A Factuality Profiler for Eventualities in Text

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A en Francesc i la Mercè, en Joan i la Rosa.

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Abstract

A Factuality Profiler for Eventualities in Text

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by Roser Saurí

Event factuality is the level of information expressing the factual status of eventualities mentioned in text. That is, it conveys whether eventualities are characterized as corresponding to facts, to possibilities, or to situations that do not hold in the world. As such, it touches on two categories more standardly assumed in the literature: modality and evidentiality. They both have been widely discussed in linguistics and philosophy, but it is not until recently that have started to receive some attention within the area of NLP.

Factuality is a necessary component for reasoning about eventualities in discourse. Inferences derived from events that have not happened, or that are possible, are different from those derived from events judged as factual. It is also essential for any task involving temporal ordering. The creation of event timelines needs to be aware of the different status of eventualities presented as uncertain or counterfactual.

My dissertation aims at designing and developing a *factuality profiler*, namely a tool devoted to identifying the factuality degree associated to eventualities mentioned in discourse.

Event factuality cannot be conceived independently from language users, who are understood here as the *sources* of factuality information. Their inclusion in the model is fundamental. Two sources can assign different factuality values to the same event.

Because of that, the factuality profiler must be capable of representing different and possibly contradictory information about the factuality nature of any event.

De Facto, the factuality profiler presented here, is grounded on the linguistic strategies speakers employ to signal degrees of factuality in discourse. These involve information at different levels: lexical, syntactic, and rhetoric. De Facto implements an *algorithm* based on the grammatical structuring of factuality in languages like English, and is informed with a set of *linguistic resources* compiled from a data-driven approach.

For evaluating De Facto, I created *FactBank*, a corpus annotated with factuality information. The interannotation agreement score for the task of assigning factuality values to events is $k_{cohen} = 0.81$. Running De Facto against the gold standard results in $F1 = 0.74$ (macro-averaging), $F1 = 0.85$ (micro-averaging) and, in terms of interannotation agreement, $k_{cohen} = 0.72$.

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Chapter 1

Introduction

1.1 Motivation

Whenever we use language to talk about situations in the world, we are not only referring to a relation among a number of participants which potentially takes place at a given location and at a point in time, but we are also expressing a particular stance about it, which manifests along different parameters. One of them, for instance, is commonly termed as subjectivity. We position ourselves in terms of a subjective scale which ranges from an absolutely favorable to a totally unfavorable attitude, and passes through a neutral (or objective) position. Another parameter configuring speaker's pragmatic stance has to do with certainty. We express our degree of certainty about the factual status of the described situation. We can characterize it as an unquestionable fact or express some degree of uncertainty if we are not sure whether the situation holds in the world. This last issue, the factuality status of eventualities mentioned in discourse, is the focus of the current dissertation.

Event factuality is understood here as the level of information expressing the commitment of relevant sources towards the factual nature of eventualities in text. That is, it is in charge of conveying whether eventualities are characterized as corresponding to a fact, to a possibility, or to a situation that does not hold in the world. As such, it is related to the notion of epistemic modality, which has been widely analyzed first in the philosophical tradition and, from the 20th century, in the linguistics discipline as well.

Similar to other semantic distinctions such as tense and aspect, epistemic modality in natural languages can be expressed by means of well-defined systems of grammatical markers (e.g., affixes, clitics, or verbal auxiliaries). In English, for instance, modal auxiliaries contribute distinctions at this level. But as it happens, there are many other mechanisms conveying factuality-related information as well. In addition to the adverbs and adjectives that have an interpretation comparable to that of modal auxiliaries (e.g., *probably, possibly*; *probable, possible*), there are also predicative elements contributing similar meaning. For example, expressions of opinion or belief (e.g., *think, suspect*) project a nuance of uncertainty on their embedded event, whereas reporting predicates (*say, claim*) characterize the speaker of the sentence as uncommitted with regard to what was said or claimed. On the other hand, predicates expressing attempt (*attempt, try*), volition (*want, hope*), command (*call for, order*), among many other types, present the factuality of the event in their embedded clauses as totally underspecified.

The following examples illustrate the use of some of these expressions. The elements bringing in factuality distinctions are in bold face, whereas the (head of the) eventualities effectively qualified by them are underlined.

(1) **Possibility:** These results indicate that Pb2+ **may** <u>inhibit</u> neurite initiation by inappropriately stimulating protein phosphorylation by CaM kinase.

Belief: Chinese analysts **believe** that the United States will <u>continue</u> to provoke North Korea.

Reporting: President Fox **said** he would <u>solve</u> the Chiapas problem in 15 minutes.

Volition: Hans Blix **wants** the US to <u>allow</u> UN inspectors back into Iraq to verify any weapons found by coalition forces.

Attempt: George Mallory and Andrew Irvine first **attempted** to <u>climb</u> Everest in 1924.

Command: John Murtha **called** for the immediate <u>withdrawal</u> of U.S. troops from Iraq.

Event factuality is a fundamental information component for reasoning about eventualities in discourse. Inferences derived from events that have not happened, or that are only possible, are different from those derived from events judged as factual in nature. Consider:

(2) Of the 14 known ways to reach the summit, only the East Ridge route has never been successfully climbed since George Mallory and Andrew "Sandy" Irvine first attempted to climb Everest in 1924.

(3) Nixon claimed that White House counsel John Dean had conducted an investigation into the Watergate matter and found that no-one from the White House was involved.

In sentence (2), the event of *Mallory and Irvine climbing Everest in 1924* is embedded in a context of attempt. Disregarding this would lead us to wrongly conclude that they first climbed Mount Everest in 1924. Similarly, ignoring the reporting context in example (3) can mistakenly lead us to conclude that no members of the White House where involved in the Watergate matter.

Knowing the factuality nature of events is also essential for any task involving the temporal ordering of eventualities mentioned in text. The creation of event timelines needs to be aware of the different status of eventualities presented as uncertain or counterfactual.

The need for this further type of information is demonstrated in highly domain-oriented disciplines such as bioinformatics (Light et al., 2004), as well as more genre-oriented tasks. For example, Karttunen & Zaenen (2005) discusses the relevance of veridicity for IE. Factuality is critical also in the area of opinion detection (Wiebe et al., 2005), given that the same situation can be presented as a fact in the world, a mere possibility, or a counterfact according to different sources. And in the scope of textual entailment, it has been taken as a basic feature in some of the systems participating in (or using the data from) previous PASCAL RTE challenges. For example, Tatu & Moldovan (2005) treat intensional contexts, de Marneffe et al. (2006) look at features accounting for the presence of polarity, modality, and factivity markers in the textual fragments, while Snow & Vanderwende (2006) check for polarity and modality scoping over matching nodes in a graph. Most significantly, the system that obtained the best absolute result in the three RTE challenges, scoring an 80% accuracy (Hickl & Bensley, 2007), is based on identifying the set of publicly-expressed beliefs of the author; that is, on the author's commitments of how things are in the world according to what is expressed in text –either asserted, presupposed, or implicated.

1.2 Goal of the dissertation

My dissertation aims at designing and developing a *factuality profiler*, namely a tool devoted to the identification of the factuality degree associated to eventualities mentioned in news text. The question from which to approach this goal is the following:

> What support do we have, as readers of news reports, about whether the events mentioned in text correspond to factual situations in the world?

Deciding whether events mentioned in discourse are referring to facts, possibilities, or situations that never took (or will take) place is a matter of perspective and depends on external factors such as what is the information provenance, i.e., who are the sources. Depending on the role conferred to them (e.g., experts vs. witnesses vs. general audience presenting their opinion, etc.), some sources are perceived as more trustworthy than others. Similarly, the credibility of politicians and social agents in general will be assessed based on the actions coloring their past public career.

The factuality nature of eventualities may also be biased by the reader's set of beliefs, her degree of ingenuity, and how much she trusts the relevant sources. Two different readers can have different views on the situation being narrated. Consider, for instance, the following fragment regarding the authorship of the Madrid bombings on March 11, 2004:

(4) Within an hour of the bombings, the Spanish government was able to say there was "no doubt" that ETA was behind the atrocity. ETA's political wing, Batasuna, later denied this and pointed the finger at the "Arab resistance". Then ETA's founder, Julen de Madariaga, said: "It's not ETA's method of working."

The text presents sources of a very different status speculating about the authorship of the bombings. On the official side, the Spanish government, which was ruled by the Popular Party at the time of the attacks. On the suspicious side, the illegalized political party Batasuna and Julen de Madariaga, ETA's founder. How certain are we, as simple newspaper readers, of the truthfulness of the Spanish government? How certain are Popular Party voters reading the same excerpt? How certain will a reader be about what an illegalized party has to say?

The present research will disregard external factors such as source reliability or reader bias –we can envision a later postprocessing applying weights in order to favor specific sources as more reliable than others. Rather, it will focus on identifying what are the judgments that the relevant participants (here, the Spanish government, Batasuna, Julen de Madariaga, and the text author) make about the factuality nature of events, independently from their intentions and beliefs, and exclusively based on the linguistic expressions employed in the text to express such judgements; e.g., *say, no doubt*, or *denied* in the fragment above.

The fact that an eventuality is depicted in a text as holding or not does not mean that this is the case in the world, but that this is how the relevant sources characterize it. In other words, the factuality nature of an eventuality is not one of its inherent features (as it could be, for example, its temporal properties or the participants engaged in it), but a property relative to sources. Going back to the example above, the factuality of ETA being the author of the Madrid bombings is different depending on who is assessing it: the Spanish government on the one hand, or Batasuna and de Madariaga, on the other. Four years after this tragedy, we know that the former was wrong: ETA was not actually involved in the crime. My factuality profiler will, in any case, disregard how things are in the world and account only for *how things are in the world as presented by the different informants in a given text.*

1.3 Approach

The analysis and identification of event factuality will be constrained to news reports, given that it constitutes a genre particularly fitted for that purpose. Its focus is contributing information about eventualities that are generally anchored to a timeline, and therefore tends to contain few generic and habitual events, for which factuality is not a pertinent parameter (Smith, 2003). Furthermore, it is concerned with issues of "truth, reliability and accountability." (Waugh, 1995:129), elements that are of absolute relevance within the scope of the current dissertation. The theoretical framework that will be proposed here can, however, be exported to other genres as well.

In order to avoid the effect of external factors such as source reliability, reader's set of beliefs, or world knowledge, in the design of the factuality profiler I will adopt the following two basic constraints:

1. *The factuality profiler must be grounded only on the linguistic expressions that signal factuality.* We will see that this involves information at different linguistic levels: lexical, syntactic, and rhetoric. The linguistic knowledge informing the profiler will be identified by means of a data-driven approach, by exploring TimeBank and a fragment of the American National Corpus. In addition, it will be modeled respecting the grammatical structure of the language, in order to guarantee both a maximum generalization capability of the resulting descriptive framework, and an optimal performance in subsequent recognition tasks.

2. *Whenever appropriate, the factuality profiler must be capable of representing different (and possibly contradictory) information* about the factuality nature of a particular event, as is the case when several sources are involved in the factuality evaluation. This confers a central role to the participants that act as information sources.

The factuality profiler aims at becoming a support tool for tasks requiring some degree of text understanding, providing them with information relative to the factuality status of events in discourse. Its input will be a text (or set of texts), and it will return as output the set of factuality assessments assigned to each eventuality by the relevant sources at play. The profiler functionality will break down into two major tasks. First, identifying the information conveying the factuality assessments of eventualities in text. This involves pinpointing the linguistic means that express such information (factuality markers and sources), and then characterizing them within the descriptive framework of event factuality. And second, computing the factuality degree assigned to each eventuality, based on the interaction of the different factuality markers scoping over it, and relative to the different sources mentioned in the text.

1.4 Related work

Event factuality touches on basic linguistic categories such as epistemic modality (dealing with the degree of certainty of a situation being a fact in the world) and polarity (applied to event entities, hence expressing whether they have happened or not). Both categories have been widely discussed in the fields of linguistics and

philosophy, but have received very minor attention in NLP. Only very recently we saw the first proposals towards a representational framework capable of accounting for these or related notions.

The work closest to my research is Rubin et al. (2005), which sets a theoretical framework for identifying certainty in text. Certainty there is understood as "a type of subjective information available in texts and a form of epistemic modality expressed through explicitly-coded linguistic means" (Rubin et al., 2005:5). It is therefore conceived along very similar terms to the notion of event factuality.

Their approach is interesting in that it is both data-driven and framed within an NLP perspective. In my opinion, however, it suffers from some lack of precision in pinpointing the phenomenon. On the one hand, there is no clear grammatical basis in the analysis (and therefore identification) of certainty markers. On the other, the set of values they propose for characterizing the different degrees of certainty is not based on any explicit semantic criteria. In my opinion, this fuzzy approach, both at the syntactic and semantic level, explains the low interannotation agreement scores they obtain for identifying explicit certainty markers in a sentence (for which a Cohen's kappa of $k = 0.33$ is obtained) and distinguishing among different degrees of certainty: $k = 0.15$, which improves up to $k = 0.41$ when stricter annotation instructions are provided (Rubin, 2007).

Factuality-related information is also accounted for in at least four corpora: the MPQA Opinion Corpus (Wiebe et al., 2005), the Penn Discourse TreeBank (Miltsakaki et al., 2004), TimeBank (Pustejovsky et al., 2003), and the ACE 2008 corpus annotated for the Relation task (ACE, 2008). All four of them address this level of information as a subset of the information they target.

The factuality-relevant expressions annotated in the MPQA Opinion Corpus are private states (opinions, beliefs, thoughts) and speech events. They both convey the stance of a source with regard to what is believed or said. Nevertheless, event factuality is not the focus of the annotation, and hence these events and states are not characterized in terms of the factual degree they convey but in terms of perspective (i.e., subjective vs. objective). Similar to the encoding of certainty information in Rubin's work, the information units in the MPQA annotation scheme is not grammatically grounded. That is, the annotation of text spans is not guided according to the grammatical structure of the sentence, and this can pose an obstacle for tasks of

automatic recognition.

The Penn Discourse TreeBank (PDTB) seems closer to my perspective in that it contemplates the attribution of abstract objects (corresponding here to what I refer to as eventualities), and encodes both their sources and the degree of factuality associated with them (Prasad et al., 2007). The task is approached from a compositional view, contrary to the two previous annotation efforts regarding certainty and opinion information.

The PDTB annotation scheme, however, lacks some sensitivity in encoding the factuality degree associated to the attributed event, which is assigned based on the type of action described by the predicate embedding it. In particular, events embedded under communication predicates are characterized as *asserted*; events embedded by propositional attitude predicates, as *beliefs*; and events embedded under factive predicates, as *facts*. As it happens, however, each of these types of predicates is not uniform in terms of the factuality they project to the embedded event. *Suggest*, for instance, is a communication verb which nevertheless conveys a nuance of belief. Similarly, *forget* is a factive predicate which, contrary to others in its class, expresses an uncommitted (or ignorant) stance of the source (i.e., the participant expressed by its subject) with regards to the factual status of its embedded complement. The classification misses therefore important factuality distinctions. The PDTB annotation, in addition, is not concerned with the effect of other markers of modality (e.g., modal auxiliaries and adverbials) on the factuality of abstract objects.

In ACE 2008, factuality information is presented in terms of modality (ACE, 2008). It distinguishes between *asserted* (for situations which can be interpreted as pertaining to "the real world") and *other* (for situations holding in "a particular counterfactual world"). It is therefore a very basic distinction which lacks the different degrees of possibility used by speakers to characterize events. Moreover, the guidelines document does not provide either a grammatical basis or a set of semantic tests in order to distinguish between the two values.

The last corpus to evaluate is TimeBank, a corpus annotated with TimeML (Pustejovsky et al., 2003), a specification language representing temporal and event information in text. Given the surface-based approach of TimeML, TimeBank is the corpus that takes the most compositional approach to annotation among the three reviewed corpora.

The factuality-relevant information encoded in TimeBank is mainly lexical: grammatical particles expressing event modality and polarity, as well as predicates selecting for an event-denoting argument, which project a factual value to their embedded event by means of subordination links (or slinks). Thus, TimeBank provides us with some of the basic components expressing factuality information in text –that is, in fact, a result from the explicit surface-based approach of TimeML. But whereas there is some characterization of event factuality (through slinks), it does not deal with the interaction among the different markers scoping over the same event.

Aside from these representational frameworks and corpora, the development of tools for automatically recognizing factuality-related information has been minimal so far. To my knowledge, there are only three initiatives in this direction. First, OpinionFinder (Wilson et al., 2005), the tool for subjectivity analysis developed within the MPQA working framework, and therefore specifically designed for identifying private states and speech events. These are indeed target expressions for any system devoted to identifying factuality information in text. However, as said above concerning the MPQA Opinion Corpus, OpinionFinder does not characterize them in terms of factuality but in terms of the opposition between objective and subjective perspective.

A second processing component is the suite of tools developed within the TimeML framework, devoted to identifying both polarity and modality using grammatical items as well as subordination contexts (Saurí et al., 2006a). Grammatical markers of polarity and modality are identified by EvITA, a non-domain specific event recognizer, which reports a performance of 74.55% precision and 78.61% recall, for a resulting F1-measure of 76.53%. The accuracy ratio (i.e., the percentage of values EvITA marks according to the gold standard) is 98.03% for grammatical polarity, and 97.04% for modality. On the other hand, modality and factuality information expressed through subordination contexts (slinks) are identified by SlinkET, with a performance of 92% precision and 56% recall (70% F1-measure).

This suite of tools is however limited in that it does not handle the interaction of several factuality markers scoping over the same event, and it does not distinguish between different sources but offer only the author perspective.

Finally, there is the algorithm proposed in Nairn et al. (2006), a first attempt to model the percolation of polarity down the tree. It puts forward an algorithm

for computing the projection of implications through embedded contexts, involving mainly *that* and infinitival clauses. Although there are no evaluation results available for this work, it is clearly a promising step towards overcoming the first problem pointed out for SlinkET. However, it is limited in that it disregards basic groups of predicates, it obviates the role of modality, and it does not commit to the presence of factuality sources.

1.5 Summary

The dissertation is divided in two main parts. Part I is in charge of setting the theoretical framework of event factuality. First, chapter 2 creates the adequate theoretical background by contextualizing this notion within the linguistics and philosophy traditions. More specifically, with respect to the areas devoted to the related categories of epistemic modality and evidentiality. Chapter 3 defines the theoretical framework for event factuality that is adopted here. It first puts forward the *set of factuality values* structuring this semantic level. Then, it presents two *basic components* of event factuality (source participants and time), and finally it introduces the formal notion of *factuality profile*, which is, as its name suggests, the processing unit of the factuality profiler. Still in the first part of the dissertation, chapter 4 will look at the main mechanisms for expressing factuality information in natural languages, the here called *factuality markers*, and then chapter 5 will deepen in the concept of *source*.

Part II, on the other hand, has a practical orientation. It focuses on the identification of event factuality throughout text. To that purpose, chapter 6 puts forward the algorithm at the core of De Facto, the factuality profiler presented in this dissertation, and then chapter 7 describes the linguistic knowledge informing it. The specifics of the implementation are provided in chapter 8. Then, chapter 9 comments on De Facto's evaluation, which has been carried out by creating FactBank, a corpus of manually-annotated factuality information, and running the profiler against a subpart of it. Chapter 10 concludes the research by pointing out its main achievements and suggesting future venues of work.

Part I

Modelling event factuality

Chapter 2

Theoretical settings

This chapter sets the necessary groundings for delimiting and defining the notion of event factuality, which will be presented in detail in the following chapter. The next section minimally sets its theoretical framework, and then section 2.2 gives an overview of the main linguistic systems it is related to; namely, epistemic modality and evidentiality.

2.1 A first approximation to event factuality

Event factuality as understood here is the category in charge of the factual status of events. That is, it conveys whether event-denoting expressions are presented as corresponding to real situations in the world (i.e., as facts), to situations that have not happened or hold (counterfacts), or to situations of uncertain status (possibilities). Event factuality is therefore a property of events as expressed in text.

For instance, in (5a) the event of *Red Sox fans cheering for players at Fenway Park yesterday* is presented as a fact; in (5b), the *size of the contingent being disclosed* is characterized as a counterfact, a situation that did not take place; and finally, in (5c) the *extension of the naval quarantine to Aqaba by the U.S.* is qualified as a possibility.

(5) a. **Fact:** *Jubilant Red Sox fans cheered for players at Fenway Park yesterday.*
b. **Counterfact:** *The size of the contingent was not disclosed.*
c. **Possibility:** *United States may extend its naval quarantine to Jordan's Red Sea port of Aqaba.*

Consider again sentence (5a). In uttering (or writing) it, the author is doing two things. On the one hand, she is introducing a new event entity in the discourse: that of Red Sox fans cheering the players at a particular time and place. At the same time, she is presenting this event as corresponding to a fact in the world. We are therefore distinguishing two levels of information: the event introduced by the sentence, and its factual characterization.

Factuality and truth values. Computing the factuality of events in text can be seen, mutatis mutandis, as equivalent to computing the truth values of the corresponding propositions in truth-conditional semantics. For example, we can say that sentence (5a) expresses a proposition which happens to be true because there exists, in our world, a set of individuals belonging to both the set of jubilant people and the set of Red Sox fans, who are in the relation of cheering players at the particular time and place stated by the proposition.

There are however some fundamental differences between the two approaches, which concern (a) the precise unit to be evaluated: propositions versus eventualities; and (b) the model of linguistic communication underlying each approach. I consider them in what follows.

Eventualities as the basic research unit. *Eventualities* are the relevant units over which factuality applies, whereas standard semantic treatments focus on propositions. Eventualities are defined here as processes or states with temporal and (possibly also) spatial location, and to which a certain number of participants are engaged. For the sake of simplicity, throughout this work the ontologically narrower term of *event* will be used as a synonym of eventuality as well, hence including both stative and dynamic situations.

Similarly, I will not distinguish between events (or eventualities) and other abstract objects widely discussed in the literature, such as *propositions*, *facts*, *possibilities*, *projective propositions* (or *outcomes*), and *situations* (cf. Vendler, 1967; Barwise & Perry, 1983; Asher, 1993; Peterson, 1997; Ginzburg & Sag, 2000). I therefore take a more pragmatic approach and assume as eventualities those potential or actual situations in the world referred to by linguistic expressions, regardless of whether they are presented as propositions (as in contexts of belief), facts (factive contexts), or any other abstract object.

The communication model implicitly assumed. Truth-conditional semantics has no underlying model of linguistic communication. The meaning of a proposition is established by knowing the conditions under which it is true. In other words, truth values are assigned to propositions by checking whether the situation it describes corresponds to a situation in the world, which is defined in terms of a domain of entities and the relations holding among them.

On the other hand, event factuality as understood here cannot be conceived independently from language users and speech time. Factuality is a property with which *discourse participants* characterize the events they mention, at a particular *point in time*.

The discourse participant most obviously related to the factuality value of events is the text author (speaker or writer). After all, she is the ultimate responsible of how situations are presented in discourse. However, other participants introduced in the text are relevant as well, such as the agents of speech acts or the holders of opinions who are mentioned in the discourse.

The inclusion of discourse participants (or sources) in the model is fundamental. Two sources can assign different factuality values to the same event. Consider for example the event of *Iraq having weapons of mass destruction*, and the opposed factuality evaluations it receives from the sources involved (underlined) in (6) and (7). In the first sentence, Colin Powell and Condoleezza Rice evaluate that event as not holding in the real world, whereas in the second, President Bush assesses it as a true fact.

(6) **In mid-2001**, <u>Colin Powell</u> and <u>Condoleezza Rice</u> both publicly denied that Iraq had weapons of mass destruction.

(7) **Six months later**, <u>President Bush</u> claimed that Iraq had WMD.

Similarly, the temporal anchoring of the factuality assessment is necessary because, at different points in time, the same source can characterize an event in different terms. Contrast the different factual assessments of the aforementioned event made by Colin Powell in mid-2001 (6) and in February 2003 (8). I will return to this in section 3.2.

(8) "There can be no doubt that Saddam Hussein has biological weapons," <u>Powell</u> said when he spoke before the U.N. Security Council **in February 2003**.

Event factuality is therefore conceived as the level of information encoding the factual status of events presented in text, according to a given source and at a particular point in time.

Factuality and presupposition. Because factuality is related to what is presented as a fact, it can be seen as concerning what is presupposed in discourse. There is certainly a connection between the notions of factuality and presupposition (as will be detailed in what comes next), but it is not a relation of equivalence. There are several reasons to motivate such distinction.

First, theoretically: presupposition is a relation between two propositions, whereas factuality is understood here as a relation between an event, a particular source committing to the factuality nature of that event, and a point in time when that commitment takes place.[1] In this respect, my account of factuality seems close to some of the pragmatic approaches to presupposition, since presupposition there is analyzed as involving speaker's knowledge. It is a view that moves from talking about the presuppositions of a proposition to talking about speaker's presuppositions; namely, the set of propositions (or beliefs) taken for granted by the speaker, or that are already included in the communication context (e.g., among others, Stalnaker, 1974; Gazdar, 1979; Horton, 1987).

Second, factuality information is not only introduced in text by means of presupposition, but it can be entailed as well. For instance, example (6) entails both propositions in (9), which express the factuality commitment of (the underlined) sources Colin Powell, on the one hand, and Condoleezza Rice, on the other, at the point in time identified as mid-2001 (bold-faced) regarding the event of *Iraq having weapons of mass destruction* (in italics below).

(9) a. **In mid-2001**, <u>Colin Powell</u> publicly denied that *Iraq had weapons of mass destruction.*

b. **In mid-2001**, <u>Condoleezza Rice</u> publicly denied that *Iraq had weapons of mass destruction.*

[1] A formal definition of this relation will be presented in the next chapter, with the concept of *factuality commitment act.*

Third, not all the presupposed material concerns the factuality evaluation of events. For example, (10a) presupposes (10b), which has nothing to do with event factuality.

(10) a. A Taliban spokesman is claiming responsibility for an attack on a ceremony attended by the president of Afghanistan.

b. Talibans have at least one spokesman.

Fourth, not all factuality information is presupposed (or entailed). For instance, by uttering (11a) the author is characterizing the event *Iran halting its nuclear activities* as uncertain (11b).

(11) a. The UN ordered *Iran to halt its nuclear activities.*

b. It is uncertain whether Iran halted its nuclear activities.

By contrast, the same event in (12a) is characterized as a fact in the world (12b), and in (13a), as a counterfact (13b).

(12) a. The UN applauded *Iran for halting its nuclear activities.*

b. It is sure that Iran halted its nuclear activities.

(13) a. The UN regretted the fact that *Iran did not halt its nuclear activities.*

b. It is sure that Iran did not halt its nuclear activities.

Propositions (12b) and (13b) are presupposed by the speakers uttering (12a) and (13a), respectively, while proposition (11b) is neither presupposed nor entailed by (11a). However, the information stated in all three *b.* bullets above concerns the factuality status of the event *Iran halting its nuclear activities.* Note that this is also the case for (11b), where that event is characterized as having an uncertain factual status. Even though this piece of information is neither presupposed nor entailed, knowing what events are presented as uncertain is fundamental for any task involving reasoning about events mentioned in discourse. For example, for the temporal ordering of events in text, or for tracking the changes of perspective about events, which takes place throughout and across documents.

2.2 Related notions

Event factuality touches on categories more standardly assumed in the literature, such as modality (more precisely, epistemic modality) and evidentiality. This section explores the most relevant approaches to these categories in order to have a better appreciation of the structure of event factuality.

2.2.1 Epistemic modality

Epistemic modality has been approached from both the logic and the linguistics traditions. Although each discipline adopts a different approach to it, in both cases the notion is clearly related to what here I call event factuality. Chafe (1986), for instance, defines epistemic modality as the degree of reliability of a situation being a fact as assessed by authors. According to Palmer (1986), one of the most complete works on the topic compiling data from multiple languages, it expresses the degree of commitment of the author towards the certainty of an uttered proposition. And Kiefer (1987) claims that modal expressions in natural language generally express the speaker's attitude toward a situation.

2.2.1.1 Modal logic

In logic, concepts related to modality derive more from philosophy, starting from Aristotle's modal syllogisms, than from studies on natural language modality. Modal logic is concerned with the notions of necessity and possibility as applied to propositions. Different kinds of modality have been distinguished (Von Wright, 1951). For instance, *alethic modality* has to do with necessary and contingent truth of propositions, *deontic modality* (sometimes also named *root modality*) is concerned with obligations and permissions, and *volitional (or bouletic) modality* deals with speaker's desires. The type that concerns us here is *epistemic modality*, which addresses necessity and possibility based on the knowledge the speaker has about the world. Thus, an epistemically necessary proposition is not synthetically true, but true according to the set of propositions that constitutes the knowledge background of the speaker. Epistemic modality has to do with contexts of knowledge and belief.

The main interest of modal logics is alethic modality, but modality in natural

language is basically of epistemic kind (Lyons, 1977; Kiefer, 1987; Gamut, 1991). Possible worlds semantics (Lewis, 1973; Hughes & Cresswell, 1996) provides a unifying framework for the different flavors of modality, and as such it makes possible a logic-based analysis of natural language modality (e.g., Kratzer, 1981, 1991). Yet, modal logic presents important drawbacks when it comes to accounting for modality in natural language. First, it does not seem to cope well with modal notions beyond necessity and possibility, such as the semantics of *should* and *ought to* in English (de Haan, 1997). McCarthy (1997) also argues that natural language very often presents different modalities in a single sentence (as in *I want him to believe that I know he has lied*), and notes that there is no framework able to cope with all modality types simultaneously.

2.2.1.2 Modality in linguistics

The study of modality from a linguistics perspective begins at the first quarter of the last century, with Jespersen (1924),[2] and it is not until very recently, that there has begun to exist some agreement on the definition and the setting of boundaries for this category. The evolution of ideas observed in Palmer's work, one of the authors that has put more effort in systematizing the category, illustrates the process of curdling of that area: in his 1990 second edition of *Mood and Modality*, he presents an account that diverges in a considerable way from his initial position presented in 1986 (Palmer, 1986, 1990).

Nowadays, there is some consensus on the definition of the category, mainly due to the intense work devoted to analyzing the modality systems of well-known languages such as English (e.g., among others, Twaddell, 1960; Ehrman, 1966; Palmer, 1979; Coates, 1983), but also exotic languages of non-Indoeuropean origin in which modality has a clear-cut manifestation (e.g, Miller, 1965; Wilson, 1974; Burgess, 1984).

There are still many open issues of research and discussion, such as: what is the place of modality in the linguistic system; what are the different types of modality expressed throughout natural languages; does each modality manifests as a continuum or as a discrete scale; if the discrete scale hypothesis is the valid one, what are the different semantic values; what is an adequate semantic analysis for modal expressions

[2]See de Haan (1997) for a more detailed account of this.

that can be interpreted as expressing different types of modality (e.g., deontic and epistemic), etc. Two of these issues are particularly relevant for setting the category of event factuality. Specifically:

1. The placing of modality in the linguistic system.
2. The structuring of modality as a category.

I address each of them in the following discussion.

The placing of modality in the linguistic system Truth-conditional approaches to modality (e.g., Kratzer, 1981, 1991) conceive modal markers in natural language as operators which scope over a proposition and establish a logical relation between this and a set of background propositions –for example, the set of propositions of what it is known, in the case of epistemic modality. The modalized proposition is true if it is consistent with the set of propositions in the background.

From a completely different approach, modality is seen as a level of information which does not have to do with the truth of the proposition but with the speaker's attitude towards it. For example, in his work on evidentiality and epistemic space, Givón (1982) argues that propositional modality is not a mere matter of truth considered independently of the context of use, but it relies instead on an implicit contract between author and recipient. That is, the core meaning of an epistemically modalized proposition can be understood without knowing its truth value (Nauze, 2006).

This second perspective is analogous to my view of event factuality presented in section 2.1, where two different layers of information were distinguished in any given sentence. On the one hand, the eventuality it introduces –equivalently, its propositional content. On the other, the factual status assigned to that event by the relevant informant.

The distinction is traceable in early work. Already back in Jespersen (1924), we find a conceptual separation between what he calls the "contents of the sentence" and the speaker's attitude towards it. Similarly, Lyons (1977) differentiates between the "proposition that the sentence expresses" and speaker's attitude. As Palmer (1986) points out, such distinction goes very much along the lines of that between locutionary and illocutionary act lying at the core of the speech act theory (Austin, 1962). This

comes as no surprise: speech act theory is assumed as the reference framework by some authors in order to develop their approach to modality in natural language.

An interesting work in this tradition is Boyd & Thorne (1969), one of the first attempts to contextualize the modal system within a more general theory of language use. Along similar lines, Lyons (1977) adopts the distinction in Hare (1970) of three utterance components as encoding the properties of utterance meaning: *phrastic*, *tropic*, and *neustic*. The phrastic level corresponds to the propositional content of all utterances. The tropic part encodes the speech act that a sentence is generally employed to perform, distinguishing between statements and questions on the one hand, and imperatives on the other, and finally, the neustic level denotes 'the speaker's commitment to the factuality, desirability, etc., of the propositional content conveyed by the phrastic.' (Lyons, 1977:750). Modality information can be applied as an extra operator at the phrastic, tropic, and neustic levels. Hence, it is conceived as an important component of utterance meaning.

A last account of modality along a more pragmatic, utterance-centered perspective is offered in Systemic Functional Grammar (SFG), by M.A.K Halliday.[3] Similar to Lyons (1977), modality in SFG is a property of different kinds of utterances, which are classified based on their speech role (giving or demanding) and the nature of the commodity being exchanged (information, or goods and services). Combining these two parameters, we obtain utterances conveying exchanges of information (called *propositions*), and utterances expressing exchanges of goods and services (*proposals*).

Within this framework, modality expresses the intermediate degrees that lay between the two poles expressed by the polarity operator, whose meaning is 'is' or 'isn't', for propositions, and 'do', 'don't' for proposals. The modality space has therefore a different tone depending on the utterance type: in propositions, it is covered by either (a) degrees of *possibility* (possibly, probably, certainly), which corresponds broadly to what in other frameworks is analyzed as epistemic modality; or (b) degrees of *usuality* (sometimes, usually, always), a property applying to generic sentences. On the other hand, the positive and negative polarity values in the case of proposals is prescribing and proscribing, respectively, and the uncertainty space is covered by either (a)

[3]The analysis presented here is partially based on Eggins (1994), but mainly on Halliday & Matthiessen (2004), a revised version of the classic introduction to Systemic Functional Grammar (Halliday, 1985).

different degrees of *obligations* (for commands), which corresponds to the notion of deontic modality, or (b) different degrees of *inclination*, in the case of offers.

The structuring of modality as a category In the section on modal logic, we saw that the different flavors of modality information (epistemic, deontic, alethic, etc.) are always formulated in terms of the binary distinction: possibility versus necessity. Most of the work done in linguistics, however, agrees that the number of relevant values in modality systems is three.[4]

For example, Lyons (1977) puts forward the set of epistemic degrees *certainly*, *probably*, and *possibly*, and Palmer (1986) proposes distinguishing between speculative (as in *Kate may be at home now*), deductive (*Kate must be at home now*), and assumptive (*Kate will be at home now*).

Similarly, Halliday & Matthiessen (2004) characterize epistemic modality as a three-fold classification that divides the probability axis into *certain* (high), *probable* (median), and *possible* (low). The justification for this tripartite system comes clear when making the proposition negative. Note that changing the scope of the negation (from the proposition to the modal operator) requires also reversing the modal operator in order for the meaning to be preserved: the low operator is used to express high probability, and the high operator to express low probability. The middle row is unaffected. Table 2.1 illustrates it for the case of modal adverbials.[5]

Table 2.1: Interaction of modal adverbials and negation

	modal(neg(P))	**neg(modal(P))**
Certain	*That's* <u>*certainly*</u> **not** *true.*	*That's* **not** <u>*possibly*</u> *true.*
Probable	*That's* <u>*probably*</u> **not** *true.*	*That's* **not** <u>*probably*</u> *true.*
Possible	*That's* <u>*possibly*</u> **not** *true.*	*That's* **not** <u>*certainly*</u> *true.*

[4]With the exception of de Haan (1997), a very interesting work from a cross-linguistic perspective in which modality is analyzed using a continuum model in order to achieve an adequate unified way to deal with modality systems of different languages.

[5]The same situation applies for modal auxiliaries, although in this case some adjustments are made in the lexical choice. For example, *may* can be used with inner negation (*That may be not true*), but not outer, where it needs to be replaced by *can* (*that can't be true*).

2.2.1.3 Horn's theory

Beyond treatments of modality from a purely logic or linguistic approach, there is the interesting research by Laurence Horn integrating both perspectives. His work is not devoted to modality in particular, but to logical operators in English and other languages. For example, Horn (1989) offers a wide historical overview and analysis of negation in natural language. His most relevant work here is Horn (1972, 1973), and especially Horn (1989: ch.4), which constitutes an update of the two previous references.

Horn analyzes modality and its interaction with polarity based on both linguistic tests and logical relations at the basis of the Aristotelian Square of Opposition. He presents modality as a continuous category. Yet, he provides a good grounding for the three-fold distinction of modal values proposed from a strictly linguistic perspective (e.g., Lyons, 1977; Palmer, 1986; Halliday & Matthiessen, 2004).

In his work, the system of epistemic modality is analyzed as a particular instantiation of scalar predication. Scalar predications are conceived as collections of predicates P_n such as $<P_j, P_{j-1}, ..., P_2, P_1>$, where P_n outranks (i.e., is stronger than) P_{n-1} in the relevant scale. In particular, he proposes the epistemic modal scale of: <*certain*, {*probable/likely*}, *possible*>.

The relations holding among predicates of the same scalar predication are manifested in syntactic contexts like the following (Horn, 1972):

- Contexts in which the speaker is explicitly leaving the possibility open that a higher value on the relevant scale obtains.

  1. (at least) P_{n-1}, if not (downright) P_n.
  2. P_{n-1}, {or/ and possibly} even P_n.
  3. P_n, or at least P_{n-1}.
  4. not even P_{n-1}, {let alone/ much less} P_n.

- Contexts in which the speaker asserts that a higher value in the scale is known to obtain.

  1. P_{n-1}, {indeed/ in fact/ and what is more} P_n.
  2. not only P_{n-1} but P_n

The appropriateness of the proposed epistemic modal scale (<*certain*, *probable*, *possible*>) can be checked based on the tests above (Horn, 1989:234-5):[6]

(14) a. possible, if not likely — #likely, if not possible
b. likely, or even certain — #certain, or even likely
c. possible, and in fact likely — #likely, and in fact possible

The same tests applied above allow Horn to conclude that the elements in the negative counterpart are ranked as <*impossible, unlikely* (*improbable*), *uncertain*> (15), and must constitute an independent scale by themselves since they cannot be copredicated with elements in the positive scale (16).

(15) a. possibly not, if not certainly not — #certainly not, if not possibly not
b. possibly not, or even certainly not — #certainly not, or even possibly not
c. possibly not, and in fact certainly not — #certainly not, and in fact possibly not

(16) a. #possibly not, if not likely — #likely if not possibly not
b. #likely, or even certainly not — #certainly not, or even likely
c. #possibly not, and in fact likely — #likely, and in fact possibly not

In sum, there are two epistemic scales which differ in quality (positive versus negative polarity):

(17) a. <*certain, likely* (*probable*), *possible*>
b. <*impossible, unlikely* (*improbable*), *uncertain*>

The beauty of the system can be appreciated when mapped to the traditional Square of Opposition (SO), employed to account for the interaction between negation and quantifiers or modal operators (Horn, 1989, after Aristotle). Its basic structure is as shown in figure 2.1.

At the horizontal axis, we have a distinction in quality: positive versus negative polarity.[7] On the other hand, the vertical axis represents a difference in quantity:

[6] In these and coming examples, the symbol # is used to express that there is some sort of semantic anomaly.

[7] The vowels naming the vertices, which are derived from Latin verbs **a***ff***i***rmo* 'I affirm', and *n***e***g***o** 'I deny', reflect this distinction.

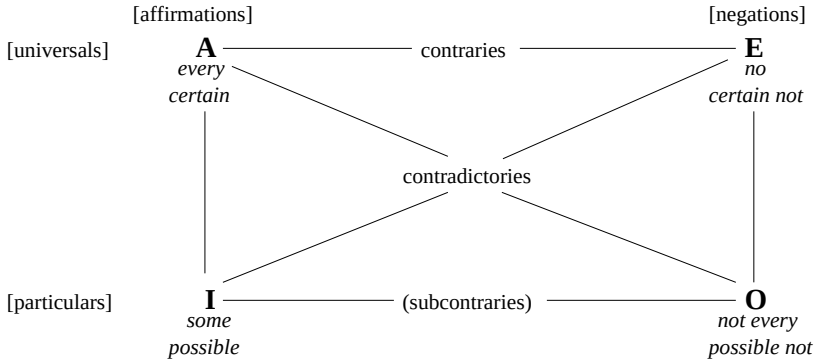

Figure 2.1: SO for quantifiers and modals (adapted from Horn (1989:10)

universal versus particular. The quantifier and modal operators corresponding to each vertex are placed under the identifying letter. Incorporating the intermediate values of the epistemic scale (*probable* and *probable not*) in the square, we obtain figure 2.2, which represents the SO for epistemic modals.

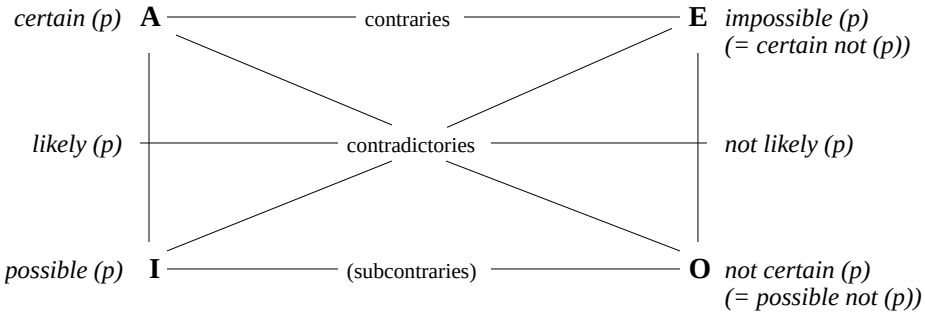

Figure 2.2: SO for epistemic modals (adapted from Horn (1989:325)

The Square of Opposition allows us to illustrate the logical relations holding between each two operators paired at the horizontal axis. Pairs A/O, I/E, and the one with the two mid values are *contradictories*. Contradictories satisfy both the Law of Contradiction (LC), which states that a statement can not be true and false at the same time, and the Law of Excluded Middle (LEM), which states that a statement must be either true or false. On the other hand, A/E are *contraries*: they satisfy the LC but not the LEM, since both can be false at the same time. Finally, I/O are *subcontraries*: both values can hold at the same time. The following examples

illustrate it with the pairs at the low, mid, and high level:

(18) SUBCONTRARY: *possible, possible not*

a. Not satisfying LC: *It is possible that P and it is possible that not P.*
b. Satisfying LEM: *#It is neither possible that P nor possible that not P.*

(19) CONTRADICTORY: *likely, likely not*

a. Satisfying LC: *#It is likely that P and it is likely that not P.*
b. Satisfying LEM: *#It is neither likely that P nor likely that not P.*

(20) CONTRARY: *certain, certain not*

a. Satisfying LC: *#It is certain that P and it is certain that not P.*
b. Not satisfying LEM: *It is neither certain that P nor certain that not P.*

2.2.2 Evidentiality

We acquire knowledge about situations in the world through very varied means, from the most physical, direct way, to purely speculative processes, passing through hearsay. Then, when talking, we can refer to the way we learnt about those situations in order to strengthen or qualify our assertions about them. Some languages grammaticalize this into the system known as evidentiality. That is, evidentiality is concerned with the origin of information or, in other words, the way in which information is acquired (Van Valin & LaPolla, 1997:43).

The term evidentiality as we know it today was introduced in the linguistics literature very recently, half a century ago, with the publication of Jakobson (1957). However, the notion can be attested a bit earlier, at the beginning of the 20 Century, in the literature on Amerindian languages generated within Americanist circles; e.g., Boas (1911).[8] A recent comprehensive cross-linguistic analysis of the category proposes six possible classes: *visual*, *sensory*, *inference*, *assumption*, *hearsay*, and *quotative*, although languages with evidentiality vary on the number of classes they have

[8]Refer to Jacobsen (1986) for a more detailed historical review of the concept.

(usually ranging from two to five) and therefore the way they partition the semantic field (Aikhenvald, 2004).

Event factuality is related to evidentiality in that different types of evidence seem to have an effect on the way the factuality nature of an event is ultimately evaluated. For example, the use of the perception predicate *see* in (21a), in contrast to the inference predicate *deduce* in (21b), expresses that the source assessing the factual status of the underlined events in the first example has a stronger evidence for judging them as facts in the world than the source assessing the factuality of the event in the second example.[9]

(21) a. He turned and **saw** the gunman <u>standing</u> and <u>firing</u>, with a straight arm toward the counter.

b. But the letter was intercepted by Amiroutzes, the Emperor's Chancellor, who **deduced** that the prince Uzum Hasan <u>wished</u> to rear a child of the blood to lead armies one day against Trebizond.

Characterizing the boundaries of evidentiality as a system has long been a matter of research. The discussion revolves around two interlaced issues, which are fundamental for establishing whether event factuality must include evidentiality information as well. They are:

1. The characterization of evidentiality as a semantic notion: is it related or subordinated to any other notion such as epistemic modality?
2. The grammatical status of evidentiality: is it an independent grammatical system?

I review the major positions with respect to these two issues in what follows.

