.

One of the useful features of situations is that semantic representations of sentences have underlying events. Parsons (1990) follows Davidson (1980) in comparing verbs with common nouns. They do not stand for something, but for *kinds* of things. Similarly, ordinary verbs

stand for *kinds* of actions or states. This means that a sentence like (14a) can be represented as (14b). For reasons of clarity, the marking of the type of eventuality is omitted here, although the distinction is identified.

14a. Homer kissed Marge.
14b. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & Culminate (e, before now)]

The representation in (14b) says that there is a kissing event whose agent is Homer and whose object is Marge that culminated some time in the past. In this way three things present in the sentence become separate conjuncts that constrain the event of Homer kissing Marge. Thus, (14a) involves an event of kissing in which two individuals (denoted by proper nouns) are involved, namely Homer being the agent of the event and Marge being the object of the event. Treating the event as a common noun and putting it in a key position of a semantic representation offers some interesting advantages over other formal semantic theories. Two of these advantages will be discussed here, logic of modifiers and explicit quantification over events.

Let's first look at the logic of modifiers. With a underlying event-structure it can be explained why a sentence like (15d) "Homer kissed Marge on the cheek in Springfield" entails (15a) "Homer kissed Marge", (15b) "Homer kissed Marge on the cheek" and (15c) "Homer kissed Marge in Springfield"; (15c) entails (15a), and (15b) entails (15a).

15a. Homer kissed Marge.
15b. Homer kissed Marge on the cheek.
15c. Homer kissed Marge in Springfield.
15d. Homer kissed Marge on the cheek in Springfield.

The formal representation of these four sentences looks as follows. Sentence (15a) reads that there is a kissing of Marge by Homer and that kissing took place before now; (15b) adds that the event took place on the cheek, (15c) that it took place in the Springfield, and (15d) that it took place on the cheek in the Springfield.

15a'. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & Culminate (e, before now)]
15b'. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & On (e, cheek) & Culminate (e, before now)]

15c'. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & Location (e, Springfield) & Culminate (e, before now)]

15d.' (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & On (e, cheek) & Location (e, Springfield) & Culminate (e, before now)]

Parsons (1990) emphasises that not both (15b) and (15c) entail (15d) as there may be a kissing event on the cheek and a separate kissing event in the Springfield where Homer did not kiss Marge on the cheek. The bottom line is that by using an underlying event analysis, the events are separated by their logical relations between the modifiers.

Explicit quantification over events gives another example of underlying events. When there is reference, there is quantification and in traditional logic inferring (16c) from (16a) and (16b) is problematic.

16a. In every burning oxygen is consumed.
16b. Homer burned the wood.
16c. Oxygen was consumed.

Intuitively we know that (16c) follows from (16a) and (16b). The inference however can be made by an underlying-event approach as Parsons (1990) shows:

16a'. (∃e1) [Burning(e1) → (∃e2) [Consuming(e2) & Object(e2, oxygen) & In(e1, e2)]]
16b'. (∃e2) [Burning(e2) & Agent(e, Homer & Object(e2, wood)]
16c'. (∃e3) [Consuming(e3) & Object(e3, oxygen)]

The above example reads that if there is a burning then there is a consuming of oxygen. There is a burning whose agent is Homer and whose object is wood and there is a consuming of oxygen.

In sum, eventualities account for the aspectual properties expressed in language. These properties are particularly important in discourse, where temporality and causality play crucial roles in cognitive processes.

Propositions versus situations: Why they are not the same?

In the discussion of situations some differences between situations and λ-propositions may already have become clear:

1. λ-Propositions have a truth value, situations do not.
2. λ-propositions are not derived from the sentence level, situations are. More specifically, its eventuality is denoted by the main verb of a clause, its participants by the syntactic information of the linguistic expression and the eventuality of the situation.
3. λ-propositions *denote* situations. λ-Propositions are true or false with respect to these situations.

There thus seem at least two fundamental differences between λ-propositions and situations: they point out different meanings and operate on different levels.

Another meaning:

Consider the following three sentences:

17a. Bart remembers Lisa's arrival.
17b. Bart remembers that Lisa arrived.
17c. Bart remembers the fact that Lisa arrived.

If propositions and situations are identical (or should be represented in the same way because of their identical meaning) the meaning of sentence (17a) and (17b) would be the same. This is not the case (Zucchi, 1993). In (17a) Bart may not have known Lisa, where such a presupposition is impossible in (17b). Example (17b) entails (17a), whereas it does not work the other way around. Both (17b) and (17c) are identical in meaning, but they differ from (17a). We may thus conclude (17b) and (17c) denote entities of the same kind and (17a) denotes an entity of a different kind, based on the definitions used here, (17a) denotes a situation, whereas (17b) and (17c) denote a proposition. This difference in meaning can be solved by using a representation in terms of eventualities.