Evidentiality as a semantic notion. From the very beginning, evidentiality has been presented as inherently interwoven with the concepts of certainty and reliability,

[9]Here and throughout the rest of this work, events in the examples will be identified by marking only the verbal, nominal, or adjectival predicates expressing them, together with polarity particles and auxiliaries when deemed necessary. This goes along the lines defined in TimeML, the specification language to represent event and temporal information in text (Pustejovsky et al., 2003).

two notions clearly related to epistemic modality. The association between evidentiality and epistemic modality is recurrent throughout the linguistics literature, but the connection is analyzed in different ways. One line of research considers evidentiality to be subsumed under epistemic modality, as defended in Palmer (1986) and subsequent work (e.g., de Haan, 1997). Along similar lines, Willett (1988) understands evidentiality as 'primarily modal', and Trask (1999) presents it as one of the categories into which modality 'shades off'.

From an opposed perspective, some other research adopts a broad conception of evidentiality and considers it as subsuming modality instead. For instance, for Chafe (1986) evidentiality includes modes of knowing, such as sensory and hearsay evidence, but he also claims that in many cases expressions of evidentiality "carry implications to the degree of reliability as well" (Chafe, 1986:266). As a matter of fact, this is the general perspective adopted in most of the work published in the monograph on evidentiality edited by Chafe & Nichols (1986).

Finally, a third approach regards evidentiality and modality as intersecting notions. This is the perspective of Van Der Auwera & Plungian (1998), which claims that both concepts meet at the inferential value.

By contrast to all this previous work, in the past years a new position has emerged which regards evidentiality as independent of any modal-related notion. Studies focussed on languages which express evidentiality through grammatical means seem to share this view, because languages that grammaticalize both categories can distinguish between the two. Yet, they also acknowledge the existence, to a certain extent, of a connection. In her very comprehensive study on evidentiality, Aikhenvald claims that the association exists, although it is not cross-linguistically universal. "Evidentials may acquire secondary meanings –of reliability, probability, and possibility (known as epistemic extensions), but they do not have to." (Aikhenvald, 2004:6). Similar observations are made in Hardman (1986), a work on Jaqi languages, and in (Donabédian, 2001), on Modern Western Armenian. The work of de Haan is also illuminating in this respect (de Haan, 1999, 2000). He specifically aims at examining the extent of the connection between the two notions based on cross-linguistic data. He argues that, although the link may not be as strong as previously assumed, it definitely exists.

The position of these last authors is summarized at Dendale & Tasmowski (2001:342-

343): "Such diverging opinions as to the relationship between evidentiality and modality are largely due to the empirical fact that in the evidential systems of many languages, the forms marking the source of information also mark the speaker's attitude towards the reliability of that information."

The grammatical status of evidentiality The way evidentiality manifests in grammar has not traditionally been questioned. That has led to the assumptions that (a) evidentiality is a feature present in most languages, if not all –every language has a way to refer to information origin; and (b) consequently, evidentiality is marked by means of linguistic expressions of very different nature.

Several works in the past twenty years present this feature. Chafe (1986) and Fox (2001), for instance, assume that English has a rich system of evidentiality, expressed through a varied collection of linguistic devices, including adverbials, modal auxiliaries, and complement taking predicates such as *think, look like*, or *seem*. These same assumptions can be found at the basis of Tasmowski & Dendale (1994), King & Nadasdi (1999), and Hassler (2002) with regards to Romance languages.

It is not until very recently that evidentiality is presented as an independent grammatical system with defined properties. The work by Anderson is one of the first attempts to constrict the notion in that respect, presenting a set of defining features for evidentiality which includes morphological specifications: "Morphologically, evidentials are inflections, clitics, or other free syntactic elements (not compounds or derivational forms)" (Anderson, 1986:275). Further work embracing the view of evidentiality as a grammaticalized level of information is de Haan (1999, 2000) and DeLancey (2001).

Along the same lines, Lazard (2001) and Aikhenvald (2004) observe that all languages have linguistic devices to express source of information, but that not all of them express this information through a grammatical category. Only in a subset of them, evidential markers are manifested morphologically and are in fact an obligatory part of the verb, similar to tense, aspect, or mood in Germanic or Romance languages. Both authors conclude that evidentiality is not grammaticalized in languages like French or English. In particular, Aikhenvald considers the use of certain elements that present evidential flavor (e.g., adverbials like *reportedly*, complement taking predicates, such as *it seems to me that*, or expressions such as *alleged*) as what

he calls an "evidentiality strategy" (Aikhenvald, 2004:105).

Among the most common evidentiality strategies she analyzes (such as non-indicative moods and modalities), there is complementation, which is generally restricted to predicates of perception and cognition. In English, for example, verbs of perception take a different complement type depending on whether the event denoted by the complement has been directly perceived (22a), or it has been inferred given indirect knowledge (22b).

(22) a. But witnesses later said they <u>saw</u> employees **beating** at least some of the birds to death.

b. Wexford leafed through it and <u>saw</u> that Hatton **had paid** twenty-five pounds for the lamp on May 22nd.

Aikhenvald also points out that the meaning of these expressions can present an epistemic extension as well, as is the case with grammatical markers of evidentiality.

Chapter 3

Defining event factuality

The previous chapter introduced event factuality as the level of information we speakers use in order to characterize the factual status of events in the world, and reviewed the linguistic categories it touches upon. The next step is defining this system in detail. To that purpose, I will first determine the spectrum of factuality degrees configuring its semantic field (section 3.1), and then look at the two components that are necessary in a theory of event factuality: sources (or informants) and time (section 3.2). All these elements (factuality values, sources, and time) will be articulated together into the formal notion of event factuality profile that will be presented in section 3.3.

3.1 The structure of event factuality

3.1.1 Factuality values

Events in discourse can be presented with absolute certainty. Depending on the polarity, events are then depicted as either *facts* (23a) or *counterfacts* (23b).

(23) a. Five other U.N. inspection teams <u>visited</u> a total of nine other sites.

b. The size of the contingent <u>was not disclosed</u>.

In other contexts, events are qualified with different shades of uncertainty. Combining that with polarity, events will be presented as *possibly factual* (24a) or *possibly counterfactual* (24b).

(24) a. United States may extend its naval quarantine to Jordan's port of Aqaba.

b. They may not have enthused him for their particular brand of political idealism.

Factuality can thus be characterized by means of a double-axis scale: on the one hand, the axis of polarity; on the other, that of epistemic modality. The resulting system is illustrated in figure 3.1.

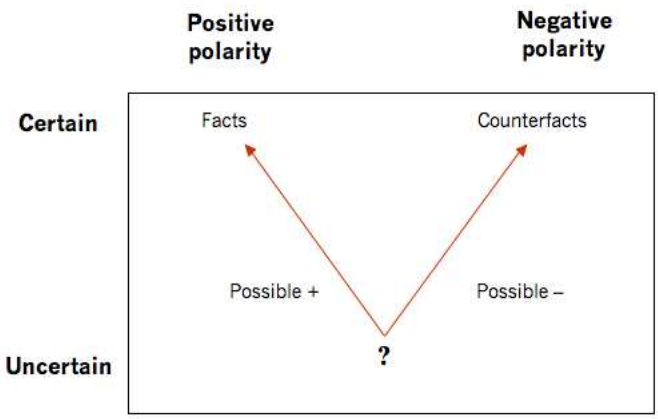

Figure 3.1: The double range of factuality force

Polarity is a discrete category consisting on two values: positive and negative. On the other hand, epistemic modality seems to be more adequately conceived as a continuum, ranging from uncertain (or possible) to absolutely certain, although as presented in the previous chapter, it has been systematized differently depending on the approach. There is some interesting work defining it as a continuous category (see, e.g., de Haan, 1997; Horn, 1989), but most of the proposals seem to favor a discrete categorization. Modal logic conceives it as a binary system that distinguishes between possibility ($\Diamond$) and necessity ($\Box$), while linguistic analyses tend to differentiate among three epistemic values: low, mid, and high. (e.g., Twaddell, 1960; Lyons, 1977; Palmer, 1986; Halliday & Matthiessen, 2004).

From the perspective of the current research, a discrete categorization of the system is also preferable. One of the goals of this work is testing the plausability of

the model of event factuality proposed here by means of identifying and representing the factuality degree with which certain expressions in natural language characterize events in text (what I will call factuality markers; refer to chapters 4 and 7), and verifying the adequacy of these representations against a manually annotated corpus (chapter 9). From a methodological point of view, a discrete set of values will allow us to represent the semantics of factuality markers in a more controlled way, and facilitate the analysis of interannotation agreement scores.

I will therefore resort to a categorization of epistemic modality already established in the literature. In particular, my approach to epistemic modality will be grounded on Horn (1989) for two main reasons. First, because he offers a very fit compromise between analyses of linguistic and logic nature. Second, given the fact that, in spite of conceiving modality as a continuous system, he shows that conceptually it can be split into three modal values.

The two parameters involved in event factuality will then be organized into the values shown below. Note that, in addition to those put forward in the preceding literature, I added an underspecified value at each level.

Probability: Expressing the degree of certainty that the informant has about an event taking (or not taking) place in the world.

CT	**(certain):**	The event certainly took (or did not take) place.
PR	**(probable):**	It is probable that the event took (did not take) place.
PS	**(possible):**	It is possible that the event took (did not take) place.
U	**(underspecified):**	The informant's degree of certainty is not known or expressed.

Polarity: Conveying whether the informant regards the event as referring to a situation that takes place in the world.

+	**(positive):**	The event is seen as (certainly/probably/possibly) happening.
−	**(negative):**	The event is seen as (certainly/probably/possibly) NOT happening.
u	**(underspecified):**	The polarity of the event is not known or expressed.

The combination of the two parameters results in the factual values illustrated in table 3.1, which are represented as tuples of the form <*mod*, *pol*>, containing a modality and a polarity value each.[1] The table includes six fully committed (or specified) values (<CT,+>, <CT,−>, <PR,+>, <PR,−>, <PS,+>, <PS,−>), and two underspecified ones: the partially underspecified <CT,u>, and the fully underspecified <U,u>. I estimate that the other possible partially underspecified combinations (e.g., <PR,u>, <U,+>, etc.) are non-applicable.

Table 3.1: Factuality values

	Positive (+)	**Negative (−)**	**Underspecified (u)**
Certain (CT)	Fact: <CT,+>	Counterfact: <CT,−>	Certain but unknown output: <CT,u>
Probable (PR)	Probable: <PR,+>	Not probable: <PR,−>	(NA)
Possible (PS)	Possible: <PS,+>	Not certain: <PS,−>	(NA)
Underspecified (U)	(NA)	(NA)	Unknown or uncommitted: <U,u>

The partially underspecified value, <CT,u>, is for cases where there is total certainty about the factual nature of the event but it is not clear what the output is (25). The fully underspecified <U,u>, on the other hand, is used when any of the following situations applies: *a.* The source does not know what is the factual status of the event (26a), *b.* the source is not aware of the possibility of the event (26b), or *c.* the source does not overtly commit to it (26c). The following examples illustrate each of these preceding situations for the underlined event when evaluated by source *John*:

(25) **John** knows whether Mary <u>came</u>.

(26) a. **John** does not know whether Mary <u>came</u>.

b. **John** does not know that Mary <u>came</u>.

c. **John** knows that Paul said that Mary <u>came</u>.

[1]Semantically, this can be interpreted as: $Val(mod)(Val(pol)(e))$ –i.e., the modal value scopes over the polarity value.

For the sake of simplicity, in what follows the factuality values will be represented in the abbreviated form of: CT+, PR−, Uu, etc.

The values proposed here as configuring the factuality system do not explicitly encode distinctions of meaning related to the category of evidentiality (e.g., what has been reported vs. what has been seen). As said in the previous chapter, English has no overt grammatical system of evidentiality, and expresses evidential-related knowledge by means of strategies of a varied sort –for instance, adverbials such as *reportedly* or *apparently*, or constructions involving complementation (Aikhenvald, 2004). A common feature of these strategies in English and other languages with no evidentiality systems is that they tend to incorporate an epistemic extension as well. For example, we understand events qualified by a predication of inference (e.g. *I deduce*) as less certain than those qualified by a predication of direct perception (*I saw*). According to authors such as de Haan (1999, 2000) and Aikhenvald (2004), it is precisely this potential extension of meaning what has caused to commonly analyze evidentiality as inherently interwoven with epistemic modality.

In order to guarantee the cross-linguistic adequacy of the factuality system proposed here, the set of factuality values will not incorporate distinctions at the basis of the evidential system. This solution, however, does not prevent us from appropriately handling the epistemic extensions of expressions of evidentiality in English and similar languages. These expressions will be considered as factuality markers as well (*cf.* next chapter), and their epistemic extension will be represented by means of the regular mechanisms to handle pure expressions of modality (*cf.* chapter 7).

3.1.2 Discriminatory tests

How are the values in the proposed factuality system distinguished from each other? Can they be easily identified on the events presented in discourse? Determining the polarity value of events appears fairly straightforward, but the task is not as transparent with regard to its modality degree –especially concerning the distinction between the values *probable*, *possible*, and *underspecified*. Thus, finding objective criteria that help in the task becomes an imperative.

For that purpose, I designed a battery of tests based on the logical relations considered in Horn (1989) in order to pinpoint the basic categories of epistemic modality;

i.e., Law of Contradiction and Law of Excluded Middle (refer to section 2.2.1.3). They are copredication tests. That is, tests which put the original context of the event together with a second fragment in which the event is qualified with a different degree of modality –either keeping the same polarity as in the original context, or reversing it.

Underspecification (U) versus different degrees of certainty (CT/PR/PS):

Events with an underspecified modality value can be copredicated with both: a context in which they are characterized as *certainly happening* (CT+), and a context in which they are presented as *certainly not happening* (CT−).

For example, sentence (27) can be followed by either fragment in (29), the first of which maintains the original underlined event as certainly happening (CT+), and the second as certainly not happening (CT+). This is not the case, however, for sentence (28), where the underlined event is explicitly characterized as probable.

(27) Iraq has agreed to allow Soviets in Kuwait to <u>leave</u>.

(28) Soviets in Kuwait will most probably <u>leave</u>.

(29) a. ... They will take the plane tomorrow early in the morning. (CT+)

b. ... However, most of them decided to remain there. (CT−)

Absolute certainty (CT) versus degrees of uncertainty (PR, PS):

Eventualities presented as certain (CT) cannot at the same time be assessed as *possible* (PS) in a context of *opposite polarity*.

(30) a. Hotels are only <u>thirty</u> (CT+) percent full.

b. #... but it is possible that they aren't (PS−).

(31) a. Nobody <u>believes</u> (CT−) this anymore.

b. #... but it is possible that somebody does (PS+).

On the other hand, eventualities that are characterized with some degree of uncertainty (PS or PR) allow for it:

(32) a. I *think* it's not going to <u>change</u> (PR−) for a couple of years.

b. ... but it *could* happen otherwise. (PS+)

(33) a. He *probably* <u>died</u> (PR+) within weeks or months of his capture.

b. ... but it is also possible that the kidnappers kept him alive for a while. (PS-)

In (32), the source expressed by the pronoun *I* characterizes the underlined event as PR− by presenting it under the scope of the predicate *think* used in 1st person. The fragment in (32b) can be added without creating any semantic anomaly. A similar situation is presented in (33): the adverb *probably* is characterizing the event as PR+, and the additional fragment presents the possibility of things being otherwise.

Probable (PR) versus possible (PS):

As just seen, both degrees of uncertainty (PR and PS) accept copredication with PS in a context of opposite polarity. However, only the lowest degree of uncertainty (PS) accepts copredication with PR in a context of *opposite polarity*.

(34) a. I *think* it's not going to <u>change</u> (PR−) for a couple of years.

b. #... but it *probably* will. (PR+)

(35) a. It *may* not <u>change</u> (PS−) for a couple of years.

b. ... but it most *probably* will. (PR+)

Table 3.2 summarizes the different copredication tests just introduced. The resulting epistemic modality values assigned to events are listed in the rows, while the tests are presented in the columns, abbreviated as $\mathrm{EM}_{subindex}$. EM expresses the epistemic modality value of the context to be copredicated to the original sentence, whereas

Table 3.2: Tests for discriminating the epistemic modality degree

	CT$_=$	**CT***op*	**PR***op*	**PS***op*
U	ok	ok	ok	ok
PS	ok	#	ok	ok
PR	ok	#	#	ok
CT	ok	#	#	#

subindex indicates its polarity: = means context of the same polarity, and *op*, context of opposite polarity.

For example, given an event e presented under a context of negative polarity in its original sentence, test PR$_{op}$ requires to create a new fragment in which e is used in a context where the modality degree is *probable* and the polarity is positive: PR+.[2]

(36) Original: I *think* it's not going to <u>change</u>. (PR−)
Testing e_2 with PR$_{op}$: #... but it probably will. (PR+)

3.1.3 Dealing with underspecification

There are events whose factual status is underspecified. Take as example (37), where the sources are in bold face:

(37) **Mary** is not aware of the fact that **John** knows he <u>is the father</u>.

The underspecification here concerns the factual assessment of source *Mary* with regard to the underlined event –i.e., John being the father. The sentence seems to convey that Mary knows it, and that consequently evaluates it as a fact in the world. Such an interpretation, however, is triggered by an implicature. Consider the following two (soap opera) situations:

Situation 1: Mary and John are friends. John has always been in love with Mary but she is married to Peter. One night that Peter is out of town for business, Mary has an unexpected affair with John. One month later

[2] As appreciated, test CT= is non-discriminative. It is added there because, combined with CP*op*, it allows us to identify U values from the rest. Recall the first test presented above.

Mary is pregnant. She knows John is the father, but doesn't tell him. John starts behaving ackwardly and Mary does not understand why. Mary is not aware John knows he is the father.

Situation 2: Mary and John are married. Mary has a friend, Amy, who recently got pregnant. Amy is single and does not want to tell who the father is to anybody –not even to Mary. As it happens, John is the father of the coming baby. John starts behaving really ackward and Mary does not understand why. Mary is not aware John knows he is the father.

In any of the two situations, using sentence (37) is perfectly felicitous. Yet, in the first one Mary knows John is the father (and thus the event is evaluated as a fact: CT+), whereas in the second, she does not (Uu).

Underspecified cases like these will receive the underspecified value Uu, disregarding more specific (possibly preferable) interpretations brought about by an implicature of any sort. The idea behind this choice is keeping the context open for further specification, in case the text contributes additional information.

3.2 Basic components involved: sources and time

Now that the set of factuality values is established, it is time to look at the two components pointed out as necessary in a theory of event factuality: sources and time. The factuality value assigned to events in text is always relative to a participant who commits to that at a particular point in time. Only under this assumption it is possible to account for the potential contradictions between factual values assigned to the same event, as is common in the case of news reports.

Events mentioned in discourse, be it oral or written, have always an implicit source. By default, such source corresponds to the author of the text (a speaker or a writer). In (38), for instance, it is the CNN that evaluated the event of Milosevic being on trial as a fact in the world.

(38) Milosevic <u>was on trial</u> for 66 counts of genocide, crimes against humanity and war crimes in the Balkans during the 1990s. (CNN, March 13, 2006)

Nonetheless, there are events whose factuality is assessed by more than one source. These are events embedded under contexts of report, belief, knowledge, inference,

etc., as created by predicates such as *tell, see, think*, or *know*. In these contexts, an additional explicit source is introduced (generally corresponding to the subject of the embedding predicate), relative to which the factuality of the embedded event is assessed as well.

In the example below, there are two relevant sources for evaluating the factuality of the underlined event, which is placed under the scope of the reporting predicate *deny*: one is the author, as in the previous sentence, and the other is Zdenko Tomanovic, Milosevic's lawyer.

(39) Milosevic's lawyer, **Zdenko Tomanovic**, on Monday *denied* [that the ex-president <u>altered</u> his medication]. (CNN, March 13, 2006)

When computing the factuality nature of events, recognizing the different sources involved is fundamental, given that factuality is not an absolute property of events, but a matter of perspective. Discourse participants can present divergent views about the very same event.[3] Consider the following two sentences concerning the event of Milosevic's death, which are extracted from the same piece of news:

(40) a. **Slobodan Milosevic's son** said Tuesday that the former Yugoslav president <u>had been murdered</u> at the detention center of the UN war crimes tribunal in The Hague.

b. **The UN war crimes tribunal** said preliminary results showed Milosevic <u>died of a heart attack</u>.

Combining the participant parameter with that of the time of commitment (that is, the point in time when a participant commits to a factuality value for a given event), the following situations may hold:

- At the same point in time,[4] two participants present different views about the factuality degree of the event. Recall the previous example regarding the cause of Milosevic's death.

[3]Here is where my work partially overlaps with research on opinion analysis (e.g., Wiebe et al., 2005). In particular, the overlap is on the subset of opinions about whether something has happened, happens, or will happen –in other words, opinions about the factuality nature of events.

[4]I am disregarding the issue of what is an adequate granularity for the temporal units here.

- The same participant can present a different view at different points in time. In sentence (41), for example, reference is made to a previous state of Van Anraat, in which he was ignorant about the underlined event.

  (41) **Van Anraat**'s attorneys argued he did *not know* the chemicals he provided to Iraq would be <u>used</u> in attacks.

  The disagreement can also be brought across different sentences or documents:

  (42) a. *In mid-2001*, **Colin Powell** and **Condoleezza Rice** both publically denied that Iraq <u>had</u> weapons of mass destruction.

  b. Secretary of State **Colin Powell** *Thursday* defended the Bush administration's position that Iraq <u>had</u> weapons of mass destruction. (CNN, January 8, 2004)

- Divergent views about the factuality nature of the same event are triggered by different participants and different points along the temporal axis. This possibility results from combining the two previous situations.

3.3 Factuality profiles

Whenever there is a mention of an event, there is a commitment act towards the factuality of that event, performed by a particular source at a specific point in time. Hence, *factuality commitment acts* are defined as involving four components:

1. The event at focus, `e`.
2. The factuality value been assigned to that event, `f`, which is the product modality and polarity information.
3. The source assigning the factuality value to that event, `s`.
4. The time of assignment of this factuality value, `t`.

We saw that every event expressed in discourse can be evaluated by more than one source and at several points in time. Thus, the factuality of each event can be characterized through more than one factuality commitment act. I define the set of factuality commitment acts associated to an event as its *factuality profile*. Formally, factuality profiles can be represented as follows:

(43) p_e={<f, s, t> | f is a factuality value of the form <*mod*, *pol*> & s is a relevant source for that event & t is a point in time}

The tool for identifying the factuality values assigned to events, which I present in the second part of this dissertation, is therefore referred to as a *factuality profiler*.

Chapter 4

Expressing factuality in text: factuality markers

Depending on how events are presented by the author, the reader will evaluate their factuality status differently. For example, simple affirmative or negative declarative sentences, containing no modality information of any sort, characterize the factuality status of events in absolute terms, as a non-negotiable feature. This is shown in example (44), where the event is in bold face. This same effect can be observed in certain subordination contexts as well, such as those introduced by aspectual or factive predicates –underlined (45).

(44) a. Five other U.N. inspection teams **visited** a total of nine other sites.

b. The size of the contingent **was not disclosed**.

(45) a. The vines had just <u>finished</u> **flowering**, and tiny dark green grapes hung intermittently among the foliage.

b. She <u>regretted</u> **calling** the prime minister a traitor.

Some other expressions convey different degrees of uncertainty about about the factuality of the event. Modality operators are among them (46), but also commissive or volitional predicates (47), for instance, whose complement factuality is unknown unless more information is provided by the context.

(46) a. Amir **may have been trying** to impress her by killing the prime minister.

b. The U.S. **may extend** its naval quarantine to Jordan's Red Sea port of Aqaba.

(47) a. The president also has offered to **help** offset Jordan's costs.

b. Anheuser just decided to **join** in the barroom brawl.

Finally, event factuality is a more complex matter for those situations that are introduced in discourse subject to a particular source. This is so for contexts of reporting (48a), knowledge (48b), or belief (48c), among others.

(48) a. *The Jordanian monarch* told reporters he **had** no message from Baghdad.

b. *They* know a peaceful solution **was in reach**.

c. *Some analysts* think he **could face** a real battle.

The present chapter examines in detail the linguistic means that are used to express event factuality in natural language, which I call *factuality markers*. For practical reasons, the work is focused on English, although it is extrapolative to (at least) other Indoeuropean languages such as Romance and Germanic ones.

Because of how event factuality is defined here, factuality markers include expressions conveying polarity or modality. The prototypical elements to express polarity and modality in English are negative particles (section 4.1) and modal auxiliaries (section 4.2), respectively. Polarity and modality are much studied areas in the linguistics field. Nevertheless, the coming sections are written for the benefit of the general reader.

Besides negative particles and modal auxiliaries, other elements can be used to create an equivalent effect; namely, predicates that select for an event as one of their arguments (section 4.3), certain syntactic constructions (section 4.4), and discourse relations between clauses or sentences (4.5). Except for the latter, all these elements will be adequately encoded in the set of linguistic resources informing the factuality profiler that will be presented in the second part of this dissertation (*cf.* chapter 7). I will conclude the chapter looking at how these markers interact among them and the effect this has on the events they qualify (section 4.6).

4.1 Polarity particles

Polarity particles express the positive or negative factuality of events mentioned in text. Generally, positive factuality is denoted by the absence of any polarity particle. Unless they are combined with other elements, such as modality operators, polarity particles leave no room for uncertainty degrees.

Polarity particles can be introduced at different structural levels: at the clausal level of the event, i.e., immediately scoping over the event-referring expression; at the subclausal level: affecting one of the arguments of the event; or at the lexical level, e.g., by means of affixes such as *un-* in *unable* (Huddleston, 1984). The examples below review the most common means to express event negation in English.[1] For a more comprehensive view, see Huddleston (1984); Quirk et al. (1985); Givón (1993).

Negating the predicate expressing the event. This is, by far the most common negation mechanism.

(49) She did<u>n't</u> **follow** the rules.

Negating the subject. This can be done by using the pronouns *nothing, nobody, no one* in the head position of the subject NP; also, by means of *no* or *neither* as determiners in the NP subject.

(50) a. <u>Nobody</u> **followed** the rules.

b. <u>Neither</u> proposal **was** satisfactory.

Negating the direct or indirect object. The same particles as for negating the subject can be employed here.

(51) a. She **followed** <u>no</u> rules.

b. Clara **saw** <u>nobody</u>.

Adverbial modification. Certain adverbial constructions negate the event as well. For example, time or place negative adverbials (52a-b), infinitival constructions dependent on the degree adverb *too* (52c), or adverbs such as *almost* directly modifying the event denoting expression (52d).

[1] The negative particles are in bold face whereas the negated event is underlined.

(52) a. She never **followed** the rules.

b. The two teenagers **went** nowhere.

c. They were too tired to **finish** it.

d. Ruth almost **touched** him.

Embedded contexts provide additional strategies:

Negating by means of an embedding predicate. The negative polarity projected on the embedded event is part of the lexical semantics of the subordinating predicate. Strictly speaking, however, these markers are not polarity particles and will be considered in more detail in section 4.3.

(53) a. She failed [to **follow** the rules].

b. The family has always doubted [that Ray **was** the killer].

The embedding predicate is negated. This phenomenon applies to a restricted group of predicates (e.g., *think, believe, expect*, etc.), which in the literature are referred to as weak assertive predicates (Hooper, 1975). By negating them, the event in the complement proposition is presented with negative polarity.

(54) He does not think [she **followed** the rules].

It needs to be pointed out that the presence of a negative polarity marker does not always result in the negation of the event it scopes over (*cf.* Polanyi & Zaenen, 2005). For example, in (55) event e is evaluated as positive because the polarity marker scoping over it, *not*, is in turn affected by the negative polarity conveyed by *denied*.

(55) The prosecutor **denied** that Spelke did **not** open$_e$ the door.

The interaction among different polarity markers will be addressed in more detail in section 7.1.

4.2 Modality particles

Modality particles contribute different shades of certainty to a given event. In English, the main sources of modality information belong to different parts of speech; namely, verbal auxiliaries, adverbials, and adjectives (Lyons, 1977; Halliday & Matthiessen, 2004).[2] Each of these categories displays an equivalent gradation of modality, to the extent that the elements in one have a semantic correspondent to the elements in the other (Givón, 1993). With regard to epistemic modality, we can identify a direct mapping between modal particles meaning and the modality degrees established in table 3.1. The following examples illustrate this:

Modal auxiliaries. They introduce modality at the local context of the event expression –in case of events expressed by verbs.

(56) a. Possible: *could, may.*
b. Probable: *will*,[3] *should.*
c. Certain: *must, have to.*

Clausal and sentential modal adverbials. Expressed at a non-local level.

(57) a. Possible: *perhaps, maybe.*
b. Probable: *probably.*
c. Certain: *necessarily, certainly.*

Modal adjectives. Generally presented as the predicative complement in impersonal constructions such as these below:

(58) a. Possible: *it is possible that....*
b. Probable: *it is likely/probable that....*
c. Certain: *it is certain/impossibe that....*

[2]Givón (1993) also includes verbs belonging to the subgroup of what he defines as 'perception-cognition-utterance' verbs (e.g., *think, know, see*). I will address them independently in section 4.3.

[3]The inclusion of this auxiliary verb as epistemic marker seems to depend on the specific dialect considered. See for example Halliday & Matthiessen (2004); Palmer (1986).

Among the three categories, verbal auxiliaries is the most studied one. Starting from the 60's, there has been a remarkable amount of work devoted to the organization of modal auxiliaries in English. Some of the most influential work for British English are Twaddell (1960), Palmer (1979)[1990], Coates (1983), and de Haan (1997). For American English, Ehrman (1966) is one of the pioneers in the field with her work based on the Brown corpus.

The modality expressions considered so far have been only of epistemic type. That seems a natural choice given that factuality is conceived as involving this kind of modality. Nevertheless, other types of modality play a role as well in characterizing the factual nature of events in text. For example, events that are modalized as deontically possible (i.e., allowed, permitted) or deontically necessary (i.e., required) are presented as uncertain. Deontic modalities have a future-projecting effect on the modalized event. The fact that an event is allowed or required does not necessarily imply that it will ever take place in the world.

Deontic modality, as well as other types of modality, can be expressed through elements belonging to different parts of speech: modal auxiliaries such as *should* or *need*, evaluative adverbs (e.g., *hopefully, unfortunately* or *luckily*), and adjectives (*fortunate, hopeful, afraid*) (Givón, 1993). All these expressions will also be considered as factuality markers and included in the lexicon informing the factuality profiler.

4.3 Event selecting predicates

In many cases, event factuality is conveyed by what I refer to as *event selecting predicates* (ESPs). These are predicates (either verbal, nominal, or adjectival) that select for an argument denoting an event of some sort.[4] Syntactically, they subcategorize for a *that*-, gerundive, or infinitival clause, but also for NPs headed by event-denoting nouns.

Examples of ESPs are verbs like *claim, suggest, promise, offer, avoid, try, delay, think*, nouns like *promise, hope, love, request*, and adjectives such as *ready, eager, able*. The ESPs in (59) are in bold face, while their embedded events are underlined.

[4]Recall that the term *event* is used here to refer to both processes and states, but also other abstract objects such as propositions, facts, possibilities, outcomes, etc. Refer to section 2.1.

(59) a. The Human Rights Committee **regretted** that discrimination against women persisted in practice.

b. Uri Lubrani **suggested** Israel was **willing** to withdraw from southern Lebanon.

c. Kidnappers **kept** their **promise** to kill a store owner they took hostage.

ESPs are interesting because they project factuality information on the event denoted by its argument (underlined in examples (59)) through syntactic means. In other words, they qualify the factuality degree of the event denoted by the selected argument. The event denoted by the argument can then be marked as:

- *Factual*. That is, the event is presented as corresponding to a fact in the world.

  This is the case of complements of certain implicative predicates (60a) (Karttunen, 1970); complements of the so-called factive predicates (60b) (Kiparsky & Kiparsky, 1970; Karttunen, 1971); complements of perception predicates (60c) (Barwise & Perry, 1983); complements of aspectual predicates (60d), complements of change-of-state predicates (60e), etc. In the following examples, the ESP is in bold face and the embedded event is underlined.

  (60) a. Russian spies **managed** [to intercept fax communications of top U.S. defense contractors].

  b. Furrow's neighbors **knew** that [he was a neo-Nazi].

  c. Austin **saw** a man [get shaved in Oxford].

  d. Culturebox just **finished** [reading one of the pieces of evidence for the case].

  e. Japan saved itself by dramatically **increasing** [its exports] .

- *Counterfactual*. The event does not correlate to any situation in the world.

  For example, arguments of certain implicative predicates, like *avoid* and *prevent* (Karttunen, 1970; Condoravdi et al., 2001; Koenig & Davis, 2001).

- *Not totally certain* (i.e., possible or probable). The source mentioning the event in discourse is not certain to whether it took or will take place in the world.

  This is the case of the complements to the so-called weak assertive predicates, such as *think* and *believe*, mainly when used with a first person subject and

in present tense (61a) (Hooper, 1975). Other predicates bear this nuance of uncertainty as well, regardless of tense and grammatical person in the subject (61b). They have been acknowledged by many authors in different ways. For example, in Bach & Harnish (1979) they are called suggestive speech act verbs, for Wierzbicka (1987) they are guess predicates, and Dor (1995) refers to them as conjecture predicates.

(61) a. I **think** [he wants to hire a woman].

b. The WSJ editorial page **speculated** that [the president suffers from an anti-social personality disorder].

- *Underspecified.* The event is mentioned in discourse, but there is no information provided about its factual status.

  There is a number of predicate classes which create such effect. For example, volition (62a), commitment (62b), and inclination predicates (e.g., *willing, ready, eager, reluctant*) (62c), among others. All of them select for an argument of what Asher (1993) calls projective proposition type.

(62) a. The GOP just **wants** [to use the tax issue as an electoral weapon].

b. American Home Products **offered** [to settle lawsuits over Norplant].

c. Jones' new lawyers seem **eager** [to go to trial].

- *The factuality value (factual, counterfactual, not totally certain, or underspecified) is according to a specific source.* Some ESPs have, in addition to the text author, one or more additional sources that are committing to the factuality of the embedded event as well. This is observed with complements of reporting predicates (e.g., Li, 1986; Bergler, 1991, 1992; Waugh, 1995; Calsamiglia & López-Ferrero, 2003, to mention but a few). The complement of verbs like *claim, say*, or *affirm*, for example, are presented as true to the subject of the verb but not according to the text author, who remains uncommitted.

  There are other classes of verbs also introducing an additional source, such as knowledge and belief predicates. They will be presented in the next subsection.

It should come as no surprise that a number of authors have pointed out the modal component in some of these predicates. The tradition has a strong background in the area of philosophy, where different types of ESPs have been analyzed under the heading of propositional attitude predicates. Propositional attitude predicates stand for a relation between a cognitive agent and some propositional content towards which the cognitive agent holds the attitude –e.g., of belief, knowledge, desire, regret, intention or hope. They have for long been studied by philosophers because of some interesting problems they pose. For example, their propositional complement can not be interchanged with correfering expressions *salva veritate*, that is, without affecting the truth value of the matrix sentence.

At the border between philosophy and linguistics, a line of research stemming from Vendler's work has been exploring them as a tool for empirically revealing the ontology underlying the organization of abstract objects in natural language (Vendler, 1967; Asher, 1993; Peterson, 1997; Ginzburg & Sag, 2000). And from the speech act theory tradition inaugurated by Austin (1962), works such as Bach & Harnish (1979), Ballmer & Brennenstuhl (1981), and Wierzbicka (1987) analyzed the subset of ESPs that denote speech acts in English.

Within a more linguistically-oriented venue, ESPs have been analyzed from varied perspectives. From the area that focuses on modality and its manifestation in natural languages for example, it is worthwhile mentioning the position of Palmer (1986), Quirk et al. (1985), and Givón (1993). The first notes the existence of "many subordinate clauses, especially object complements", introduced by a lexical subordinator (a verb or adjective), that "report the attitudes and opinions of the subjects of the main clauses" (Palmer, 1986:126). Along similar lines, Givón (1993) considers that verbs belonging to the subgroup of 'perception-cognition-utterance' predicates (e.g., *think, know, see*) can be used to denote epistemic judgements about the modality status of the embedded complement. He distinguishes between those verbs expressing what he terms epistemic judgement (i.e., relative certainty, as in the case of *think*), presuppositional or factive character (when the speaker considers the clause in the complement to be true; e.g., *know*), negative factive (the speaker considers the clause in the complement to be false; e.g., *pretend*), or quotation (the proposition in the complement is verbally expressed by the subject of the main verb; e.g., *say*), a classification that pairs very well with the different factuality nuances listed above. Finally,

Quirk et al. (1985) puts forward a graded classification of verbs that can behave as auxiliaries. Such classification includes the so-called catenatives, namely, verbs in between auxiliaries and main verbs, which bear meanings related to modality or aspect (e.g., *seem, appear, fail*, or *attempt*).

From a more cognitivist perspective, the function of these elements as markers of factuality is also discussed in some of the work on epistemic stance in natural language. In this tradition, stance is defined as the pragmatic relation between linguistic items and context, which can be of different kinds, including: attitude, judgement, or commitment (Biber & Finegan, 1989). Hence, stance concerns subjectivity in language; that is, how linguistic expressions are interpreted in terms of some cognisant observer, emoter, or thinker (Mushin, 2001). In particular, Field (1997), Mushin (2001) and Thompson (2002) agree in considering ESPs more as markers of speaker's epistemic, evidential or evaluative stance, than as main predicates of the clauses in which they appear.

Finally, the modal ingredient of these predicates has also been acknowledged within the work devoted to the mapping between syntactic functions and semantic arguments. Dor (1995), for example, analyses information and attitude bearing predicates that select for an embedded clause, and charaterizes them by distinguishing their representational component (the information expressed by the embedded proposition) from their epistemic layer (speaker's attitude towards that proposition). Similarly, Koenig & Davis (2001) differentiate between a core and a modal component (what they call sublexical modality) in the semantics of verbs. Modality components are also present in the verbal classification put forward by Jackendoff & Culicover (2003) in their account for constructions of control in English.

Here, I distinguish between two kinds of ESPs: those that introduce an additional source as a factuality evaluator in the discourse, and those that do not. The next subsections focus on each of these classes.

4.3.1 Source introducing predicates

Source introducing predicates (SIPs, for short) are ESPs that contribute an additional source relative to which the factuality of the embedded event is assessed. Part of their

meaning is actually the encoding of both the factual assessment of that source towards the the complement event, as well as the factual assessment of the text author.

Consider the sentences in (63). They each present a SIP, *suspects* and *knows* (underlined), which introduce the participant *Berven* as a relevant source for computing the factuality of event e (Freidin leaving the country in June). The use of *suspects* in (63a) presents Berven as considering e to be just a possibility, whereas in (63b) she is depicted as considering it a fact.

(63) a. Berven <u>suspects</u> that Freidin **left**$_e$ the country in June.

b. Berven <u>knows</u> that Freidin **left**$_e$ the country in June.

Indeed, the text author adopts a particular view as well. He is uncommitted in the first sentence but agrees with Berven's judgement, in the second.

The new source is expressed by the grammatical subject of the SIP in most of the cases (64a), but an oblique, possibly optional, complement can also be used (64b-c). Additional sources can be introduced by nominal SIPs as well (64d). In the following examples, the new sources are in bold face, the SIPs underlined, and the SIP-embedded events in italics and bearing the subindex e.

(64) a. In mid-2001, **Colin Powell** and **Condoleezza Rice** both publically <u>denied</u> that Iraq *had*$_e$ weapons of mass destruction.

b. It <u>seems</u> to **him** that a girl's story about her goat and its butting *was*$_e$ more important.

c. He was <u>told</u> by **Cheney** that Bush had *approved*$_e$ a plan in which Libby would brief a specific New York Times reporter.

d. **Unisys Corp.**'s <u>announcement</u> Friday of a $648.2 million *loss*$_e$ for the third quarter showed that the company is moving even faster than expected.

SIPs can be classified as belonging to one of the following classes:

Predicates of report: for example, *say, tell, add; claim, argue* –even if they express report by other means than oral; e.g., *write, publish, post.*

Predicates of knowledge: they can express the state of having knowledge (*know, understand, remember*), acquiring knowledge (*learn, find out, discover*), loosing knowledge (*forget*), admitting knowledge (*acknowledge, accept, admit*).

Predicates of belief and opinion: for example, *think, find, consider, guess, predict, suggest.*

Predicates of doubt: such as *doubt, wonder, ask* (they generally subcategorize for a *wh*-clause complement.

Predicates of perception: e.g., *see, hear, feel.*

Predicates expressing proof: e.g., *prove, show, support, explain.*

Predicates expressing some kind of inferencing process: e.g., *infer, deduce; conclude, decide (that); mean, suggest* (as in: *it means/suggests that*); *appear, seem* (as in: *it seems/appears that*).

Predicates expressing some psychological reaction as a result of an event or situation taking place: *regret, be glad/pleased (that), like (that), love (that).*

4.3.2 Non-source introducing predicatess

ESPs not contributing any additional source are identified as non-source introducing predicates (NSIPs). The only source at play here is the text author –unless additional sources have been introduced at a higher embedding level. NSIPs include a varied set of classes, among which:

Implicative and semi-implicative predicates: such as *fail, manage*, or *allow.*

Predicates introducing a future event as their complement: this type includes many different semantic classes, such as volition (*want*), commissive (*offer*), and command (*require*) predicates. The complement event is always of intensional nature. Hence, the source is uncommitted with respect to the factuality value of that embedded event, regardless of the contextual polarity and modality of the main predicate.

Change of state predicates: for example, *increase*, *change*, or *improve*.

Aspectual predicates: such as *begin*, *continue*, and *terminate*.

4.4 Syntactic constructions

Some syntactic constructions involving subordination relations introduce factuality information of some sort. The following list, although not exhaustive, gives an indication of how pervasive this phenomenon is. It is based on Levinson (1983) and Givón (1993).

Relative clauses: In a non-restrictive relative clause, the event denoted by the main predicate (underlined in the following example) is presupposed as true.

(65) Rice, [who <u>became</u> secretary of state two months ago today], took stock of a period of tumultuous change.

Cleft sentences: The event denoted by the main predicate in the embedded clause is presupposed as true.

(66) It was Mr. Bryant [who, on July 19, 2001, <u>asked</u> Rep. Bartlett to pen and deliver a letter to him].

Temporal clauses: The event in the temporal clause (underlined) is presupposed as true in most cases.[5]

[5]This is, however, not always the case. For instance, with temporal clauses introduced by the preposition *before*, the veridicality of the embedded event depends on factors such as the semantics of the two events in the sentence, main and embedded (contrast the two examples in (67): only in the second sentence is the embedded event presented as a fact), or the presence of negative polarity items, which are not possible with other temporal prepositions (68).

(67) a. The bus felt down the cliff [before the driver could <u>abandon</u> it].
b. The bus stopped [before it started <u>raining</u>].

(68) a. The bus turned [before **anybody** could <u>see</u> the massacre].
b. *The bus turned [after **anybody** could <u>see</u> the massacre].

Similary, the events in clauses introduced by *before* or *until* are in some cases presented as uncertain:

(70) [While Chomsky was revolutionizing linguistics], the rest of the social sciences was asleep.

Causal clauses: The event in the causal clause (underlined) is presupposed as true.

(71) [Since Chomsky was revolutionizing linguistics], the rest of the social sciences was asleep.

Concessive clauses: Similar to the previous case, the event in the subordinated clause (underlined) is presupposed as true.

(72) [Although Chomsky was revolutionizing linguistics], the rest of the social sciences was asleep.

Participial adverbial clauses: The event in the subordinated clause (underlined) is presupposed as true.

(73) [Having revolutionized linguistics], Chomsky moved to political activism.

Purpose clauses: The main event is intensional in nature –thus, presented as uncertain.

(74) The environmental commission must adopt regulations [to ensure people are not exposed to radioactive waste].

Conditional constructions: The main event in the consequent clause (underlined) is intensional and dependent on the factuality of the main event in the antecedent clause (bold face), which is also intensional.

(75) On Dec. 2 Marcos promised [to return to the negotiating table] [if the conflict zone was **demilitarized**].

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(69) They will stay [until they are given a visa].

In spite of the relevance of this issue, it will not be discussed here due to time and research constraints. Refer to Anscombe (1964), Heinämäki (1974), Sánchez Valencia et al. (1993), Ogihara (1995), Beaver & Condoravdi (2003), among many others.

4.5 Discourse relations

A further mean for conveying factuality information is located at the discourse level. Some events may first have their factual status characterized in one way, and at a later sentence be presented differently. The most common mechanisms in charge of this type of overwriting are relations of opposition between clauses or sentences, expressed by means of discourse connectors. Consider the following example, concerning the event of drug dealers being tipped off (underlined):

(76) Yesterday, the police **denied** that [drug dealers <u>were tipped off</u> before the operation]. However, it emerged last night that a reporter from London Weekend Television unwittingly <u>tipped off</u> residents about the raid when he phoned contacts on the estate to ask if there had been a raid —before it had actually happened .

Strictly speaking, discourse (or rhetorical) relations are not factuality markers but contribute to the final assessment of the factuality of an event according to a given source. Despite their pervasiveness, the present work will ignore factuality assessments expressed (or overwritten) at a cross-sentence (or even cross-document) level.

4.6 The interaction among factuality markers

Factuality markers have an effect on the event within their immediate local scope, but may contribute as well to characterizing the factuality of events expressed at a non-local level of embedding. Consider the following examples:[6]

(77) a. The Royal Family will <u>continue</u> to <u>allow</u> detailed fire brigade **inspections**$_e$ of their private quarters.

b. The Royal Family will <u>continue</u> to <u>refuse</u> to <u>allow</u> detailed fire brigade **inspections**$_e$ of their private quarters.

c. The Royal Family <u>may</u> <u>refuse</u> to <u>allow</u> detailed fire brigade **inspections**$_e$ of their private quarters.

[6] As startling as it may seem, the original sentence in this set is (77b), from the BNC.

The event *inspections* in (77a), where *allow* is embedded under the factive predicate *continue*, is characterized as a fact in the world –i.e., there have been such inspections. Example (77b), on the other hand, depicts *inspections* as a counterfact because of the effect of the predicate *refuse* scoping over *allow*. Now contrast the two previous sentences with that in (77c), where the factual status of the event *inspections* is uncertain due to the modal auxiliary *may* scoping over *refuse*.

Hence, the factuality status of a given event cannot be obtained from the strict local modality and polarity operators scoping over that event but, if present, appealing to their interaction with other non-local markers as well. Due to the nature of some modality markers (in particular, ESPs and the syntactic constructions presented above) this interaction is articulated in terms of subordination relations. Therefore, computing the factuality values of events requires work at the lexical representation but also through the syntactic tree. As will be shown later, the design of my factuality profiler is based on this requirement (*cf.* chapters 6 and 7).

Chapter 5

Facts and their sources

As argued, event factuality is not an inherent property of events mentioned in text, in the sense that it is always relative to one or more sources. These sources play therefore a fundamental role in the computation of event factuality. The current chapter will look at them in detail, focusing on the aspects that will become relevant in later chapters when addressing the computational identification of event factuality.

The next section defines the concept of source, which is refined in section 5.2 with the notion of nested sources. Section 5.3 addresses the different roles that a source can play when assessing the factuality status of events, and introduces the distinction between anchor and cognizer, which will become fundamental for automatically identifying the factuality of events in text. The consequences of this distinction will be further elaborated in section 5.4. Finally section 5.5 addresses the possible situations in which sources are not made explicit in text.

5.1 Sources in discourse

Sources are understood here as the cognitive individuals presented as holding a specific stance with regards to the factuality status of events in text.

In any given discourse, there is always a default source for all the events mentioned there, which is the author of the text. Further sources can be incorporated by means of source introducing predicates (SIPs). As seen in the previous chapter, these are reporting predicates (such as *say, tell*), predicates of knowledge and opinion

(e.g., *know, believe*), psychological reaction (*regret*), etc. Semantically speaking, these new sources correspond to agents of speech acts, holders of opinions, experiencers of psychological reactions, etc.

The sources introduced by SIPs play a role in assessing the factuality of the event the SIP selects for. Consider the following examples:

(78) a. Donald Trump **managed**$_{e_1}$ to **make**$_{e_2}$ an unfavorable impression upon some 70 percent of those polled.

b. <u>Slobodan Milosevic's son</u>$_{s_1}$ **said**$_{e_1}$ Tuesday that the former Yugoslav president had been **murdered**$_{e_2}$.

Both sentences contain two events, e_1 and e_2, the latter being embedded (and hence modalized) by the former. The difference between the two sentences is that e_1 in (78a) is a NISP, whereas e_1 in (78b) is a SIP. Hence, no additional source is contributed in the first sentence, which means that both events there, e_1 and e_2, have only one relevant source assessing them; namely, the author of the text, which from here on will be identified as source s_0.

On the other hand, the events in (78b) have a different set of relevant sources each. Event e_1 is the main predication in the sentence, and as such, it is only evaluated by the author of the text (s_0), whereas its embedded event, e_2, has the text author (s_0) and Slobodan Milosevic's son (s_1). Observe that Milosevic's son commits to e_2 as a fact, whereas the author keeps a neutral attitude towards that same event.

Sources in text are therefore associated with one of the following actor types:

- A discourse participant: generally the author of the discourse, but possibly also the hearer or reader when the text contains references in second person.
- An individual referred to by a particular argument of a SIP –generally corresponding to its logical subject.

While the term *source* is generally used as a synonym of informant, in the scope of the current dissertation it is used in a very specific, technical sense. First, it not only refers to the typical informants, that is, those participants actively committing to the factuality of an event by means of a speech act or a writing event of some sort

(e.g., *Mary says/claims/pointed out/wrote...*), but also to those that are presented as holding (or being able to hold) a position about the factuality of that event: be it because they are characterized as holding a mental attitude about the situation (*Mary knows/learned/thinks/suspects that...*), because they are the experiencers of a psychological reaction generated by the event in question (*Mary regrets/is sad...*), or because they are presented as witnesses or perceivers of the situation (*Mary saw/heard that ...*).

Second, the notion of source as used here includes participants that are presented as unaware of the relevant event as well. Consider:

(79) Former Ambassador to Croatia Peter Galbraith is claiming President George W. Bush was unaware that there were two major sects of Islam just two months before the President ordered troops to invade Iraq.

A complete analysis of the facts, causes, and consequences regarding the war in Iraq needs to include that in that country there are two major sects of Islam, and what this means in terms of the potential stability of the area. But it should also include that President George W. Bush did not know this piece of information beforehand, as claimed by some political actors (here, source Peter Galbraith). Hence, the factuality analysis of the sentence will consider President Bush as a source as well. In particular, a source who, at the point in time two months before the invasion was started, held an uncommitted factuality stance (Uu) with regards to the existence of two major Islamic sects in Iraq.

The notion of source as part of the meaning component in certain ESPs is implicit in previous research, carried out from a strictly theoretical perspective, on factive (Kiparsky & Kiparsky, 1970; Karttunen, 1971) and assertive predicates (Urmson, 1952; Hooper, 1975). Most significantly, Cattell (1973) explicitly points out the potential disagreement between different sources (the text author and the subject) in the so-called semi-factive predicates –i.e., verbs of *knowledge*.

Within the vast work devoted to presuppositional phenomena, it is also implicitely assumed in Karttunen (1974), and in more explicit terms, in Geurts (1998), among others. The later, for example, distinguishes between what the speaker presupposes and what the speaker presupposes that the cognizer (i.e., the individual denoted by the subject of an attitude verbs) believes (Geurts, 1998:551-552).

Recently and from a more applied perspective, the research on emotion and opinion detection carried out by Jan Wiebe and her collaborators (Wiebe et al., 2002; Wiebe, 2003; Wiebe et al., 2005) defines the notion of source within the framework of that task, and points out its relevance.

5.2 Nested sources

Consider example (78b) again. I just argued that event e_2 has two relevant sources: the author of the text (s_0) and Milosevic's son (s_1). Strictly speaking, however, Milosevic's son is not the licit source of the factuality of event e_2. We as readers do not have direct access to the factual assessment of Milosevic's son with regard to e_2. We know about Milosevic's son perspective only according to what s_0, the author, asserts. Hence, we need to appeal to the notion of **nested source** as presented in Wiebe (2003); Wiebe et al. (2005). That is, the source assessing the factual status of e_2 in (78b) is not Milosevic's son (s_1), but him according to the text author, s_0. I will represent this subordination or nesting of sources as $s_1_s_0$ (or alternatively, as *son_author*), which is equivalent to the notation <*author*, *son*> in Wiebe's work. I adopt a reversed representation of nested sources (i.e., the non-embedded source last) because it positions the most direct source of the event at the outmost layer, thus facilitating its reading.

Generally speaking, all the sources in a text will be represented in terms of source chains of the form: $s_n_s_{n-1}_\ldots_s_0$. Only the author will be represented by means of a simple source (s_0).

5.3 Source roles

I will distinguish between two different source roles. Sources introduced by the SIPs will play the **cognizer** role. They are the sources most immediately committed (or uncommitted, in the case of unaware sources) to the factuality status of the event in question. On the other hand, the author of the text will be considered the **anchor**, given that it is the source that presents (or anchors) the factuality commitment of the cognizer towards the embedded event. These definitions will prove a bit too narrow

later, but they suffice for the moment. More precise definitions will be provided in section 6.3.2.

The distinction is basic for representing SIPs and the way they qualify the factuality of their embedded event. As part of their lexical semantics, they convey the factuality value that both the new source they introduce (aka cognizer), as well as the text author (anchor), assign to their event-denoting complement. Compare the two following contexts:

(80) a. He$_{s_1}$ **knows**$_{e_1}$ that he'll **save**$_{e_2}$ congregational seats as well.

b. He$_{s_1}$ **says**$_{e_1}$ that he'll **save**$_{e_2}$ congregational seats as well.

Event e_2 is evaluated as a fact by both the anchor (s_0) and the cognizer (s_1_s_0) when embedded under the SIP *know* (80a). However, when embedded under *say*, the author remains uncommitted (80b).

We can attempt to reflect this difference in the lexical entries of the two predicates in the way illustrated below, where e refers to the embedded event, c to the cognizer, and a is a skolemized constant corresponding to the anchor.

(81)

Predicate:		**Factuality assignment:**
know:	$\lambda e, \lambda c$: know(c, e)	f(e, a) = CT+ f(e, c) = CT+
say:	$\lambda e, \lambda c$: say(c, e)	f(e, a) = Uu f(e, c) = CT+

The role that a source plays is always relative to a particular event. In other words, a source is not a cognizer (or an anchor) in absolute terms, but the cognizer (or anchor) of a given event. Furthermore, a source performing the cognizer role for one event can be the anchor source of another. For example:

(82) Bush$_{s_1}$ also **said**$_{e_1}$ Thursday that King Hussein$_{s_2}$ **assured**$_{e_2}$ him Jordan would **close**$_{e_3}$ the last remaining free port to most Iraqi trade.

Source *Bush* (s_1_s_0) is the cognizer of e_2 (King Hussein assuring something), given that Bush is the agent of the speech act introducing e_2 (*Bush said*). At the same time, source *Bush* is the anchor of event e_3 (that Jordan will close the port), because it is the source anchoring (or presenting) the speech act concerning event e_3, performed by King Hussein.

5.4 Linguistic means for agreement and disagreement

Due to the distinction between anchor and cognizer roles, we can look at SIPs as one of the main devices in English for expressing factuality agreement (or disagreement) among sources. I claim that this is, in fact, an important component of their lexical semantics –part of what distinguishes among them.

Each predicate expresses a particular configuration of the factuality judgments performed by anchor and cognizer. In the previous section, we saw the different behavior between *know* and *say*. Table 5.1 provides additional examples of the factuality values that certain SIPs attribute to the anchor and cognizer sources of their embedded event, in contexts of positive polarity (+) and modality set to certain (CT).

Table 5.1: Factuality information in SIPs

Predicate	**Factuality assignments**
say:	f(e, a) = Uu f(e, c) = CT+
deny:	f(e, a) = Uu f(e, c) = CT−
suppose:	f(e, a) = Uu f(e, c) = PR+
doubt:	f(e, a) = Uu f(e, c) = PR−

Predicate	**Factuality assignments**
know:	f(e, a) = CT+ f(e, c) = CT+
forget:	f(e, a) = CT+ f(e, c) = Uu
pretend:	f(e, a) = CT− f(e, c) = CT+

Work on propositional attitude predicates has typically neglected the involvement of the second source; i.e., that of the here called cognizer. Work on factive predicates (Kiparsky & Kiparsky, 1970; Karttunen, 1971) constitutes a clear example of that from an area that is of interest in this dissertation. These predicates have traditionally being defined as presenting the speaker as presupposing the truth of their propositional complement. Translated to the terms employed here, that corresponds to defining them as presenting an author that commits to the embedded event as a fact (CT+). But because no distinction is established between the speaker and the participant expressed by the subject, it is impossible to differentiate among predicates which make this very distinction. Contrast the behavior of *know*, *forget* (that), and *disclose* in contexts of positive and negative polarity, as shown below:

(83) a. <u>He</u> **knows** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=CT+

b. <u>He</u> **does not know** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=Uu

(84) a. <u>He</u> **forgot** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=Uu

b. <u>He</u> **did not forget** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=CT+

(85) a. <u>He</u> **disclosed** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=CT+

b. <u>He</u> **did not disclose** [he'll **save**$_e$ congregational seats]. f(e,a)=CT+
f(e,c)=CT+

All these three predicates are considered to belong to the same class of factive predicates and yet, they differ in meaning. These differences, however, cannot be accounted for without appealing to the presence of a second factuality evaluator.

The omission of that additional source is remarkably pervasive among work on modality and evidentiality from a more strict linguistic perspective (e.g., Palmer,

1986; Givón, 1993), where these predicates are mentioned appealing only to the notion of "speaker's attitude".

There are, however, some exceptions. In her analysis of reporting predicates, Bergler is implicitly assuming the existence of two perspectives (that of the author and that of the predicate grammatical subject) when establishing the dimension of complement strength as one of the parameters defining reporting predicates. She defines it as referring to "the reliability, certainty, or credibility of the complement as encoded in the reporting verb by the reporter." (Bergler, 1992:135).

A more explicit approach to the distinction between two sources is offered in Dor (1995), where epistemic and attitude verbs are characterized, among other elements, by how they convey the attitude (or epistemic state) of both speaker and cognitive agent. And from a more cognitive approach, Field (1997) addresses factive predicates as a strategy to index alignment (or non-alignment) of epistemic stance between speaker and grammatical subject.

5.5 Implicit sources

There are two situations in which the source participant is not made explicit in the text, in addition to the default one concerning the text author.

Generic sources. Certain predicates used in impersonal constructions (e.g., *it seems/appears/is clear/...*) or in passive constructions with no agentive argument expressed (e.g., *it is expected/confirmed/...*) introduce a non-explicit generic source, which can be rephrased as *everybody* or *somebody*, among similar expressions. They will be represented as `GEN` in the nesting chain expressing the relevant source. In the example below, such source is implicitly introduced by the SIP *become clear* –i.e., it became clear to somebody. The relevant sources for event e_2 will therefore be: `author` (as the anchor) and `GEN_author` (as the cognizer).

(86) At one point, when it **became**$_{e_1}$ clear controllers could not **contact**$_{e_2}$ the plane, someone **said**$_{e_3}$ a prayer.

Dummy sources. In the type of text I am focusing here, some sentences are presented between quotation marks in their entire length. That is, there is no mention

of its source throughout the whole sentence. What is even more, if they are part of a longer quoted fragment, they will only have quotation marks at the beginning or end (87) –or no quotation marks at all, if the quoted material spans more than two sentences.

(87) a. "There are no unsettled **problems**$_{e_1}$ anymore.

b. We have **solved**$_{e_2}$ them all."

This material is reported by somebody who is not the author and that is most probably introduced somewhere else in the text. I encode cases like this by introducing a reference to a dummy source (abbreviated as `DUM`). Hence, the relevant source chains for events e_1 and e_2 above are: `author` and `DUM_author`.

Part II

De Facto: a factuality profiler

Chapter 6

Computing the factuality value of events

The previous part of the dissertation defined my formal approach to event factuality. In what comes next, I will design an algorithm to recognize it, which will be grounded on the body of knowledge presented so far, and develop the set of linguistic resources (mainly lexical) informing the algorithmic process. Both algorithm and linguistic knowledge will be implemented as the core of De Facto, a factuality profiler for events mentioned in text.

The current chapter is devoted to defining the algorithm. My approach is strictly based on information made explicit through linguistic expressions –i.e., through factuality markers. In addition, the algorithm assumes the model of linguistic communication presented in chapter 2 as underlying the concept of event factuality; that is, a model that conceives factuality as a property that sources attribute to events, and not as a property evaluated against a world established as the reference for truth, independently of speakers.

As seen, this model confers a basic role to factuality sources and factuality commitment time. De Facto incorporates the first of these two elements (in fact, making it a key piece for the computation of event factuality). The second element, however, will be left out of consideration in order to limit the scope of the current research.

The first three sections of this chapter will set the background for the algorithm. First, I will present an overview of my computational approach: I will justify the

choice of a top-down algorithm, illustrate its functionality with very basic examples, and set its formal framework (section 6.1). Given the substantial lexically-based orientation of De Facto, lexicon design acquires a central position. Section 6.2 is devoted to that, focusing on each of the lexical factuality markers presented earlier: polarity and modality particles, as well as event-selecting predicates. Then, section 6.3 addresses how to identify the factuality sources that are relevant for each event, as well as the roles that each of them perform. I have already emphasized how important sources are from a conceptual perspective. Here, we will see that they are also basic from a computational point of view. The chapter will conclude with section 6.4, which introduces the algorithm.

6.1 Computational approach

6.1.1 Top-down algorithm

I compute the factuality value of events by means of a top-down algorithm traversing a dependency tree. Two reasons motivate a top-down approach. The first one is of empirical nature. As seen in the section on factuality markers, syntactic subordination is directly involved in the factual characterization of events, and due to the recursive character of natural language, the factuality of a given event may depend on non-local information located several levels higher in the tree –cf. the set of sentences (77), in the chapter on factuality markers.

The second reason for a top-down approach is methodological. I conceive the factuality profiler as a neutral and naïve decoder; neutral in that it considers all sources as equally reliable; and naïve, because it assumes that sources are trustworthy, based on the Gricean maxim of quality. That is, a factuality profiler will represent information presented in the text as true, without questioning anyone's view or adopting a particular side.[1]

Because of conceiving the factuality profiler as a naïve decoder, each sentence will have its top context level initiated with a default factuality value of CT+; that is, all sentences are assumed to be true according to their author. This initial value

[1]We can then think on a later postprocessing using different weights in order to favor one source as more reliable than another.

will be potentially modified by the factuality markers available at subsequent levels of the tree. The factuality of every event will then correspond to the factuality information available at its context, obtained from the interaction of the different factuality markers scoping over it.

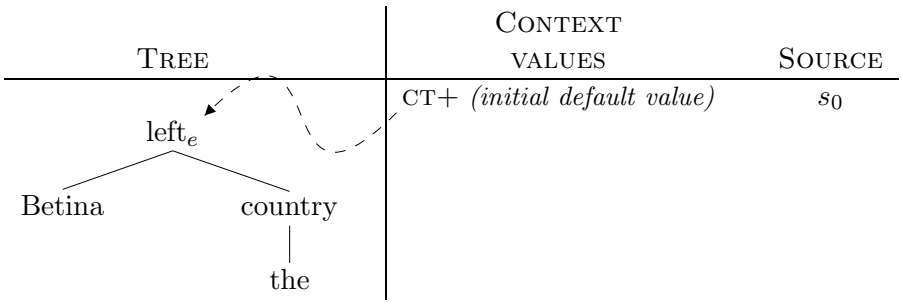

Figure 6.1: Computing event factuality in *Betina left$_e$ the country*.

Figure 6.1 illustrates the process of computing the factuality of event e in *Betina left$_e$ the country*, a declarative affirmative sentence. The computation in cases like this is trivial. There is only one relevant source involved: the author of the text (s_0). By the naïve decoder assumption, the factuality at the top context level is set to CT+, and because there is no other factuality marker available, the value that event e will receive corresponds to the value set at the initial level. That is, Betina leaving the country is evaluated as a fact (CT+) according to source s_0, the text author. This is indicated by the dotted line in the figure.

The presence of factuality markers will potentially modify the original factuality value. Modality markers, for instance, contribute a specific probability degree to the context they immediately scope over. Figure 6.2 exemplifies how the modal auxiliary *may* (as in *Betina may have left$_e$ the country*) updates the initial modality value CT to that of *possible* (PS).[2]

On the other hand, polarity markers will affect the polarity value inherited from the previous context. For example, the negation particle *not* (as in *Betina did not leave$_e$ the country*) shifts the polarity value of its context (figure 6.3).

[2]The contribution of the marker is signaled with `m` if it affects the modality value, and `p` if it impacts on the polarity one. In this and following trees, determiners, auxiliaries other than modals, and other elements may be left off the representation when not relevant for the computation.

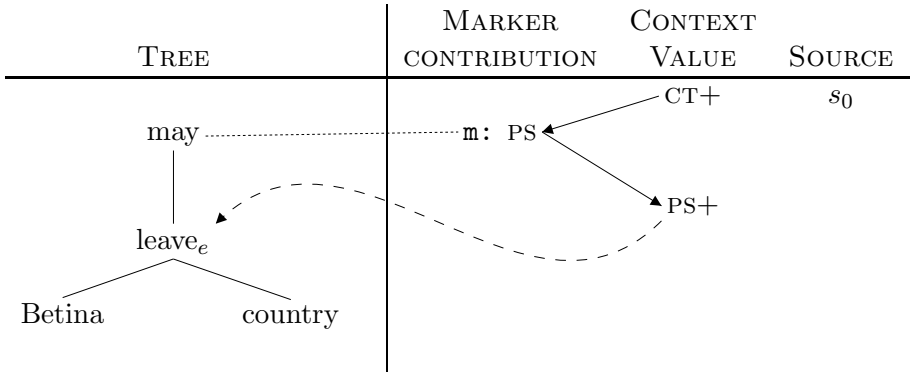

Figure 6.2: Computing event factuality in *Betina may have left$_e$ the country.*

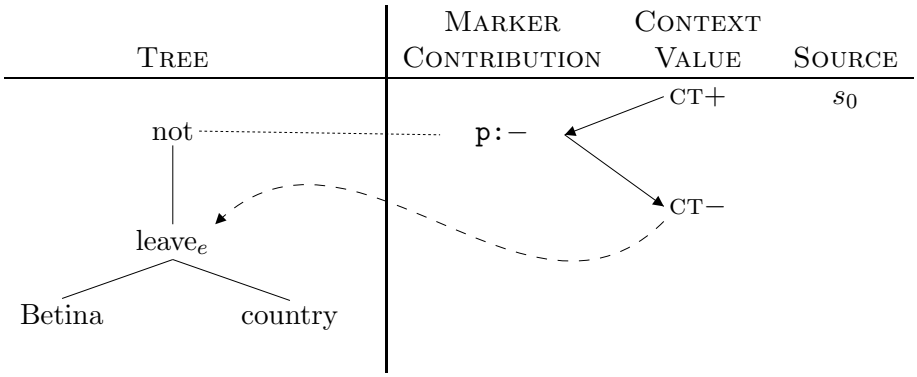

Figure 6.3: Computing event factuality in *Betina did not leave$_e$ the country.*

6.1.2 Evaluation levels

Sentences like those exemplified above concern only one relevant source, but the computation needs to be made extensible to cases where more than one source is involved. From a purely impressionistic view, it seems clear that SIPs should have a pivotal role, since they contribute a new source and potentially reassign the roles of previously existing ones. In other words, they update the context for evaluating event factuality. But in order to make this approach operational, we first need to create the adequate formal framework by defining what are the contexts of factuality evaluation, and what is the relevant information that is available in them. This is the goal of the current section.

Consider each sentence, S, as consisting of one or more **evaluation levels**, l.

They are the levels of dependency embedding that are created every time a SIP is consumed. A simple sentence (88a) will have one level, while a sentence with two SIPs, underlined in (88b), will have three. We identify each evaluation level by its depth of embedding. The root level has depth 0, corresponding to l_0.

(88) a. [$_{l_0}$ Betina left the country].

b. [$_{l_0}$ Danielle <u>regrets</u> [$_{l_1}$ that Shannon does not <u>know</u> [$_{l_2}$ Betina left the country]].

Given that evaluation levels are only triggered by SIPs, a sentence can contain several levels of syntactic embedding and yet only one evaluation level, corresponding to the top one, l_0. This is so for sentences containing syntactic subordination triggered by mechanisms other than SIPs. Sentence (89), for example, contains four embedded clauses (signaled with curly brackets) but only one evaluation level.

(89) [$_{l_0}$ {After four years here}, Freidin managed {to return to the country {where she was from}} and started {teaching yoga}}].

Each level l_n has a **set of relevant sources**, represented as RS_n. At the initial level l_0, RS_0 contains only one relevant source, s_0, corresponding to the author of the text. At higher levels l_n, where $n > 0$, a new source is introduced by the appropriate argument of the SIP triggering this new level. Furthermore, at each level l_n there is **a set E_n of one or more events**, the factuality of which is evaluated relative to each source $s \in \text{RS}_n$. Within this framework, the factuality of events in sentence S should be obtained by applying the following sequential steps:

1. Identifying the different evaluation levels l in S.

   Given the definition of evaluation level, this is achieved by identifying the SIPs present in S.

2. At each level l_n:

   (a) Identifying the set of events E_n to be evaluated.

   (b) Identifying the set of relevant sources RS_n at that level, in charge of evaluating the factuality of all events $e \in E_n$.

(c) Updating the contextual factuality based on the factuality markers operating at l_n. This update must be applied to each relevant source $s \in \text{RS}_n$ in the level.

The factuality value that every source $s \in \text{RS}_n$ assigns to each event $e \in E_n$ will result from the updating carried out in this last step.

I will now analyze how these steps can be applied to sentences of different structural complexity –letting aside, however, how to properly identify what are the events at each level (step 2a above), which is not the focus of the current dissertation.[3]

Sentences with no SIPs contain only one evaluation level. The processing here is trivial. There is only one evaluation level, l_0 (step 1), and thus only one source at play, s_0 (step 2b). The effect of factuality markers in this type of sentences was already illustrated in figures 6.1-6.3 (step 2c).

The difficulty increases, however, as new evaluation levels are added, given that they incorporate new sources to be taken into account as well. The simplest example are sentences with two evaluation levels –that is, sentences containing one SIP. Events expressed at the main level, l_0, will be in the same situation described above: they will have only one relevant source, s_0, and their factuality will be assessed according to the factuality markers available at that level. On the other hand, the events embedded under the SIP will belong to level l_1 and have two relevant sources: the text author (s_0), corresponding to the anchor, and the new source introduced by the SIP, which is assigned the role of cognizer. For sentence (90), for example, the relevant sources at each level are as shown in (91).[4]

(90) [$_{l_0}$ Mary$_{s_m}$ **said**$_{e_1}$ [$_{l_1}$ John **is**$_{e_2}$ the father]].

		[$_{l_0}$ Mary$_{s_m}$	**said**$_{e_1}$	[$_{l_1}$ John	**is**$_{e_2}$ the father]]
(91)	Event evaluated relative to:		s_0		s_0 (a) s_m-s_0 (c)

[3] I will give some hints about it in chapter 8.

[4] The notation *(a)* signals the anchor, whereas *(c)* points to the cognizer. The distinction is irrelevant for source s_0 at level l_0.

The last step at level l_1, updating the factuality value, will be based on the information provided by the SIP *said*. As presented in (81) (in section 5.3), the predicate *say* attributes the value Uu to the anchor source, and the value CT+ to the cognizer. Hence, the factuality values of e_2 relative to each of its relevant sources are:

(92) a. f(e_2, s_0) = Uu
b. f(e_2, s_m_s_0) = CT+

The procedure however becomes more complex when the sentence contains multiple SIP embeddings. Consider:

(93) [$_{l_0}$ Mary$_{s_m}$ **said**$_{e_1}$ [$_{l_1}$ John$_{s_j}$ **told**$_{e_2}$ her [$_{l_2}$ he **is**$_{e_3}$ the father]]].

We know now how to proceed at levels l_0 and l_1, but it is not clear how we can extend this strategy to further levels. There are two issues to handle. First, what are the relevant sources there. Given that the relevant source in level l_0 was s_0, and that the relevant sources in the subsequent level, l_1, were that previous source, s_0, and the new chain s_m_s_0, can we now just assume a regular progression establishing sources s_m_s_0 and s_j_s_m_s_0 as the relevant ones at l_2? Shouldn't the author (after all, the ultimate responsible for the content of the text) belong to the set of relevant sources at that level as well? In short, we need to pinpoint the mechanism establishing the set of relevant sources at each evaluation level.

The second issue concerns source roles. We saw that factuality is a matter of perspective, and that such perspective is mainly articulated through SIPs, which can attribute different factuality values to different sources based on the roles these play –recall the case of *say* in the example above. Thus, finding the strategy for reassigning source roles as new sources are introduced in discourse is an imperative as well.

The following three components are essential in order to compute the factuality value of events:

- A mechanism determining the set of relevant sources at each level, RS$_n$.
- A mechanism determining the roles each relevant source $s \in$ RS$_n$ performs.
- An adequate design of the lexicon for SIPs, which allows us to represent the divergent (or equal) values that different sources assign to the events at their corresponding level, based on the role they play.

These three issues will be addressed in the coming sections, before presenting the final algorithm at the end of the chapter. I will first start by addressing the issue of the lexicon design, given that the solutions proposed there will be useful later on, when focusing on source identification.

6.2 Lexicon design

The lexical entries for SIPs need to reflect that these markers express factuality information relative to two relevant sources: anchor and cognizer. Furthermore, they must encode the different factuality values the marker will express, depending on the polarity and modality of its context.

SIPs are the only factuality markers that express the lexical commitment of sources relative to the role these play: anchor and cognizer. In some cases, these two sources agree in their factuality judgement (94a), whereas in others they do not (94b). The following examples were first introduced and commented as (80). The factuality assessments for e_2 in each sentence are given in (95), where argument a refers to the source performing as anchor (s_0), and argument c to that in the cognizer role (s_1-s_0).

(94) a. <u>He</u>$_{s_1}$ **knows**$_{e_1}$ that he'll **save**$_{e_2}$ congregational seats as well.

b. <u>He</u>$_{s_1}$ **says**$_{e_1}$ that he'll **save**$_{e_2}$ congregational seats as well.

(95) a. f(e_2, a) = CT+
f(e_2, c) = CT+

b. f(e_2, a) = Uu
f(e_2, c) = CT+

However, such factuality assessments are adequate only when the SIP is in a context of positive polarity (+) and modality set to certain (CT). Tables 6.1 and 6.2 show the factuality assessments of the embedded event in other possible contexts.[5]

[5]The interpretation provided in some of the contexts here may generate some controversy. For example, there is a tendency to interpreting sentence *He did not say he'll save congregational seats*, in table 6.2, as presenting both the anchor and the cognizer committed to event e_2 as a fact (CT+) by the effect of a generalized conversational implicature. As argued in section 3.1.3, I favor the most underspecified interpretation.

Table 6.1: Factuality information conveyed by *know* in different contexts of modality and polarity

Context		**Example**	**Factuality of e_2**
Mod	**Pol**		
CT	+	$\underline{\text{He}}_{s_1}$ **knows**$_{e_1}$ he'll **save**$_{e_2}$ congregational seats.	f(e_2, a)=CT+ f(e_2, c)=CT+
	−	$\underline{\text{He}}_{s_1}$ **does not know**$_{e_1}$ he'll **save**$_{e_2}$ congregational seats.	f(e_2, a)=CT+ f(e_2, c)=Uu
PS	+	$\underline{\text{He}}_{s_1}$ **may know**$_{e_1}$ he'll **save**$_{e_2}$ congregational seats.	f(e_2, a)=CT+ f(e_2, c)=Uu
	−	$\underline{\text{He}}_{s_1}$ **may not know**$_{e_1}$ he'll **save**$_{e_2}$ congregational seats.	f(e_2, a)=CT+ f(e_2, c)=Uu

In the case of *know*, note that the constant commitment of the author towards the factual nature of the embedded event, regardless of the polarity and modality values in the main context, reflects the factive nature of this predicate as described in Kiparsky & Kiparsky (1970).

Table 6.2: Factuality information conveyed by *say* in different contexts of modality and polarity

Context		**Example**	**Factuality of e_2**
Mod	**Pol**		
CT	+	$\underline{\text{He}}_{s_1}$ **said**$_{e_1}$ he'll $\underline{\text{save}}_{e_2}$ congregational seats.	f(e_2, a)=Uu f(e_2, c)=CT+
	−	$\underline{\text{He}}_{s_1}$ **did not say**$_{e_1}$ he'll $\underline{\text{save}}_{e_2}$ congregational seats.	f(e_2, a)=Uu f(e_2, c)=Uu
PS	+	$\underline{\text{He}}_{s_1}$ **may have said**$_{e_1}$ he'll $\underline{\text{save}}_{e_2}$ congregational seats.	f(e_2, a)=Uu f(e_2, c)=Uu
	−	$\underline{\text{He}}_{s_1}$ **may not have said**$_{e_1}$ he'll $\underline{\text{save}}_{e_2}$ congregational seats.	f(e_2, a)=Uu f(e_2, c)=Uu

We can systematize these data in a lexicon for SIPs, where each entry specifies the factual value assigned to the embedded event by both the anchor and the cognizer, relative to the polarity and modality values in the context of the main predicate. This is presented in table 6.3, where each predicate has the information distributed in two

different rows: one for the anchor (a), and another for the cognizer (c).[6]

Table 6.3: Lexicon fragment for SIPs

		Contextual factuality								
		mod=CT			**mod**<CT			**mod**=U		
		+	**−**	**u**	**+**	**−**	**u**	**+**	**−**	**u**
know	(a)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
	(c)	CT+	U	U	U	U	U	U	U	U
say	(a)	U	U	U	U	U	U	U	U	U
	(c)	CT+	U	U	U	U	U	U	U	U

Conceiving SIPs as elements that distribute possibly different factuality judgments among independent participants allows, among other things, the modeling of event factuality as a property relative to sources.

6.3 Source identification

I now turn to defining the mechanisms for identifying the set of relevant sources at each evaluation level l (section 6.3.1), as well as their appropriate roles (section 6.3.2). Both are basic for automatically computing the factuality of events.

As seen in section 6.1.2, identifying the relevant sources and their corresponding roles at levels l_0 and l_1 is straightforward. Deeper evaluation levels, however, pose a challenge. Consider sentence (96), a variation of example (93).

(96) $[_{l_0}$ Mary$_{s_m}$ **said**$_{e_1}$ $[_{l_1}$ John$_{s_j}$ **told**$_{e_2}$ her $[_{l_2}$ Paul **is**$_{e_3}$ the father $]]]$.

Because determining the relevant sources of events at low evaluation levels (l_0, l_1) is easier than for events at higher evaluation levels, I begin making the case for the simplest clause in the sentence above, corresponding to example (97), which expresses the proposition that, according to Mary, was uttered by John.[7]

(97) $[_{l_0}$ Paul **is**$_{e_3}$ the father $]$.

[6]For better visual clarity, factuality values Uu are simplified as U.

[7]In this and coming examples, I keep the event identifier e_n as in the original sentence (96), but update the level degree n in l_n according to the structural complexity of the example.

As a simple sentence, its main event, e_3, has only one relevant source, which corresponds to its author (s_0). We know the sentence was uttered by John. Hence, s_0 refers to him. As for the role of that source, the distinction between anchor and cognizer is not applicable here given that we are at the top evaluation level, l_0. The resulting assignation of relevant sources is as follows:

(98)

	$[_{l_0}$ Paul	**is**$_{e_3}$ the father]
Event evaluated relative to:		s_0 (=john)

This very same sentence can be embedded as the complement of a SIP, adding therefore an additional evaluation level. Imagine that John tells Mary (97) and she then reports (99) to Sue.

(99) $[_{l_0}$ John$_{s_j}$ **told**$_{e_2}$ me $[_{l_1}$ Paul **is**$_{e_3}$ the father]].

In this new sentence, there are two events for which we need to find their relevant sources and the roles associated to each of them. This is an easy task for the event at the top level, e_2. It has only one relevant source, the text author (s_0), who now is Mary. As stated earlier, the distinction between anchor and cognizer is not relevant here.

(100)

	$[_{l_0}$ John$_{s_j}$	**told**$_{e_2}$ me	$[_{l_1}$ Paul	**is**$_{e_3}$ the father]]
Event evaluated relative to:		s_0 (=mary)		

With regard to the embedded event, e_3, John is still a relevant source, since he is the one who uttered it and therefore committed to it –recall (98). But because his commitment act (i.e., him asserting e_3) is reported by the author of the text (Mary, s_0), he is represented now as a nested source: s_j-s_0.

(101)

	$[_{l_0}$ John$_{s_j}$	**told**$_{e_2}$ me	$[_{l_1}$ Paul	**is**$_{e_3}$ the father]]
Event evaluated relative to:		s_0 (=mary)		s_j-s_0 (=john)

Note, however, that the author is also taking a stance regarding the factuality of e_3. She is the one deciding how to present John's commitment (e.g., *John told me* vs.

John pretended/knew/...). By selecting the predicate *tell*, she is positioning herself as uncommitted with respect to the factuality of e_3; hence, $f(e_3, s_0)$=Uu (102a). By contrast, by selecting the predicates *know* or *pretend* she would have presented e_3 as a fact (102b) or as a counterfact (102c), respectively.

(102)
a. [$_{l_0}$ John$_{s_j}$ **told**$_{e_2}$ me [$_{l_1}$ Paul **is**$_{e_3}$ the father]] $f(e_3, s_0)$=Uu
b. [$_{l_0}$ John$_{s_j}$ **knew**$_{e_2}$ [$_{l_1}$ Paul **is**$_{e_3}$ the father]] $f(e_3, s_0)$=CT+
c. [$_{l_0}$ John$_{s_j}$ **pretended**$_{e_2}$ [$_{l_1}$ Paul **is**$_{e_3}$ the father]] $f(e_3, s_0)$=CT−

The relevant sources for event e_3 are therefore s_j-s_0 and s_0. The former points to John, who is the source most immediately committing to e_3 (he uttered the sentence asserting it as a fact); thus, he performs the role of cognizer. The latter, on the other hand, refers to Mary, who is the source presenting (or anchoring) John's commitment. She therefore performs the role of anchor.

(103)

	[$_{l_0}$ John$_{s_j}$	**told**$_{e_2}$ me	[$_{l_1}$ Paul	**is**$_{e_3}$ the father]]
Evaluated		s_0 (=mary)		(a) s_0 (=mary)
relative to:				(c) s_j-s_0 (=john)

Next, imagine that Sue reports what Mary told her (99) to somebody else by uttering the sentence in (104), our original example (96). There is now a deeper level of evaluation.

(104) [$_{l_0}$ Mary$_{s_m}$ **said**$_{e_1}$ [$_{l_1}$ John$_{s_j}$ **told**$_{e_2}$ her [$_{l_2}$ Paul **is**$_{e_3}$ the father]]].

We already know how to identify the relevant sources and their roles at levels l_0 and l_1, as just shown (103). At l_0 there is only one source, corresponding to the text author, and at level l_1 there is the new source introduced by the SIP (nested by the author) and the text author. Applying this strategy to (104), we obtain:

(105)

	[$_{l_0}$Mary$_{s_m}$	**said**$_{e_1}$ [$_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her [$_{l_2}$he	**is**$_{e_3}$ the father]]]
Evaluated		s_0 (=sue)	(a) s_0 (=sue)	
relative to:			(c) s_m-s_0 (=mary)	

It is now time to move one evaluation level deeper: l_2. The event there is e_3, for which we already know some of its relevant sources. They include: the immediate source committing to e_3 (that is, John, who is now represented as s_j-s_m-s_0) and the source presenting John's commitment (i.e., Mary, represented as s_m-s_0). The former performs the role of cognizer, whereas the latter becomes the anchor.

(106)		$[_{l_0}$Mary$_{s_m}$	**said**$_{e_1}$ $[_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her $[_{l_2}$he	**is**$_{e_3}$ the father]]]
	Evaluated relative to:		s_0 (=sue)	(a) s_0 (=sue) (c) s_m-s_0 (=mary)	(a) s_m-s_0 (=mary) (c) s_j-s_m-s_0 (=john)

Once the relevant sources and their roles are identified, we can assess the factuality value of each event relative to their evaluating sources. Event e_1 is asserted by source s_0, who presents it as a fact. Because we assume the naïve decoder assumption, the factuality of e_1 according to s_0 is $f(e_1, s_0)$=CT+. Event e_2, on the other hand, was asserted as a fact by Mary according to what the author says (hence, $f(e_2, s_m\text{-}s_0)$=CT+). The other relevant source for that event, the author, keeps herself uncommitted ($f(e_2, s_0)$=Uu). Finally, event e_3 presents a similar situation to e_2: its cognizer, John, is characterized as committing to it as a fact ($f(e_3, s_m\text{-}s_j\text{-}s_0)$=CT+), whereas its anchor, Mary, remains uncommitted ($f(e_3, s_m\text{-}s_0)$=Uu). The resulting factuality analysis is as shown:

(107)	$[_{l_0}$ Mary$_{s_m}$	**said**$_{e_1}$ $[_{l_1}$ John$_{s_j}$	**told**$_{e_2}$ her	$[_{l_2}$ he	**is**$_{e_3}$ the father]]]
		f(e_1, s_0)=CT+	(a) f(e_2, s_0)= Uu (c) f(e_2, s_m-s_0)= CT+		(a) f(e_3, s_m-s_0)= Uu (c) f(e_3, s_j-s_m-s_0)= CT+

We can verify that the assignments at evaluation levels l_n, where $n > 0$, are adequately predicted by the information in our SIPs lexicon (Table 6.3). In sentence (107), level l_1 is triggered by the SIP *say*, which is presented in a context of positive polarity (+) and modality set as certain (CT). According to the lexical table, the factuality of events embedded by *say* (here, event e_2) given contextual factuality CT+ is: underspecified (Uu) according to the anchor (here, s_0), and certainly positive (CT+) according to the cognizer (s_m-s_0). This prediction corresponds to the assignments shown above: $f(e_2, s_0)$=Uu, in the case of the anchor, and $f(e_2, s_m\text{-}s_0)$=CT+, for the cognizer.

The next level, l_2, is triggered by the SIP *tell*, whose lexical entry is exactly like the one for *say*. The contextual factuality of *told* in the sentence is CT+. Thus, as with event e_2, the anchor of e_3 is presented as uncommitted ($f(e_2, s_m\text{-}s_0)$=Uu), whereas its cognizer is characterized as committing to it as a fact ($f(e_2, s_j\text{-}s_m\text{-}s_0)$=CT+).

We therefore see that all the assignments as predicted by the lexicon correctly match the factuality analysis that was presented in (107).

Up to here, we have taken a sentence as example, and step by step, have decided what seemed to be the relevant sources (and their roles) at each evaluation level. Once this information has been established, we have determined what are the factuality values that each of these sources assigns to the events in question, and finally, we have verified that these assignments were correctly predicted by the information in the lexicon.

In what comes next, we will work on a second sentence. We will again determine what are the relevant sources (and their roles) at each evaluation level, but then, we will reverse the order of the following steps: instead of first analyzing the factuality of each event in the sentence based on its interpretation and then verifying the resulting assignments by means of the information in the lexicon, we will first assign the factuality values to events according to the lexical information, and then compare this result with our interpretation of the sentence. That will show that the approach used so far in order to determine the set of relevant sources and their roles is not fully adequate. The next example to consider is:

(108) $[_{l_0}\text{Mary}_{s_m}$ is not **aware**$_{e_1}$ that $[_{l_1}\text{John}_{s_j}$ **knows**$_{e_2}$ $[_{l_2}$Paul **is**$_{e_3}$ the father]]].

First, we determine the relevant source and their roles at each level. Because it has the same syntactic structure as the previous sentence, we can postulate that the source chains that were relevant for the events at each level there will apply here as well. The distribution of sources and roles in example (109) compares then to that in example (106).

(109)		[Mary$_{s_m}$ is not	**aware**$_{e_1}$ that $[_{l_1}$John$_{s_j}$	**knows**$_{e_2}$ $[_{l_2}$Paul	**is**$_{e_3}$ the father]]
	Evaluated relative to:		s_0	(a) s_0 (c) s_m-s_0	(a) s_m-s_0 (c) s_j-s_m-s_0

Next, we will use the information in the SIPs lexicon (table 6.3) to compute the factual values that each of these sources assigns to its corresponding events. At level l_0, the value assigned by the author to event e_1 is CT− due to the presence of the polarity particle *not*. At level l_1, we use the lexical information of the SIP *be aware*, a factive predicate that encodes the same factuality values as *know*.

Given that *be aware* is presented here in a context of factuality set to CT−, only the anchor (s_0) of event e_2 will assess it as a fact (CT+). Its cognizer (s_m-s_0), on the

other hand, remains uncommitted (Uu). Finally, level l_2 is triggered by *know*, which in our sentence is presented in a context of factuality CT+. Hence, both the anchor (s_m-s_0) and the cognizer (s_j-s_m-s_0) of the embedded event (e_3) will characterize it as a fact (CT+). The final result is as shown:

(110)

[$_{l_0}$Mary$_{s_m}$ is not	**aware**$_{e_1}$ that [$_{l_1}$John$_{s_j}$	**knows**$_{e_2}$ [$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	f(e_1, s_0)=CT−	(a) f(e_2, s_0)=CT+	(a) f(e_3, s_m-s_0)=CT+
		(c) f(e_2, s_m-s_0)=Uu	(c) f(e_3, s_j-s_m-s_0)=CT+

Now that the factuality values have been assigned according to the lexical information, the next step is to check whether they reflect the meaning of the sentence.

The factual values assigned to e_2 (John knowing Paul is the father) seem adequate. By chosing the factive predicate *be aware*, the author commits to e_2 as a fact (i.e., $f(e_2, s_0)$=CT+). On the other hand, because *be aware* is used in a context of negative polarity (CT−), the cognizer, Mary, is presented as ignorant of e_2, hence $f(e_2, s_m\text{-}s_0)$=Uu.

There are, however, problems in the factuality assignments for e_3. The first wrong prediction in (110) is the value assigned to e_3 relative to source *John* (s_j-s_m-s_0), which is CT+. Sentence (108) certainly asserts that John knows about Paul's paternity, and so presents him committing to e_3 as a fact in the world. Note however that John as a source is referred to here by the nested source expression s_j-s_m-s_0, which includes a reference to Mary. And as mentioned, Mary is clueless about John's state of information concerning Paul's paternity. In other words, the reader knows that John commits to Paul's paternity according to the author (hence, s_j-s_0) but certainly not according to Mary (s_j-s_m-s_0). We should therefore expect a distinction between $f(e_3, s_j\text{-}s_0)$, a factuality evaluation which is absent from (110), and $f(e_3, s_j\text{-}s_m\text{-}s_0)$. The first should evaluate to CT+; the second, to Uu –as opposed to the value CT+ that is presented above.

A second problem is the factual assessment of event e_3 relative to source *Mary* (that is, $f(e_3, s_m\text{-}s_0)$), which is computed as CT+, instead of Uu. The proposition, however, is underspecified regarding Mary knowing about Paul's paternity. I justified this in section 3.1.3, when addressing potential underspecified situations.