17a'. (∃e∃e') [remembering(e) & Subj(e, Bart) & (∃e')[arriving (e') & Subj(e', Lisa) & Obj(e, e')]].
17b'. (∃e) [remembering(e) & Subj(e, Bart) & Obj(∃e, ∃e'[arriving (e') & Subj(e', Lisa)]].

In (17a) there is an explicit reference to the event of arriving. In (17b) however, the reference is not to the event of arriving, but to the proposition that Lisa arrived.

Another level:

The difference between proposition and situation can also be illustrated by distinguishing between the different levels within an utterance. Lyons (1977) makes a similar distinction between propositions and events in terms of first, second and third order entities (see also Hengeveld, 1989):

I. First Order Entities are located in a three dimensional space. They may be referred to, properties may be ascribed to them within the framework of first order languages (i.e. lower predicate calculus for instance). Properties of first-order entities may be ascribed to individuals.

II. Second Order Entities are events, processes and states, located in time, occurring or taking place, rather than existing. Properties of second-order entities may be ascribed to first-order properties.

III. Third Order Entities are abstract entities as propositions, outside time and place. Properties of third-order entities may be ascribed to second-order properties.

The distinction between first-order entities and second-order entities is one of 'abstractness'. The former is relatively constant with respect to its perceptual properties, whereas the latter is more abstract (or rather less concrete, as they do have a spatio-temporal location). The distinction between second-order and third-order entities is one of a spatio-temporal nature. The former are observable and have a temporal duration (or are instantaneous), the latter are not observable and do not occur in space or time.

The historical term proposition stands for something different than what it is used for in psychology. With situations being a representation of what ψ-propositions attempt to be, and with *λ*-propositions being what ψ-propositions are not, the question can be raised whether the use of situations is preferred to avoid muddying in historical waters (cf. Kintsch, 1974).

Problems with ψ-propositions and their solutions with situations

The use of ψ-propositions has become subject of criticism (Moore, 1995). This criticism does not really concern the use of a semantic representation as such, but the actual definition of propositions. Four examples will be given why ψ-propositions are rather problematic.

Spatial Problem:

Consider the following sentences (after Sanford & Moxey, 1995):

18a. Bart put the wallpaper paper on the wall.
18b. Then he rested his mug of coffee on the wallpaper.

18a'. (PUT-ON, BART, WALL, WALLPAPER)
18b'. (PUT-ON, BART, WALLPAPER, MUG-OF-COFFEE)

A traditional representation in ψ-propositions does not account for the anomaly. If a ψ-proposition is a simple linguistic representation, based e.g. on thematic role assignment, the incoherence cannot be detected. This can be taken as a serious defect in propositionalizing subsequent events. The anomaly becomes clear after the inference is drawn from the mug of coffee to the wallpaper on the wall. The representation of a series of events is slightly more complicated, but it does show the anomaly if world knowledge is included that mugs cannot be put on a vertical wall. In fact, the λ-proposition itself is not anomalous at all. Instead, it is the occurrence of the events in the world that makes it peculiar. A representation in terms of situations can be given as follows:

18a''. (∃e1) [Putting(e1) & Subj(e1, Bart) & Obj(e1, wallpaper) & On(e1, wall)]
18b''. (∃e2) [Putting(e2) & Subj(e2, Bart) & Obj(e2, mug) & On(e2, wallpaper) & On(e2, wall)], e1 < e2]

Note however that the representation of 18b'' stems from the integration of the two events. In that sense 18b'' does not independently reflect 18b, but highlights the importance of incorporating the two events and marking where the problem lies. The fact that a part of the event (in which the object is put on the wall) is not possible in 'our' world makes the situation odd.

Multiple quantifier problem:

Another drawback of representation in ψ-propositions can be found in the use of multiple quantifiers. Compare the following two ambiguous sentences and their preferred meaning (after Sanford and Moxey 1995):

19. Each student has a tutor (Each student has his/her own tutor).
20. Each room has a bath (Each room has its own bath).

The one-student-one-tutor is coupled to one-tutor-more-students, whereas one-room-one-bath is coupled with one-bath-one-room. Only interpretation could prevent the integration of incorrect propositions. The different meanings cannot be pointed out in a simple propositional representation. Again, a formal semantic representation in underlying events does offer a solution for the multiple quantifier problem:

19a. (∃e) [Having(e) & Subj(e, student(x)) & Obj(e, tutor(y)) & ∃y(∀x(Having(x,y)]
19b. (∃e) [Having(e) & Subj(e, student(x)) & Obj(e, tutor(y)) & ∀x(∃y(Having(x,y)]

20a'. (∃e) [Having(e) & Subj(e, room(x)) & Obj(e, bath(y)) & ∃y(∀x(Having(x,y)]
20b'. (∃e) [Having(e) & Subj(e, room(x)) & Obj(e, bath(y)) & ∀x(∃y(Having(x,y)]

The difference in interpretation can be explained in terms of quantifier movement. In example (20a) the all-quantifier is in the scope of the existential-quantifier, resulting in the inappropriate interpretation.