A further descriptive inadequacy in the example above concerns source author (s_0). The analysis does not reflect that, by using two factive predicates, the author of

the text is actively commiting to e_3 as a fact. That is, the evaluation $f(e_3, s_0)$=CT+ should be available in the resulting representation as well.

In conclusion, the factual assignments that we should expect for sentence (108) are:

(111)

[$_{l_0}$ Mary$_{s_m}$ is not	**aware**$_{e_1}$ that [$_{l_1}$John$_{s_j}$	**knows**$_{e_2}$ [$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	f(e_1, s_0)=CT−	f(e_2, s_0)=CT+	f(e_3, s_0)=CT+
		f(e_2, s_m_s_0)=Uu	f(e_3, s_m_s_0)=Uu
			f(e_3, s_j_s_0)=CT+
			f(e_3, s_j_s_m_s_0)=Uu

The factuality assessment in (110) is therefore incorrect in two ways. First, not all the relevant sources have been appropriately identified. Second, the factuality values assigned to sources are not always the correct ones. We will see that by solving the first issue with adequate mechanisms for determining both relevant sources and source roles, we will bring a solution to the second problem as well.

6.3.1 Identifying relevant sources of an event

From the example above, finding the relevant sources seems to involve keeping track of all possible source chains created in previous levels when moving into deeper evaluation contexts. Thus, the process for identifying the relevant sources RS_n at each evaluation level l_n can be defined inductively.

Definition 1 ***Relevant sources***

i. *The set of relevant sources at level l_0 contains only a non-nested source, which corresponds to the text author:* $\text{R}S_0 = \{s_0\}$.

ii. *The set of relevant sources at level l_n, where $n > 0$, is:*

$\text{R}S_n = \text{R}S_{n-1} \cup \{s_n_z \mid s_n$ *is the new source introduced at level* l_n & $z \in \text{R}S_{n-1}\}$

Clause *i.* needs no additional comment. Clause *ii.* states that the set of relevant sources RS_n at level l_n contains (a) the set of relevant sources at the previous level l_{n-1} –that is, RS_{n-1} (this is expressed as the first part of the union); and (b) the set of all source chains which consist of the new source introduced at the level by

the corresponding SIP, s_n, and a relevant source from the preceding level, $z \in rS_{n-1}$ (second part of the union).

Given this definition, the set of relevant sources at each level of the two sentences used as examples throughout the previous discussion are as shown:

(112)

a.	[$_{l_0}$Mary$_{s_m}$	**says**$_{e_1}$	[$_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her	[$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
b.		s_0		s_0		s_0
				s_m-s_0		s_m-s_0
						s_j-s_0
						s_j-s_m-s_0

(113)

a.	[$_{l_0}$Mary$_{s_m}$ is not	**aware**$_{e_1}$ that	[$_{l_1}$John$_{s_j}$	**knows**$_{e_2}$	[$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
b.		s_0		s_0		s_0
				s_m-s_0		s_m-s_0
						s_j-s_0
						s_j-s_m-s_0

The next step is to determine what are the roles of all these sources.

6.3.2 Identifying source roles

The two source roles were first defined in section 5.3. The cognizer for events in level l_n was presented as the new source introduced by the SIP triggering that level; for example, source John is the cognizer of event e_1 in (114a). Note that this same source also performs the role of cognizer in (114b), where John is presented as uncommitted.

(114) a. [$_{l_0}$ John said/knew/regretted/suspected/... [$_{l_1}$ ψ_{e_1}]]

b. [$_{l_0}$ John did **not** say/know/regret/suspect/... [$_{l_1}$ ψ_{e_1}]].

On the other hand, the anchor was defined as the source presenting (or anchoring) the factuality commitment of the cognizer towards the embedded event. That is, the source who states/knows/... John's act (or mental state) of saying/knowing/regretting/suspecting that ψ_{e_1}.

Applying these definitions to examples (112) and (113) above, it is clear what are the cognizer and anchor for event e_2 at level l_1: Mary is the cognizer (s_m-s_0), whereas the author is the anchor (s_0).

(115)

a.	$[_{l_0}$Mary$_{s_m}$	**says**$_{e_1}$	$[_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her	$[_{l_2}$Paul **is**$_{e_3}$ the father]]]
b.		s_0		(a) s_0	s_0
				(c) s_m-s_0	s_m-s_0
					s_j-s_0
					s_j-s_m-s_0

(116)

a.	$[_{l_0}$Mary$_{s_m}$ is not	**aware**$_{e_1}$ that	$[_{l_1}$John$_{s_j}$	**knows**$_{e_2}$	$[_{l_2}$Paul	**is**$_{e_3}$ the father]]]
b.		s_0		(a) s_0		s_0
				(c) s_m-s_0		s_m-s_0
						s_j-s_0
						s_j-s_m-s_0

Now we turn to determining the anchor and the cognizer for event e_3, located at l_2, one evaluation level deeper.

First, the anchor. In (115), *Mary* is the source presenting the factuality commitment of John towards event e_3. Thus, the anchor of e_3 must be s_m-s_0. Nonetheless, this same source s_m-s_0 is uncommitted (Uu) with regards to John's commitment in (116) –i.e., Mary is unaware of e_2.The source presenting John's commitment is actually the text author, s_0. That is, then, the anchor of e_3 in that second example.

The mechanism for finding anchors can be stated generally as follows: the anchor of any event e_1, a_{e_1}, is a source that is not uncommitted (Uu) to event e_0, the SIP embedding e_1. Applying that to the examples above, the anchor of event e_3 (Paul being the father) is the source that is not uncommitted to event e_2 (John telling/knowing/not telling/not knowing e_3). In (115), that corresponds to Mary (s_m-s_0), whereas in (116) the anchor is the text author (s_0).

Given that more than one source can positively commit to an event at the same time, each event can have more than one anchor.

Once the anchor is identified, finding the cognizer is immediate. From the introductory definitions provided above, we know that the cognizer of an event e, c_e, involves the new source introduced by the SIP that is embedding e. We also know that, because cognizer c_e belongs to an evaluation level l_n where $n > 0$, it must necessarily be a chain source constituted of that new source and a second source belonging to the previous level. Specifically, c_e corresponds to the new source introduced at level l_n, nested relative to anchor a_e, given that a_e is the elicitor of the factuality stance of that new source with respect to event e.

Computationally, the notion of *cognizer* is therefore dependent on that of *anchor*. Given that more than one anchor is possible for each event, the cognizer role can be performed by several source chains at the same time as well. The sets of anchors and cognizers of event e are identified as $a(e)$ and $c(e)$, respectively, and computed as follows:[8]

Definition 2 ***Source roles***

i. *At level* l_0*:* $a(e_0) = \{s_0\}$ *and* $c(e_0) = \{s_0\}$.

ii. *At level* l_n*, for* $n > 0$*:*
$a(e_n) = \{s \mid s \in \text{R}S_{n-1}\ \&\ f(e_{n-1}, s) \neq Uu\}$ *and*
$c(e_n) = \{s_n_s_a \mid s_n$ *is the new source introduced in level* $l_n\ \&\ s_a \in a(e_n)\}$.

Clause *i.* defines the sets of anchors and cognizers at the evaluation level l_0 as containing one only source, which in both cases correspond to the text author (s_0). Because at this level the distinction between anchor at cognizer is irrelevant, I establish s_0 as performing both roles.

Clause *ii.*, on the other hand, defines anchors and sources for higher evaluation levels, $l_{n>0}$. In particular, anchors are defined as those sources $s \in \text{R}S_n$ that are not uncommited towards the factuality of e_{n-1}, the event embedding e_n and hence located at the previous level l_{n-1}. And cognizers are presented as those sources composed of the new source introduced at level l_n, s_n, nested relative to any anchor source at that level, $s_a \in a(e_n)$.

All other sources that do not satisfy the definition of either *anchor* or *cognizer* are assigned the role of *none* –expressed as (_).

The result from applying this definition to the sentences above is as shown:

(117)

[$_{l_0}$Mary$_{s_m}$	**says**$_{e_1}$	[$_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her	[$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	(a,c) s_0		(a) s_0		(_) s_0
			(c) $s_m_s_0$		(a) $s_m_s_0$
					(_) $s_j_s_0$
					(c) $s_j_s_m_s_0$

[8]Strictly speaking, anchors and sources are relative to evaluation levels, and not only to events. That is, all the events in a given evaluation level l_n share the same set of anchors and cognizers.

(118)

[$_{l_0}$Mary$_{s_m}$ is not	**aware**$_{e_1}$ that	[$_{l_1}$John$_{s_j}$	**knows**$_{e_2}$	[$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	(a,c) s_0		(a) s_0		(a) s_0
			(c) s_m_s_0		(_) s_m_s_0
					(c) s_j_s_0
					(_) s_j_s_m_s_0

As a last step, we can verify that the factuality assignments according to the information in the SIPs lexicon (Table 6.3), shown in (119) and (120), correspond to the expected factuality assignments for each of the relevant sources. I leave this as an exercise for the reader.

(119)

[$_{l_0}$Mary$_{s_m}$	**says**$_{e_1}$ [$_{l_1}$John$_{s_j}$	**told**$_{e_2}$ her [$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	(a,c) $f(e_1, s_0)$=CT+	(a) $f(e_2, s_0)$=Uu	(_) $f(e_3, s_0)$=Uu
		(c) $f(e_2, s_m$_$s_0)$=CT+	(a) $f(e_3, s_m$_$s_0)$=Uu
			(_) $f(e_3, s_j$_$s_0)$=Uu
			(c) $f(e_3, s_j$_s_m_$s_0)$=CT+

(120)

[$_{l_0}$Mary$_{s_m}$ is not	**aware**$_{e_1}$ that [$_{l_1}$John$_{s_j}$	**knows**$_{e_2}$[$_{l_2}$Paul	**is**$_{e_3}$ the father]]]
	(a,c) $f(e_1, s_0)$=CT−	(a) $f(e_2, s_0)$=CT+	(a) $f(e_3, s_0)$=CT+
		(c) $f(e_2, s_m$_$s_0)$=Uu	(_) $f(e_3, s_m$_$s_0)$=Uu
			(c) $f(e_3, s_j$_$s_0)$=CT+
			(_) $f(e_3, s_j$_s_m_$s_0)$=Uu

6.4 Algorithm

6.4.1 Sequentialization of the flow

The core procedure of the FP applies top-down traversing a dependency tree. At the beginning of each new level, l_n, one or more factuality values are set for that level. We can refer to them as *contextual factuality values*, CF$_n$. These must be set relative to the relevant sources in RS$_n$, since different sources may assess the same event in different ways within the same level. The set of contextual factuality values at level l_n can be defined as: CF$_n$={ $<f, s>$ | f is a factuality value & $s \in$ RS$_n$ }.

By default, at level l_0 the set CF$_n$ contains only the value CT+ relative to the text author (i.e., <CT+, s_0>). This applies the naïve decoder assumption. Additional markers within each level l_n (polarity particles, modality particles, and NSIPs) may

modify the values in CF_n according to the factuality information they convey (*cf.* next chapter). When an event e_n is found, its factuality profile, p_{e_n}, is the set of contextual factuality values CF_n available at that point.

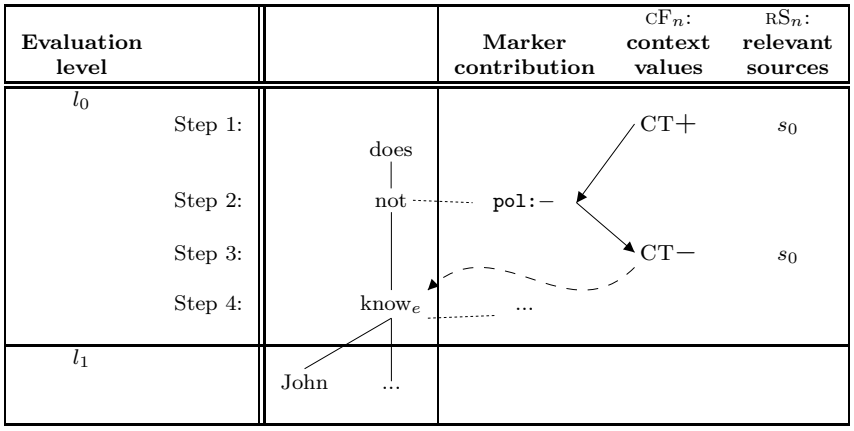

Figure 6.4: Computing event factuality in *John does not know he is the father*.

Figure 6.4 illustrates the initial steps of this process: in Step 1 of level l_0, the profiler sets the factuality values for the only relevant source at that level –the text author, s_0. We are at the top of the tree, and so this is a default step satisfying the naïve decoder assumption. Then, the profiler travels down the tree until it finds the polarity marker *not*, which switches the polarity initially assigned to the context, from positive to negative. The resulting contextual factuality value is that in Step 3. Next, the verb *know* is found, which denotes an event. Its factuality profile, p_{know_e}, is the set of factuality values relative to the relevant sources in that level: $p_{know_e} = \{<\text{CT}+,s_0>\}$.

The factuality profiler algorithm is provided in Algorithm 1, which enhances that presented in Saurí & Pustejovsky (2007). It consists of three main parts: a first, syntax-based one, that implements the effect of syntactic-based factuality markers (specifically, relative, participle, and purpose clauses); a second one, in charge of assigning the factuality value to every event found; and finally a third one, which implements the effect of lexical markers on any coming event.

Checking whether the node found is a lexical marker of any sort and subsequently updating the contextual factuality if appropriate (part 3), needs to be performed after part 2, in charge of verifying whether the expression is an event and, if so,

Algorithm 1 De Facto: the Factuality Profiler

```
1: n ← 0
2: set level l_n
3: for all i in TREE do
4:     #Part 1: Check for syntactic marker
5:     if i is head of relative, participle, or purpose clause then
6:         update contextual factuality, cF_n
7:     end if
8:     #Part 2: Check for event
9:     if i is an event then
10:        obtain the factuality profile of i, p_i
11:    end if
12:    #Part 3: Check for lexical marker
13:    if i is a SIP then
14:        n ← n + 1
15:        set level l_n
16:    else if i is another type of marker then
17:        update contextual factuality, cF_n
18:    end if
19: end for
```

obtaining its factuality profile. This is relevant for ESPs because they denote events and, at the same time, function as lexical markers. As lexical markers, ESPs affect the contextual information by either updating the contextual factuality, or by creating a new evaluation level (if they are SIPs). Hence, their factuality evaluation as events (part 2) needs to take place before they are used as markers (part 3). Consider the following sentence:

(121) [$_{l_0}$He **forgot**$_{e_1}$ [$_{l_1}$to **thank**$_{e_2}$ the member [who **recommended**$_{e_3}$ him]]].

Figure 6.5 illustrates a snapshot of the activity when de Facto, the factuality profiler, is positioned at the node corresponding to the ESP *forgot*. Part 2 (marked with the continuous arrow) is applied before part 3 (dotted arrow), so that *forgot* can first receive its factuality value from the contextual factuality, cF_n, and then can affect that value in the context so that the next event, *thank*, can be assessed as CT−.

By contrast, part 1 needs to be run before evaluating the factuality of the event given that it implements the effect of syntactically-based factuality markers (that is, of subordinated constructions) imposing a specific factuality value to its main event. Take again the same sentence in (121). Figure 6.6 illustrates now the activity of the profiler at node *recommended*.

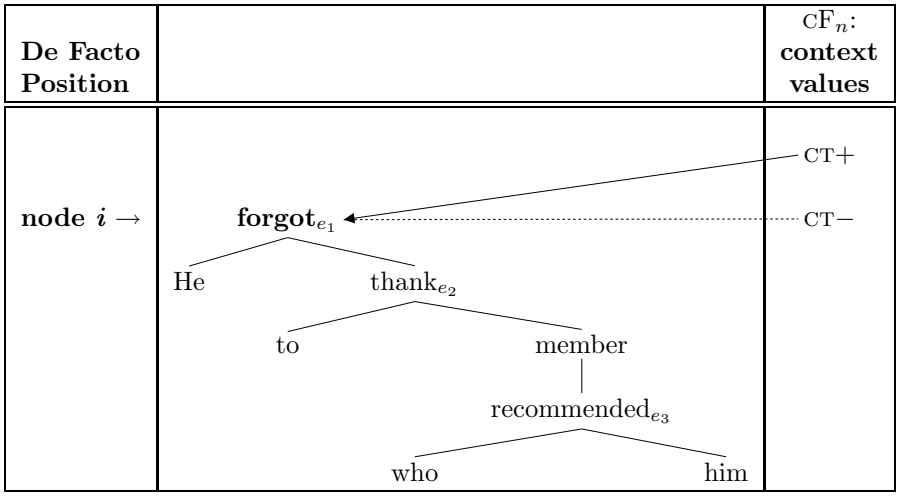

Figure 6.5: Sequencing part 2 before part 3 (Algorithm 1)

The factuality value provided by the context is CT− (obtained from *forgot*). But because the current node *recommended* is in a relative clause, it must be assessed as CT+. Therefore, part 1 (signaled with the continuous arrow) checks the syntactic construction and updates the factual value accordingly, before part 2 is applied (dotted arrow).

6.4.2 Main components

The functionality of the algorithm proposed here splits into three main components, which are in charge of: (i) setting each new evaluation level l_n; (ii) updating the contextual factuality for the current level, CF$_n$, every time a new marker is found; and (iii) obtaining the factuality profile of events. I discuss them in what follows.

I. Set Level l_n (lines 1-2 and 13-15)
This function is called every time a new level is triggered, be it at the top of the tree (lines 1-2) or when a SIP is found (lines 13-15). It executes the following steps:

a. ***Identify the set of relevant sources at the current level,*** R$\boldsymbol{S_n}$**.** The procedure is defined inductively, as presented in Definition 1 (section 6.3.1).

In computing the source chains that are relevant at each level, De Facto applies a

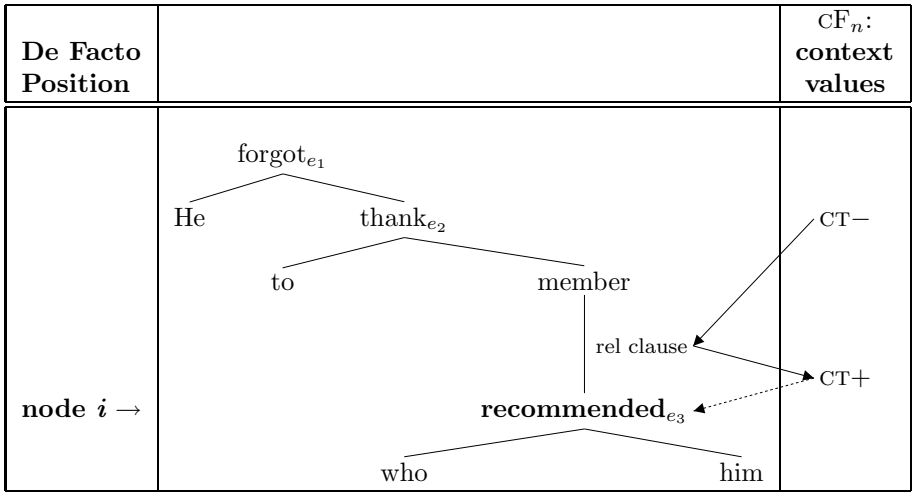

Figure 6.6: Sequencing part 1 before part 2 (Algorithm 1)

minimal correference resolution module in order to create adequate chains when two of the source expressions refer in fact to the same participant. Correference is represented by the equality symbol (=) between two source expressions. Consider (122), where the entity denoted by *she* corresponds to the same person identified as *Hanna*.

(122) [$_{l_0}$Hanna **acknowledged**$_{e_1}$ [$_{l_1}$she **told**$_{e_2}$ police interrogators [$_{l_2}$that she prayed$_{e_3}$ for him to have a heart attack$_{e_4}$ and die$_{e_5}$]]].

Example (123) provides the set of relevant sources for the events at each evaluation level in the sentence above. Notice that at level l_2 the source expressed by *she* has been correfered to that expressed by *Hanna*.[9]

(123) l_0: RS$_0$= $\{s_0\}$
l_1: RS$_1$= $\{s_0,$ $hanna_s_0\}$
l_2: RS$_2$= $\{s_0,$ $she{=}hanna_s_0\}$

[9]As a consequence, the number of relevant sources in that level is the same as in the previous one, instead of doubling it.

The correference resolution module implements a very simple, heuristic-based algorithm, which is described in appendix D, given that it is not a core component of the factuality profiler.

b. ***For each*** $s \in$ R$\boldsymbol{S_n}$***, identify its role: anchor and cognizer.*** This is a vacuous step at the top level, but it becomes fundamental as soon as new sources are introduced. The roles of anchor and cognizer are computed applying Definition 2 in section 6.3.2.

c. ***Set the contextual factuality values,*** C$\boldsymbol{F_n}$***.*** Each level can have more than one relevant source, which can contribute divergent factuality values towards the same event. Contextual factuality is obtained as follows:

i. At level l_0: CF$_n$={<CT+,s_0> }

ii. At level l_n, for n>0: CF$_n$={ <f, s> | $s \in$ RS$_n$ & f=$Lex(e_{n-1}, c_{e_{n-1}}, s_r)$}

Clause *i.* applies the assumption of the naïve decoder. In clause *ii.*, function *Lex* performs a search in the lexical base (here, table 6.3). Its parameters are:

(a) e_{n-1}, referring to the SIP in the previous evaluation level l_{n-1}, which triggered the current level l_n. Its lexical entry will indicate what are the new contextual factuality values, CF$_n$, at the current evaluation level.

(b) $c_{e_{n-1}}$, the committed factuality value assigned to e_{n-1} in the previous level l_{n-1}. All factuality values, except for the fully underspecified Uu, are considered committed values.

This step is basically identifying what is the contextual polarity and modality under which the SIP e_{n-1} was assessed. For example, in (124), the value used to set the contextual factuality in level l_2 is CT+ (the value assigned by the anchor to the SIP *say* in level l_1), whereas in example (125), it is CT−, the value with which the cognizer evaluates the SIP in l_1.

(124) [$_{l_0}$ Mary$_{s_m}$ is not **aware**$_{e_0}$ that [$_{l_1}$John$_{s_j}$ **knows**$_{e_1}$ [$_{l_2}$ ...]]
(a) f(e_0,s_0)=CT− (a) f(e_1,s_0)=CT+
(c) f(e_1,s_m-s_0)=Uu

(125)

$[_{l_0}$ Mary$_{s_m}$	**says**$_{e_0}$	$[_{l_1}$John$_{s_j}$ doesn't	**know**$_{e_1}$	$[_{l_2}$ ...]]
	(a) f(e_0,s_0)=CT+		(a) f(e_1,s_0)=Uu	
			(c) f(e_1,s_m_s_0)=CT−	

(c) s_r, the role of s (anchor, cognizer, or none). If the role is none, there is no need to perform the search to the lexical base. The contextual factuality value will be set as underspecified (Uu).

II. Update the contextual factuality, CF$_n$ (lines 5-6 and 16-17)

The update may be triggered by either a syntactic or a lexical marker. Lexical markers that are appropriate here are polarity particles, modality particles, or NSIPs. Any time one of them is found in l_n, the profiler updates the contextual factuality values $v \in$ CF$_n$ according to the information it conveys (lines 16-17). Lexical entries for each of these marker types will be specified in the next chapter.

On the other hand, syntactic constructions (in particular, participle, relative and purpose clauses) reset the contextual factuality values according to Algorithm 2.

Algorithm 2 Syntactic Markers in De Facto

```
 1: if i is head of a participle or a relative clause then
 2:    if i is in a quoted area then
 3:       #Apply plug
 4:       anchor=Uu
 5:       cognizer=CT+
 6:    else
 7:       #Project presupposition
 8:       anchor=CT+
 9:       cognizer=CT+
10:    end if
11: else if i is head of a purpose clause then
12:    #Apply uncommitment
13:    anchor=Uu
14:    cognizer=Uu
15: end if
```

Given that this algorithm is articulating the linguistic analysis concerning event factuality in those clauses, the detailed explanation about its function will be provided in section 7.4, within the chapter on the linguistic resources informing De facto's algorithm.

III. Obtain the factuality profile of e, P_e (lines 9-10)
Applied when an event is found. Due to the on-the-fly updating of the contextual factuality values in CF_n whenever a new level is set (stage I above) or a new marker is found (stage II), the event profile is in fact already computed. The factuality profile for event, e_n, p_{e_n}, corresponds to the set of contextual factuality values CF_n available at that point.

6.4.3 Full-fledged example

In what follows, the algorithm processing is illustrated step by step using the sentence:

(126) Mrs. Koenig explained that Casey realized he forgot to cite the book she had written.

For reasons of space, I represent De Facto's traversing the tree divided in two independent figures. Each step is identified by the algorithm lines applied there.

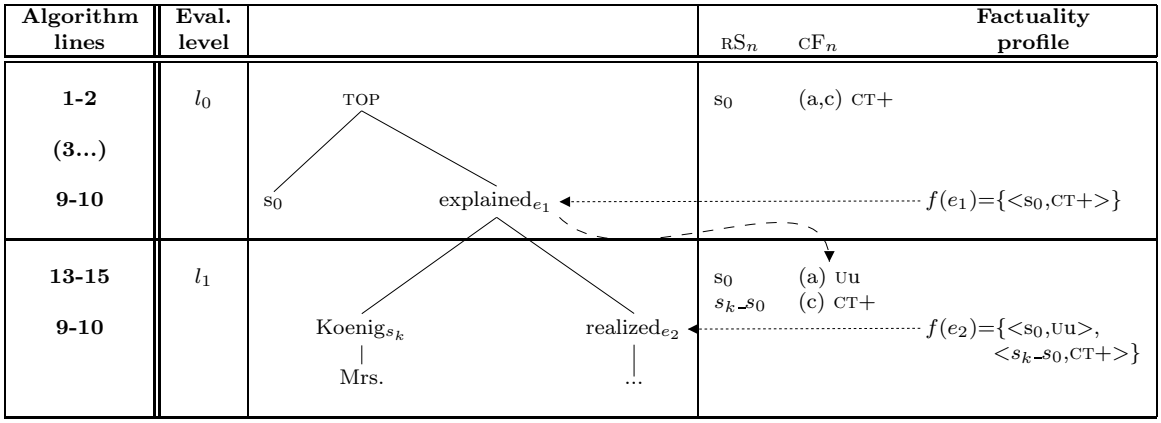

Figure 6.7: Computing event factuality in *Mrs. Koenig explained that Casey realized he forgot to cite the book she had written.* (1st part)

The first part of the process is illustrated in figure 6.7. De Facto starts by setting the initial evaluation level l_0, as stated in **lines 1 and 2** of the algorithm. It first applies Definition 1 and Definition 2 in order to identify the relevant sources at that level (RS_0) and assign them their corresponding roles, and then it sets the contextual factuality values (CF_0). Given that we are at the top level, there is only one relevant source, s_0, who is identified as both the anchor and the cognizer, and it is assigned the factuality value CT+, following the naïve decoder assumption.

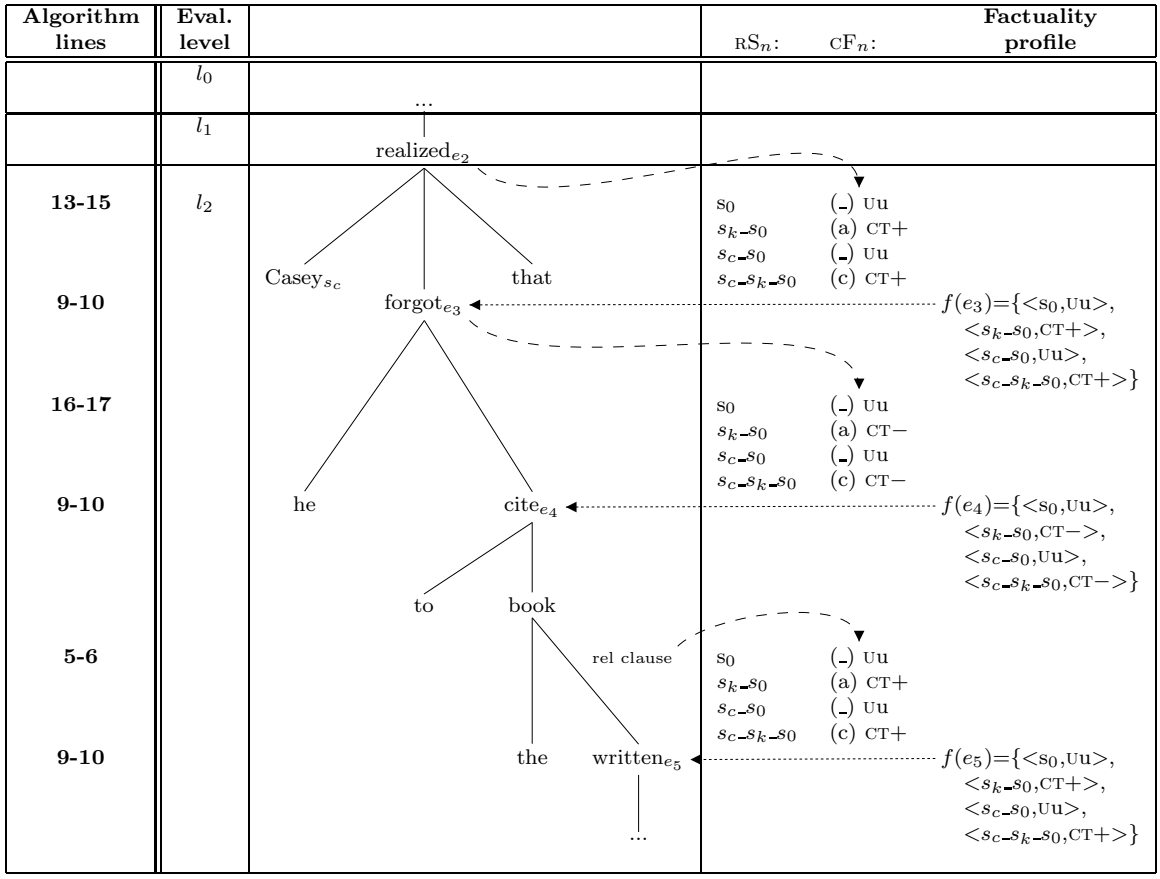

Figure 6.8: Computing event factuality in *Mrs. Koenig explained that Casey realized he forgot to cite the book she had written.* (2nd part)

De Facto begins then to traverse the tree (**line 3 and forward** of the algorithm). When it reaches the node *explained*, it identifies it as an event-denoting expression and therefore obtains its factuality profile, $f(e_1)$, as indicated by **lines 9 and 10** of the algorithm. In particular, $f(e_1)$ contains the pairings consisting of a relevant source $s \in \text{RS}_0$ and the factuality value $f \in \text{CF}_0$ that source s assigns to event e_1.

The next step is defined by **lines 13 to 15** in the algorithm. Given that *explained* is a SIP, De Facto opens a new level, l_1, and sets it appropriately. That is, it computes the new set of sources that are relevant at this level (RS_1), it identifies their roles, and finally it assigns them the adequate contextual factuality values (CF_1). The first two steps apply Definitions 1 and 2, respectively, which result in CF_1={s_0, s_k-s_0}, where

s_0 is the anchor and s_k-s_0 is the cognizer. The last step is applied by looking into the lexical entry for *explain* and getting the factuality values stated for the anchor and cognizer of the embedded event. Each lexical entry specifies different values depending on the factual status of the SIP. Event e_1 was evaluated as a fact (CT+). This is therefore the factuality context under which to look for the factual assigments of anchor and cognizer of the embedded level.

The tree-traversing algorithm keeps walking down the tree until it finds the expression *realized*, which denotes an event. **Lines 9 and 10** are applied again in order to obtain its factuality profile, $f(e_2)$. Because there are now two relevant sources in the current level, $f(e_2)$ contains two profiles.

The second part of the process is illustrated in figure 6.8. Given that *realize* is a SIP, a new level is set, l_2, as stipulated in **lines 13 to 15** of the algorithm. Again, the set of relevant sources for that level is identified (RS_2), together with the roles each of these sources performs. Then, the contextual factuality values (CF_2) are assigned in the same way it was done when setting level l_1. That is, pairing the sources anchor and cognizer with the factuality values indicated in the lexical entry of *realize*, given the (committed) factuality context of *realized*, the event triggering the new level – again, CT+. When the event *forgot* is found, its factuality profile $f(e_3)$ can already be assigned (**lines 9 and 10**), as already explained for the previous events in the text.

The predicate *forget*, when selecting for a *to*-clause, is an NSIP. Hence, the next step is updating the contextual factuality values assigned to each relevant source at that level, according to the information in the lexical entry for *forget* (**lines 16 and 17**). As can be seen, this switches the polarity value of the factuality assignments by sources anchor and cognizer. The result from this steps provides the information for the factuality profile of event *cite*, $f(e_4)$ –according to **lines 9 and 10**.

The next factuality marker found is now syntactic: a relative clause. Thus, De Facto applies **lines 5 and 6** in order to update the contextual factuality, which results again in switching the polarity of the factuality values assigned by sources anchor and cognizer. Once this is done, the factuality profiler for event *written*, $f(e_5)$ is obtained (**lines 9 and 10**).

Chapter 7

Linguistic resources

This is the third time I focus on the linguistic expressions involved in representing event factuality in natural language. I addressed them in chapter 4, where I presented factuality markers and reviewed what has been said about them in the literature. Then, I came back to (some of) them again in chapter 6, when presenting the factuality profiler algorithm. The attention there was put on the general design of SIP lexical entries given the framework set for computing event factuality.

In the current chapter, the focus is on the specific linguistic information effectively used in the building of De Facto, as well as some of the most relevant problems this has posed.

7.1 Negation particles

The polarity markers included in the De Facto lexicon are:

Polarity adverbs: *'not', 'nor', 'neither', 'never'.*

Polarity determiners: *'no', 'non', 'neither'* (e.g., *Neither proposal was followed*), *'little'* (e.g., *There is little doubt*).

Polarity pronouns: *'none', 'nobody', 'nothing', 'nowhere'* (e.g., *They went nowhere.*)

It is generally assumed that, whereas unmarked contexts bear positive polarity (127a), polarity particles express negation (127b). Hence, we could think of a simple

lexicon for polarity markers in English which would represent these negative elements as shifting the polarity into negative.

(127) a. Spelke $\underline{\text{opened}}_e$ the door.

b. Spelke did **not** $\underline{\text{open}}_e$ the door.

This is, however, not completely adequate (*cf.* Polanyi & Zaenen, 2005). For example, the ESP *denied* in (128a) sets the polarity of the evaluation level l_1 as negative ($-$). The polarity marker *not*, then, will switch this value into positive ($+$). Similarly, in (128b) the negative verbal predication *did not say* sets the contextual polarity of level l_1 as underspecified (Uu). Now, the polarity marker *not* in the embedded clause will not have any effect, and event e will be evaluated as Uu.

(128) a. The prosecutor **denied** [$_{l_1}$ that Spelke did **not** $\underline{\text{open}}_e$ the door].

b. The prosecutor did **not** say [$_{l_1}$ that Spelke $\underline{\text{did **not** open}}_e$ the door].

We thus need to account for the effects of polarity markers considering contextual polarity. Table 7.1 shows the interaction of contextual polarity (columns) and the polarity value contributed by a new marker (rows). Such information is implemented independently of the lexicon, and accessed every time a polarity marker is found.

Table 7.1: Polarity value given contextual polarity

	Contextual polarity		
Marker value	$+$	$-$	**u**
$+$	$+$	$-$	u
$-$	$-$	$+$	u

Section 4.1, in the chapter on factuality markers, provided a list of the most common means to express negative polarity in English, including: directly negating the predicate that expresses the event, negating one of the arguments of the predicate (subject, direct object, or indirect object), using adverbial modification of some sort, or negating the predicate (a particular type of SIP, e.g., *think*) embedding the event (e.g., *He doesn't think mary came*).

All of them are contemplated by De Facto. Still, there are some cases that the profiler can not account for, or that it handles in a partial way. They are:

Negation transportation. In some cases, negating the main predicate negates in fact the predication in the complement clause. This is the case of predicates like *think* and *believe*, which Hooper (1975) calls weak assertive predicates. She claims that the following two sentences are synonymous:

(129) a. He$_{s_1}$ does<u>n't</u> **believe**$_{e_1}$ [Gore was ever **aware**$_{e_2}$ of the arrangement].

b. He$_{s_1}$ **believes**$_{e_1}$ [Gore was <u>never</u> **aware**$_{e_2}$ of the arrangement].

According to Hooper, in sentences with weak assertive predicates the main clause in the sentence does not contain an assertion, but its complement instead. In other words, weak assertive predicates trigger a parenthetical interpretation of the sentence (Urmson, 1952). The main predicate does not properly refer to an event, but acts more as an epistemic modalizer of the event in the embedded clause.

Hence, in sentences (129) above there should be only one event marked as such (e_2: *aware*), the factuality of which needs to be evaluated. Its value is the same in both sentences:

(130) e_2: f(e_2, s_0) = Uu
f(e_2, s_0_s_1) = CT−

Weak assertive predicates are a subtype of SIPs and, hence, their lexical information will be defined in the next subsection. As will be seen there, the negation of the complement event when the SIP is in a context of negative polarity (129a) is stated as part of its lexical entry. However, De Facto is currently not suited to regard weak asserted predicates as non-event expressions, and computes their factuality as well. The resulting factual assignments for both event expressions in sentences (129a-b) above are (131) and (132), respectively.

(131) e_1: f(e_1, s_0) = CT−
e_2: f(e_2, s_0) = Uu
f(e_2, s_0_s_1) = CT−

(132) e_1: f(e_1, s_0) = CT+
e_2: f(e_2, s_0) = Uu
f(e_2, s_0_s_1) = CT−

In order to fully comply with the linguistic analysis, De Facto would need to filter weak assertive predicate out from the list of events to be assessed in terms of their factuality. On the other hand, the factuality profile of the embedded event (e_2 above) predicted by De Facto is correct.

Double polarity markers. This construction is inexistent in TimeBank. De Facto, however, can handle it according to the information in table 7.1.

Constructions involving certain adverbials negating the event. They are highly infrequent constructions, such as these below. De Facto does not handle them.

(133) a. They were too tired to **finish** it.
b. Ruth almost **touched** him.

Partially negated events. In some sentences, it is not the event that it is negated, but the event restricted to the situation defined by its participants. For example, negation in *cleft*-sentences like (134) is only affecting one of the arguments:

(134) It's not John who **kissed** the goat.

Similarly, if a predicate has any optional argument, negating the predicate tends to be interpreted as negating the argument –properly speaking, negating the event as restricted by the argument (Givón, 1993:198).

(135) She didn't **write** the book *for her father.* (i.e., She wrote it, but not for him)

In De Facto, the resulting interpretation is that the full event, and not only the event restricted to the situation defined by the participant, is negated.

Ambiguity between clausal and subclausal interpretations. A negated object does not always translate into a negated main predication.

(136) We could do nothing.

Sentence in (136), for example, is ambiguous between a clausal (137a) and a subclausal (137b) negation (Huddleston, 1984).

(137) a. We couldn't do anything.
b. We could always do nothing.

De Facto disambiguates these contexts as cases of clausal negation.

7.2 Modality particles

The modality particles included in the De Facto lexicon are the following:

Modal auxiliaries: *'can'*, *'could'*, *'may'*, *'might'*, *'must'*, and *'should'*.

Modal adverbs: *'apparently', 'certainly', 'necessarily', 'presumably', 'probably', 'possibly', 'reportedly', 'supposedly'*.

Modal adjectives: *'apparent', 'certain', 'hypothetical', 'improbable', 'impossible', 'likely', 'necessary', 'presumed', 'probable', 'possible', 'reported', 'supposed', 'sure', 'uncertain', 'unlikely', 'unsure'*.

As can be seen, the list of modal auxiliaries does not include: *have (to)* and *need*. The former has been disregarded because of a practical reason. The dependency parser used to generate the input to De Facto does not treat it as a regular auxiliary but as a main verbal predicate selecting for a small clause. On the other hand, *need* will be accounted for as a regular ESP, to be detailed in section 7.3.

As for modal adjectives, they include both adjectives that typically function as predicative complements and take a clausal complement (e.g., *it is possible/probable/likely that...*), and attributive noun modifiers such as *apparent, presumed*, and *supposed*. Predicative adjectives that subcategorize for an embedded clause are included here for homogeneity with their equivalent adverbial forms (e.g., *certainty, possibility*, etc.). In De Facto, they are however considered ESPs. The factuality values expressed by the markers listed above are as indicated in table 7.2.

The use of a given modality particle, however, does not necessarily color the event with the inherent modal value of that element. Similar to polarity markers, the factuality value that the event receives depends on the interaction between the modal particle and the current modality and polarity of the context. Consider:

(138) a. Koenig **denies** [$_{l_1}$that Freidin <u>*may* have left</u>$_e$ the country].
b. Koenig **suspects** [$_{l_1}$that Freidin <u>*may* have left</u>$_e$ the country].

Table 7.2: Factuality values conveyed by modality markers

	Factuality value
Adverbs	
certainly, necessarily	CT+
apparently, probably	PR+
possibly, presumably, seemingly	PS+
reportedly, supposedly	Uu
Adjectives	
certain, necessary, sure	CT+
impossible	CT−
apparent, likely, probable	PR+
improbable, unlikely	PR−
possible, presumed, hypothetical	PS+
uncertain, unsure	PS−
reported, supposed	Uu
Auxiliaries	
can, could; may, might	PS+
must, should	Uu

In (138a), *may* is used in a context of negative polarity and absolute certainty (CT−) set by the SIP *deny*, whereas in (138b), it is used in a context of positive polarity and modality set to probable (PR+). Because of this, in the first example, event e is presented as a counterfact according to Koenig (CT−), but in the second, as a possibility (PS+).

Table 7.3 illustrates the interaction between the contextual modality (expressed in the columns) and the modal value contributed by the marker (rows). It has been compiled by exploring corpus data as well as made up examples. Combinations with mid values (probability) are highly unusual; the resulting values are only estimated.

Note that the resulting values do not specify polarity information, except for the contexts where contextual modality or polarity is underspecified (columns 4th, 8th, and 12th, and last row), where the resulting polarity is u (underspecified). In all other cases, the polarity contributed by the marker will interact with that from the context as specified in table 7.1. That is, positive contextual polarity will respect

Table 7.3: Modality value given contextual factuality

	Contextual factuality											
	Polarity = +				**Polarity = −**				**Polarity = u**			
Marker	**CT**	**PR**	**PS**	**U**	**CT**	**PR**	**PS**	**U**	**CT**	**PR**	**PS**	**U**
CT	CT	PR	PS	Uu	PS	PR	PS	Uu	CT	PR	PS	Uu
PR	PR	PR	PS	Uu	PR	PR	PS	Uu	PR	PR	PS	Uu
PS	PS	PS	PS	Uu	CT	PR	PS	Uu	PS	PS	PS	Uu
U	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

the original polarity denoted by the marker, whereas negative polarity will switch it. Hence, the marker *impossible*, which in a positive context denotes CT−, in a negative context will express PS+.

Further remarks are worthwhile here. First, regarding the contexts with modality set to certain (CT). The table reflects the value switch that takes place in contexts of negative polarity with regard to contexts of positive polarity (5th vs. 1st row). Markers expressing the highest value of modality in positive contexts (i.e., CT), will switch to the lowest in a negative environment (PS), and viceversa. For example, the adjective of certainty *sure* (CT+) when preceded by a negation will express uncertainty (PS−), whereas in the same context, the adjective *possible*, which is at the lowest position of the modal scale (PS+), will denote absolute counterfactuality (CT−).

As for contexts with modality set to either PR or PS, note that in contexts of positive (+) or underspecified (u) polarity the lowest value prevails, whereas in negative contexts (−), the dominant modal value is the one provided by the context.

In the remainder of this section, I will focus on the most important specific issues I addressed in putting forward the treatment of modality particles just presented.

Distinguishing between epistemic and other modal interpretations. This problem only concerns modal auxiliaries. Epistemic adjectives and adverbs unambiguously express a particular type of modality.

Modal auxiliaries have been identified throughout the literature as able of expressing different sorts of modality. That is, they are able to characterize events along different parameters, all of which are articulated by means of the contrast between what is possible and what is necessary. There is a number of classifications of

event modality, both in linguistics and in philosophy. In certain linguistics schools, modality is contemplated as a two-fold category that differentiates between epistemic and root modality, as is the case of the Chomskian tradition. At the other extreme, there are authors distinguishing among epistemic, alethic, volition, obligation, ability, and permission, among other types (*cf.* Nauze, 2006).

Regardless of the number of distinctions, what is of interest here is the possibility of identifying epistemic modality (traditionally having to do with knowledge and belief) from other types. Markers of epistemic modality convey the different degrees in the modality axis defining event factuality –i.e., PS, PR, CT (139). By contrast, events qualified with markers expressing other types of modality (e.g., deontic, volition, etc.) are characterized as factually underspecified (Uu). Sentences (140) exemplify it with events whose modality markers receives a deontic (concerning obligations) and an alethic interpretation (concerning necessary and contingent conditions), respectively.

(139) The uneasy relationship between the U.S. and China <u>can</u> be further **disrupted**$_e$ by the Taiwan news. f(e, s_0)=PS+

(140) a. Irish citizens <u>can</u> **vote**$_e$ in every election and referendum. f(e, s_0)=Uu
b. You <u>can</u> **be**$_e$ a Communist and still be a Christian. f(e, s_0)=Uu

The underspecified value Uu is valid also when the modal marker expresses the highest degree of necessity –e.g., *must*:

(141) The country <u>must</u> **add**$_e$ at least 7.5 million jobs a year just to absorb the people entering the labor force. f(e, s_0)=Uu

Modal auxiliaries in English, as in many other languages, are ambiguous between one or another modality reading. Sentences in (139-140) illustrate it for the auxiliary *can*. What is more: in some contexts, an auxiliary can receive more than one interpretation at a time. In the following example, *could* allows for both an epistemic (i.e., it is possible that Iraq starts hostilities) and an dynamic (ability) reading (i.e., Iraq has the means for that to happen):

(142) Iraq <u>could</u> **start** hostilities with Israel.

Disambiguating among different modality interpretations of the same auxiliary is a goal that goes beyond the scope of the current dissertation. Thus, I have simplified the lexical entries for ambiguous modal auxiliaries, by assuming they only denote epistemic modality.

Modality markers with an evidential nuance. Some of the modal markers listed above have an evidential interpretation comparable to that of reporting or similar predicates –e.g., *reportedly, supposedly* (143). As such, they have the effect of attributing the proposition to somebody else (i.e., *somebody said that...*).

(143) Apple Geniuses are reportedly **unbricking** iPhones.

In order to reflect the parallel between these adverbs and reporting predicates, the factuality profiler should establish a way to introduce an additional (generic) source (as SIPs do) in charge of evaluating the corresponding event. However, I opted for a more simplified version and set them to indicate only the factual value of the event with respect to the anchor of the text, which will be underpecified (Uu).

The auxiliary *would*. The auxiliary *would* can be used to convey a conditional value, for example in counterfactual constructions employed to express what would be the case if something were different (144a). It can also be used to convey a remote degree of possibility (144b) or, finally, as the morphological past form of *will*, for example in contexts of reported speech (144c).

(144) a. The Islamic Saudi Academy has twelve hundred mostly American students but would **take**$_e$ thirty-five hundred if it had the room.

b. Under terms of the new proposal, Equus would **pay**$_e$ 12 cash and one new preferred share with a liquidation preference of 1.65 a share for each of Tony Lama's 2.1 million shares outstanding.

c. Party spokesman Bernd Droese said the People's Union would **challenge**$_e$ the fine in court.

Dealing with lexical ambiguity is out of the scope of this dissertation, which means that one use of *would* needs to be prioritized over the others. A look at the 30% of

instances of *would* in the development corpus (the non-contracted form only, thus excluding form *'d*) showed that 75% of them are employed in a context of reported speech, which contrasts with the almost 25% used in a conditional construction of some sort. As for its use to express remote possibility, there is only one instance. Because of that, the auxiliary *would* in De Facto is taken as a marker of future tense and hence not included in the lexicon of modal auxiliaries.

7.3 Event selecting predicates

De Facto contains a total of 646 lexical entries for ESPs, distributed as shown in table 7.4. In each part-of-speech class, the items have been selected according to the following criteria:

Table 7.4: Distribution of ESPs in De Facto

ESP type	**POS**	**#Lexical entries**
SIPs	Verbs	204
	Nouns	58
	Adjectives	27
	Total	**289**
NSIPs	Verbs	189
	Nouns	107
	Adjectives	61
	Total	**357**
BOTH	Verbs	393
(SIPs and NSIPs)	Nouns	165
	Adjectives	88
	Total	**646**

For verbs:

- The 200 most frequent event-selecting verbs in the ANC fragment constituted by Slate and New York Times (ANC-Slate and ANC-NYT). They were selected as follows: given the list of all verbs in that ANC fragment, I manually chose those that are susceptible of taking either (*a*) a clause complement, or (*b*) an

event-denoting direct object. After sorting them according to their frequency in that ANC fragment, the 200 most frequent verbs were finally selected.

- All the verbs in TimeBank1.2 introducing a lexically-triggered SLINK; that is, introducing any SLINK except for those representing purpose clauses and conditional constructions. SLINKs encoding conditional constructions could be filtered out automatically by excluding SLINK with `relType CONDITIONAL`. Purpose clauses, on the other hand, had to be filtered out by manual means.
- All the verbs in SlinkET, except for few manually rejected cases.
- Verbs that are synonym, antonym, or related in some way, to other verbs already introduced following the previous criteria.
- Verbs related to nouns or adjectives selected according to the criteria presented below.
- Other verbs of interest that have been analyzed in the literature (e.g., *accomplish, bother*). They have been added if they were found missing.

For nouns:

- All the nouns introducing a lexically-triggered SLINK in TimeBank1.2. As with the case of verbs, the selection was partially manual.
- All the nouns in SlinkET, except for few manually rejected cases.
- Nouns derived from, or in some way related to the verbs introduced above.
- Nouns expressing epistemic evaluations (e.g., *impossibility, probability*, etc.)

For adjectives:

- All the adjectives that introduce a lexically-triggered SLINK in TimeBank1.2. The selection was partly manual.
- All the adjectives in SlinkET.

- Adjectives derived from, or related in some way, to some of the verbs or nouns introduced above.
- Adjectives expressing epistemic evaluations (e.g., *possible, likely*, etc.)

The effect that each ESP has on its selected event is expressed in its lexical entry. Entries for SIPs represent the factuality assignments of the sources identified as anchor and cognizer, whereas the entries for NSIP provide a unique factuality assignment, attributed to the anchor source. Each entry specifies a total of twelve potential factuality assignments, one for each factuality context that results from the cartesian product of epistemic modality (CT, PR, PS, U) and polarity values (+,−,*u*). This is illustrated in tables 7.5 and 7.6, for SIPs and NSIPs, respectively.[1]

Table 7.5: Lexical entries for SIPs *know* and *say*

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
know:												
(a)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
(c)	CT+	U	U	U	U	U	U	U	U	U	U	U
say:												
(a)	U	U	U	U	U	U	U	U	U	U	U	U
(c)	CT+	U	U	U	U	U	U	U	U	U	U	U

Table 7.6: Lexical entries for NSIPs *manage* and *fail*

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
manage:												
(a)	CT+	CT-	CTu	PR+	PR-	PRu	PS+	PS-	PSu	Uu	Uu	Uu
fail:												
(a)	CT-	CT+	CTu	PR-	PR+	PRu	PS-	PS+	PSu	Uu	Uu	Uu

[1]Table 7.5 is a complete version of table 6.3 in the previous chapter.

The information in each lexical entry has been compiled based on real data, by exploring the use of the predicates in my corpora of reference: TimeBank1.2, ANC-Slate and ANC-NYT. I decided not to apply any filtering based on the number of instances, thus creating entries even for those predicates with a limited number of occurrences in the corpora. In case some of the potential factuality contexts where not supported in the reference corpora, I used my own linguistic intuitions to fill the gaps in the lexical entry.

Furthermore, some generalizations have been applied in order to simplify the task. In particular, any meaning distinction brought in by a difference of tense or grammatical person has been disregarded. The verb *think*, for example, behaves differently when used in 1st or 3rd person (*cf.* Hooper (1975), among others). There is a weaker epistemic commitment in the 1st person use, especially if employed with present tense. Compare:

(145) a. **I**$_{s_1}$ <u>think</u> the kids **enjoyed**$_e$ the function as well. f(e, s_1_s_0)=PR+
b. **He**$_{s_1}$ <u>thought</u> the kids **enjoyed**$_e$ the function as well. f(e, s_1_s_0)=CT+

Similarly, differences in tense can be significant in some predicates. For example, in (146b) the use of *allow* in present tense triggers a generic interpretation of event e, which therefore receives an underspecified factual evaluation (Uu).

(146) a. The union <u>allowed</u> me to **make**$_e$ some semblance of a decent living. f(e, s_0)=CT+
b. This unique design <u>allows</u> you to **hide**$_e$ your weapon inside the front of your trousers. f(e, s_0)=Uu

ESPs will be characterized in the lexicon according to their use in the 3rd person. The decision is partially supported by the nature of the data in the corpora employed here. They are all constituted of texts belonging to the news genre, in which, although the use of other persons is also possible, there is in general a great dominance of 3rd person. Similarly, ESPs will be characterized according to their use in the past tense. That means that both present and future uses will receive the same assignments than those in past tense. I am aware that these two decisions will result in an oversimplification of the lexicon, but it suffices for the purpose of the dissertation.

7.3.1 Lexical types

In the scope of the current research, what distinguishes *say* from *know* and *fail* from *manage* is their set of factuality assignments relative to the potential contexts (*cf.* the tables above). As it happens, however, other predicates may share such information. *Acknowledge* and *admit*, for example, behave exactly as *know*, whereas *affirm* and *maintain* can be grouped together with *say*. The factuality assignments for different ESPs can therefore be typified.

The set of lexical types organizing De Facto's lexicon was created during the process of compiling it, and not in a previous, theoretical-oriented step. In other words, a new lexical type was generated every time a novel set of factuality assignments was needed to describe an ESP. For easy identification, lexical types have been named after a prototypical predicate belonging to it. Appendix A provides the list of lexical types alphabetically sorted. Each type presents, in addition, the list of predicates it describes. On the other hand, the alphabetical list of predicates is provided in appendix B.

The resulting set of types is interesting in that it reflects some of the findings accounted for in the literature. The factuality types for both NSIPs and SIPs can be naturally grouped into semantic classes. It is not surprising, for example, that the factuality types of what have been traditionally referred to as factive predicates is different from those of reporting predicates. The following subsections focus on the lexical types for SIPs and NSIPs. They are presented clustered into what can be considered natural semantic classes.

7.3.1.1 Source-introducing predicates

Four main groups of types are distinguished here.

Presuppositional types. These are the types defining the so-called factive predicates. Factive predicates were first identified in Kiparsky & Kiparsky (1970) appealing to criteria of syntactic but mainly semantic kind. They are defined as presupposing the truth of their embedded complement, a feature that can be attested in negative and modalized contexts.

In section 6.2, I showed how the presuppositional nature of these predicates is

translated into the current factuality model: the factuality of the embedded event is presented as CT+ in all contexts according to the anchor source. This is reflected in types ***disclose***, ***know_that***, and ***forget*** in table 7.7.

Note that type ***pretend*** does not properly belong to the the class of factives as traditionally defined in the literature, given that it does not presuppose the truth of its embedded proposition but its falsity instead. Givón (1980) is an exception to that. He defines factives as presupposing its complement clause and then classifying predicates like *pretend* or *lie* as negative presuppositional factives –or *neg-presuppositional*, in his own terms.

		Contextual factuality											
		CT			PR			PS			U		
		+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
disclose:	(a)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
	(c)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
know_that:	(a)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
	(c)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
forget:	(a)	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+
	(c)	Uu	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
pretend:	(a)	CT−	CT−	CT−	CT−	CT−	CT−	CT−	CT−	CT−	CT−	CT−	CT−
	(c)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.7: Lexical types for SIPs: Presuppositional

To my knowledge, the only subclassification proposed for factive predicates is the one distinguishing between (fully) factive and semi-factives (Karttunen, 1971; Klein, 1975). Semi-factives do not presuppose their embedded proposition in certain modal contexts, such as conditional constructions. Broadly speaking, (fully) factives include predicates expressing a psychological reaction, like *regret* or *be glad*, whereas semi-factives correspond to knowledge predicates like *discover* or *notice*.

The distinction, as presented in Karttunen's work, applies in contexts of 1st and 2nd grammatical person, but not 3rd. This is illustrated in the following examples, concerning the factuality assignment attributed to the author source (s_0).

(147) a. If $\mathbf{I}_{s_1}$ <u>discover</u> later that I have not $\mathbf{told}_e$ the truth, I will confess it to everyone. f(e, s_0=s_1)= Uu

b. If $\mathbf{you}_{s_1}$ <u>discover</u> later that you have not $\mathbf{told}_e$ the truth,... f(e, s_1_s_0)= Uu
f(e, s_0)= Uu

c. If **he**$_{s_1}$ <u>discovers</u> later that he have not **told**$_e$ the truth,... f(e, s_1_s_0)= Uu
f(e, s_0)= CT+

Because of the decision of modelling lexical entries in their use in 3rd person and present tense, the difference between fully factive and semi-factive predicates is not accounted for here.[2]

There are, however, other distinctions among factive predicates which have not been noted in the literature, and that here are reflected by contrasting types ***disclose***, ***know_that***, and ***forget***. According to the presupposition-based definition of factives, these predicates behave all in the same way. Namely, they all presuppose the truth of their embedded proposition –or, in our own terms, they characterize the anchor source as committing to the embedded event as a fact, regardless of the polarity and modality of the context. Things are different, however, when looked from the perspective of the cognizer. Observe that his commitment is different in each of the considered types. In the case of ***disclose***, he is committed to the complement as a fact in all possible contexts; in the case of ***know_that***, he is committed to that only in contexts of factuality value CT+. If the SIP is negated (e.g., *he doesn't know*) or modalized (e.g., *he may (not) know*), the cognizer remains non-committal. Finally, in the case of ***forget***, the cognizer is only committed in contexts of value CT−.

Opinion and reporting types (I). This second grouping of SIP types includes most predicates of report and opinion. It clusters together those types with source anchor assigning the value of Uu in all possible contextual situations. The cognizer, on the other hand, is committed (i.e., expressing a value other than Uu) at least in the factuality context of CT+. The uncommittal character of source anchor is in fact reflecting the nature of these predicates as presuppositional *plugs*, as described by Karttunen (1973). That is, as predicates that report that "a certain illocutionary act has taken place without thereby committing oneself to the presupposition of whatever was said on that occasion" (Karttunen, 1973:74).

Other authors have also grouped together the predicates belonging to these types based on criteria of different nature. Appealing to their syntactic and semantic be-

[2]Essentially, it would involve an additional type similar to *know_that* but with underspecified values (Uu) in context of uncertain modality.

haviour, for example, Kiparsky & Kiparsky (1970) group them under the term of *non-factive predicates*. Stemming from this distinction, Hooper (1975) applies further syntactic criteria to conclude that the non-factive category can be further subdivided into (weak and strong) assertive and nonassertive predicates, classes that correlate, broadly speaking, with some of my types below.

The current class can also be correlated to that of *constative predicates* in Bach & Harnish (1979), established from a pragmatic perspective, based on the theory of speech acts. Constative predicates are defined as expressing the speaker's belief (in our context, the cognizer) and her intention that the hearer accepts it as true. The class is further subdivided into several subclasses, some of which coincide with the types below. For example, their *suggestive* and *suppositive* predicates map with my ***conjecture*** type. Table 7.8 presents the types falling under the current grouping.

		Contextual factuality											
		CT			PR			PS			U		
		+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
say:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
imply:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	Uu	Uu	PR+	Uu	Uu	PS+	Uu	Uu	Uu	Uu	Uu
think:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	CT−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
sure:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	PS−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
deny:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
know_if:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CTu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
conjecture:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PR+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
lookLike:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PR+	PR−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
skeptical:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PR−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
doubt:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PR−	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
fear:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PS+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
unsure:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PS−	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.8: Lexical types for SIPs: Opinion and reporting (I)

The simplest types in this class are those presenting only one factuality commitment, which in all cases is attributed to the cognizer in the context of factuality CT+. These are: ***say*** (with the cognizer committing to CT+), ***deny*** (where the cognizer is committed to CT−), ***know_if*** (CTu), ***conjecture*** (PR+), ***skeptical*** (PR−), and ***fear*** (PS+). Note that no type for expressing a commitment of PS− was needed.

Type ***say***, one of the largest in the class, defines prototypical reporting predicates such as *affirm* and *say*, but also other less typical cases like *claim, complain, insist, publish, swear,* or *yell*. Types ***conjecture*** and ***fear*** are modalized versions of the former; that is, they express a weaker commitment of the cognizer. Type ***know_if*** expresses polarity underspecification –it is the type for events in contexts like: *X knows whether Y*). Finally, types ***deny*** and ***skeptical*** are the polarity opponents of ***say*** and ***conjecture***, respectively.

As for more complex types, ***imply*** and ***think*** are similar to ***say*** in that they all characterize the cognizer with the same value of certainty in contexts of factuality CT+. In type ***think***, the CT− value in context of factuality CT− is encoding the effect of negation transportation that predicates in this type allow for (*cf.* example (129) above). On the other hand, ***imply***, is distinguished by the fact that the cognizer is also committed in modalized contexts of positive polarity (i.e., PR+ and PS+). As can be seen, the modal value of the context is passed onto the embedded event as well. This is actually one of the features characterizing the so-called implicative predicates (a subclass of NSIPs; refer to next subsection). It should come as no surprise, then, that this is also part of the lexical semantics of the predicate *imply*.

Types ***sure***, ***unsure***, and ***lookLike*** are clear correlates of particles of epistemic modality. The former corresponds to those expressing high values (e.g., *certainly*), type ***lookLike*** is related to mid-scalar elements (e.g., *probably*), and type ***unsure***, to low markers (e.g., *possibly*). All three types are very small in the number of the lexical entries they include.

Opinion and reporting types (II). Types in this class can semantically grouped together with those in the previous one, since they express opinion and report as well. However, I present them as belonging to an independent class because, contrary to the previous types, these here have an anchor which can be committed in certain contexts, in addition to the cognizer.

In the contexts where this is the case, they function similar to presuppositional types in the sense that the source anchor is not only expressing the position of the cognizer with regards to the embedded complement, but her own position as well.

		Contextual factuality											
		CT			PR			PS			U		
		+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
announce:	(a)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
expected:	(a)	PR+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	PR+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
imagine:	(a)	Uu	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.9: Lexical types for SIPs: Opinion an reporting (II)

The double commitment in ***announce*** (both, by the anchor and the cognizer) in contexts of factuality set to CT+, conveys the authority role that is conferred to the agent of announcements (and equivalent) acts. For example, by chosing the predicate *announce* in the sentence below, the anchor (here, the author) assumes that what the cognizer (Putin) is asserting corresponds (or will correspond) to a fact in the world, precisely because of the authority that it is conferred onto him –and regardless of how much the anchor believes him.

(148) Putin **announced** that he would not nominate a successor up front, but would back a candidate after the campaign had begun.

The other two types in this class, ***imagine*** and ***expected***, are very small. The former conveys the use of verbs *imagine* and *guess* in contexts of negative polarity, as in (149), where the anchor presents the embedded event as a fact. And type ***expected*** is instantiated by only one lexical item: the predicate *expect* used in it passive form, where the cognizer receives a generic interpretation (150).

(149) Bush did not **imagine** that there would be as much international hubbub.

(150) After the screwup with the Can Fàbregas affair, it was **expected** that Mataró councilman Ramon Bassas would resign immediately.

Interrogative types. This last class contains only one single type, ***wonder***, which includes predicates expressing questioning about the factuality of the embedded event; e.g., *ask, investigate* or *determine*, when subordinating an *if*-clause. Hence, they are predicates involving uncertainty for both the anchor and the cognizer.

		Contextual factuality											
		CT			PR			PS			U		
		+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
wonder:	(a)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
	(c)	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.10: Lexical types for SIPs: Interrogative

7.3.1.2 Non-source introducing predicates

Types organizing NSIPs can be grouped into five different classes.

Presuppositional types. It contains only one lexical type, which includes predicates of different sorts. For example, predicates expressing change of state (e.g., *break, decline, organize, solve*), some of the aspectual predicates (e.g., *stop, end, continue*, but not *begin*),[3] and predicates denoting some sort of reaction (e.g., *respond (to), accept*).

Many of the predicates under this type do not take a clausal complement but a nominal direct object instead (e.g., *improve collaboration, ease his isolation*). What all these predicates have in common is that they all presuppose that their selected event is a fact in the world. In this respect, they are very close to the group of predicates commonly referred to as factive, presented in the previous section.

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
stop:	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+	CT+

Table 7.11: Lexical types for NSIPs: Presuppositional

[3]Indeed, aspectual predicates express change of state as well.

Implicative types. Implicative predicates were first singularized as a group in Karttunen (1970). They are characterized by the implication relation they hold with their embedded event. For example, *manage* shows a direct correlation between its truth (or falsity) and that of the embedded event (151). In the terms of the current dissertation, we can say that there is a direct correlation between the factual nature of the event denoted by the implicative predicate and that of its embedded event. In the case of negative implicatives, such as *fail*, this correlation is reversed (152).

(151) a. Russian spies **managed** [to *intercept* fax communications].
b. Russian spies did <u>not</u> **manage** [to *intercept* fax communications].

(152) a. She **failed** [to *follow* the rules].
b. She did <u>not</u> **fail** [to *follow* the rules].

Predicates *manage* and *fail* are examples of the so-called two-way implicatives, because they show an implicative relation with their embedded event in contexts of both positive and negative polarity. There are also one-way (or semi-) implicatives, which divide into positives and negatives (Nairn et al., 2006). Positive one-way implicatives entail the truth (or falsity) of their complement only when affirmed, whereas when negated the factuality of the embedded event remains uncommitted (153-154).

(153) a. He was **forced** [to <u>retire</u> from the board of directors when he turned 70].
b. He was not **forced** [to <u>retire</u> from the board of directors when he turned 70].

(154) a. Israel **refused** [to release an extra 50 prisoners as part of the deal].
b. Israel did not **refuse** [to release an extra 50 prisoners as part of the deal].

On the other hand, negative one-way implicatives hold the relation only in negative contexts (155-156).

(155) a. McCain **attempted** [to <u>hang</u> himself].
b. McCain did not **attempt** [to <u>hang</u> himself].

(156) a. He **hesitated** [to <u>lecture</u> nations on their failings].
b. He did not **hesitate** [to <u>lecture</u> nations on their failings].

Because of this direct correlation between the factuality value of the two events, modality modification in the main sentence percolates to the embedded event as well:

(157) a. Russian spies may have **managed** [to *intercept* fax communications].

b. Russian spies may have not **managed** [to *intercept* fax communications].

(158) a. She may have **failed** [to *follow* the rules].

b. She did may have not **failed** [to *follow* the rules].

The different types of implicative predicates are organized as shown:

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
manage:	CT+	CT−	CTu	PR+	PR−	PRu	PS+	PS−	PSu	Uu	Uu	Uu
fail:	CT−	CT+	CTu	PR−	PR+	PRu	PS−	PS+	PSu	Uu	Uu	Uu
cause:	CT+	Uu	Uu	PR+	Uu	Uu	PS+	Uu	Uu	Uu	Uu	Uu
refuse:	CT−	Uu	Uu	PR−	Uu	Uu	PS−	Uu	Uu	Uu	Uu	Uu
hesitate:	Uu	CT+	Uu	Uu	PR+	Uu	Uu	PS+	Uu	Uu	Uu	Uu
attempt:	Uu	CT−	Uu	Uu	PR−	Uu	Uu	PS−	Uu	Uu	Uu	Uu

Table 7.12: Lexical types for NSIPs: Implicatives

Epistemic types (I). Among NSIP types, two classes of epistemic predicates can be identified. The class described here includes prototypical epistemic expressions such as *certainty* or *probability*, conveying either positive (e.g., *possibility*) or negative (e.g., *impossibility*) polarity. They all have a limited number of lexical entries.

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
certainty:	CT+	PS−	Uu	PR+	PR−	Uu	PS+	PS−	Uu	Uu	Uu	Uu
impossibility:	CT−	PS+	Uu	PR−	PR+	Uu	PS−	PS+	Uu	Uu	Uu	Uu
probability:	PR+	PR−	Uu	PR+	PR−	Uu	PS+	PS−	Uu	Uu	Uu	Uu
improbability:	PR−	PR+	Uu	PR−	PR+	Uu	PS−	PS+	Uu	Uu	Uu	Uu
possibility:	PS+	CT−	Uu	PS+	PR−	Uu	PS+	PS−	Uu	Uu	Uu	Uu
uncertainty:	PS−	CT+	Uu	PS−	PR+	Uu	PS−	PS+	Uu	Uu	Uu	Uu

Table 7.13: Lexical types for NSIPs: Epistemic (I)

Epistemic types (II). The second class of epistemic types is more heterogeneous, but it differs from the former by the fact that types here express uncommitted values (Uu) in contexts of negative polarity (except for type ***appear***) and in contexts of modality lower than certain (CT) (except for type ***evidence***).

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
evidence:	CT+	Uu	Uu	CT+	Uu	Uu	CT+	Uu	Uu	Uu	Uu	Uu
confirm:	CT+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
suggest:	PR+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
appear:	PR+	PR−	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu
consider:	PS+	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.14: Lexical types for NSIPs: Epistemic (II)

Types ***confirm***, ***suggest***, ***appear***, and ***consider*** are all correlates of SIP types presented in the previous subsection, belonging to the class of *Opinion and reporting types (I)*. Specifically, type ***confirm*** correlates with type ***say***, type ***suggest*** with type ***conjecture***, ***appear*** with ***lookLike*** and ***consider*** with ***fear***. The two elements in each pair can in fact include the same lexical entries: the SIP type expresses their use when presented with a cognizer participant (e.g., *she suggested that...*; to him, it looked like...), whereas the NSIP type represents its impersonal use (e.g., *this suggests that...*; *it looks like...*). In this second situation, there is only one relevant source, corresponding to the anchor.

Type ***evidence***, on the other hand, represents only two lexical entries: *evidence* and *evident*. As the class name suggests, it indicates the existence of evidence about a particular event.

Projective types. This last class is composed of one single type, which nevertheless contains the largest number of predicates. It include predicates expressing volition (e.g., *want*), command (*order, demand*), permission (*allow, permit*), commitment (*offer, commit*), among others. They are characterized by taking a complement event that is located at a point in time later than that of the event they themselves express. The name *projective* is based on the term *projective proposition* put forward by Asher (1993) in order to identify the abstract objects that these predicates typically select for.

	Contextual factuality											
	CT			PR			PS			U		
	+	−	**u**	+	−	**u**	+	−	**u**	+	−	**u**
want:	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu

Table 7.15: Lexical types for NSIPs: Projective

Predicates in this type color their embedded event as only potential, and hence convey an inescapable degree of uncertainty. That is why the factuality value in each context is fully uncommitted (Uu). In this respect, type ***want*** correlates with type ***wonder*** for SIPs.

7.3.2 Lexicon

Once the lexical types for ESPs are established, the compiling of the lexicon proceeds in a straightforward manner. Each ESP lexical entry is associated with the factuality type (or types) that best describes its factuality behavior.

Often times, the same ESP conveys a different factuality assignment depending on the type of complement it takes. For example, *investigate* expresses uncertainty (Uu) when subordinating an *if/whether*-clause (159a), but characterizes its complement event as a fact (CT+) when it is expressed by an event-denoting NP (159b):

(159) a. Officials are investigating whether Rudolph **participated** in all three attacks.

b. Officials are investigating all three **attacks**.

The classification of ESPs into factuality types must therefore take into account the syntactic type of the complement event as well. Hence, the lexicon maps pairs of ESP and syntactic type of the complement into factuality types. The lexical entry for *investigate* is as shown below. It contemplates the possibility of three different syntactic complements: a *that*-clause (*ccomp*), an NP direct object (*dobj*), and an *if/whether*-clause (*ifcomp*):

(160) *Investigate*	Complement:	*ccomp*	Factual Type:	**know_that**
		dobj		**know_that**
		ifcomp		**wonder**

The subcategorization contexts for each ESP and the factuality value associated with them have been established manually, by analyzing the corpora of reference (TimeBank 1.2, ANC-NYT, and ANC-Slate).

There is also a number of polysemous cases where the possibility of multiple interpretations is not due to a difference in the syntactic type of the complement, but to its semantic type instead. Compare the two contexts in (161). In the first one, the embedded event *trial* is presented as a counterfact (CT−), whereas in the second, *offer* is characterized as a fact (CT+). De Facto cannot currently account for such distinctions.

(161) a. They **blocked** the trial.

b. They **blocked** the offer.

The complete lexicon is presented in appendix B, whereas the list of syntactic types used there is described in appendix C. They mainly correspond to those used by the dependency parser employed to generate the input trees feeding De Facto (de Marneffe et al., 2006). Refer to next chapter for a more complete description.

7.4 Syntactic constructions

When presenting the factuality markers in English (chapter 4), I listed a number of syntactic constructions that have an effect on the factuality of the events they involve; e.g., cleft sentences, temporal, causal or concessive clauses, and conditional constructions. From that set of constructions, only three of them are recognized and labeled as such by the dependency parser on which De Facto relies: relative clauses (`rcmod`), participial clauses (`partmod`), and purpose or final clauses (labeled `purpcl` or `infmod`, depending on whether they modify a verb or a noun). Within the scope of the current dissertation, these are the only syntactic constructions De Facto will consider.[4]

I detail how De Facto handles each of these constructions in what follows. Such treatment corresponds to that stated in Algorithm 2, briefly presented in the previous chapter.

Purpose (or final) clauses. The main event denoted by the clause is of intensional nature. Therefore, all its relevant sources will assess it as underspecified (Uu), even if it is embedded in a context of clear factuality. Take for instance the sentence in (162a). Both events *fired* (e_1) and *restore* (e_2) appear in the complement clause of the SIP *regretted*. As such, they have the same two relevant sources: s_0 and $s_1_s_0$. The first corresponds to the anchor, whereas the second performs the role of the cognizer.

[4]Indeed, additional constructions can be incorporated if the parser is customized to those other contexts as well, or De Facto is enhanced with parsing capabilities targeting well-defined set of contexts.

(162) a. [$_{l_0}$ Prof. Devlin$_{s_1}$ <u>regretted</u> [$_{l_1}$ that after World War II most industrial companies ***fired***$_{e_1}$ the women workers in their plants [in order to ***restore***$_{e_2}$ the status quo that had prevailed before the war.]]]

b. f(e_1, s_0)=CT+
f(e_1, s_1_s_0)=CT+

c. f(e_2, s_0)=Uu
f(e_2, s_1_s_0)=Uu

Given that *regret* is a factive predicate, the main event of the complement clause, *fired*, is assessed as a fact by both the event anchor and the cognizer (162b). This is not the case, however, for e_2, the main event in the purpose clause (162c). From the information provided by the text, the attitude of both the text author (s_0) and Prof. Devlin (s_1_s_0) towards e_2 is of uncommittal nature.

Relative clauses. The event expressed by the main predicate in a relative clause is presupposed as corresponding to a fact in the world. Hence, even if the main predication of the sentence is characterized with a low modality degree or negative polarity, the main event in the relative clause (here e_3) receives a factual interpretation.

(163) a. [$_{l_0}$ After World War II, industrial companies <u>could not</u> ***fire***$_{e_2}$ the women [that had been ***working***$_{e_3}$ in their plants during the war period.]]

b. f(e_2, s_0)=CT−

c. f(e_3, s_0)=CT+

But because the factuality value of events such as e_3 above are due to a presuppositional process, the question is how do these values project when relative clauses appear in embedded contexts –which, moreover, may contribute more than one relevant source. Factive and implicative ESPs pose no problem here (164), since they act as *holes* in the sense that they "let all the presuppositions of the complement sentence become presuppositions of the matrix sentence" (Karttunen, 1973:73).

(164) a. [$_{l_0}$ Prof. Devlin$_{s_1}$ <u>*regretted*</u>$_{e_1}$ [$_{l_1}$ that after World War II, industrial companies could not ***fire***$_{e_2}$ the women [that had been ***working***$_{e_3}$ in their plants during the war period.]]]

b. (a) f(e_2, s_0)=CT−
   (c) f(e_2, s_1-s_0)=CT−

c. (a) f(e_3, s_0)=CT+
   (c) f(e_3, s_1-s_0)=CT+

A different situation is created when the relative clause is embedded by a predicate belonging to any of the classes characterized as *plugs* due to their capability of blocking the presupposition of the complement sentence (Karttunen, 1973:74). These are, most notably, reporting an attitude predicates, underlined in (165) and (166) respectively (Karttunen, 1973, 1974; Heim, 1992).

(165) a. [$_{l_0}$ Prof. Devlin$_{s_1}$ <u>*said*</u>$_{e_1}$ [$_{l_1}$ that after World War II, industrial companies could not ***fire***$_{e_2}$ the women [that had been ***working***$_{e_3}$ in their plants during the war period.]]]

b. (a) f(e_3, s_0)= Uu
   (c) f(e_3, s_1-s_0)=CT+

(166) a. [$_{l_0}$ Prof. Devlin$_{s_1}$ <u>*thinks*</u>$_{e_1}$ [$_{l_1}$ that after World War II, industrial companies could not ***fire***$_{e_2}$ the women [that had been ***working***$_{e_3}$ in their plants during the war period.]]]

b. (a) f(e_3, s_0)= Uu
   (c) f(e_3, s_1-s_0)=CT+

In our framework, the effect of having such presupposition blocked translates into the factuality assessments for e_3 presented in (165b) and (166b). Put in words: the source directly committed to the proposition in the reporting or attitudinal context (our cognizer) accepts e_3 as a fact in the world, whereas the source that is committed at the higher level (our anchor) remains uncommitted.

The possibility of a blocking effect is, to me, more clear in the reporting context example (165), but less so in the attitudinal one (166). That there is a gradation in these judgements is already acknowledged in Karttunen (1973), which presents complements of direct quotes as the most evident cases undergoing presuppositional blocking:

(167) a. [$_{l_0}$ "[$_{l_1}$After World War II, industrial companies could not ***fire***$_{e_2}$ the women [that had been ***working***$_{e_3}$ in their plants during the war period]]," *argued*$_{e_1}$ Prof. Devlin$_{s_1}$].

b. (a) f(e_3, s_0)= Uu
(c) f(e_3, s_1-s_0)=CT+

As much as the blocked reading is possible in the reporting and attitudinal examples above, however, I am more inclined to think that the preferred interpretation is the one in which the presupposition projects up to the embedding level as well.

Other authors assume this view as well. Most remarkably, Geurts (1998) claims that in sentences like (165-166), three different interpretations are possible: (a) What he calls an internal reading, which corresponds to the blocked (or plugged) reading, in Karttunian terms; (b) An external interpretation, in which the speaker presupposes the proposition of the embedded fragment, but not the agent of the attitude –imagine for instance that Prof. Devlin believed women had been working in industrial companies before, but not during, the war; and (c) A reading combining both, an internal and an external perspective. Within the framework of the current dissertation, the internal reading corresponds to the one represented in (165b) and (166b), the external would be represented as (168), and the one that accepts both situations, as (169). He considers this last interpretation as the most plausible in attitudinal contexts.

(168) (a) f(e_3, s_0)= CT+
(c) f(e_3, s_1-s_0)=Uu

(169) (a) f(e_3, s_0)= CT+
(c) f(e_3, s_1-s_0)=CT+

Glanzberg (2003) offers a similar account for reporting contexts. In his work on the notion of felicity and its role on presupposition, he points out a difference between reported (or indirect) speech and quoted contexts, which he uses in order to distinguish between two types of presuppositions. He shows that reported speech cannot be employed when the author of the sentence does not assume that the embedded presupposition holds, unless some additional text is added in order to repair the situation. In Geurts terms, reported speech cannot be employed for a pure internal interpretation if no additional material is added to the text.

Following Geurts (1998) and Glanzberg (2003), I generalize the interpretation of presuppositions within attitudinal, reported, and quoted contexts as follows:

In attitudinal contexts, the presupposition is projected up to the embedding level –or, in Geurts terms, it receives both an internal and an external reading. Thus, the factuality assignments for e_3 in example (166) will be as shown in (169).

In reported speech, the same situation as in attitudinal contexts holds. Again, the factuality assignments for e_3 in (165) are (169).

In quoted contexts, the presupposition remains blocked at the quoted level –in Geurts terms, the internal reading is applied. The factuality assessment of e_3 in (167a) is therefore the one presented in (167b).

I understand that such generalization may be inadequate in certain situations but it suffices in the context of the current dissertation.

Participial clauses As with relative clauses, the main event in the subordinated clause is presupposed as true. Hence, the same treatment as for relative clauses will be applied here.

Chapter 8

Implementing De Facto

De Facto is the factuality profiler developed in the scope of the current dissertation. As such, it aims at identifying the factuality profiles of events mentioned in text. Its functionality can be divided into two interwoven tasks:

- Identifying the basic elements contributing to event factuality; that is, the elements playing a role in the notion of factuality profile, which was defined in chapter 3 as follows:

  (170) p_e={<f, s, t> | f is a factuality value of the form <*mod*, *pol*> & s is a relevant source for that event & t is a point in time}

  Because the time component (i.e., the point in time when the factuality assignment takes place) is left out of consideration in the scope of the current dissertation, the basic elements that De Facto needs to identify are: events, relevant sources, and factuality markers.

- Computing the factuality profile of each event mentioned in text by implementing Algorithm 1 and its associated set of linguistic resources, presented in chapters 6 and 7, respectively.

This chapter focusses on the specific issues concerning the implementation of the tool.

8.1 General design

De Facto takes as input a document (or a set of them) and returns the factuality profiles associated to each events mentioned there. The processing flow of De Facto is illustrated in figure 8.1.

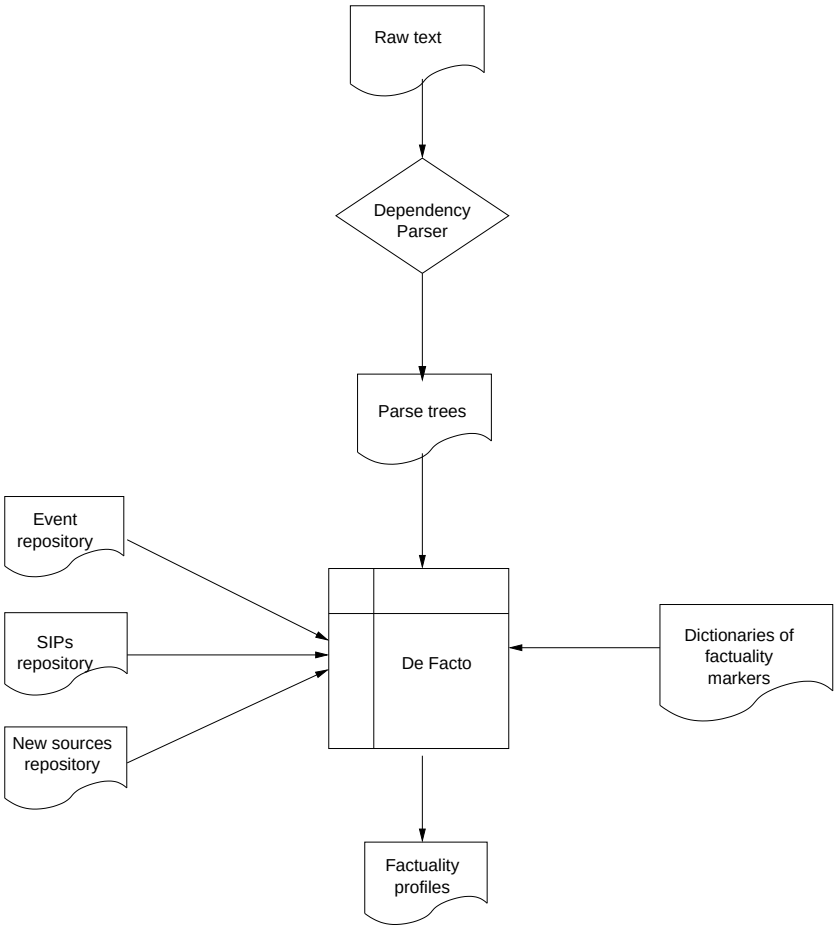

Figure 8.1: De Facto's processing flow

The factuality profiler corresponds to the component named De Facto, which is the module implementing Algorithm 1. As can be seen, it obtains its input from a dependency parser, to be detailed in next section. Furthermore, it depends on three additional data repositories, explained in section 8.3, and a collection of dictionaries of factuality markers (section 8.4). The current version of De Facto is implemented

in Python. It takes an average of 95 seconds to process the whole TimeBank, when run on a MacBook with a processor of 2.16 GHz.

8.2 Input and output

Input. The input documents must be processed by a dependency parser. De Facto adopts the Stanford Parser (version 1.5.1) and it is therefore based on the set of grammatical dependencies this parser assumes (de Marneffe et al., 2006). Figure 8.2 illustrates the dependency tree returned for sentence (171).

(171) He said he'd double his money.

```
<dep type="nsubj">
<governor idx="2">said</governor>
<dependent idx="1">He</dependent> </dep>
<dep type="nsubj">
<governor idx="5">double</governor>
<dependent idx="3">he</dependent> </dep>
<dep type="aux">
<governor idx="5">double</governor>
<dependent idx="4">'d</dependent> </dep>
<dep type="ccomp">
<governor idx="2">said</governor>
<dependent idx="5">double</dependent> </dep>
<dep type="poss">
<governor idx="7">money</governor>
<dependent idx="6">his</dependent> </dep>
<dep type="dobj">
<governor idx="5">double</governor>
<dependent idx="7">money</dependent> </dep>
```

Figure 8.2: Dependency tree

Output. De Facto returns a set containing the factuality profile for each event in text. Example (173) shows the set of factuality profiles for events in sentence (172).

(172) Analysts$_{s_1}$ **said**$_{e_1}$ the government$_{s_2}$ **knew**$_{e_2}$ a peaceful solution **was**$_{e_3}$ in reach.

(173)

e_1: *said*	fp(e_1) = { <s_0, CT+> }		(a)
e_2: *knew*	fp(e_2) = { <s_0, Uu>,		(a)
	<s_1_s_0, CT+> }		(c)
e_3: *was*	fp(e_3) = { <s_0, Uu>,		
	<s_1_s_0, CT+>,		(a)
	<s_2_s_0, Uu>,		
	<s_2_s_1_s_0, CT+> }		(c)

The output expresses the factual assignments of all those sources considered relevant according to Definition 1 in chapter 6. By the nature of this definition, the number of relevant sources grows exponentially, in some cases generating source chains that do not seem necessary for characterizing the factuality profile of the event; e.g., source s_2_s_0 of event e_3. Hence, we can think of a pruning postprocess that filters out any source not corresponding to the text author, the anchor or the cognizer. Such strategy is however not implemented in De Facto.

8.3 Auxiliary input data

De Facto counts on three additional data repositories that contain different levels of information concerning the input text:

- A repository indicating the events in the input text.
- A repository containing the SIPs present in the input text.
- A repository indicating the new sources that those SIPs introduce.

The information in these resources is the product of three tasks necessary for event factuality identification, which are, respectively: (a) event recognition; (b) SIP identification; and (c) identification of the SIP arguments referring to the new source introduced in the discourse.

Currently, most of the information in these resources has been obtained by manual annotation. The actual version of De Facto has been created with the purpose of evaluating both the model of event factuality proposed in the first part of this dissertation, and the algorithm put forward in order to compute it. As such, one of its design criteria was to avoid any potential source of external error, and so I opted for manually-generated data, avoiding error due to automatic processing. I will show, however, that these tasks are reasonably achievable by automatic means. I detail each of these modules in what follows.

8.3.1 Event repository

It contains the tokenized and POS tagged version of the input text, with events indicated as such. Specifically, each token is associated with: its file name, its sentence number, its position in the sentence, its word form, its part-of-speech tag and, if appropriate, an event tag, the event ID, and its position within the event tag ('B' for beginning, 'I' for any other non-beginning position). For example, sentence (171) above is represented as:

(174)
```
ABC19980108.1830.0711.tml 12 0 He PRP
ABC19980108.1830.0711.tml 12 1 said VBD EVENT e20 B
ABC19980108.1830.0711.tml 12 2 he PRP
ABC19980108.1830.0711.tml 12 3 'd MD
ABC19980108.1830.0711.tml 12 4 double VB EVENT e21 B
ABC19980108.1830.0711.tml 12 5 his PRP$
ABC19980108.1830.0711.tml 12 6 money NN
ABC19980108.1830.0711.tml 12 7 .  .
```

The repository is obtained by aligning two different versions of the input text: (a) a tokenized and POS tagged version, and (b) a version with the events marked.

Tokenization and POS tagging. In order to guarantee the mapping of this information with that in the input data (i.e., the input dependency trees), the tokenizing and POS tagging is performed employing the tokenizer and POS tagger in the Stanford Parser, which can be used as stand-alone modules.

Event recognition. Event recognition does not fall into the immediate research target of the current dissertation, and so De Facto needs to obtain this information from independent resources. The event information in the corpus used here for development and testing was manually annotated (*cf.* next section). However, an event recognizer can be used as well in order to obtain such information.

There currently exist several event extractors conceived from different approaches. From a theoretical perspective, they diverge in the notion of event. In some cases, it is conceived as a relationship among participants, locations and times, as in all the work developed within the Scenario Template task of the different Message Understanding Conference competitions (Grishman & Sundheim, 1996) or, equivalently, in the Automatic Content Extraction (ACE) program (ACE, 2005). In others, the notion of event is based on temporal properties. For instance, EvITA (Saurí et al., 2005) assumed the notion of event as a situation that participates in the narrative of a given document and which can be temporally ordered, as defined in TimeML (Pustejovsky et al., 2005; Saurí et al., 2004). Other event extractors focus only on verbal predicates (Harabagiu & Bejan, 2006).

From a more applied point of view, they differ with regards to event coverage: many of them are domain-dependent and use a predefined list of event types, possibly structured into an ontology (e.g., Brill et al., 2002; Ravichandran & Hovy, 2002; Hovy et al., 2002; Soubbotin & Soubbotin, 2002), but recently some focus has been brought to unrestricted coverage of events as well (Filatova & Hatzivassiloglou, 2003; Saurí et al., 2005; Harabagiu & Bejan, 2006; Bethard, 2007).

The notion of event adopted by De Facto corresponds to that proposed by the TimeML specification language, which includes both events in specific topics or highly specialized domains, and expressions that refer to more generic situations (e.g., *want* or *say*), which can be fundamental for computing the factuality of events. De Facto requires then an event recognizer assuming that same notion of event.

The most natural choice is EvITA (or an equivalent one –e.g., Bethard & Martin, 2006; Bethard, 2007), either in its stand-alone version, or as part of the TARSQI toolkit, TTK (Verhagen et al., 2005), given that it has been built within the same research framework as TimeML.[1]

[1]TimeML and EvITA are both products nurtured within TARSQI (Temporal Awareness and Reasoning Systems for Question Interpretation), a project devoted to building a set of resources for

8.3.2 Repository of SIPs

This repository contains the list of SIPs in the input text, which has been obtained from manual annotation. The interannotation agreement achieved for that annotation task is *kappa*=0.88 (refer to next chapter), a result that suggests such task is feasible by automatic means. In coming versions of De Facto, SIP identification will be automatized and integrated as part of the full processing.