Tense and aspect:

A representation of tense and aspect in a ψ-propositional representation is also problematic. As we have already seen, in situations aspectual information is included in different types of eventualities (state, process, event accomplishment and event achievement). But other instances of tense and aspect provide further evidence for the difference between ψ-propositions and situations, and why the latter is preferable. Consider the following sentences:

21a. Homer kissed Marge.
21b. Homer has kissed Marge.
21c. Homer had kissed Marge.
21d. Homer is kissing Marge.
21e. Homer was kissing Marge.

A ψ-propositional representation of the examples (21a-f) would look like:

21a'. P1 (PAST(P2))
21b'. P2 (KISS, HOMER, MARGE)

Such a representation does not take into account important information from the surface structure of the sentence. We need a representation that captures the essence of the meaning as well as the aspect and tense information. This is offered in a representation into situations. Sentences read as follows (following Parsons, 1990).

21a''. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & Cul(e, before now)].
For some event e: e is a kissing, the agent of e is Homer and the object of e is Marge and e culminates before now.

21b''. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge)].
For some event e: e is a kissing, the agent of e is Homer and the object of e is Marge and e's resultant-state holds now (where e's resultant-state holds at time t ≡ e terminates at some time at or before t)

21c''. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & (∃t) [RS(e,t) & Holds(e,t)]].
For some event e: e is a kissing, the agent of e is Homer and the object of e is Marge and e's resultant-state holds before now (where e's resultant-state holds at time t ≡ e terminates at some time at or before t)

21d''. ∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & (∃t) [IP(e,t) & Holds(e,t)]].
For some event e: e is a kissing, the agent of e is Homer, and e's in progress-state holds now (where the in-progress state holds while e is in progress and at no other time)

21e''. (∃e) [Kissing(e) & Agent (e, Homer) & Object (e, Marge) & (∃t) [IP(e,t) & Holds(e,t) & Cul(e, before now)]]
For some event e: e is a kissing, the agent of e is Homer, and e's in progress-state holds before now (where the in-progress state holds while e is in progress and at no other time).

As can be seen, whereas the essence of the meaning of the sentence remains the same in the examples [Kissing(e) & Subject (e, Homer) & Object (e, Marge)] and is also expressed by ψ-propositional representation. The differences in tense and aspect are additions to this core representation into situations.

Such an addition is desirable. Several studies have shown verb aspect has an impact on the perception of the duration of situations in narrative. Morrow (1985), for instance, showed that subjects perceived the location of a character in a narrative differently depending on the aspect of the verb (perfective, imperfective). Carreiras, Carriedo, Alonso and Fernandez (1997) found differences in subjects between foregrounded imperfective situations and background perfective situations. Magliano and Schleich (2000) found further evidence that

aspect provides processing instructions for situation construction and the maintenance of information in working memory. Magliano and Schleich investigated the role of verb aspect in text comprehension using imperfective and perfective aspect sentences. Their experiments showed that comprehenders are sensitive to aspectual information in the text and that activation of this information is dependent on working memory capacities. They demonstrated that comprehenders keep track of whether or not activities are completed.

Furthermore, Louwerse (2002b) showed in a computational model based on Kintsch's (1988) Construction Integration model that in both summarization and recall the distinction between states, processes, event accomplishments and achievements plays an important role. States and processes hardly contributed to the likelihood of a situation being recalled, whereas events played a highly significant role. Louwerse concluded that the effect of static situations (states) or dynamic situations extended in time (processes) might have less impact on the mental representation than momentary situations. States differ from events in that the former involve a continuation, whereas the latter involve a termination. As processes do not have finishing points they show similarities with states (Kamp & Reyle, 1993). In other words, what happens in a narrative is mainly decided by accomplishments and achievements, which are distinguished from states and processes of having output (result) states as terminal points.

Temporality and causality:

ψ-Propositional networks can be constructed from the text and connected ψ-propositions can be marked by a connective as their predicate. However, as pointed out in the previous section, representing coherence relations in ψ-propositions is problematic, as the construction of a coherence relation often does not come from clausal information, but rather from the contextual information. Consider the following clauses and their ψ-propositional representations.