8.3.3 Repository of new sources

It contains the elements expressing the sources introduced by the SIPs identified in the previous step. For example, given the sentence in (175), where SIPs are in bold face, this repository provides the position of the new sources (underlined) that each of these SIPs contribute (176).

(175) Intel$_{s_1}$ **said**$_{e_{14}}$ that last week a customer$_{s_7}$ **discovered**$_{e_{15}}$ two flaws$_{e_{16}}$ in its 80486 microprocessor chip's floating-point unit.

(176)
```
...
wsj_0781.tml e14 1
wsj_0781.tml e15 7
...
```

For each new source in the data file, De Facto applies Definition 1 (section 6.3.1) in order to obtain the source chains conforming the set of relevant sources at that specific level. Definition 2 (section 6.3.2) is applied next, assigning the adequate source role to each relevant source.

This data repository was also compiled from manual annotation but will be automatized in future versions of De Facto. The interannotation agreement obtained for that task is high, *kappa*=0.95, which suggests the task is reasonably defined, linguistically well constrained, and thus with good potential for success by automatic means. There already exists some work on source identification within the field of opinion analysis (Bethard et al., 2004; Kim & Hovy, 2005; Choi et al., 2005). In the last chapter, on future work, I will comment a bit on the potential venues for this task.

identifying, annotating, and reasoning about temporal information in discourse Pustejovsky et al. (2003, 2005); Mani (2005); Verhagen et al. (2005).

8.4 Dictionaries of factuality markers

They compile the factuality markers specified in chapter 7 (polarity and modality particles, as well as ESPs of the two identified sorts: SIPs and NSIPs), in compliance with the lexical design put forward in chapter 6.

In Saurí et al. (2006a), I already presented a suite of tools developed within the TARSQI framework, devoted to identifying most of the factuality markers that are of interest here. Specifically, grammatical markers of polarity and modality were recognized by EvITA (Saurí et al., 2005), whereas modality and factuality information expressed through subordination contexts were identified by SlinkET, a partial parser for event modality (Saurí et al., 2006b).

Thus, a feasible possibility could have been employing here the knowledge already compiled in these tools, and somehow translate the result into set of factuality profiles. Instead of that, I chose to unify and enhance these two resources by importing the linguistic knowledge they are based upon into De Facto, and enriching it whenever appropriate. This way, all the linguistic knowledge could be represented uniformly according to the model of event factuality presented earlier. The most relevant improvements from EvITA and SlinkET are as follows:

Dictionary of polarity particles: EvITA identifies polarity particles introduced at the VP level. De Facto accounts for this while considering, in addition, event polarity expressed within the subject or direct object scope (refer to section 4.1). This is now possible due to the use of a dependency tree as the backbone of the computation. Furthermore, De Facto also deals with the interaction between polarity particles and contextual polarity, as set in table 7.1.

Dictionary of modality particles: Modal auxiliaries are recognized by EvITA, which nevertheless does not interpret its modality value. By contrast, De Facto's repository of modality markers specifies them with the corresponding mapping into the appropriate factuality degree. As for modal adjectives, some of them are identified by SlinkET, which maps them into one of the possible modality values specified by TimeML: `factive, counterfactive, modal, evidential`, and `negative evidential`. De Facto accounts for those adjectives in SlinkET and further ones,

specifying in addition the adequate degrees of event factuality. Finally, modal adverbials are not handled by either EvITA or SlinkET but only in De Facto.

The factuality values expressed by all these elements are represented in table 7.2. On the other hand, in contrast to EvITA and SlinkET, De Facto also accounts for the interaction between the modality value these contribute and the factuality information available in the context (table 7.3).

Dictionary of ESPs: SlinkET was precisely designed with the aim of identifying subordination relations triggered by ESPs and marking the embedded event with one of the five TimeML modality types just listed above. SlinkET is nonetheless limited in two fundamental aspects:

- It does not cope with the interaction between ESPs and other factuality markers, be it ESPs as well or polarity and modality particles of different sort. The lexicon of ESPs in De Facto, on the other hand, handles that interaction by providing the different factuality values that ESPs project onto their events depending on the contextual factuality. Refer to section 6.2.

- It does not consider the role of factuality sources, and therefore does not account for the potential difference among factuality assessments from different participants. This limitation is however overcome in De Facto's lexicon for ESPs, given that SIPs there provide information for two types of participants: anchors and cognizers.

Syntactic contexts: Because of the use of the dependency parser at the basis of the De Facto processing, the factuality triggered by specific syntactic contexts (purpose, participial, and relative clauses) can be accounted for as well.

Chapter 9

Experiments and evaluation

For developing and evaluating De Facto, I have compiled FactBank, a corpus annotated with factuality information. I describe it in section 9.1, and report the results of running De Facto against it in section 9.2.

9.1 Corpus building

9.1.1 FactBank

FactBank (Saurí & Pustejovsky, 2008) consists of 208 documents containing a total of 8837 events manually annotated according to the notion of event as defined in TimeML (Pustejovsky et al., 2005; Saurí et al., 2004). FactBank includes all the documents in TimeBank (Pustejovsky et al., 2003) and a subset of those in the AQUAINT TimeML Corpus (A-TimeML Corpus).[1] The contribution of each of these subcorpora is shown in table 9.1.

Table 9.1: Contribution of TimeBank and the A-TimeML Corpus to FactBank

	# Documents		# Events	
TimeBank	183	(88%)	7935	(90%)
A-TimeML Corpus	25	(12%)	902	(10%)
Total	**208**		**8837**	

[1] http://www.timeml.org/site/timebank/timebank.html

TimeBank has been used as the development corpus for implementing De Facto and compiling its lexical resources, whereas the AQUAINT TimeML Corpus fragment has been employed as the test bed for evaluating its performance.

9.1.2 Annotation design

Annotating the factuality of events poses challenges at different levels. They have therefore determined the design of the task.

World knowledge. Judging the factuality status of an event can be influenced by what annotators know about how things are in the world. If this knowledge is allowed in the annotation, there is the risk of obtaining different judgments because of the difference in the degree of information each annotator has –let it aside a potential difference in opinions. Hence, the annotation must be surface-based, reflecting only what is expressed in the text and avoiding any judgment based on knowledge of how things are in the world.

Textual unit of information. A second challenge concerns the textual unit on which annotators base their judgments. The factuality of events is mainly expressed within the sentence where they are mentioned, but it is not uncommon that it is also qualified through several sentences. An event may be presented in a totally uncommitted way first (for example, embedded under a predicate expressing promise), and later on be characterized as a fact.

Discourse relations are, however, not handled by De Facto. Thus, a further constraint on the annotation task requires it to emulate the processing conditions of the profiler, in order to reduce the potential noise from external variables when evaluating its performance. Judgments must be constrained to information present at the sentence level, given that this is the information unit in De Facto algorithm.

Complexity of the linguistic data. Identifying event factuality requires linguistic processing at different layers. First, it involves the interaction of the local and non-local context of events. Second, it puts into play at least one, but generally more, relevant sources for each event, which bear a nesting relation among them. Thus, if not

structured adequately, the annotation task can become too complex and inevitably result in a questionable outcome. Annotating event factuality needs to be addressed by steps that can both help annotators to mentally structure and comprehend the different information layers involved, as well as allow me to partially automate certain parts of the annotation process. Because of that, I divided the annotation effort into three consecutive tasks, presented in the next section. The full version of the annotation guidelines are provided in appendix E.

9.1.3 Annotation tasks

Task 1: Identification of Source-Introducing Predicates. Given a text with the events already recognized and marked as such, the annotator identified those that correspond to SIPs. This initial task allowed annotators to get familiarized with both the notion of source and the notion of SIP as marker of factuality information.

For processing purposes, this task is basic as well, given that SIPs are the elements triggering new embedding levels of factuality, and introducing the new source that pivots the computation of the relevant sources at each level. De Facto currently uses the result of this manual annotation as one of its data repositories. In particular, these SIPs are employed to identify the different factuality levels throughout the corpus (refer to section 8.3.2). In coming versions, SIP identification will be performed automatically, most probably through a machine learning approach given that it is a very well-defined classification task concerning a constrained set of lexical elements. The manual annotation generated from this task will therefore be of great value.

Task 2: Identification of new sources. The annotator was provided with a text with the following information already annotated: (a) all the SIPs in the text, obtained from the previous task; and (b) for each of these SIPs, a set of elements that can potentially express the new source it introduces –that is, the set of new source candidates. New source candidates had been automatically identified by selecting NP heads holding any of the syntactic functions listed here:[2]

[2]These syntactic functions were obtained from parsing the corpus with the Stanford Parser (de Marneffe et al., 2006).

1. Subject of any verbal predicate in the sentence.
2. Agent of a SIP in a passive construction (e.g., *The crime was reported by the **neighbor**.*)[3]
3. Direct object of a SIP that has, as one of its arguments, a control clause headed by another SIP (e.g., *He criticized **Ed** for saying...*).
4. Complement of preposition *to* at the beginning of a sentence (e.g., *To **me**, she didn't want to go.*).
5. Complement of preposition *to* that is in a dependency relation with a SIP (e.g., *according to **me**, it seems to **me***, etc.)
6. Complement of preposition *of* that is in a dependency relation with a noun SIP (e.g., *the announcement of **Unisys** Corp.*).
7. Possessor in a genitive construction whose noun head is a SIP (e.g., ***Unisys** Corp.'s announcement*).

For every SIP, the annotator selected the new source it introduces among those in the candidate set. Two exceptional situations were also accounted for: (i) The new source did not correspond to any of the candidates in the list. The annotator would in these cases select option OTHER, and a posterior adjudication process would pick the adequate text item. (ii) There was no explicit segment in the text referring to the new source –for instance, in the case of generic sources (e.g., *it was expected that...*). The annotator would then select for option NONE.

As in the case of the manually identified SIPs from task 1, the result of this second task was compiled into a repository and used by De Facto to compute the set of relevant sources at each level (see section 8.3.3). In future work, these data will also be used for automatizing the task.

Task 3: Assigning factuality values. This final task was devoted to selecting the factuality value assigned to events by each of their relevant sources. The annotators were provided with a text where every event expression was paired with its relevant

[3]In this and coming examples, the new source candidate is marked in bold face and the SIP is underlined.

sources. Hence, sentences containing events with more than one relevant source were repeated several times, each presenting a different event/relevant source pair.

The set of relevant sources for each event had been automatically computed given the new sources manually identified in the previous task, and based on the algorithm for finding them presented in Definition 1 (section 6.3.1).

Table 9.2: Factuality values

VAL	USE
	Committed Values
CT+	According to the source, it is **certainly** the case that X.
PR+	According to the source, it is **probably** the case that X.
PS+	According to the source, it is **possibly** the case that X.
CT-	According to the source, it is **certainly not** the case that X.
PR-	According to the source it is **probably not** the case that X.
PS-	According to the source it is **possibly not** the case that X.
	(Partially) Uncommitted Values
CTu	The source knows whether it is the case that X or that not X.
PRu	The source knows whether it is probably the case that X or that not X.
PSu	The source knows whether it is possibly the case that X or that not X.
Uu	The source does not know what is the factual status of the event, or does not commit to it.
	Other Values
Other	Covering the following two situations - A different value is required here (e.g., U+, U-). - The annotator does not know what value to assign.
NA	The factuality nature of the eventuality cannot be evaluated.

The annotators had to choose among the set of factuality values presented in table 9.2, which corresponds *grosso modo* to table 3.1 with the addition of values PRu and PSu. In establishing the former table, these two values were estimated as non relevant, but I wanted to confirm they were also considered unnecessary by the annotators when looking at real data. Two further values were allowed as well in order to pinpoint potential limitations in my value set: OTHER, covering situations where a different value would be required (e.g., the combinations U+ and U−), or when the annotator did not know what value to select; and NA (non-applicable), for events whose factuality cannot be evaluated.

To discern among the different factuality values, the annotators were asked to apply the discriminatory tests presented in section 3.1.2

9.1.4 Annotation evaluation

9.1.4.1 Interannotation agreement and error analysis

FactBank has been annotated by a pair of annotators. Overall, three annotators participated in the effort: annotators A and B participated in the first task, and annotators B and C carried out tasks 2 and 3. All of them are notably competent undergraduate Linguistics Majors. In addition, there was one adjudicator handling cases of disagreement. I myself have done some annotation and adjudication, but only for the development corpus.

In addition to assessing the overall quality of FactBank, the interannotation agreement score will be a good indication of the feasibility in identifying event factuality, as well as the adequacy of the factuality model (and its corresponding factuality values) proposed here. Furthermore, it will provide some hints about the results we can expect when attempting to identify it by automatic means.

Interannotation agreement has been assessed using the *kappa* coefficient. *Kappa* is defined as $k = \frac{P(A)-P(E)}{1-P(E)}$, where $P(A)$ is the observed agreement among annotators and $P(E)$ the expected agreement. The literature offers different formulas for computing $P(E)$ (*cf.* Di Eugenio & Glass, 2004), although the most typically used is that proposed in Cohen (1960). $P(E)$ in Cohen's *kappa* is defined as the summation of the probability of each category c, P_c, which in turn corresponds to the product of each category probability according to every annotator a, P_{c_a}:

$$P(E) = \sum^{c} P_c \tag{9.1}$$

$$P_c = \prod^{a} P_{c_a} \tag{9.2}$$

As pointed out in Di Eugenio & Glass (2004), Cohen's *kappa* suffers from skewed distributions of categories (the so-called prevalence problem), as well as from the degree to which the annotators disagree (the bias problem). In order to overcome these tendencies, the authors propose to report interannotation agreement by means

of three numbers; namely, Cohen's *kappa* and two adjustments of it: one in which it is adjusted for bias, which corresponds to *kappa* coefficient as defined in Siegel & Castellan (1988), and another in which it is adjusted for prevalence, which is equal to $2P(A) - 1$. The interannotation agreement for the three tasks in FactBank are reported in this way –with Cohen's *kappa* emphasized in bold face.[4]

Task 1. The interannotation ratio achieved here is k_{cohen}=**0.88** over 40% of the corpus (on the number of events). The ratios obtained from the two adjusting measures are: $k_{s\&c}$=0.88 and $2P(A)-1$=0.92. Some of the most common cases of disagreement were:

- SIP candidates which present a generic source –and hence, not explicit in the text (e.g., *He's **expected** to meet with Iraqi deputy prime minister Tariq Aziz later this afternoon.*).
- SIP candidates which do not have an explicit event complement (e.g., *The executives didn't **disclose** the size of the expected gain.*).
- SIP candidates whose event complement is not expressed by a direct object or a complement clause (e.g., *Telerate has **criticized** Dow Jones [for not disclosing ....]*).
- SIP candidates whose event complement is dislocated from its standard position, appearing either somewhere else in the current sentence, or in a preceding sentence (e.g., *Har-Shefi said [she heard Amir talk about killing Rabin] but did not **tell** the police because...*).
- SIP candidates which appear negated. Some of the examples already provided illustrate this as well (e.g., *didn't disclose, did not tell*).
- SIP candidates which are polysemous between a SIP and an non-SIP interpretation (e.g., *Nhek Bunchhay **appeared** confident he would find Howes' remains.*).

[4] As will be seen, Cohen's *kappa* will give the same results as Siegel & Castellan's. I will nonetheless provide the two of them independently, for completion's sake.

- Speech act predicates which nevertheless do not behave as SIPs (e.g., *"It looks as though they panicked," a detective,* ***speaking*** *on condition of anonymity, said of the robbers.*).

Task 2. The interannotation agreement achieved for this task is: k_{cohen}=**0.95**, $k_{s\&c}$=0.95, and $2P(A) - 1$=0.97. As before, these figures were obtained from 40% of the corpus on the number of events. Such good results come as no surprise since this is a very well-defined task, both in syntactic and semantic terms: essentially, it requires identifying the SIP logical subjects. The most common cases of disagreements are those in which:

- There is a second expression in the text correfering with the new source. For example, the first person pronoun in a quoted fragment (e.g., *"<u>We</u> are going to maintain our forces in the region for the foreseeable future,"* **said** *spokesman Kenneth* **<u>Bacon</u>**.)[5]

  Another common situation was given with relative clauses (e.g., *British police* **<u>officers</u>** *<u>who</u> had been searching for Howes* **concluded** *that ...*).

- The new source introduced by the SIP referred to a non-human entity (e.g., **<u>Reports</u>** *attributed to the Japanese foreign ministry* ***said*** *...*).

- The implicit sources of passivized events were sometimes interpreted as corresponding to other entities mentioned in text. For example, one of the annotators understood the entity *Unisys* in the following sentence as the new source introduced by *expect*: *And <u>Unisys</u> is* **expected** *to do little better than break even in the fourth quarter.*

- The new source (generally, of a noun event) was expressed by means of a PP complement of optional nature (e.g. *<u>Netanyahu</u>'s comments last week were in response to* **signals** *from* **<u>Syria</u>** *that <u>it</u> wants to renew the long-stalled peace talks between the two countries.*)

[5]In this and the following examples, the SIP is presented in bold face and the new source to be selected in bold face and underlined. If an additional expression enters in consideration as new source candidate as well, it will only be underlined.

Task 3. Interannotion agreement for this task scores at k_{cohen}=**0.81**, $k_{s\&c}$=0.81, and $2P(A) - 1$=0.80, over the 30% of the corpus (in terms of number of events). I consider this a very acceptable result given the complexity of the task.

An analysis of disagreement instances on 10% of the corpus shows that around two thirds of them are cases of true ambiguity, originated from different kinds of constructions. Some of the most recurring ones concern:

- The scope of a reporting predicate, or in other words, the span of the attributed fragment. In (177), for example, the reporting predicate (in bold face) can be interpreted as scoping over both events *want* and *traveled*, or only over *traveled*.

  (177) Authorities <u>want</u> to question the unidentified woman who allegedly <u>traveled</u> with Kopp, **according** to an investigator quoted by the newspaper.

- Syntactic constructions typically triggering a presupposition (e.g., relative clauses, temporal clauses, appositions), when embedded under a reporting predicate (178). Annotators would disagree on whether the presupposition would be projected to the main clause, which in our terms can be stated as to whether the author of the text commits to the embedded event (underlined below) as a fact. This is a highly common case of disagreement among annotators.[6]

  (178) The killing of Dr. Barnett Slepian, a gynecologist in Buffalo who <u>performed</u> abortions, has become a factor in at least two campaigns in New York, **say** political consultants and some campaign advisers.

- Event-denoting nouns, especially when embedded under a reporting predicate. Similarly to the previous case, there is disagreement concerning whether the event is understood as a fact by the anchor of the event. In the following sentence, for instance, the annotators disagreed about the factuality judgement of source *author* with regard to the event in bold face.

  (179) Last week, FBI Director Louis Freeh, on an official **visit** to Mexico, asked Mexican authorities to join the hunt for Kopp, federal officials have said.

[6]There is no clear position about that in the literature, either. Refer to section 7.4, where I reviewed some work commenting on that.

This issue is a highly frequent source of disagreement, which comes as no surprise: the annotation guidelines did not address at all how to deal with nominal events. The omission was deliberate, however, given the complexity concerning nominal interpretation, which touches on thorny issues such as definiteness, or involves ontological-based information –recall for example the factual distinction between *block a trial* and *block an offer*, in example (161).

- Present perfect clauses, which seem to allow for both a factual (CT+) or an uncommitted (Uu) interpretation of the mentioned event:

  (180) **Extending** membership to these three democracies helps to stabilize a region that historically has been the staging ground for many of the disasters of this century.

- Purpose clauses, whose event tends to be characterized as uncommitted (Uu) but it can be understood as factual in some contexts as well.

  (181) The murder of Dr. Barnett Slepian is the latest depraved assault on the small number of courageous physicians who still risk their safety to **perform** legal abortions in this country.

- ESPs that can be interpreted as qualifying the factuality of their embedded events in different ways. Some of the frequent disagreements concerned the predicates *believe*, *think*, *admit*, *agree*, *decide*, and *help*. I comment on a couple of them.

  ***Believe*:** One annotator understands that the cognizer (in bold face below) is characterizing the embedded events (underlined) as probable, PR+, whereas the other interprets he holds a factual position (CT+).

  (182) a. **Each** wrongly *believes* he is <u>justified</u> in using all means possible to achieve his goal .

  b. But The Buffalo News reported Friday that the hair was in a packet that was found buried in the ground more than 50 feet from a tree where **police** *believe* the sniper <u>stood</u> and <u>fired</u>.

***Admit*:** It arguably has a factive interpretation, which in our terms means that both the source and the cognizer commit to its embedded event (underlined) as a fact (CT+). However, there were several instances in which one of the annotators interpreted that predicate as a regular reporting predicate –i.e., only the cognizer committing to the embedded event as a fact.

(183) **Police** *admit* that despite a worldwide search and $1 million reward, they don't <u>know</u> where he is.

- Modal auxiliaries, which in some cases are polysemous by nature; mainly, *can* and *would*. The event in bold face in the sentence below, for example, was characterized as both possible (PS+) and uncertain (UU).

(184) With their membership secure, they also <u>can</u> **participate** in planning for the NATO summit in April.

The remaining cases of disagreement are true errors. The most common of them concern: (a) a wrong (unaccurate or careless) application of the guidelines –especially in cases of negated events, conditional constructions, and sentences presented in quotation marks; and (b) the misunderstanding of a source chain, mainly if it involves a generic source.

The interannotation agreement scores obtained here can be compared with those in the work by Rubin and her colleagues (Rubin et al., 2005), devoted to the identification of certainty in text. They propose a five-fold categorization: *absolute, high, moderate, low*, and *uncertain*. The interannotation results they obtain are less encouraging. Distinguishing among different degrees of certainty gives them $k_{cohen} = 0.15$, which improves to $k_{cohen} = 0.41$ when stricter annotation instructions are provided (Rubin, 2007). Their approach and mine are not completely equivalent, since they annotate only sentences where there are "explicit markers of certainty", whereas I consider that factuality is a value affecting all events in text, and assume unmarked cases are by default assessed with absolute certainty (CT+). In addition, their system does not consider polarity as part of the information to identify. In any case, there exist a quantitative difference between the agreement score in both works.

In my opinion, the low score they report is due to two basic gaps in their approach. At the structural level, it lacks a well-defined grammatical grounding in pinpointing the markers of certainty, which translates into a level of imprecision in the identification process. At the semantic level, it lacks a set of clear discriminatory tests that can help distinguish between different degrees. At most, those annotators that received stricter instructions were provided with an alphabetized index with markers of certainty mapped into the degree they supposedly express, which not only neglects the effect that the interaction among markers may have on the resulting certainty value, but does not provide the annotator with a clear method for discerning the certainty degree of additional markers not included in the list.

The work presented here, on the other hand, aimed specifically at establishing a good grounding for delimiting factuality information, both structurally, by singling out the set of factuality markers employed in English from a grammatical perspective, and semantically, by determining the criteria transmuting our intuitions as speakers into well-identified semantic values.

9.1.4.2 Data distribution

The annotation in the third task provides a good insight about the value set proposed in this dissertation in order to account for event factuality. The following table shows the distribution of each value in the development subcorpus (corresponding to the 10% of the overall, in number of events).

Table 9.3: Distribution of factuality values (evaluation corpus)

Value	**CT+**	**CT-**	**Ctu**	**PR+**	**PR-**	**Pru**	**PS+**	**PS-**	**Psu**	**Uu**	**other**	**NA**
Counts	1276	51	1	25	0	0	33	2	0	804	0	5
%	58.1	2.3	0.05	1.15	0	0	1.5	0.1	0	36.6	0	0.2

First, we can see that the data is really skewed, favoring two main categories: CT+ and Uu. The prevalence of the first value should come as no surprise here. We are analyzing data from news reports, which, after all, are about things that have happened. However, the high frequency of Uu is less obvious, especially considering that categories with a modality degree lower than CT (i.e., PR and PS) or a non-

positive polarity ($-$ and u) appear to be very infrequent in the analyzed corpus (occupying all together only the 5.1% of the events).

But a closer look at the data sheds some light at it. Table 9.4 shows the counting and percentages of each value for the events above, split into two subcorpora: one containing those events expressed at evaluation level l_0, and another containing those events presented in deeper evaluation contexts. I refer to them as events in simple and embedded contexts, respectively.

Table 9.4: Distribution of factuality values in simple and embedded contexts (evaluation corpus)

Value	**CT+**	**CT-**	**Ctu**	**PR+**	**PR-**	**Pru**	**PS+**	**PS-**	**Psu**	**Uu**	**other**	**NA**
#Simple	794	31	0	2	0	0	4	0	0	156	0	0
#Embed	482	20	1	23	0	0	29	2	0	648	0	5
%Simple	36.1	1.4	0	0.1	0	0	0.2	0	0	7.1	0	0
%Embed	22	0.9	0.05	1.05	0	0	1.3	0.1	0	29.5	0	0.2

As can be seen, the frequency of category Uu is remarkably larger in embedded contexts than in simple ones. As a matter of fact, over 80% of the instances of Uu are assigned to events in embedded contexts. The reason for that is clear. Events in simple contexts generally involve events subordinated by NSIPs of the ***want*** type (e.g., predicates of volition, commitment or command),[7] and therefore have only one relevant source (i.e., the text author). On the other hand, events in embedded contexts have at least two sources, one fulfilling the role of anchor, and the other the cognizer. Most of these embedded contexts express a reporting or opinion of some sort, in which the anchor remains uncommited with regards to the factuality of the embedded event.

It is worthwhile to note that there is a qualitative difference between the meaning of value Uu when used in simple contexts and when used to express uncommitment of a source, like in contexts of reporting. The uncertain nature of the events in the first situation can be changed or overwritten if more information is provided about that event, whereas the uncommitted values in the second situation can be changed into a more informative value if a measure of source reliability is applied.

[7]Although they are syntactically embedded events, they are considered here as belonging to simple contexts because the embedding predicate, an NSIP, does not trigger a new evaluation level, l_{n+1}.

A second observation at the light of the annotated data concerns the values PRu and PSu. As said above, they were not considered applicable when designing the semantic field of event factuality, in section 3.1.1, but were nevertheless presented to the annotators as well, to test their utility. A look at the confusion matrix for task 3 (table 9.5) shows that there was no event judged as either PRu or PSu in 30% of the corpus (as a matter of fact, there was no event judged as such throughout the whole corpus), which confirms the previously assumed hypothesis.

Table 9.5: Confusion matrix for task 3 (over 30% of the corpus)

	CT+	**CT-**	**Ctu**	**PR+**	**PR-**	**Pru**	**PS+**	**PS-**	**Psu**	**Uu**	**other**	**NA**	
CT+	2483	1	0	21	0	0	2	0	0	97	1	0	2605
CT−	17	136	0	0	1	0	0	0	0	15	0	0	169
CTu	1	0	0	0	0	0	0	0	0	2	0	0	3
PR+	5	0	0	38	0	0	0	0	0	8	0	1	52
PR−	1	0	0	0	4	0	0	0	0	2	0	0	7
PRu	0	0	0	0	0	0	0	0	0	0	0	0	0
PS+	1	0	0	1	0	0	34	0	0	25	0	0	61
PS−	0	0	0	0	0	0	0	1	0	1	0	0	2
PSu	0	0	0	0	0	0	0	0	0	0	0	0	0
Uu	189	21	0	31	6	0	23	0	0	1615	2	6	1893
other	2	0	0	1	0	0	0	0	0	0	0	0	3
NA	6	0	0	0	0	0	0	0	0	0	0	0	6
	2705	158	0	92	11	0	59	1	0	1765	3	7	4801

The data also validates the need for distinguishing between two uncertain modalities, probable (PR) and possible (PS). Table 9.5 demonstrates that there is barely confusion between the two categories among annotators.

A interesting observation concerns the category OTHER, which does not reflect any linguistic distinction but was introduced in the category set to provide annotators with a way out in cases of ambiguty (more than one value could be chosen) or doubt (they were not sure what to choose). As it turned out, this category was not selected in the whole evaluation corpus (corresponding to the 10% of the overall), and only 6 times out of the 4801 instances of pairs event-source in the 30% of the total (table 9.5). This suggests that, when annotating, we tend to look for a disambiguated interpretation of the textual fragment very much in the same way we do when using language in natural contexts.

The number of instances in the categories of OTHER and NA are also used to indirectly evaluate the notion of relevant source introduced in this dissertation. The

set of relevant sources of each event is computed recursively given the set of relevant sources at the previous evaluation level (Definition 6.3.1). This recursive computation causes an exponential growth on the number of relevant sources at each level, which makes human identification a difficult task. Because of that, I opted for testing the concept of relevant source in an indirect way.

Instead of asking annotators to come up with the sources they thought were relevant for each event, I used the formal definition mentioned above and automatically computed the set of sources relevant for each event in the corpus.[8] When in task 3 annotators were asked to determine the factuality value of events according to the computed relevant sources, they had the option of selecting value NA, if they decided that the factuality could not be evaluated, or OTHER if they did not know what to select. These were, therefore, the values they would have opted for in case of considering that the sources computed as relevant were in fact not adequate for evaluating that event. As shown in table 9.5, however, the two annotators together selected NA or OTHER only for 19 instances over a total number of 4801 source/event pairs (10 in one case, 9 in the other).

9.2 Running De Facto

9.2.1 Performance

De Facto was run on the parsed version of my evaluation corpus. In order to avoid external noise in the results, I manually corrected an estimated 2% (at the lowest bound) of the dependencies involving subordination structures which were wrong. Table 9.6 illustrates the confusion matrix resulting from mapping the gold standard (rows) against De Facto output (columns). As can be appreciated, instances annotated as NA or OTHER were excluded from the evaluation, given that De Facto does not include these two categories in its value set.

De Facto performance is evaluated both in terms of interannotation agreement (by means of *kappa*) and using precision and recall. For evaluating precision and recall, I have taken into account only those categories for which there exists more than

[8]The annotators had previously identified what was the new source introduced at each level, through task 2.

Table 9.6: Confusion matrix: Gold standard (rows) vs. De Facto output (columns)

	CT+	**CT-**	**Ctu**	**PR+**	**PR-**	**Pru**	**PS+**	**PS-**	**Psu**	**Uu**	
CT+	1180	0	0	1	0	0	2	0	0	93	1276
CT−	11	38	0	0	0	0	0	0	0	2	51
CTu	0	0	0	0	0	0	0	0	0	1	1
PR+	11	0	0	11	0	0	0	0	0	3	25
PR−	0	0	0	0	0	0	0	0	0	0	0
PRu	0	0	0	0	0	0	0	0	0	0	0
PS+	8	0	0	0	0	0	22	0	0	3	33
PS−	0	0	0	0	0	0	0	2	0	0	2
PSu	0	0	0	0	0	0	0	0	0	0	0
Uu	161	4	1	3	0	0	15	1	0	619	804
	1374	42	1	15	0	0	39	3	0	723	2192

10 instances classified as such in both the gold standard and the De Facto output. This includes: CT+, CT−, PR+, PS+, Uu. Categories with less instances are not statistically relevant.

Table 9.7: Precision and Recall for each relevant category

	CT+	**CT-**	**PR+**	**PS+**	**Uu**
Precision	0.86	0.90	0.73	0.56	0.86
Recall	0.92	0.75	0.44	0.67	0.77
F-1	0.89	0.82	0.55	0.61	0.81

Precision and recall for each of these categories is as shown in table 9.7. As expected, the best score (in terms of F-1 measure) is achieved for CT+. The next category in the ranking is then CT−, although this result, together with those for PR+ and PS+ have to be taken cautiously, given the sparsity of data in these categories. Nevertheless, the 0.90 precision achieved for CT− is encouraging, if we consider that polarity here is not only determined locally but by means of subordinating predicates as well.

In order to obtain the precision and recall for the whole corpus, two averaging measures have been applied: macro-averaging and micro-averaging. The first one corresponds to averaging the result for that measure obtained in each category. The second one consists in, first, collecting together the decisions for all the categories in a single contingency table, and then applying the measure over those data (Manning

& Schütze, 1999). Because the first one gives equal weight to each category, it over-emphasizes the performance of less populated categories. On the other hand, the second gives equal weight to each classified instance, and therefore tends to over-emphasize the performance of larger categories. Both measures are given in table 9.8.

Table 9.8: Precision and Recall for the evaluation corpus

	Macro-averaging	**Micro-averaging**
Precision	0.78	0.85
Recall	0.71	0.85
F-1	**0.74**	**0.85**

On the other hand, in terms of interannotation agreement, De Facto achieves a *kappa* of k_{cohen}=**0.72**, which can be adjusted by $k_{s\&c}$=0.70 and $2P(A) - 1$=0.71. Overall, these are very positive results.

9.2.2 Error analysis

Interestingly, many sources of error coincide with sources of annotator disagreement, reviewed in section 9.1.4. I will comment on the most significant cases in what follows, addressing first those situations where De Facto was not sophisticated enough to identify contexts of polarity other than positive. In particular, those in which the gold standard opts for CT− and De Facto selects CT+. Then, we will analyze the cases were De Facto was not able to identify a lower modality degree, annotating as CT+ what in the gold standard is characterized as PR+ or PS+. Next, we will look at the contexts in which the profiler moved to an uncommitted value instead of keeping the default CT+, and finally the situations in which it was not able to select the uncommitted Uu.

Missing contexts of negative polarity. This specifically concerns those cases in which the gold standard opts for CT− and De Facto selects CT+ or Uu. There are three types of error here. First, those originating from a limitation in De Facto's treatment of negation. De Facto accounts for several ways of expressing negation in English;

e.g., direct negation of the predicate, negation of one of the predicate arguments, such as the subject or the object, certain types of adverbial modification, etc. (refer to section 7.1). However, it still misses some other contexts. Most commonly:

- Cleft constructions; e.g., *But it's not tonight we're* **worried** *about.*
- Copulative constructions (e.g., *was not a defendant*).

Because of how these structures are represented in the dependency parse, De Facto should be customized to identify and handle them appropriately. It is therefore not a problem of feasibility, but of algorithm specificity.

Another type of error here has to do with the interpretation of aspectual predicates of termination (e.g., *stop, finish*). De Facto interprets them as qualifying their embedded event as a fact in the world (CT+), whereas the gold standard treats them as introducing counterfactuality (CT−).

Finally, some of the errors are due to a wrong parse from the dependency parser, which escaped my manual error checking step and mislead De Facto's algorithm.

Missing contexts of modality lower than certain (CT). This includes those situations in which the gold standard opted for either PR+ or PS+ whereas De Facto selected the default CT+.

As before, some of the problems here are due to the inability of De Facto for handling certain constructions –not because it is not feasible, but because their treatment has not been implemented as part of the algorithm. In particular, it is the case of copulative constructions, already identified as a source of error for cases of negative polarity.

A second problem here has to do with lexical information. De Facto cannot cope with the polysemy of certain factuality markers. For instance, *believe* or *think* when used with a subject in 3rd person tends to express the highest degree of certainty of that subject with regards to the complement event –refer to examples (182) above. This is the way these predicates are modeled in De Facto's lexicon. In some cases, however, they allow for an interpretation with a lower degree of modality as well (PR+). Similarly, the modal auxiliary *would* is employed in embedded contexts to express future (and hence CT+, which is how De Facto models it), but there are certain constructions in which it expresses some degree of uncertainty. For instance:

(185) For now, though, that would **be** a theoretical advantage since the authorities have admitted they have no idea where Kopp is.

This same problem is observed in the case of the modal auxiliary *can*, which according to De Facto always qualifies its modified event as PS+, but that in its ability interpretation, is actually qualifying it as underspecified.

Selecting the underspecified value Uu, instead of the default CT+. This situation includes 93 instances of error. Most error sources here were also cases of disagreement between annotators. For example:

- Purpose clauses. They generally express uncertainty in the future (Uu) and this is how De Facto interprets them. However, some contexts may allow for an factual interpretation (CT+). Refer to example (181).

- Nouns embedded under contexts of uncertainty. Despite the contextual factuality being uncertain (Uu), the event expressed by the noun can, in some cases, be presented as factual (CT+). In the following sentence, for example, the event *shooting* is embedded in the uncertain context triggered by the EPS *charged* –when evaluated relative to the source author. Refer also to example (179).

  (186) The Canadian warrant issued Monday charged Kopp with attempted murder in the 1995 **shooting** of Dr. Hugh Short, who was wounded in the elbow but survived the attack at his home in Ancaster, Ontario .

- Presupposition-triggering constructions (such as temporal clauses), embedded under a reporting predicate. For example.

  (187) Authorities obtained a material-witness arrest warrant for Kopp after they said Kopp's car was spotted in Amherst in the weeks [before Slepian was **killed**].

  De Facto assumes the event in these constructions is only characterized as a fact (CT+) according to the cognizer of the reporting event, but not the anchor (here, the text author), which remains uncommitted (Uu). However, the gold standard considers that (for at least in some cases) the text author takes the event as factual as well.

Aside from these issues, I could identify over 8% of errors due to wrong parses from the dependency parser, and what is more, around 7% of cases in which De Facto was actually correct. For instance, in the following sentence, the factuality assignment of source *author* with regards to event *agreed* should be Uu, as predicted by De Facto.

(188) All the political parties in the upper house, with the exception of the Greens, **agreed** on the enlargement process, according to reports reaching here .

Opting for a value other than the underspecified value Uu. This situation includes the cases where the gold standard selects for the underspecified value Uu, whereas De Facto chooses a more committed value; that is, involving any degree of modality equal or higher than PS. There are a total of 185 cases.

A common source of error here is De Facto's inability to identify particular syntactic contexts introducing factuality underspecification, such as conditional constructions or structures of the form *the goal is*, in which the event in the predicative complement is qualified as Uu by the nominal in the subject position. Similarly, De Facto cannot recognize generic events, which tend to require the underspecified value Uu as well. De Facto also suffers from some gaps at the lexical level. In spite of its extensive lexical coverage, it still lacks some ESPs such as *conspiracy* (as in *a conspiracy to commit murder*) or *easy* (as in *it is easier to seek an alternative candidate*).

The second main source of error here is polysemy. At the syntactic level, for example, De Facto assumes a unique interpretation for relative and participial clauses when embedded under a reporting or belief context; namely, that the event in the clause is evaluated as a fact by both the cognizer of the reporting act (or belief state), and the anchor (as justified in section 7.4). Most of these contexts in the gold standard are characterized as such, but there are some as well in which the anchor is presented as uncommitted (189). De Facto has no way of distinguishing between the two situations.

(189) Preliminary DNA tests link a missing anti-abortion activist to a strand of hair found near where a sniper shot and killed a Buffalo, N.Y., doctor [who **performed** abortions], a law enforcement official said Friday.

Polysemy is indeed present at the lexical level as well. ESPs or modal markers can have more than one factuality interpretation; that is, they can characterize the event

they scope over with different factuality values, depending on the context. Typically ambiguous modality markers are for example the auxiliaries *would* and *can*, as seen above.

Finally, there are also a number of errors due to a difference in the interpretation of certain ESPs between the gold standard and De Facto –without however being the case that these ESPs are ambiguous. An interesting example of this is provided by ESPs typically considered factive predicates, such as *announce* or *inform*. In the gold standard, there are instances of these predicates which are interpreted as regular reporting predicates; that is, the anchor is presented as uncommitted with regards to the event in the embedded complement. In the following sentence, for instance, the gold standard presents source *company_author* as uncommitted with regards to event *violated*.

(190) The company said it was <u>informed</u> Friday that it **violated** MindSpring's policy on "threatening and harassing language."

As with previous situations, a number of errors are due to external sources as well; in particular, due to the dependency parser. For example, some purpose clauses are wrongly tagged and therefore cannot be properly handled by De Facto. Similarly, there is a number of cases which are in fact correctly analyzed by the algorithm.

Chapter 10

Conclusions and future work

10.1 Conclusions

This work attempts to provide a contribution to the problem of identifying factuality in discourse. Its main achievements concern both the theoretical framework presented in the first part of the work, and its computational model, introduced in the second.

With regard to the descriptive framework, I have put forward a *set of factuality values* in accord with the dominant view on the modal system within the linguistics literature. It distinguishes among three degrees of epistemic modality (*certain, probable*, and *possible*), in addition to a fourth underspecified value. The final set results from the cartesian product between these values and the set of values structuring the polarity system: *positive, negative*, and *underspecified*.

Furthermore, I designed the *battery of tests* that help distinguish among the different factuality values, which is inspired on the findings in Horn (1989). The adequacy of such approach is confirmed by the fairly good interannotation agreement score obtained for task 3 (annotating the factuality assessments of events by each of their relevant sources): $k_{cohen} = 0.81$. There is indeed room for improvement, although as explained earlier, around two thirds of the disagreement are cases of true ambiguity.

Comparing these results with less encouraging ones obtained in similar work (i.e., Rubin, 2007), I argued that they are due to the approach intentionally assumed in this dissertation. Namely, the setting of a solid grounding to the analyzed phenomenon, both structurally, by singling out the set of factuality markers employed in English

from a grammatical perspective, and from a semantic level, by determining the criteria transmuting our intuitions as speakers into well-identified semantic values.

A second contribution of my dissertation concerns the notion of *source*. The necessary role of source participants is already acknowledged in previous work on opinion and perspective (e.g., Wiebe, 2003; Wiebe et al., 2005), where the concept of nested source is assumed as basic. Stemming from that research, my proposal contributes an additional level of refinement by formally identifying the set of *relevant sources* for each event, as well as distinguishing between the roles of *anchor* and *cognizer*. Assessing event factuality relative to a set of one or more relevant sources allows us to express the different factuality values that are sometimes attributed to the same event. On the other hand, the concepts of anchor and cognizer not only add expressiveness to the descriptive model for EPSs, but become fundamental as well in the resulting computational model.

The notions of relevant source, anchor role, and cognizer role are not easy to evaluate by means of manual annotation of corpora. Nonetheless, their adequacy has been tested indirectly: through annotation task 3, in the case of relevant sources, and by means of De Facto evaluation, in the case of anchor and cognizer, given the fundamental role they play in computing event factuality.

The descriptive framework put forward in the first part of the dissertation has been central in designing (a) the algorithm for computing the factuality of events, implemented at the core of the factuality profiler De Facto, as well as (b) the set of linguistic resources informing it. The algorithm applies top-down, traversing a dependency tree, and is strictly based on information made explicit through linguistic expressions –the so-called factuality markers. It overcomes the limitations of the suite of tools presented in Saurí et al. (2006a), by incorporating the effects of the interaction among different factuality markers scoping over the same event, as well as identifying the relevant sources and assessing the factuality of events relative to them.

The results obtained from running De Facto against the evaluation corpus are fairly satisfactory. In terms of interannotation agreement, it achieves a score of $k_{cohen} = 0.72$. In terms of precision and recall, it obtains $P = 0.78$, $R = 0.71$, $F1 = 0.74$ (macro-averaging) and $P = R = F1 = 0.85$ (micro-averaging). Some of the identified errors are due to limitations in the implementation of the tool (e.g., not covering certain syntactic constructions, lexical gaps, or incapacity of dealing with

lexical polysemy). Others, however, are due to the inherent ambiguity in certain constructions or wrong analyses in the dependency parse used as De Facto's input.

On the other hand, these results should be taken cautiously. De Facto does not have implemented yet two of its basic components: the module for identifying SIPs, and the module for determining the new sources that are introduced by each of these SIPs. In addition, error in the input data has been minimized as much as possible by manually correcting parsing errors in the input dependency trees, as well as feeding it with manually identified events. Indeed, these two measures cannot be assumed in a final system.

A particular rewarding component of the research was the manual creation of the lexical resources informing De Facto, in particular, the dictionaries of ESPs. The work was carried out in a data-driven fashion, by exploring the behavior of those predicates in real corpora and subsequently characterzing them with the set of factuality assignments they express in different factuality contexts. During this compilation process, ESPs were grouping themselves into factuality types, which in addition could be clustered into semantic classes reflecting the major findings in the literature on this kind of predicates and the semantics of their embedded events (e.g., among many others, Kiparsky & Kiparsky, 1970; Karttunen, 1970, 1971, 1973; Hooper, 1975; Bach & Harnish, 1979; Givón, 1980; Bergler, 1992; Asher, 1993; Dor, 1995; Peterson, 1997; Ginzburg & Sag, 2000).

Testing De Facto against a manually annotated corpus has been a very valuable exercise for confirming (or denying) the analyses on specific issues in the linguistics literature. For example, the projection, up to the matrix clause level, of presupposed material embedded under a reporting predicate, which is a controversial issue in the literature, became one of the main sources of disagreement between annotators first, and between the gold standard and De Facto judgments later.

A further consequence of this work is the creation of FactBank, a corpus of over 200 documents with event factuality manually annotated. FactBank is still a bit limited in the sense that some of the factuality values are underrepresented. However, it constitutes a very valuable resource for deepening in the analysis of event factuality and its automatic identification.

10.2 Future research

Further work stemming from this dissertation ranges from quite specific tasks enhancing De Facto, to wider and more open projects related to event factuality in general.

Within the first category, there is the possibility of completing De Facto as an autonomous tool. At present, it relies on three auxiliary input data sources providing it with manually annotated information that it should be able to obtain by automatic means. They contain: the set of events to be assessed in each text, the set of SIPs in each text, and the set of new sources introduced by those SIPs.

Event recognition within De Facto can handled by one of the already existing event identifiers. The most natural choice is EvITA, either in its stand-alone version, or as part of the TARSQI toolkit (Verhagen et al., 2005), given that De Facto embraces the same concept of event that is assumed there. On the other hand, SIP recognition can be carried out by means of a classifier trained on FactBank. Finally, identifying the new sources introduced by SIPs can be possibly approached as a very restricted problem of semantic role labeling. In particular, as the subtask of labeling core arguments (for which current results are reasonable) of a very delimited set of predicates. There exists a growing interest on source identification within the field of opinion analysis, although the results obtained so far show some room for improvement (Bethard et al., 2004; Kim & Hovy, 2005; Choi et al., 2005). Nevertheless, the recent achievements in the area of semantic role labeling is encouraging for the purpose of the task at hand (cf. Gildea & Jurasky, 2002; Carreras & Màrquez, 2005; Pradhan et al., 2007).

A second enhancement of De Facto involves enriching the set of factually relevant syntactic constructions that it handles. Currently, it only deals with some of those that the dependency parser is able to identify with some degree of reliability (relative clauses, participial clauses, and purpose clauses), but there are other constructions that are fundamental as well, such as conditional structures or appositions. De Facto would need to be specifically customized for each of them.

De Facto has shown an acceptable level of performance as a proof of concept, but it can only cope with very limited cases of lexical polysemy –those triggered by predicative elements if the polysemy correlates with a difference in the syntactic

type of the selected argument. Hence, the different factual interpretation of nominals in a direct object position, or of modal auxiliaries, cannot be accounted for. A further enhancement of De Facto requires tackling this issue, possibly by introducing a statistical component that can interact with the information currently available in the lexicon.

At a more theoretical level, there are at least three areas that deserve some attention. My research has neglected the specific issues brought in by event-denoting nouns with regards to their factual interpretation, which involves issues such as definiteness or information of ontological nature. Similarly, the effect of the so-called *plug* predicates (Karttunen, 1973) in the projection of presupposed material to the matrix clause level is not completely clear. And finally, additional work should be devoted to the role of temporal connectives (e.g., *before, until*), which allow for a veridical or non-veridical interpretation of the embedded event depending on contextual information such as the presence of polarity items, or the main predication in the sentence and its relation with the one in the temporal clause. An interesting line of research would be exploring these three issues in light of the data in FactBank.

More general lines of research involve widening the theoretical framework of event factuality as presented in this dissertation. An interesting and necessary topic along these lines is source reliability. At the moment, the computation of event factuality rests on the naïve decoder assumption. However, the framework needs to be enriched in order to account for the different credibility degrees that readers assign to sources depending on their set of beliefs, or on the role conferred to each source (e.g., witness, expert, etc.).

A further potential enrichment of the current framework involves incorporating discourse structure as a source of factual information as well. That requires having an event correference resolution component and, equally importantly, a mechanism for overwriting previously assigned factuality values. The same approach could indeed be used for multi-document factuality identification. My hypothesis is that such technology could be remarkably beneficial for enhancing the performance of tools in the areas of summarization or question answering.

Finally, another line of research resulting from this dissertation would be extending the approach presented here to the identification of opinion and perspective information as well. In particular, this other area could benefit from the definition of relevant

sources and the algorithm to automatically compute them, as well as the algorithm for computing the interaction among different markers of polarity and modality, very much along the research line proposed in Polanyi & Zaenen (2005).

Part III

Appendices

Appendix A

Factual types and their lexical entries

Class	POS	ESP	Syntactic type of the embedded event
announce	Verb	*agree*	ccomp
		announce	dobj, ccomp
		assure	prep, ccomp
		certify	ccomp
		confirm	ccomp
		convict	prep_of
		declare	xcomp, purpcl, dobj
		deduce	ccomp
		deliver	dobj
		discuss	dobj
		divulge	dobj, ccomp
		ensure	ccomp
		guarantee	dobj, ccomp
		notify	ccomp
		post	dobj
		prove	ccomp
		publish	dobj
		reassure	prep, ccomp
		report	dobj
		rule	ccomp
		show	dobj, ccomp
	Noun	*announcement*	prep_of, ccomp
		assurance	prep_of, ccomp
		certification	prep_of, ccomp
		confirmation	ccomp
		discovery	prep_of, ccomp
		guarantee	ccomp

		indication	prep_of, ccomp
		proof	prep_of, ccomp
		report	prep_of
appear	Verb	*appear*	ccomp
		seem	xcomp, ccomp
	Noun	*appearance*	prep_of, ccomp
attempt	Verb	*attempt*	xcomp, purpcl
		authorize	dobj
		dare	xcomp, purpcl
		intend	xcomp, purpcl
		invite	purpcl
		promise	xcomp, purpcl, infmod
		try	xcomp, purpcl
	Noun	*attempt*	xcomp, purpcl, infmod
		effort	xcomp, purpcl, infmod
		promise	xcomp, purpcl, infmod
	Adj	*available*	prep_for
		enough	xcomp, purpcl, infmod, advcl
cause	Verb	*assist*	xcomp, purpcl
		cause	xcomp, purpcl
		ensure	dobj, ccomp
		force	xcomp, purpcl
		grant	ccomp
		guarantee	dobj, ccomp
		help	xcomp, purpcl, ccomp
		implement	dobj
		indicate	ccomp
		lure	dobj
		mean	ccomp
		persuade	dobj
		prove	acomp, ccomp
		reveal	ccomp, dobj
		show	dobj, ccomp
		use	xcomp, purpcl
	Noun	*help*	xcomp, purpcl, infmod
		indication	prep_of, ccomp
		indicator	prep_of, ccomp
		sign	prep_of, prep, ccomp
	Adj	*due*	xcomp, purpcl, infmod
certainty	Noun	*certainty*	prep_of, prep_about, ccomp
	Adj	*certain*	ccomp
		sure	ccomp
confirm	Verb	*confirm*	ccomp
	Noun	*confirmation*	prep_of
		proof	prep_of, ccomp
		recognition	prep_of, ccomp
conjecture	Verb	*anticipate*	ccomp
		assume	ccomp

		caution	prep_about
		concern	ccomp
		conjecture	ccomp
		estimate	prep_at, ccomp
		expect	xcomp, purpcl, dobj, ccomp
		feel	ccomp
		figure	ccomp
		forecast	dobj, ccomp
		foresee	prep_as, dobj
		guess	dobj, ccomp
		intimate	dobj, ccomp
		postulate	dobj
		predict	dobj, ccomp
		presume	xcomp, purpcl, ccomp, dobj
		project	ccomp
		reckon	prep_on
		rumor	dobj, ccomp
		speculate	ccomp
		suggest	dobj, ccomp
		suppose	nsubjpass, ccomp
		suspect	prep_of, dobj, prep, ccomp
		talk	prep_of
		worry	prep_about, ccomp
	Noun	*assumption*	prep_of, ccomp
		concern	ccomp
		conjecture	ccomp
		estimate	ccomp
		expectation	ccomp
		feeling	ccomp
		hypothesis	ccomp
		prediction	prep_of, ccomp
		presumption	prep_of, ccomp
		suggestion	ccomp
		supposition	ccomp
		suspicion	prep_of, ccomp
		warning	ccomp
	Adj	*accused*	prep_of, ccomp
		confident	ccomp
		presumed	xcomp, purpcl, ccomp
		worried	prep_about, ccomp
consider	Verb	*consider*	xcomp, dobj
deny	Verb	*deny*	ccomp
		exclude	ccomp
disclose	Verb	*agree*	nsubjpass
		applaud	dobj
		ask	whycomp
		assail	prep_for, prep, dobj
		attack	dobj

		attribute	dobj
		believe	nsubjpass
		cable	prep_about
		celebrate	dobj, ccomp
		comment	prep_on
		complain	prep_about
		concern	prep_about, dobj
		condemn	dobj
		confirm	dobj, nsubjpass
		criticize	prep_for, dobj, nsubjpass, ccomp
		declare	nsubjpass
		decry	dobj
		defend	dobj
		delight	xcomp, purpcl, prep_with, prep_about, ccomp
		demonstrate	dobj
		denounce	dobj, ccomp
		deny	dobj
		deplore	dobj, ccomp
		describe	nsubjpass, dobj
		disclose	ccomp
		disregard	dobj
		enjoy	xcomp, dobj, ccomp
		estimate	nsubjpass, dobj
		exclude	dobj
		excuse	prep_for, ccomp
		expect	nsubjpass
		experience	dobj
		explain	dobj
		feel	prep_about, nsubjpass
		find	nsubjpass
		forgive	ccomp
		gloss	prep_over
		hail	dobj
		hate	dobj, ccomp
		hear	nsubjpass
		inform	ccomp
		investigate	nsubjpass, ccomp
		know	whycomp
		lament	ccomp
		laugh	prep_at
		learn	prep_about
		list	nsubjpass, dobj
		look	prep_at
		love	ccomp, dobj
		mean	nsubjpass
		notice	whycomp
		notify	prep_about
		observe	dobj
		oppose	nsubjpass

		please	xcomp, ccomp
		predict	nsubjpass
		presume	nsubjpass
		protest	dobj
		publish	prep_on, nsubjpass
		quote	dobj
		recall	ccomp
		recognize	prep_as, dobj
		refer	prep_to
		regret	dobj, ccomp
		reject	dobj
		remember	dobj, whycomp
		report	prep_on, nsubjpass
		resent	dobj, ccomp
		reveal	ccomp
		rumor	nsubjpass
		say	nsubjpass
		see	nsubjpass
		sketch	dobj
		specify	ccomp
		spell	dobj
		spread	dobj, ccomp
		support	dobj
		surprise	xcomp, purpcl, nsubjpass
		tell	prep_about
		testify	prep_about
		thank	dobj
		value	nsubjpass, dobj
		view	dobj
		watch	ccomp
		welcome	dobj
		witness	dobj
		wonder	whycomp
	Noun	*acceptance*	prep_of
		affirmation	prep_about
		comment	prep_on, prep_about
		complaint	prep_about
		concern	prep_about
		disappointment	ccomp
		disclose	prep_of, ccomp
		estimate	prep_of
		laugh	prep_about
		pleasure	ccomp
		regret	prep_at, ccomp
		resentment	prep_about, ccomp
		view	prep_of
	Adj	*crazy*	xcomp, purpcl, infmod, prep_about, ccomp
		delighted	xcomp, prep_with, purpcl, ccomp, prep_about,

			infmod
		exciting	ccomp
		glad	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
		happy	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
		interesting	ccomp
		pleased	xcomp, infmod, ccomp
		presumed	nsubjpass
		proud	xcomp, infmod, ccomp
		strange	ccomp
		sure	prep_about
		surprised	xcomp, purpcl, nsubjpass
		unfortunate	ccomp
		unhappy	xcomp, prep_over, prep_with, purpcl, ccomp, prep_about, infmod, prep
		unknown	whycomp
		unsure	prep_about
		well-known	nsubj, ccomp
doubt	Verb	*doubt*	ccomp
	Noun	*doubt*	prep_on, ccomp
evidence	Noun	*evidence*	prep_of, ccomp
	Adj	*careful*	xcomp
		evident	ccomp
expected	Verb	*believe*	xcomp
		expected	xcomp, purpcl, ccomp
		thought	xcomp
fail	Verb	*avoid*	xcomp, purpcl
		cancel	nsubjpass, dobj
		deprive	prep_of
		excuse	prep_from
		fail	xcomp, purpcl
		forestall	dobj
		forget	xcomp
		head	xcomp, purpcl, dobj
		prevent	xcomp, purpcl, prep, prep_from, dobj
		refrain	prep_from
	Noun	*cancellation*	prep_of
		failure	prep_of
		lack	prep_of
	Adj	*false*	ccomp
fear	Verb	*confer*	prep_on, dobj
		consider	xcomp, purpcl, dobj, ccomp
		fear	dobj, ccomp
	Noun	*fear*	prep_of, ccomp
	Adj	*afraid*	dobj, ccomp
forget	Verb	*forget*	ccomp
hesitate	Verb	*delay*	dobj

		hesitate	xcomp, purpcl
		postpone	dobj
		stall	dobj
imagine	Verb	*imagine*	xcomp, ccomp
	Noun	*guess*	prep_of, ccomp
imply	Verb	*imply*	ccomp
		indicate	dobj, ccomp
	Noun	*implication*	ccomp
impossibility	Noun	*impossibility*	xcomp, infmod, ccomp
	Adj	*impossible*	xcomp, infmod, ccomp
improbability	Noun	*improbability*	xcomp, infmod, ccomp
	Adj	*improbable*	xcomp, infmod, ccomp
		inconceivable	ccomp
		unlikely	xcomp, infmod, ccomp
know_that	Verb	*accept*	ccomp
		account	prep_for, prep
		acknowledge	ccomp
		admit	ccomp
		clear	ccomp
		concede	ccomp
		discover	dobj, ccomp
		emphasize	dobj, ccomp
		expected	nsubjpass
		explain	whycomp
		figure	prep_out
		find	prep_out, ccomp
		hear	prep_about, dobj, ccomp
		ignore	ccomp
		investigate	dobj
		know	xcomp, prep_as, dobj, prep_about, prep_of, ccomp
		learn	ccomp
		note	ccomp
		notice	ccomp
		perceive	ccomp
		point	ccomp
		read	prep_about
		realize	prep_about, ccomp
		remember	xcomp, prep_about, ccomp
		say	whycomp
		see	xcomp, purpcl, dobj, ccomp
		shout	whycomp
		signal	ccomp
		stress	dobj, ccomp
		understand	ccomp
		warn	ccomp
	Noun	*account*	prep_of
		confirmation	prep_of
		conjecture	prep_about

		signal	ccomp
		understanding	prep_of, ccomp
	Adj	*aware*	prep_of, prep, ccomp
know_if	Verb	*calculate*	ifcomp
		know	ifcomp
		notice	ifcomp
		remember	ifcomp
		say	ifcomp
		see	ifcomp
		shout	ifcomp
	Noun	*indication*	ifcomp
	Adj	*certain*	ifcomp
		unknown	ifcomp
lookLike	Verb	*appear*	ccomp
		look	ccomp
manage	Verb	*accept*	dobj
		accomplish	xcomp, dobj
		achieve	xcomp, dobj
		acquire	dobj
		agree	xcomp, purpcl, prep_on
		allow	xcomp, purpcl
		approach	dobj
		become	dobj
		begin	xcomp, purpcl, dobj
		bother	xcomp, purpcl
		carry	dobj
		choose	xcomp, purpcl
		commit	xcomp, purpcl, prep, prep_to
		complete	xcomp, purpcl, dobj
		convince	xcomp, purpcl
		decide	xcomp, purpcl
		develop	dobj
		elect	xcomp, purpcl
		enable	xcomp, purpcl
		face	dobj
		finish	xcomp, purpcl, dobj
		happen	ccomp
		hold	dobj
		keep	xcomp, purpcl
		launch	dobj
		lead	xcomp, purpcl
		let	ccomp
		manage	xcomp, purpcl
		name	xcomp, purpcl
		offer	dobj
		open	dobj
		remember	xcomp, purpcl
		result	prep, prep_in, ccomp

		spark	dobj
		start	xcomp, purpcl, dobj
		suffer	dobj
		turn	prep_out, ccomp
	Noun	*accomplishment*	prep_of
		achievement	prep_of
		beginning	prep_of
		close	prep_of, prep
		closing	prep_of, prep
		commitment	xcomp, purpcl, infmod, prep_to, prep
		completion	prep_of
		effect	prep_of
		end	prep_of, prep
		ending	prep_of, prep
		opening	prep_of
		outcome	prep_of
		ratification	prep_of
		result	prep_of
	Adj	*successful*	prep_at, prep_in
		true	ccomp
possibility	Verb	*chance*	prep_of, prep
	Noun	*chance*	xcomp, purpcl, prep_to, infmod, prep_of, prep
		possibility	prep_of, xcomp, prep, purpcl, infmod
	Adj	*able*	xcomp
		possible	xcomp, ccomp
pretend	Verb	*pretend*	ccomp
		purport	xcomp
probability	Noun	*encouragement*	xcomp, prep_for, infmod, purpcl
		likelihood	prep_of, ccomp
		probability	ccomp
	Adj	*likely*	xcomp, ccomp
		probable	xcomp, ccomp
refuse	Verb	*block*	prep_from
		decide	prep_against
		decline	xcomp, purpcl
		forbid	xcomp, purpcl, prep_from, prep
		refuse	xcomp, purpcl
	Noun	*prohibition*	xcomp, purpcl, prep_from
say	Verb	*according*	according
		accuse	prep_of
		add	ccomp
		affirm	ccomp
		allege	ccomp
		answer	ccomp
		argue	ccomp
		assert	ccomp
		assume	dobj
		attribute	xcomp, prep_to, prep_on

		bet	ccomp
		brim	ccomp
		calculate	ccomp
		call	xcomp, purpcl, dobj
		chant	ccomp
		charge	prep_with, ccomp
		choose	ccomp
		cite	prep_as, dobj
		claim	ccomp, dobj
		complain	ccomp
		conclude	ccomp
		counter	ccomp
		decide	ccomp
		declare	ccomp
		defend	ccomp
		describe	prep_as
		establish	dobj, ccomp
		explain	ccomp
		express	dobj, ccomp
		hold	dobj
		indicate	ifcomp
		indict	prep_as
		insist	ccomp
		list	prep_as, prep
		maintain	ccomp
		mention	ccomp
		object	ccomp
		observe	ccomp
		persuade	ccomp
		plead	acomp
		publish	prep_as, ccomp
		quote	prep_as, prep_at, prep
		read	ccomp
		reason	ccomp
		refer	prep_as, prep
		reply	ccomp
		report	prep_as, ccomp
		say	xcomp, purpcl, advmod, ccomp, tmod
		shout	xcomp, purpcl, ccomp
		sigh	ccomp
		sign	ccomp
		sound	ccomp
		state	ccomp
		swear	xcomp, purpcl, ccomp
		tell	ccomp
		term	dobj
		testify	ccomp
		view	prep_as
		write	ccomp

		yell	ccomp
	Noun	*accusation*	ccomp
		affirmation	ccomp
		assertion	ccomp
		belief	ccomp
		call	dobj
		charge	prep_of, prep_with, ccomp
		claim	ccomp
		complaint	ccomp
		conclusion	ccomp
		declaration	ccomp
		news	prep_about, prep
		objection	ccomp
		perception	ccomp
		remark	ccomp
		report	ccomp
		sign	ccomp
	Adj	*alleged*	infmod
		evident	ccomp
skeptical	Adj	*skeptical*	ccomp
stop	Verb	*accept*	nsubjpass
		account	prep_for, prep, dobj
		adopt	dobj
		appeal	prep_to, dobj
		approve	dobj
		assume	dobj
		avoid	dobj
		bid	prep_for
		block	xcomp, purpcl, dobj
		break	dobj
		challenge	dobj
		continue	xcomp, purpcl, dobj
		control	dobj
		cover	dobj
		decline	dobj
		deflect	dobj
		design	dobj
		destroy	dobj
		devote	prep_to
		distort	dobj
		ease	dobj
		end	xcomp, purpcl, dobj
		expand	nsubjpass, dobj
		explore	dobj
		extend	dobj
		halt	dobj
		handle	dobj
		impose	dobj

		improve	dobj
		increase	dobj
		keep	dobj
		last	nsubj
		link	prep_to, xcomp, purpcl
		listen	prep_to, xcomp, purpcl
		maintain	dobj
		meet	dobj
		move	dobj
		nullify	dobj
		organize	dobj
		price	prep_at
		protect	nsubjpass, dobj
		provide	dobj
		rebut	dobj
		refer	prep_to, xcomp
		reject	dobj
		relate	prep_to
		remain	nsubj
		renounce	dobj
		respond	prep_to, prep_close_to, prep
		resume	xcomp, purpcl, dobj
		settle	dobj
		solve	nsubjpass, dobj
		staunch	dobj
		stop	prep_from, dobj
		suspend	dobj
		symbolize	dobj
		thank	dobj
		withdraw	dobj
	Noun	*acquisition*	prep_of
		adoption	prep_of
		anniversary	prep_of
		approach	dobj
		approval	prep_of
		bid	prep_for
		boost	prep_of, prep_from
		break	prep_of
		breakup	prep_of
		cease	prep_of
		challenge	prep_of
		change	prep_of
		compliance	prep_with
		conversation	prep_about
		coordination	prep_of
		criticism	prep_of, prep
		decline	prep_of
		decrease	prep_of
		destruction	prep_of

		exploration	prep_of
		extension	prep_of
		fact	prep_of, ccomp
		help	dobj
		improvement	prep_of
		increase	prep_of
		reference	prep_to, xcomp, infmod
		rejection	prep_of
		responsibility	prep_of, prep_for
		settlement	prep_of
		thanks	prep_to
		view	prep_of
	Adj	*compliant*	prep_of
		exciting	ccomp
		glad	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
		interesting	nsubj
		irrelevant	nsubj
		obvious	xcomp, nsubj, ccomp
		odd	xcomp, nsubj, ccomp
		relevant	nsubj
		responsible	prep_of, prep_for
		sad	prep_about, prep_for, ccomp
		significant	ccomp
		sorry	prep_about, prep_for, ccomp
		strange	xcomp, nsubj, ccomp
		sure	prep_about
		tragic	ccomp
		unfortunate	xcomp, nsubj, ccomp
		well-known	nsubj, ccomp
suggest	Verb	*assume*	ccomp
		suggest	ccomp
	Noun	*assumption*	prep_of, ccomp
		suspicion	prep_of
	Adj	*conceivable*	ccomp
sure	Verb	*mean*	ccomp
	Adj	*certain*	ccomp
		sure	ccomp
think	Verb	*believe*	purpcl, dobj, ccomp
		consider	acomp
		file	dobj
		find	xcomp, purpcl
		reckon	xcomp, purpcl, ccomp
		see	prep_as, acomp
		sees	dobj, ccomp
		think	xcomp, purpcl, dobj, nsubjpass, ccomp
		thought	purpcl, dobj, nsubjpass, ccomp
		value	prep_at

		view	ccomp
	Noun	*confidence*	ccomp
		thought	xcomp, purpcl, nsubjpass, prep_of, ccomp
		view	prep_as, ccomp
uncertainty	Noun	*uncertainty*	prep_of, prep_about, ifcomp, ccomp
	Adj	*uncertain*	ifcomp, ccomp
unsure	Verb	*dream*	ccomp
	Adj	*unsure*	ccomp
want	Verb	*accept*	xcomp
		advocate	dobj
		aim	prep_at
		appeal	prep_for
		ask	xcomp, purpcl
		await	xcomp, purpcl, dobj
		bid	xcomp, purpcl
		call	xcomp, prep_for, prep
		charge	prep_with
		choose	ifcomp
		compel	xcomp, purpcl
		demand	ccomp, dobj
		depend	prep_on, prep
		deserve	xcomp, dobj, ccomp
		design	xcomp, purpcl
		determine	xcomp, purpcl
		devote	purpcl, xcomp
		encourage	xcomp, purpcl
		enforce	prep_of, dobj
		entitle	xcomp, purpcl
		establish	xcomp, purpcl, dobj, ccomp
		expect	xcomp, purpcl
		fancy	xcomp, purpcl, dobj
		favor	xcomp, dobj
		hold	prep_for
		hope	xcomp, purpcl, ccomp
		invite	xcomp
		lead	prep_to
		like	prep_to, xcomp, purpcl
		love	prep_to, xcomp, purpcl
		need	xcomp, purpcl, infmod, dobj
		negotiate	xcomp, prep_for, infmod, purpcl, dobj
		offer	xcomp, purpcl
		order	xcomp, purpcl, dobj
		pay	xcomp, purpcl
		permit	xcomp, purpcl, dobj
		plan	xcomp, purpcl
		pledge	xcomp, purpcl
		poised	xcomp, purpcl, infmod
		prefer	xcomp, purpcl

		prepare	xcomp
		press	xcomp, purpcl
		price	xcomp, purpcl
		prohibit	xcomp, purpcl, dobj, prep_from, prep
		propose	purpcl, xcomp, nsubjpass, dobj
		protect	purpcl, xcomp
		provide	ccomp
		request	dobj
		require	ccomp, dobj
		schedule	xcomp, prep_for
		search	xcomp, prep_for, purpcl
		seek	xcomp, purpcl, prep_for, dobj
		sell	xcomp, purpcl
		sense	xcomp, purpcl
		set	xcomp, purpcl, prep_for
		sign	xcomp, purpcl
		suggest	xcomp, purpcl
		target	prep_for, dobj
		threaten	xcomp, purpcl, prep_with, prep
		urge	xcomp, purpcl
		vote	xcomp, purpcl
		vow	xcomp, purpcl
		wait	xcomp, purpcl
		want	xcomp, purpcl, prep_for
		wish	xcomp, purpcl, ccomp
		work	xcomp, purpcl
	Noun	*ability*	xcomp, purpcl, infmod
		access	xcomp, purpcl, infmod
		agreement	xcomp, purpcl, infmod
		approach	prep_to, prep_for
		argument	xcomp, prep_for, purpcl
		authorization	xcomp, purpcl, infmod
		bid	xcomp, infmod, purpcl
		call	xcomp, purpcl, infmod
		charge	prep_of
		clearance	xcomp, purpcl, infmod
		conversation	xcomp
		decision	xcomp, purpcl, infmod
		delay	prep_of
		demand	prep_of, ccomp
		desire	prep_of, xcomp, purpcl
		development	prep_of
		enforcement	prep_of, prep
		evidence	xcomp
		goal	xcomp
		hope	xcomp, prep_of
		intent	xcomp, purpcl, prep_on, prep_of, infmod
		intention	xcomp, purpcl, prep_of, infmod, prep
		invitation	xcomp, purpcl, infmod

		need	prep_of, xcomp, infmod, purpcl
		negotiation	prep_of, prep_for, xcomp, purpcl, infmod
		offer	xcomp, purpcl, infmod
		option	xcomp, purpcl, infmod
		order	xcomp, purpcl, infmod, dobj
		permission	xcomp, purpcl, infmod, prep_for
		permit	xcomp, purpcl, infmod
		plan	xcomp, purpcl, infmod
		potential	xcomp, purpcl, prep_of, infmod, prep_for
		preference	xcomp, purpcl, infmod, prep_for
		proposal	prep_of, prep_for, prep, infmod
		right	xcomp, purpcl, infmod
		search	prep_of, prep_for, xcomp, prep, purpcl
		struggle	xcomp, prep_for, infmod, purpcl
		subject	prep_to, xcomp, infmod, purpcl
		threat	prep_of, prep
		willingness	xcomp, purpcl, infmod
		wish	xcomp, purpcl, prep_of, ccomp
	Adj	*able*	prep_of
		anxious	xcomp, purpcl, infmod
		better	xcomp, purpcl, infmod
		capable	prep_of
		certain	ifcomp
		conditional	prep_on
		dependent	prep_on, prep
		difficult	xcomp
		eager	xcomp, purpcl, infmod
		eligible	xcomp, prep_for
		important	xcomp, infmod, ccomp
		intent	prep_on
		keen	xcomp, purpcl, prep_on, infmod, prep_for, prep
		lucky	xcomp, infmod, ccomp
		necessary	xcomp, infmod, ccomp
		negative	xcomp, infmod
		poised	xcomp, purpcl, infmod
		positive	xcomp, infmod
		ready	xcomp, purpcl, infmod
		reluctant	xcomp, purpcl, infmod
		responsible	xcomp, purpcl, infmod
		sufficient	xcomp, infmod
		unwilling	xcomp, purpcl, infmod
		urgent	xcomp, infmod, ccomp
		vital	xcomp, ccomp, infmod, nsubj
		willing	xcomp, purpcl, infmod
		worse	xcomp, purpcl, infmod
		worthwhile	xcomp, ccomp, nsubj
wonder	Verb	*ask*	ifcomp
		check	ifcomp, ccomp
		choose	ifcomp

		determine	ifcomp
		hope	xcomp, purpcl, ccomp
		investigate	ifcomp
		mean	xcomp, purpcl
		oppose	dobj, ccomp
		question	ccomp
		say	prep_of
		verify	ifcomp, ccomp
		vow	ccomp
		wonder	ifcomp, ccomp
	Noun	*call*	xcomp, purpcl, infmod
		hope	xcomp, purpcl, infmod, ccomp
		talk	prep_about, prep
	Adj	*worthwhile*	xcomp, ccomp, nsubj

Table A.1: ESP lexical entries classified by factuality types

Appendix B

Lexical entries and their factual types

B.1 SIP Lexical entries

POS	ESP	Class	Syntactic type of the embedded event
Adj	accused	*conjecture*	prep_of, ccomp
	afraid	*fear*	dobj, ccomp
	alleged	*say*	infmod
	aware	*know*	prep_of, prep, ccomp
	certain	*know_if*	ifcomp
		sure	ccomp
	confident	*conjecture*	ccomp
	crazy	*disclose*	xcomp, purpcl, infmod, prep_about, ccomp
	delighted	*disclose*	xcomp, prep_with, purpcl, ccomp, prep_about, infmod
	evident	*say*	ccomp
	exciting	*disclose*	ccomp
	glad	*disclose*	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
	happy	*disclose*	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
	interesting	*disclose*	ccomp
	pleased	*disclose*	xcomp, infmod, ccomp
	presumed	*conjecture*	xcomp, purpcl, ccomp
		disclose	nsubjpass
	proud	*disclose*	xcomp, infmod, ccomp
	skeptical	*skeptical*	ccomp
	strange	*disclose*	ccomp
	sure	*disclose*	prep_about
		sure	ccomp
	surprised	*disclose*	xcomp, purpcl, nsubjpass
	unfortunate	*disclose*	ccomp

	unhappy	*disclose*	xcomp, prep_over, prep_with, purpcl, ccomp, prep_about, infmod, prep
	unknown	*disclose*	whycomp
		know_if	ifcomp
	unsure	*disclose*	prep_about
		unsure	ccomp
	well-known	*disclose*	nsubj, ccomp
	worried	*conjecture*	prep_about, ccomp
	worthwhile	*wonder*	xcomp, ccomp, nsubj
Noun	acceptance	*disclose*	prep_of
	account	*know*	prep_of
	accusation	*say*	ccomp
	affirmation	*disclose*	prep_about
		say	ccomp
	announcement	*announce*	prep_of, ccomp
	argument	*want*	xcomp, prep_for, purpcl
	assertion	*say*	ccomp
	assumption	*conjecture*	prep_of, ccomp
	assurance	*announce*	prep_of, ccomp
	belief	*say*	ccomp
	call	*say*	dobj
		wonder	xcomp, purpcl, infmod
	certification	*announce*	prep_of, ccomp
	charge	*say*	prep_of, prep_with, ccomp
	claim	*say*	ccomp
	comment	*disclose*	prep_on, prep_about
	complaint	*disclose*	prep_about
		say	ccomp
	concern	*conjecture*	ccomp
		disclose	prep_about
	conclusion	*say*	ccomp
	confidence	*think*	ccomp
	confirmation	*announce*	ccomp
		know	prep_of
	conjecture	*conjecture*	ccomp
		know	prep_about
	declaration	*say*	ccomp
	disappointment	*disclose*	ccomp
	disclose	*disclose*	prep_of, ccomp
	discovery	*announce*	prep_of, ccomp
	doubt	*doubt*	prep_on, ccomp
	estimate	*conjecture*	ccomp
		disclose	prep_of
	expectation	*conjecture*	ccomp
	fear	*fear*	prep_of, ccomp
	feeling	*conjecture*	ccomp
	guarantee	*announce*	ccomp
	guess	*imagine*	prep_of, ccomp

	hope	*wonder*	xcomp, purpcl, infmod, ccomp
	hypothesis	*conjecture*	ccomp
	implication	*imply*	ccomp
	indication	*announce*	prep_of, ccomp
		know_if	ifcomp
	laugh	*disclose*	prep_about
	news	*say*	prep_about, prep
	objection	*say*	ccomp
	perception	*say*	ccomp
	pleasure	*disclose*	ccomp
	prediction	*conjecture*	prep_of, ccomp
	presumption	*conjecture*	prep_of, ccomp
	proof	*announce*	prep_of, ccomp
	regret	*disclose*	prep_at, ccomp
	remark	*say*	ccomp
	report	*announce*	prep_of
		say	ccomp
	resentment	*disclose*	prep_about, ccomp
	sign	*say*	ccomp
	signal	*know*	ccomp
	suggestion	*conjecture*	ccomp
	supposition	*conjecture*	ccomp
	suspicion	*conjecture*	prep_of, ccomp
	talk	*wonder*	prep_about, prep
	thought	*think*	xcomp, purpcl, nsubjpass, prep_of, ccomp
	understanding	*know*	prep_of, ccomp
	view	*disclose*	prep_of
		think	prep_as, ccomp
	warning	*conjecture*	ccomp
Verb	accept	*know*	ccomp
	according	*say*	according
	account	*know*	prep_for, prep
	accuse	*say*	prep_of
	acknowledge	*know*	ccomp
	add	*say*	ccomp
	admit	*know*	ccomp
	affirm	*say*	ccomp
	agree	*announce*	ccomp
		disclose	nsubjpass
	allege	*say*	ccomp
	announce	*announce*	dobj, ccomp
	answer	*say*	ccomp
	anticipate	*conjecture*	ccomp
	appear	*lookLike*	ccomp
	applaud	*disclose*	dobj
	argue	*say*	ccomp
	ask	*disclose*	whycomp
		wonder	ifcomp
	assail	*disclose*	prep_for, prep, dobj

assert	*say*	ccomp
assume	*conjecture*	ccomp
	say	dobj
assure	*announce*	prep, ccomp
attack	*disclose*	dobj
attribute	*disclose*	dobj
	say	xcomp, prep_to, prep_on
believe	*disclose*	nsubjpass
	expected	xcomp
	think	purpcl, dobj, ccomp
bet	*say*	ccomp
brim	*say*	ccomp
cable	*disclose*	prep_about
calculate	*know_if*	ifcomp
	say	ccomp
call	*say*	xcomp, purpcl, dobj
caution	*conjecture*	prep_about
celebrate	*disclose*	dobj, ccomp
certify	*announce*	ccomp
chant	*say*	ccomp
charge	*say*	prep_with, ccomp
check	*wonder*	ifcomp, ccomp
choose	*say*	ccomp
	wonder	ifcomp
cite	*say*	prep_as, dobj
claim	*say*	ccomp, dobj
clear	*know*	ccomp
comment	*disclose*	prep_on
complain	*disclose*	prep_about
	say	ccomp
concede	*know*	ccomp
concern	*conjecture*	ccomp
	disclose	prep_about, dobj
conclude	*say*	ccomp
condemn	*disclose*	dobj
confer	*fear*	prep_on, dobj
confirm	*announce*	ccomp
	disclose	dobj, nsubjpass
conjecture	*conjecture*	ccomp
consider	*fear*	xcomp, purpcl, dobj, ccomp
	think	acomp
convict	*announce*	prep_of
counter	*say*	ccomp
criticize	*disclose*	prep_for, dobj, nsubjpass, ccomp
decide	*say*	ccomp
declare	*announce*	xcomp, purpcl, dobj
	disclose	nsubjpass
	say	ccomp
decry	*disclose*	dobj

deduce	*announce*	ccomp
defend	*disclose*	dobj
	say	ccomp
delight	*disclose*	xcomp, purpcl, prep_with, prep_about, ccomp
deliver	*announce*	dobj
demonstrate	*disclose*	dobj
denounce	*disclose*	dobj, ccomp
deny	*deny*	ccomp
	disclose	dobj
deplore	*disclose*	dobj, ccomp
describe	*disclose*	nsubjpass, dobj
	say	prep_as
determine	*wonder*	ifcomp
disclose	*disclose*	ccomp
discover	*know*	dobj, ccomp
discuss	*announce*	dobj
disregard	*disclose*	dobj
divulge	*announce*	dobj, ccomp
doubt	*doubt*	ccomp
dream	*unsure*	ccomp
emphasize	*know*	dobj, ccomp
enjoy	*disclose*	xcomp, dobj, ccomp
ensure	*announce*	ccomp
establish	*say*	dobj, ccomp
estimate	*conjecture*	prep_at, ccomp
	disclose	nsubjpass, dobj
exclude	*deny*	ccomp
	disclose	dobj
excuse	*disclose*	prep_for, ccomp
expect	*conjecture*	xcomp, purpcl, dobj, ccomp
	disclose	nsubjpass
expected	*expected*	xcomp, purpcl, ccomp
	know	nsubjpass
experience	*disclose*	dobj
explain	*disclose*	dobj
	know	whycomp
	say	ccomp
express	*say*	dobj, ccomp
fear	*fear*	dobj, ccomp
feel	*conjecture*	ccomp
	disclose	prep_about, nsubjpass
figure	*conjecture*	ccomp
	know	prep_out
file	*think*	dobj
find	*disclose*	nsubjpass
	know	prep_out, ccomp
	think	xcomp, purpcl
forecast	*conjecture*	dobj, ccomp
foresee	*conjecture*	prep_as, dobj

forget	*forget*	ccomp
forgive	*disclose*	ccomp
gloss	*disclose*	prep_over
guarantee	*announce*	dobj, ccomp
guess	*conjecture*	dobj, ccomp
hail	*disclose*	dobj
hate	*disclose*	dobj, ccomp
hear	*disclose*	nsubjpass
	know	prep_about, dobj, ccomp
hold	*say*	dobj
hope	*wonder*	xcomp, purpcl, ccomp
ignore	*know*	ccomp
imagine	*imagine*	xcomp, ccomp
imply	*imply*	ccomp
indicate	*imply*	dobj, ccomp
	say	ifcomp
indict	*say*	prep_as
inform	*disclose*	ccomp
insist	*say*	ccomp
intimate	*conjecture*	dobj, ccomp
investigate	*disclose*	nsubjpass, ccomp
	know	dobj
	wonder	ifcomp
know	*disclose*	whycomp
	know	xcomp, prep_as, dobj, prep_about, prep_of, ccomp
	know_if	ifcomp
lament	*disclose*	ccomp
laugh	*disclose*	prep_at
learn	*disclose*	prep_about
	know	ccomp
list	*disclose*	nsubjpass, dobj
	say	prep_as, prep
look	*disclose*	prep_at
	lookLike	ccomp
love	*disclose*	ccomp, dobj
maintain	*say*	ccomp
mean	*disclose*	nsubjpass
	sure	ccomp
	wonder	xcomp, purpcl
mention	*say*	ccomp
note	*know*	ccomp
notice	*disclose*	whycomp
	know	ccomp
	know_if	ifcomp
notify	*announce*	ccomp
	disclose	prep_about
object	*say*	ccomp
observe	*disclose*	dobj
	say	ccomp

oppose	*disclose*	nsubjpass
	wonder	dobj, ccomp
perceive	*know*	ccomp
persuade	*say*	ccomp
plead	*say*	acomp
please	*disclose*	xcomp, ccomp
point	*know*	ccomp
post	*announce*	dobj
postulate	*conjecture*	dobj
predict	*conjecture*	dobj, ccomp
	disclose	nsubjpass
presume	*conjecture*	xcomp, purpcl, ccomp, dobj
	disclose	nsubjpass
pretend	*pretend*	ccomp
project	*conjecture*	ccomp
protest	*disclose*	dobj
prove	*announce*	ccomp
publish	*announce*	dobj
	disclose	prep_on, nsubjpass
	say	prep_as, ccomp
purport	*pretend*	xcomp
question	*wonder*	ccomp
quote	*disclose*	dobj
	say	prep_as, prep_at, prep
read	*know*	prep_about
	say	ccomp
realize	*know*	prep_about, ccomp
reason	*say*	ccomp
reassure	*announce*	prep, ccomp
recall	*disclose*	ccomp
reckon	*conjecture*	prep_on
	think	xcomp, purpcl, ccomp
recognize	*disclose*	prep_as, dobj
refer	*disclose*	prep_to
	say	prep_as, prep
regret	*disclose*	dobj, ccomp
reject	*disclose*	dobj
remember	*disclose*	dobj, whycomp
	know	xcomp, prep_about, ccomp
	know_if	ifcomp
reply	*say*	ccomp
report	*announce*	dobj
	disclose	prep_on, nsubjpass
	say	prep_as, ccomp
resent	*disclose*	dobj, ccomp
reveal	*disclose*	ccomp
rule	*announce*	ccomp
rumor	*conjecture*	dobj, ccomp
	disclose	nsubjpass

say	*disclose*	nsubjpass
	know	whycomp
	know_if	ifcomp
	say	xcomp, purpcl, advmod, ccomp, tmod
	wonder	prep_of
see	*disclose*	nsubjpass
	know	xcomp, purpcl, dobj, ccomp
	know_if	ifcomp
	think	prep_as, acomp
sees	*think*	dobj, ccomp
shout	*know*	whycomp
	know_if	ifcomp
	say	xcomp, purpcl, ccomp
show	*announce*	dobj, ccomp
sigh	*say*	ccomp
sign	*say*	ccomp
signal	*know*	ccomp
sketch	*disclose*	dobj
sound	*say*	ccomp
specify	*disclose*	ccomp
speculate	*conjecture*	ccomp
spell	*disclose*	dobj
spread	*disclose*	dobj, ccomp
state	*say*	ccomp
stress	*know*	dobj, ccomp
suggest	*conjecture*	dobj, ccomp
support	*disclose*	dobj
suppose	*conjecture*	nsubjpass, ccomp
surprise	*disclose*	xcomp, purpcl, nsubjpass
suspect	*conjecture*	prep_of, dobj, prep, ccomp
swear	*say*	xcomp, purpcl, ccomp
talk	*conjecture*	prep_of
tell	*disclose*	prep_about
	say	ccomp
term	*say*	dobj
testify	*disclose*	prep_about
	say	ccomp
thank	*disclose*	dobj
think	*think*	xcomp, purpcl, dobj, nsubjpass, ccomp
thought	*expected*	xcomp
	think	purpcl, dobj, nsubjpass, ccomp
understand	*know*	ccomp
value	*disclose*	nsubjpass, dobj
	think	prep_at
verify	*wonder*	ifcomp, ccomp
view	*disclose*	dobj
	say	prep_as
	think	ccomp
vow	*wonder*	ccomp

	warn	*know*	ccomp
	watch	*disclose*	ccomp
	welcome	*disclose*	dobj
	witness	*disclose*	dobj
	wonder	*disclose*	whycomp
		wonder	ifcomp, ccomp
	worry	*conjecture*	prep_about, ccomp
	write	*say*	ccomp
	yell	*say*	ccomp