22. Marge hit Homer, because he kissed her.
22a'. P1 (BECAUSE, P2, P3)
22b'. P2 (HIT, MARGE, HOMER)
22c'. P3 (KISS, HOMER, MARGE)

23. Marge hit Homer after he kissed her.
23a'. P1 (AFTER, P2, P3)
23b'. P2 (KISS, HOMER, MARGE)
23c'. P3 (HIT, MARGE, HOMER)

24. Homer kissed Marge before she hit him.
24a'. P1 (BEFORE, P2, P3)
24b'. P2 (HIT, MARGE, HOMER)
24c'. P3 (KISS, HOMER, MARGE)

25. Marge hit Homer. He kissed her.
25a'. P1 (HIT, MARGE, HOMER)
25b'. P2 (KISS, HOMER, MARGE)

What we need is a formal representation that captures the information in the text, but also allows a representation of the possible implicatures. Situations offer such a representation.

22. Marge hit Homer because he kissed her.
22'. (∃I) [I > now & (∃e1) (∃t1) [t1 ∈ I & Kissing(e) & Subject (e1, Homer) & Object (Marge) & Cul (e1, t1) & (∃e2) (∃t2) [Hitting(e2) & Subject (e2, Marge) & Object (e2', Homer) & Cul(e1, t2) & **CAUSE(e1, e2)**]]].

23. Marge hit Homer after he kissed her.
23'. (∃I) [I > now & (∃e1) (∃t1) [t1 ∈ I & Kissing(e) & Subject (e1, Homer) & Object (Marge) & Cul (e1, t1) & (∃e2) (∃t2) [Hitting(e2) & Subject (e2, Marge) & Object (e2', Homer) & Cul(e1, t2) & **t2 is after t1**]]].

24. Homer kissed Marge before she hit him.
24'. (∃I) [I > now & (∃e1) (∃t1) [t1 ∈ I & Kissing(e) & Subject (e, Homer) & Object (Marge) & Cul (e, t1) & (∃e2) (∃t2) [Hitting(e2) & Subject (e2, Marge) & Object (e2, Homer) & Cul(e2, t2) & **t1 is before t2**]]].

25. Homer kissed Marge. She hit him.
25'. (∃I) [I > now & (∃e1) (∃t1) [t1 ∈ I & Kissing(e) & Subject (e1, Homer) & Object (Marge) & Cul (e1, t1) & (∃e2) (∃t2) [Hitting(e2) & Subject (e2, Marge) & Object (e2', Homer) & Cul(e1, t2) & **CAUSE(e1, e2)**]]].

These four sentences can –and most likely are– interpreted in the same way, i.e., that Marge hit Homer because he kissed her. As a ψ-proposition is an abstract representation of the meaning of the clauses, we would expect a representation like the one presented in (22a-c). But at the same time, such an abstract representation does not do justice to *possible* different interpretations. In other words, implied interpretations, e.g. in the case of implicit

coherence relations, are difficult to represent in ψ-propositions. They can be represented in situations. Except for the parts in bold, the examples (22-25) are identical. The parts in bold make the representations unique to the particular sentence: they specify the event. The overlap between the sentences points out the *possible* different interpretations.

The examples in this section show some of the problems a ψ-propositional representation is concerned with. The main problem lies in the rigidity of ψ-propositional representations: they do not allow for the flexibility often needed. In recent years formal semantics often used a representation in terms of situations for this purpose. It has been shown here that such a representation offers more essential details than ψ-propositions and is therefore preferred.

CONCLUSION

For structural reasons and/or for functional reasons, a language representation is needed that captures results of top-down and bottom-up processes. This representation model should form a bridge between the cohesion cues in the text that are used by bottom-up processes and the coherent mental representation formed by top-down processes. This paper has shown that ψ-propositions share the terminology of λ-propositions but they are fundamentally different. The definition of proposition differs in linguistics/philosophy and psychology. Furthermore, as λ-propositions do not occur in time and place temporality and causality do not play a role, something is needed in a (ψ-propositional) representation of text. An alternative to ψ-propositions is situations. The definition of λ-proposition and situation dictates the conclusion that λ-propositions and situations are not the same. On the other hand, ψ-propositions don't share terminology of situations but they are fundamentally the same, but situations specify where ψ-propositions do not.

In this paper I have not argued that ψ-propositions are useless, neither have I argued that the notion of ψ-propositions and the rich research going with the terminology should be abandoned. Instead, I have made an attempt to outline that a more refined representation is needed in discourse psychology than the current ψ-propositional representation and that the notion of ψ-propositions for such a representation should clearly be distinguished from the notion of λ-propositions. Using situations distinguishes ψ-propositions from λ-propositions and offers a more refined representation.

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