Table B.1: SIP lexical entries

B.2 NSIP Lexical entries

POS	ESP	Class	Syntactic type of the embedded event
Adj	able	*possibility*	xcomp
		want	prep_of
	anxious	*want*	xcomp, purpcl, infmod
	available	*attempt*	prep_for
	better	*want*	xcomp, purpcl, infmod
	capable	*want*	prep_of
	careful	*evidence*	xcomp
	certain	*certainty*	ccomp
		want	ifcomp
	compliant	*stop*	prep_of
	conceivable	*suggest*	ccomp
	conditional	*want*	prep_on
	dependent	*want*	prep_on, prep
	difficult	*want*	xcomp
	due	*cause*	xcomp, purpcl, infmod
	eager	*want*	xcomp, purpcl, infmod
	eligible	*want*	xcomp, prep_for
	enough	*attempt*	xcomp, purpcl, infmod, advcl
	evident	*evidence*	ccomp
	exciting	*stop*	ccomp
	false	*fail*	ccomp
	glad	*stop*	xcomp, prep_with, purpcl, ccomp, prep_about, infmod, prep
	important	*want*	xcomp, infmod, ccomp
	impossible	*impossibility*	xcomp, infmod, ccomp
	improbable	*improbability*	xcomp, infmod, ccomp
	inconceivable	*improbability*	ccomp
	intent	*want*	prep_on
	interesting	*stop*	nsubj

	irrelevant	*stop*	nsubj
	keen	*want*	xcomp, purpcl, prep_on, infmod, prep_for, prep
	likely	*probability*	xcomp, ccomp
	lucky	*want*	xcomp, infmod, ccomp
	necessary	*want*	xcomp, infmod, ccomp
	negative	*want*	xcomp, infmod
	obvious	*stop*	xcomp, nsubj, ccomp
	odd	*stop*	xcomp, nsubj, ccomp
	poised	*want*	xcomp, purpcl, infmod
	positive	*want*	xcomp, infmod
	possible	*possibility*	xcomp, ccomp
	probable	*probability*	xcomp, ccomp
	ready	*want*	xcomp, purpcl, infmod
	relevant	*stop*	nsubj
	reluctant	*want*	xcomp, purpcl, infmod
	responsible	*stop*	prep_of, prep_for
		want	xcomp, purpcl, infmod
	sad	*stop*	prep_about, prep_for, ccomp
	significant	*stop*	ccomp
	sorry	*stop*	prep_about, prep_for, ccomp
	strange	*stop*	xcomp, nsubj, ccomp
	successful	*manage*	prep_at, prep_in
	sufficient	*want*	xcomp, infmod
	sure	*certainty*	ccomp
		stop	prep_about
	tragic	*stop*	ccomp
	true	*manage*	ccomp
	uncertain	*uncertainty*	ifcomp, ccomp
	unfortunate	*stop*	xcomp, nsubj, ccomp
	unlikely	*improbability*	xcomp, infmod, ccomp
	unwilling	*want*	xcomp, purpcl, infmod
	urgent	*want*	xcomp, infmod, ccomp
	vital	*want*	xcomp, ccomp, infmod, nsubj
	well-known	*stop*	nsubj, ccomp
	willing	*want*	xcomp, purpcl, infmod
	worse	*want*	xcomp, purpcl, infmod
	worthwhile	*want*	xcomp, ccomp, nsubj
Noun	ability	*want*	xcomp, purpcl, infmod
	access	*want*	xcomp, purpcl, infmod
	accomplishment	*manage*	prep_of
	achievement	*manage*	prep_of
	acquisition	*stop*	prep_of
	adoption	*stop*	prep_of
	agreement	*want*	xcomp, purpcl, infmod
	anniversary	*stop*	prep_of
	appearance	*appear*	prep_of, ccomp
	approach	*stop*	dobj
		want	prep_to, prep_for
	approval	*stop*	prep_of

assumption	*suggest*	prep_of, ccomp
attempt	*attempt*	xcomp, purpcl, infmod
authorization	*want*	xcomp, purpcl, infmod
beginning	*manage*	prep_of
bid	*stop*	prep_for
	want	xcomp, infmod, purpcl
boost	*stop*	prep_of, prep_from
break	*stop*	prep_of
breakup	*stop*	prep_of
call	*want*	xcomp, purpcl, infmod
cancellation	*fail*	prep_of
cease	*stop*	prep_of
certainty	*certainty*	prep_of, prep_about, ccomp
challenge	*stop*	prep_of
chance	*possibility*	xcomp, purpcl, prep_to, infmod, prep_of, prep
change	*stop*	prep_of
charge	*want*	prep_of
clearance	*want*	xcomp, purpcl, infmod
close	*manage*	prep_of, prep
closing	*manage*	prep_of, prep
commitment	*manage*	xcomp, purpcl, infmod, prep_to, prep
completion	*manage*	prep_of
compliance	*stop*	prep_with
confirmation	*confirm*	prep_of
conversation	*stop*	prep_about
	want	xcomp
coordination	*stop*	prep_of
criticism	*stop*	prep_of, prep
decision	*want*	xcomp, purpcl, infmod
decline	*stop*	prep_of
decrease	*stop*	prep_of
delay	*want*	prep_of
demand	*want*	prep_of, ccomp
desire	*want*	prep_of, xcomp, purpcl
destruction	*stop*	prep_of
development	*want*	prep_of
effect	*manage*	prep_of
effort	*attempt*	xcomp, purpcl, infmod
encouragement	*probability*	xcomp, prep_for, infmod, purpcl
end	*manage*	prep_of, prep
ending	*manage*	prep_of, prep
enforcement	*want*	prep_of, prep
evidence	*evidence*	prep_of, ccomp
	want	xcomp
exploration	*stop*	prep_of
extension	*stop*	prep_of
fact	*stop*	prep_of, ccomp
failure	*fail*	prep_of
goal	*want*	xcomp

help	*cause*	xcomp, purpcl, infmod
	stop	dobj
hope	*want*	xcomp, prep_of
impossibility	*impossibility*	xcomp, infmod, ccomp
improbability	*improbability*	xcomp, infmod, ccomp
improvement	*stop*	prep_of
increase	*stop*	prep_of
indication	*cause*	prep_of, ccomp
indicator	*cause*	prep_of, ccomp
intent	*want*	xcomp, purpcl, prep_on, prep_of, infmod
intention	*want*	xcomp, purpcl, prep_of, infmod, prep
invitation	*want*	xcomp, purpcl, infmod
lack	*fail*	prep_of
likelihood	*probability*	prep_of, ccomp
need	*want*	prep_of, xcomp, infmod, purpcl
negotiation	*want*	prep_of, prep_for, xcomp, purpcl, infmod
offer	*want*	xcomp, purpcl, infmod
opening	*manage*	prep_of
option	*want*	xcomp, purpcl, infmod
order	*want*	xcomp, purpcl, infmod, dobj
outcome	*manage*	prep_of
permission	*want*	xcomp, purpcl, infmod, prep_for
permit	*want*	xcomp, purpcl, infmod
plan	*want*	xcomp, purpcl, infmod
possibility	*possibility*	prep_of, xcomp, prep, purpcl, infmod
potential	*want*	xcomp, purpcl, prep_of, infmod, prep_for
preference	*want*	xcomp, purpcl, infmod, prep_for
probability	*probability*	ccomp
prohibition	*refuse*	xcomp, purpcl, prep_from
promise	*attempt*	xcomp, purpcl, infmod
proof	*confirm*	prep_of, ccomp
proposal	*want*	prep_of, prep_for, prep, infmod
ratification	*manage*	prep_of
recognition	*confirm*	prep_of, ccomp
reference	*stop*	prep_to, xcomp, infmod
rejection	*stop*	prep_of
responsibility	*stop*	prep_of, prep_for
result	*manage*	prep_of
right	*want*	xcomp, purpcl, infmod
search	*want*	prep_of, prep_for, xcomp, prep, purpcl
settlement	*stop*	prep_of
sign	*cause*	prep_of, prep, ccomp
struggle	*want*	xcomp, prep_for, infmod, purpcl
subject	*want*	prep_to, xcomp, infmod, purpcl
suspicion	*suggest*	prep_of
thanks	*stop*	prep_to
threat	*want*	prep_of, prep
uncertainty	*uncertainty*	prep_of, prep_about, ifcomp, ccomp
view	*stop*	prep_of

	willingness	*want*	xcomp, purpcl, infmod
	wish	*want*	xcomp, purpcl, prep_of, ccomp
Verb	accept	*manage*	dobj
		stop	nsubjpass
		want	xcomp
	accomplish	*manage*	xcomp, dobj
	account	*stop*	prep_for, prep, dobj
	achieve	*manage*	xcomp, dobj
	acquire	*manage*	dobj
	adopt	*stop*	dobj
	advocate	*want*	dobj
	agree	*manage*	xcomp, purpcl, prep_on
	aim	*want*	prep_at
	allow	*manage*	xcomp, purpcl
	appeal	*stop*	prep_to, dobj
		want	prep_for
	appear	*appear*	ccomp
	approach	*manage*	dobj
	approve	*stop*	dobj
	ask	*want*	xcomp, purpcl
	assist	*cause*	xcomp, purpcl
	assume	*stop*	dobj
		suggest	ccomp
	attempt	*attempt*	xcomp, purpcl
	authorize	*attempt*	dobj
	avoid	*fail*	xcomp, purpcl
		stop	dobj
	await	*want*	xcomp, purpcl, dobj
	become	*manage*	dobj
	begin	*manage*	xcomp, purpcl, dobj
	bid	*stop*	prep_for
		want	xcomp, purpcl
	block	*refuse*	prep_from
		stop	xcomp, purpcl, dobj
	bother	*manage*	xcomp, purpcl
	break	*stop*	dobj
	call	*want*	xcomp, prep_for, prep
	cancel	*fail*	nsubjpass, dobj
	carry	*manage*	dobj
	cause	*cause*	xcomp, purpcl
	challenge	*stop*	dobj
	chance	*possibility*	prep_of, prep
	charge	*want*	prep_with
	choose	*manage*	xcomp, purpcl
		want	ifcomp
	commit	*manage*	xcomp, purpcl, prep, prep_to
	compel	*want*	xcomp, purpcl
	complete	*manage*	xcomp, purpcl, dobj
	confirm	*confirm*	ccomp

consider	*consider*	xcomp, dobj
continue	*stop*	xcomp, purpcl, dobj
control	*stop*	dobj
convince	*manage*	xcomp, purpcl
cover	*stop*	dobj
dare	*attempt*	xcomp, purpcl
decide	*manage*	xcomp, purpcl
	refuse	prep_against
decline	*refuse*	xcomp, purpcl
	stop	dobj
deflect	*stop*	dobj
delay	*hesitate*	dobj
demand	*want*	ccomp, dobj
depend	*want*	prep_on, prep
deprive	*fail*	prep_of
deserve	*want*	xcomp, dobj, ccomp
design	*stop*	dobj
	want	xcomp, purpcl
destroy	*stop*	dobj
determine	*want*	xcomp, purpcl
develop	*manage*	dobj
devote	*stop*	prep_to
	want	purpcl, xcomp
distort	*stop*	dobj
ease	*stop*	dobj
elect	*manage*	xcomp, purpcl
enable	*manage*	xcomp, purpcl
encourage	*want*	xcomp, purpcl
end	*stop*	xcomp, purpcl, dobj
enforce	*want*	prep_of, dobj
ensure	*cause*	dobj, ccomp
entitle	*want*	xcomp, purpcl
establish	*want*	xcomp, purpcl, dobj, ccomp
excuse	*fail*	prep_from
expand	*stop*	nsubjpass, dobj
expect	*want*	xcomp, purpcl
explore	*stop*	dobj
extend	*stop*	dobj
face	*manage*	dobj
fail	*fail*	xcomp, purpcl
fancy	*want*	xcomp, purpcl, dobj
favor	*want*	xcomp, dobj
finish	*manage*	xcomp, purpcl, dobj
forbid	*refuse*	xcomp, purpcl, prep_from, prep
force	*cause*	xcomp, purpcl
forestall	*fail*	dobj
forget	*fail*	xcomp
grant	*cause*	ccomp
guarantee	*cause*	dobj, ccomp

halt	*stop*	dobj
handle	*stop*	dobj
happen	*manage*	ccomp
head	*fail*	xcomp, purpcl, dobj
help	*cause*	xcomp, purpcl, ccomp
hesitate	*hesitate*	xcomp, purpcl
hold	*manage*	dobj
	want	prep_for
hope	*want*	xcomp, purpcl, ccomp
implement	*cause*	dobj
impose	*stop*	dobj
improve	*stop*	dobj
increase	*stop*	dobj
indicate	*cause*	ccomp
intend	*attempt*	xcomp, purpcl
invite	*attempt*	purpcl
	want	xcomp
keep	*manage*	xcomp, purpcl
	stop	dobj
last	*stop*	nsubj
launch	*manage*	dobj
lead	*manage*	xcomp, purpcl
	want	prep_to
let	*manage*	ccomp
like	*want*	prep_to, xcomp, purpcl
link	*stop*	prep_to, xcomp, purpcl
listen	*stop*	prep_to, xcomp, purpcl
love	*want*	prep_to, xcomp, purpcl
lure	*cause*	dobj
maintain	*stop*	dobj
manage	*manage*	xcomp, purpcl
mean	*cause*	ccomp
meet	*stop*	dobj
move	*stop*	dobj
name	*manage*	xcomp, purpcl
need	*want*	xcomp, purpcl, infmod, dobj
negotiate	*want*	xcomp, prep_for, infmod, purpcl, dobj
nullify	*stop*	dobj
offer	*manage*	dobj
	want	xcomp, purpcl
open	*manage*	dobj
order	*want*	xcomp, purpcl, dobj
organize	*stop*	dobj
pay	*want*	xcomp, purpcl
permit	*want*	xcomp, purpcl, dobj
persuade	*cause*	dobj
plan	*want*	xcomp, purpcl
pledge	*want*	xcomp, purpcl
poised	*want*	xcomp, purpcl, infmod

postpone	*hesitate*	dobj
prefer	*want*	xcomp, purpcl
prepare	*want*	xcomp
press	*want*	xcomp, purpcl
prevent	*fail*	xcomp, purpcl, prep, prep_from, dobj
price	*stop*	prep_at
	want	xcomp, purpcl
prohibit	*want*	xcomp, purpcl, dobj, prep_from, prep
promise	*attempt*	xcomp, purpcl, infmod
propose	*want*	purpcl, xcomp, nsubjpass, dobj
protect	*stop*	nsubjpass, dobj
	want	purpcl, xcomp
prove	*cause*	acomp, ccomp
provide	*stop*	dobj
	want	ccomp
rebut	*stop*	dobj
refer	*stop*	prep_to, xcomp
refrain	*fail*	prep_from
refuse	*refuse*	xcomp, purpcl
reject	*stop*	dobj
relate	*stop*	prep_to
remain	*stop*	nsubj
remember	*manage*	xcomp, purpcl
renounce	*stop*	dobj
request	*want*	dobj
require	*want*	ccomp, dobj
respond	*stop*	prep_to, prep_close_to, prep
result	*manage*	prep, prep_in, ccomp
resume	*stop*	xcomp, purpcl, dobj
reveal	*cause*	ccomp, dobj
schedule	*want*	xcomp, prep_for
search	*want*	xcomp, prep_for, purpcl
seek	*want*	xcomp, purpcl, prep_for, dobj
seem	*appear*	xcomp, ccomp
sell	*want*	xcomp, purpcl
sense	*want*	xcomp, purpcl
set	*want*	xcomp, purpcl, prep_for
settle	*stop*	dobj
show	*cause*	dobj, ccomp
sign	*want*	xcomp, purpcl
solve	*stop*	nsubjpass, dobj
spark	*manage*	dobj
stall	*hesitate*	dobj
start	*manage*	xcomp, purpcl, dobj
staunch	*stop*	dobj
stop	*stop*	prep_from, dobj
suffer	*manage*	dobj
suggest	*suggest*	ccomp
	want	xcomp, purpcl

	suspend	*stop*	dobj
	symbolize	*stop*	dobj
	target	*want*	prep_for, dobj
	thank	*stop*	dobj
	threaten	*want*	xcomp, purpcl, prep_with, prep
	try	*attempt*	xcomp, purpcl
	turn	*manage*	prep_out, ccomp
	urge	*want*	xcomp, purpcl
	use	*cause*	xcomp, purpcl
	vote	*want*	xcomp, purpcl
	vow	*want*	xcomp, purpcl
	wait	*want*	xcomp, purpcl
	want	*want*	xcomp, purpcl, prep_for
	wish	*want*	xcomp, purpcl, ccomp
	withdraw	*stop*	dobj
	work	*want*	xcomp, purpcl

Table B.2: NSIP lexical entries

Appendix C

List of syntactic types

The following table presents the syntactic types employed to describe lexical types in the lexicon (appendix B). The list correspond to that at the basis of the dependency parser employed to generate the input to De Facto (de Marneffe et al., 2006), except for types *ifcomp* and *whycomp*, which I created for convenience, as subtypes of the original *ccomp*.

Type	Description
acomp	Adjectival complement
advcl	Adverbial clause modifier
advmod	Adverbial modifier
ccomp	*That*-clause
dobj	Direct object
ifcomp	*Whether*-clause
infmod	Infinitival modifier (of nouns)
nsubj	Nominal subject
nsubjpass	Passive nominal subject
prep	Prepositional modifier
prep_about	Object of preposition *about*
prep_according_to	Object of prepositional construction *according to*
prep_against	Object of preposition *against*
prep_as	Object of preposition *as*
prep_at	Object of preposition *at*
prep_close_to	Object of prepositional construction *close to*
prep_for	Object of preposition *for*
prep_from	Object of preposition *from*
prep_in	Object of preposition *in*
prep_of	Object of preposition *of*
prep_on	Object of preposition *on*

prep_out	Object of preposition *out*
prep_over	Object of preposition *over*
prep_to	Object of preposition *to*
prep_with	Object of preposition *with*
purpcl	Purpose clause
tmod	Temporal modifier
whycomp	*Why*-clause
xcomp	*To*- or *ing*-clause (clausal complement with external subject)

Table C.1: Syntactic types for embedded events

Appendix D

Correference resolution module

During the task of identifying the set of relevant sources RS_n at each level l_n, De Facto uses a very basic correference resolution module in order to create adequate chains when two of the source expressions refer to the same participant. Its algorithm checks whether the new source s_n introduced at factuality level l_n does correfer with any of the sources $s_p \in \text{RS}_{n-1}$, the set of relevant sources at level l_{n-1}.

Algorithm 3 Correference resolution module

```
for all s_p ∈ RS_{n-1} do
    if s_p.firstElement expresses correference then
        return False
    else if s_n is in 3rd person then
        if s_p.length > 1 & s_p.firstElement != DUMMY then
            return True
        end if
        return False
    else if s_n is in 1st person then
        if s_p.firstElement == AUTHOR then
            if RS_{n-1}.length == 1 then
                return True
            end if
            return False
        end if
        return True
    end if
    return False
end for
```

In essence, Algorithm 3 postulates the following heuristics:

- No new source s_n will correfer with a relevant source $s_p \in \text{RS}_{n-1}$ that has al-

ready a correfering expression as its first member of the chain (lines 2-3). For example, at level l_3 in (191) the new source `Amir` cannot be correfered to source `she=Hanna_author` from the previous level in order to return `Amir=she=Hanna_author`.

(191) [$_{l_0}$Hanna **acknowledged**$_{e_1}$ [$_{l_1}$she **told**$_{e_2}$ police interrogators [$_{l_2}$that Amir **mentioned**$_{e_3}$ to her [$_{l_3}$ he had planned$_{e_4}$ to kill$_{e_5}$ Rabin.]]]]

- A new source s_n in 3rd person can correfer with any relevant source $s_p \in \text{RS}_{n-1}$ of length greater than 1 (that is, a source chain that consists of the author and at least another participant) as long as the first element of s_p does not express a dummy source (lines 4-8).

  For instance, the new source `she` introduced at level l_2 in (192) can correfer with `hanna_`s_0 but not with $\mathtt{s}_0$, both of them relevant sources at the previous level l_1. The relevant sources at level l_2 are therefore `she=hanna_`s_0 and $\mathtt{s}_0$.

  (192) [$_{l_0}$Hanna **acknowledged**$_{e_1}$ [$_{l_1}$she **told**$_{e_2}$ police interrogators [$_{l_2}$that she prayed$_{e_3}$ for him to have a heart attack$_{e_4}$ and die$_{e_5}$]]]

  The constraint on dummy sources is to prevent inadequate correferences in cases like (193). Note that in level l_1, source `they` cannot correfer with source `DUM_`$\mathtt{s}_0$ in order to get `they=DUM_`$\mathtt{s}_0$.

  (193) [$_{l_0}$ "They **believe**$_{e_1}$ [$_{l_1}$that his words cannot distract$_{e_2}$ the world from the facts of Iraqi aggression$_{e_3}$."]]

  By contrast, the correference is possible when the new source is in 1st person. In (194), the source chain `we=DUM_`$\mathtt{s}_0$ is in fact a relevant source at level l_1.

  (194) [$_{l_0}$ "We **believe**$_{e_1}$ [$_{l_1}$that his words cannot distract$_{e_2}$ the world from the facts of Iraqi aggression$_{e_3}$."]]

- A new source s_n in 1st person can correfer with any relevant source $s_p \in \text{RS}_{n-1}$ referring to the author, as long as this is the only relevant source available RS_{n-1}; that is, if they are introduced by the first embedding SIP in the sentence; i.e. at level l_1 (lines 9-15).

(195) [$_{l_0}$<u>I</u> **think**$_{e_1}$ [$_{l_1}$they're finally going to be downsizing$_{e_2}$ some management.]]

- A new source s_n in 1st person can correfer with any relevant source $s_p \in \text{RS}_{n-1}$ that does not refer to the author (lines 9 and 16). In the sentence below, the new source `I` introduced for level l_2 can be correfered to source `Hobbs_s`$_0$, into `I=Hobbs_s`$_0$.

(196) [$_{l_0}$ [$_{l_1}$ "<u>I</u> **think**$_{e_1}$ [$_{l_2}$ they're finally going to be downsizing$_{e_2}$ some management,"]] <u>Hobbs</u> said$_{e_3}$.]

Appendix E

Annotation guidelines

E.1 Introduction

This document provides the guidelines for annotating information related to the factuality of events. Section E.2 introduces the basic notions that are of relevance here (*event factuality, factuality markers* and *sources*), and section E.3 covers the specifics of each annotation task.

E.2 Relevant Notions

E.2.1 Event Factuality

Eventualities in discourse are characterized with different degrees of factuality. In some contexts, the factual status of events is presented with absolute certainty. Events are then depicted as *facts* –that is, as situations that happened or took place in the world (197a)– or *counterfacts* –situations that did not take place in the world (197b).

(197) a. Five other U.N. inspection teams <u>visited</u> a total of nine other sites.

b. The size of the contingent was not <u>disclosed</u>.[1]

[1]Here and throughout this document, events in the examples will be identified by marking only the verbal, nominal, or adjectival predicates expressing them, along the lines of TimeML annotation. Furthermore, only the events relevant at each point of the discussion will be identified for clarity. The examples have been extracted from the British National Corpus, the American National Corpus, TimeBank, and Google.

Other contexts introduce different shades of uncertainty. If the contextual polarity is positive, events are then qualified as being *possibly factual* (198a); by contrast, in contexts of negative polarity events are presented as being *possibly counterfactual* (198b).

(198) a. United States may extend its naval quarantine to Jordan's Red Sea port of Aqaba.

b. They may not have enthused him for their particular brand of political idealism.

We will therefore understand **event factuality** as the level of information expressing whether events in discourse refer to real situations in the world (facts), have no real counterpart (counterfacts), or are of an uncertain nature (possibilities).

E.2.2 Factuality markers

Event factuality is expressed in text by means of what we call **factuality markers**. There are a number of them. For example, a negative polarity particle expresses the counterfactive nature of an event (197b), whereas a modal auxiliary such as *may* introduces uncertainty (198).

Predicates subcategorizing for a clause of some sort are another type of marker. In (199), for instance, the verbal predicate *said* (e_0) has an effect on the factual status of its embedded event (e_1). Specifically, e_0 frames e_1 within an evidential context, and as a result, e_1 is presented as a fact according to the reporting source, Slobodan Milosevic's son.

(199) Slobodan Milosevic's son **said**$_{e_0}$ Tuesday that the former Yugoslav president had been murdered$_{e_1}$ at the detention center of the U.N. war crimes tribunal in The Hague. [Herald Tribune, 03/14/2006]

Sentence (200) provides another example of predicates functioning as factuality markers. Here, the predicate *attempt* qualifies the climbing event with a degree of uncertainty.

(200) George Mallory and Andrew Irvine first **attempted**$_{e_0}$ to climb$_{e_1}$ Everest in 1924. [EverestNews.com, 2004]

E.2.3 Sources

The factuality value assigned to events in text is always relative to one or more participants who commit to that value at a particular point in time. They are referred to as **sources**.

By default, events mentioned in discourse, be it oral or written, have always an implicit source corresponding to the author of the text (from here on referred to as s_0). In (201), for example, CNN commits to the factuality of Milosevic being on trial.

(201) Milosevic was on trial$_{e_0}$ for 66 counts of genocide, crimes against humanity and war crimes in the Balkans during the 1990s. [**CNN**$_{s_0}$, 03/12/2006]

Additional sources can be introduced by means of what we call *source-introducing predicates* (SIPs). These are, for instance, predicates referring to reporting events (such as *say, tell*), but also predicates of knowledge and opinion (e.g., *believe, know*), psychological reaction (*regret*), etc.

The new source tends to be expressed as the grammatical subject of the SIP, and play a role in assessing the factuality of the event the SIP selects for. Let's consider example (199) in detail, repeated below as (202).

(202) **Slobodan Milosevic's son**$_{s_1}$ said$_{e_0}$ Tuesday that the former Yugoslav president had been murdered$_{e_1}$ at the detention center of the U.N. war crimes tribunal in The Hague. [**Herald Tribune**$_{s_0}$, 03/14/2006]

It contains two event expressions: e_0 and e_1. We need to find the relevant sources for each of them. By default, the main event of the sentence, e_0, has the text author, s_0, as its relevant source –that is, as the source expressing either commitment or non-commitment towards its factual status. Now, what about e_1? It it is selected by e_0, in fact a SIP introducing a new source in discouse: Slobodan Milosevic's son (s_1). Hence, event e_1 has two sources: the text author (s_0) and Slobodan Milosevic's son (s_1). Observe that Milosevic's son commits to e_1 as a fact, whereas the author keeps a neutral attitude towards that same event.[2]

[2]For readers, the factuality status of e_1 depends to a greater or lesser degree on the reliability of the reporting source. Followers of the ex-president of Serbia may take the statement of Milosevic's son as expressing a fact, whereas for other people that may be utterly false. In the present work, we are not interested in assessing the factuality of events given our own beliefs and knowledge, but based on the information provided by the text.

Strictly speaking, however, we do not have direct access to the factual assessment of e_1 by Milosevic's son. We know about Milosevic's son's perspective only according to what s_0, the author, asserts. Hence, we need to appeal to the notion of *nested source*. That is, the second source in (202) is not Milosevic's son, but Milosevic's son (s_1) according to the author (s_0), which we will represent as: $s_1_s_0$. To sum it up, the relevant sources for each of the events in (202) are:

(203) a. e_0: *said* $< s_0 >$

b. e_1: *had been murdered* $< s_0 >, < s_1_s_0 >$

E.3 Annotation Tasks

E.3.1 Task 1: Identification of Source-Introducing Predicates

Given a text with the events already recognized, identify the set of predicates that satisfy the following criteria:

1. Event Status: They are recognized as **events**.

2. Part of Speech: They are expressed by either a **verb** (*think, say*), a **noun** (*report, doubt*), or an **adjective** (*aware, confident*).

3. Lexical Semantics: As part of their meaning, **they express the stance or commitment of a given source towards the factuality of the embedded event**. For example, *suspects* in (204a) presents Danielle as committing to the factual status of event e_1 (Betina leaving) as being lower than the factual status of the same event in (204b), where it is embedded under *knows*. In other words, in (204a) Danielle considers event e_1 as being just a possibility, whereas in (204a) she contemplates it as a fact.

(204) a. Danielle **suspects**$_{e_0}$ that Betina left$_{e_1}$ the country in June.

b. Danielle **knows**$_{e_0}$ that Betina left$_{e}$ the country in June.

Our predicates can be classified as belonging to one of the following classes:

Predicates of report. E.g., *say, tell, add; claim, argue* –even if they express report by other means than oral; e.g., *write, publish, post.*

Predicates of knowledge. They can express the state of having knowledge (*know, understand, remember*), acquiring knowledge (*learn, find out, discover*), loosing knowledge (*forget*), admitting knowledge (*acknowledge, accept, admit*).

Predicates of belief and opinion. E.g., *think, find, consider, guess, predict, estimate, suggest.*

Predicates of doubt. E.g., *doubt, wonder, ask* (they generally subcategorize for a *wh*-clause complement).

Predicates of perception. E.g., *see, hear, feel.*

Predicates expressing proof. E.g., *prove, show, support, explain.*

Predicates expressing some kind of inferencing process. E.g., *infer, deduce; conclude, decide (that); mean, suggest* (as in: *it means/suggests that*); *appear, seem* (as in: *it seems/appears that*).

Predicates expressing some psychological reaction as a result of an event or situation taking place: *regret, be glad/pleased (that), like (that), love (that).*

Other classes are also possible, as long as the predicate satisfies the other criteria.

Dealing with Polysemy: Many of these predicates are polysemous. In some cases, the different senses all fall in the classes listed above. For example, *explain* denotes both a reporting act (205a) and a proving state (205b).

(205) a. She <u>explained</u> that she was going to stay with her sister.

b. This could <u>explain</u> why educational interventions haven't been more successful.

In other cases, some of the senses may not be classifiable under any of the classes above. *Promise* and *agree* can be used as reporting predicates:

(206) a. Clinton promised that he had totally changed. (≈Clinton said that...)

b. CBS agrees that online video is not the enemy. (≈CBS says it is true that...)

Yet, they can also be used to express the attitude of the subject towards a potential future event (207). In that case, the complement is generally realized by means of an infinitival clause –although a *that*-clause is also possible.

(207) a. Prime Minister John Howard , a monarchist himself, promised to put the question to a national referendum next year.

b. Iraq agreed to give inspectors full access to eight of Saddam Hussein's presidential palaces.

In these second senses, *agree* and *promise* are similar to other predicates that subcategorize for *to*-clauses as well (such as *want, force, offer*, or *need*), which are not SIPs. They all share the following features:

1. The complement event is always a future possibility relative to the embedding event.

2. The attitude of the subject towards the complement event is different than the attitude in the predicates classified above (predicates of report, belief, knowledge, etc.). In those predicates, the subject attitude is epistemic in nature; that is, concerning the degree of certainty that an event has taken (or will take) place –or, in our words, concerning the factual status of events.

   By contrast, predicates like *want, force*, and *offer* present their subjects as:

   - Either having some degree of responsability on the potential event (e.g., *agree/*
     promise/offer to go; *force somebody to go*), or:
   - Being in a greater or lesser favorable state towards the accomplishment of the embedded event (*need/want to go*).

Neither these predicates (*want, force, offer, need*), nor the senses of *promise* and *agree* in examples (207), among other predicates, will be identified as SIPs.

4. COMPLEMENT: They take a **complement which expresses another event**. Complement of **verbal SIPs** can be of any of the categories listed below (where the complement is marked with square brackets, its main event-denoting expression identified as s_1, and the SIP as s_0):

A *that*-clause. E.g., *He* $\underline{\textit{thinks}}_{e_0}$ *[several steelmakers will* $\underline{\textit{report}}_{e_1}$ *actual losses through the third quarter of 1990].*

An infinitival clause: *Gore never* $\underline{\textit{claimed}}_{e_0}$ *[to have* $\underline{\textit{invented}}_{e_1}$ *the Internet].*

An *ing*-clause: *He was caught when a flight attendant* $\underline{\textit{saw}}_{e_0}$ *him [*$\underline{\textit{attempting}}_{e_1}$ *to light a match on the tongue of his shoe].*

An NP headed by an event-denoting noun. E.g., *Coast Savings Financial Inc.* $\underline{\textit{reported}}_{e_0}$ *[a third-quarter* $\underline{\textit{loss}}_{e_1}$*].*

Possibly other constructions, as long as their head expresses an event.

In some cases, the event complement is not used as a direct complement of the SIP, but as a predicative one. Contrast examples in (208) versus (209):

(208) a. He **thinks**$_{e_0}$ [several steelmakers will report$_{e_1}$ actual losses through the third quarter of 1990].

b. You made the **comment**$_{e_0}$ [that the Gulf War coalition in '91 was$_{e_1}$ far stronger than this].

c. Washington was **aware**$_{e_0}$ [that a deadly tidal wave was building$_{e_1}$ up in the Indian Ocean].

(209) a. What he **thinks**$_{e_0}$ is [that the Vail Valley and Colorado are losing$_{e_1}$ the Western heritage upon which the West was founded].

b. The **news**$_{e_0}$ about real estate here was [that the sky was$_{e_1}$ the limit the highest prices in the world].

c. What he is **confident**$_{e_0}$ about is [that the opposition will be united$_{e_1}$ in the end].

It is also possible that the SIP complement is expressed by a pronoun referring to a previously mentioned event. For instance, in the next example, *this* refers to e_1.

(210) They believed it will be$_{e_1}$ always up forever. Nobody believes$_{e_0}$ **this** any more.

5. Cognitive Agent: In addition to that complement, they also select for an **argument expressing a cognitive agent** (or cognizer). Part of the predicate semantics is expressing the stance of that cognitive agent towards the factual value of the complement event (recall the examples in (204)). Using our terminology, we say that the cognitive agent is introduced as a source of the factual status of the complement event.

In case of doubt, the presence of a cognitive agent can help to decide whether a given element is truly a SIP, precisely because SIPs are defined as *source-introducing* predicates. Note that the cognizer (or source) may correspond to a new discourse participant. In (211a), for example, *Milosevic's son* is introduced as a source assessing the factuality of e_1, in addition to the text author. But in other cases, the cognizer corresponds to a previously known cognizer, such as in (211b), where the pronoun *I* refers to the text author.

(211) a. **Slobodan Milosevic's son** said$_{e_0}$ Tuesday that the former Yugoslav president had been murdered$_{e_1}$.

b. **I** think$_{e_0}$ it's not going to change$_{e_1}$ for a couple of years.

Here are some guidelines for identifying cognizers:

1. In most of the cases, cognitive agents are realized as the **grammatical subject** of the predicate. In the example below, where *denied* is the SIP, the individuals referred to by the grammatical subject, *Colin Powell* and *Condoleezza Rice*, are both presented as sources of e_1.

   (212) In mid-2001, **Colin Powell** and **Condoleezza Rice** both publically denied$_{e_0}$ that Iraq had$_{e_1}$ weapons of mass destruction.

2. If the SIP candidate is embedded under another predicate, the cognitive agent may correspond to one of the arguments of that outmost embedding predicate (generally, its subject). For example, in (213) *Lady Charlotte Wynn* is the cognitive agent introduced by the SIP *regretted*, but also by the second SIP *learning*, which is embedded under the former.

(213) **Lady Charlotte Wynn** regretted$_{e_0}$ learning$_{e_1}$ that Dundas and his relatives had received$_{e_2}$ upwards of £50,000 annually out of the public funds.

3. Sometimes, the cognitive agent is also expressed by means of an **oblique, possibly optional, complement**. In the following examples, the SIP is identified as e_0, the complement event as e_1, and the cogntive agent in bold face.

   (214) It seems$_{e_0}$ to **him** that a girl's story about her goat and its butting was$_{e_1}$ more important.

   (215) He was told$_{e_0}$ by **Cheney** that Bush had approved$_{e_1}$ a plan in which Libby would brief a specific New York Times reporter.

   Particular attention deserves the construction *according to NP*, where *according* is also a SIP:

   (216) According$_{e_0}$ to **Jordanian officials**, a smaller line into Jordan remained$_{e_1}$ operating.

4. Cognitive agents may also be introduced by nominal SIPs:

   (217) **Unisys Corp.**'s announcement$_{e_0}$ Friday of a $648.2 million loss$_{e_1}$ for the third quarter showed that the company is moving even faster than expected.

5. In some constructions, the cognitive agents are not expressed in the sentence. Different situations require different treatments:

   Constructions with impersonal interpretation, where a cognizer different than the text author is implied. The SIP does not select for a cognizer as one of its arguments. However, there is an implicit reference to this participant.

   This is for instance the case of SIPs in past participle form. The cognitive agent is optionally expressed by means of a *by*-PP, but when not present in the sentence, a reference to an implicit cognizer is still understood. In the following example, for instance, the belief about Iraq's ability (e_0) is implicitly assigned to a specific group –probably experts.

(218) Iraq is <u>believed</u>$_{e_0}$ to <u>have</u>$_{e_1}$ the ability to deliver chemical weapons in artillery shells.

Nominal SIPs also tend to offer impersonal interpretations of this type:

(219) There have been <u>reports</u>$_{e_0}$ of wholesale <u>looting</u>$_{e_1}$.

Because the predicate is presuming an additional source, these cases WILL be identified as a SIPs (as long as all the remaining requirements apply).

Constructions with impersonal interpretations, where no cognizer is implied. This is generally the case for certain predicates that optionally introduce a cognitive agent by means of an oblique complement. Contrast (220) with (221):

(220) a. The move <u>seemed</u>$_{e_0}$ <u>aimed</u>$_{e_1}$ at heading off more trouble with Iran.

b. Bush <u>seemed</u>$_{e_0}$ to <u>suggest</u>$_{e_1}$ that American forces could be in the gulf region for some time.

(221) a. To **him**$_{s_1}$, the move <u>seemed</u>$_{e_0}$ <u>aimed</u>$_{e_1}$ at heading off more trouble with Iran.

b. To **some analysts**$_{s_1}$, Bush <u>seemed</u>$_{e_0}$ to <u>suggest</u>$_{e_1}$ that American forces could be in the gulf region for some time.

In (220), the SIP candidates, *seemed*, do not introduce any cognizer argument. Note that the grammatical subject of *seemed* in (220b) does not satisfy this role either, even though it expresses a cognitive individual. Compare it with example (221b): whereas here *seemed* expresses the factual status that *some analysts* assign to event e_1, in (220b) *seemed* does not denote the way *Bush* evaluates the event denoted by *suggest*.

If the phrase denoting the cognizer is not explicit in the text, the predicate will NOT be identified as a SIP.

Final Remarks Other classes are possible, as long as the predicate expresses the assessment of a given cognizer with regards to the factual nature of a complement event.

E.3.2 Task 2: Identifying Sources

For this task, the text to annotate has the following elements already identified:

- The source-triggering predicate (SIP), colored in blue in figure E.1.
- A set of potential candidates to be the source (or *cognitive agent*) introduced by the SIP. Their head will be colored in red and identified by a subscripted id.

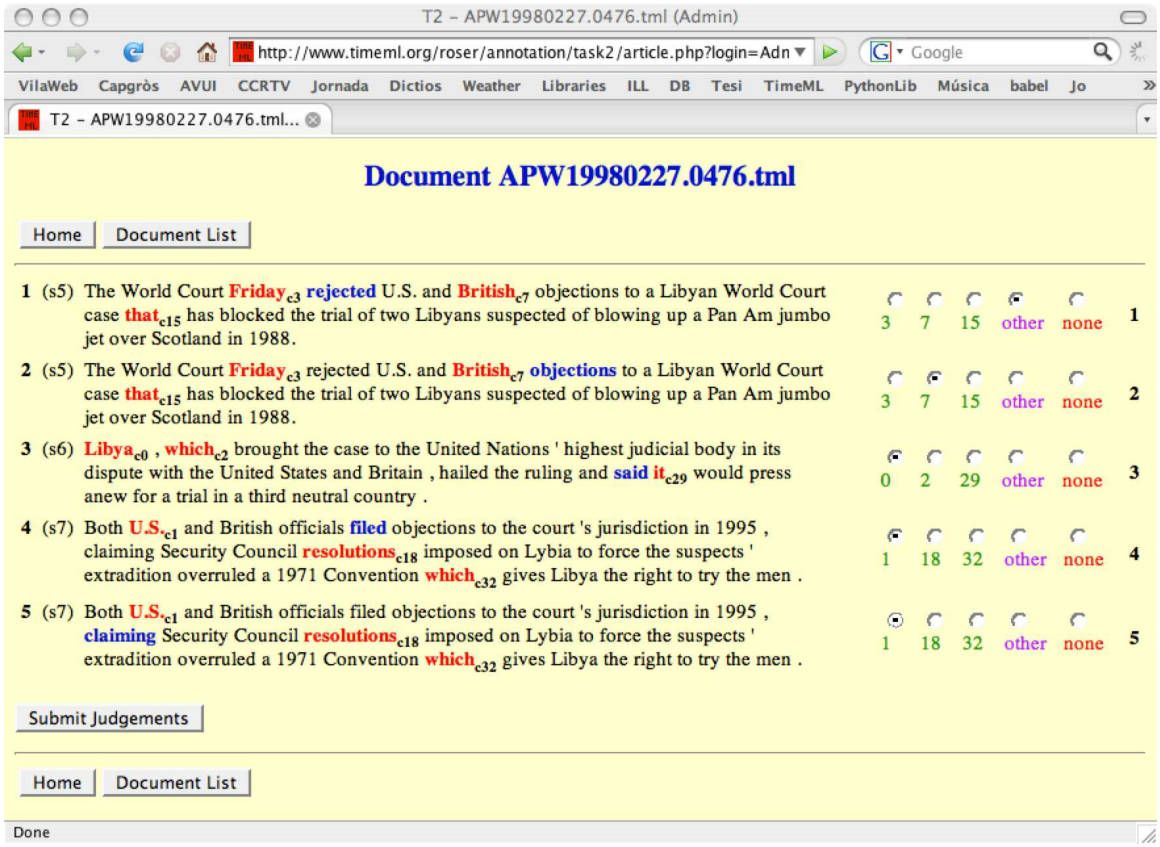

Figure E.1: Task 2 annotation screen

The goal of this task is to select, from the set of source candidates colored in red, the source introduced by the blue-colored SIP. We will use the criteria 1-5 (pages 7-9) presented in Task 1 for deciding whether a predicate has a cognitive agent.

The annotation tool is presented in figure E.1. The candidate is selected by clicking on the appropriate button at the right hand side of each sentence. Different situations may apply:

I. The source corresponds to one of the entities identified in red in the text. Select the button corresponding to the candidate id. Refer to example in line #3 (s6) in figure E.1.
Some sentences may present additional complications:

- *The sentence presents two source candidates that semantically refer to the same entity.* Select the source grammatically introduced by the SIP; that is, the source that is expressed by either one of the SIP arguments or adjuncts.[3]

  (222) So when Wong **Kwan**$_{c3}$ spent seventy million dollars for this house, **he**$_{c12}$ <u>thought</u> **it**$_{c14}$ was a great deal.

  In (222), *Kwan* and *he* co-refer. We consider however that the source introduced by the SIP *thought* is *he*, its grammatical subject.

  Because of this grammatically oriented apporach, relative pronouns are perfectly accepted as sources as well. Consider:

  (223) There was no independent confirmation of the report by the government-run news agency, **which**$_{c14}$ did not <u>say</u> when the reported **attempt**$_{c21}$ occurred.

  Here, the relative pronoun *which* refers to *the government-run news agency*, which semantically is the source of the SIP *say*. However, the argument of *say* is *which*, and hence this will be the element selected as the source here. This case is parallel to example (222) above. Sentence (224) provides a second example of this.

[3]In these and the following examples, source candidates will be in bold, and the SIPs underlined.

(224) The move seemed aimed at heading off more trouble with Iran, **which**$_{c12}$ had condemned Iraq's invasion of Kuwait on Aug. 2 but also criticized the multinational force dispatched to Saudi Arabia.

- *The source is expressed by a phrase longer than one word-length.* If the source head is not marked in red, but another element of the source phrase is, select that element as the correct source.

  (225) **They**$_{c1}$ don't want to play with us," one U.S. **crew**$_{c15}$ chief said .

  The source of *said* in (225) is the whole phrase *one U.S. crew chief*, which has *chief* as its head. Since *chief* is its head, this is the element that should be marked in red (here, in bold face) as the source candidate of that SIP. But instead, the element that has been automatically selected as head is *crew*. We will consider this later element as the correct source of *said*.

II. The source is in fact a set of entities, expressed by means of a coordination structure. This is the case of the source of *objections* (figure E.1, line #2), which actually includes *U.S.* as well as *British*, and the source of *filed* (figure E.1, line #4), encompassing not only *U.S.* but also *British officials*.

When only one of the elements of the coordination is identified in red as candidate, we will select it as our choice (as in the examples above). On the other hand, if both are marked as candidates, we will select the first one.

III. The source does not correspond to any of the entities presented as candidates. That is, there is a segment in the sentence that expresses the SIP source, but neither its head nor any other of its constituents are marked in red.

Select the button labeled as OTHER; e.g., line #1 in figure E.1, where the cognizer of *rejected* corresponds to *The World Court*.

IV. There is not an explicit segment referring to the SIP source. Select option NONE if no cognizer can be identified in the current sentence.

The following general guidelines can be of use for approaching each sentence:

Semantic criterion: First, be *semantically guided* in deciding what is the participant playing the role of SIP source.

Syntactic criterion: Once this participant has been identified, be *syntactically oriented*:

1. Select the source segment that is in a grammatical relation to the SIP (it is either one of its arguments or adjuncts). Personal and relative pronouns are therefore possible correct sources.
2. Identify the syntactic extent of the source (i.e., the syntactic phrase expressing it) and its head.
3. If the source is expressed by a phrase longer than one word, the head is ideally the segment that will be in red and needs to be selected. If however the element in red is not the head but another constituent in the phrase, select that constituent as the source.
4. If the source is expressed by a coordinated construction, apply the criterion in II above.

Option OTHER**:** If the source is not expressed by any of the element marked in red, select OTHER.

Option NONE**:** If the sentence has no explicit segment (word or phrase) expressing the source, select NONE.

E.3.3 Task 3: Annotating Factuality Assignments

The goal in this final task is selecting the factuality value that is assigned to each event by its relevant sources; in other words, deciding whether those sources evaluate the event as a fact that has happend, holds, or will happen for sure in the world; only as a possible fact; or as a counterfact. This task is fairly more complex than the previous two, so it is recommended that you review section 2 on *relevant notions* grounding the current research.

The annotation tool (figure E.2) presents the sentences (third column) with the event to be assessed in blue. The relevant source is displayed in the fourth column, and the fifth column contains the factual values to select from.

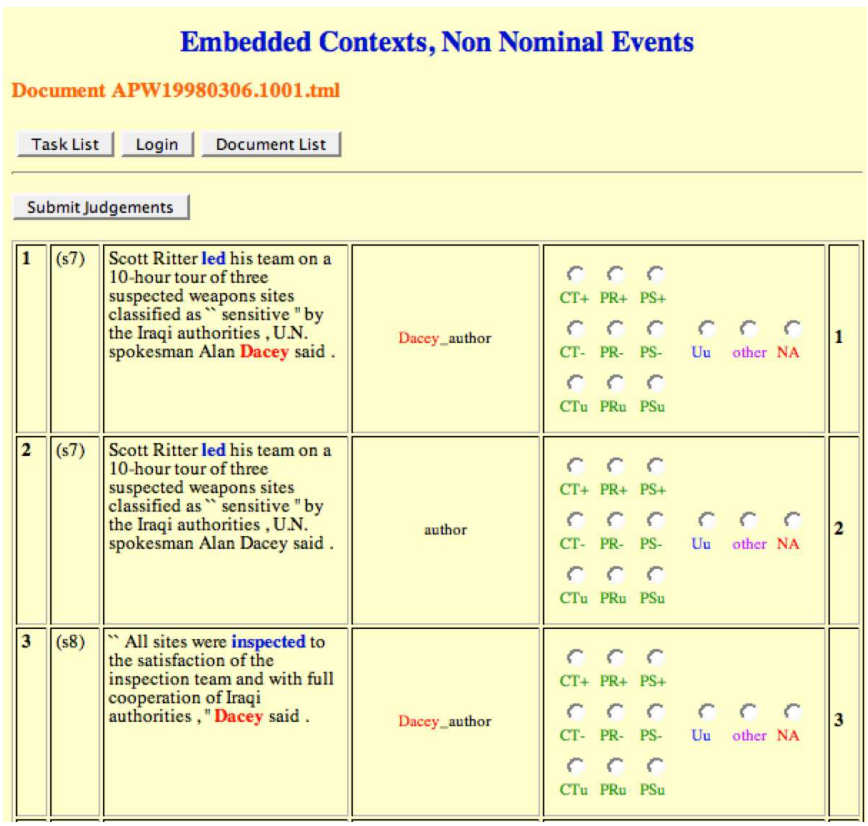

Figure E.2: Task 3 annotation screen

For some events, their factuality value is easily identifiable. Some others, however, pose a bit more of a problem since they may be embedded under other events or have

several source chains that need to be evaluated against. The following sections provide 3 steps aimed at simplifying the annotation task for cases that are not clear. Step 1 and 2 are of a methodological nature and will help in complex cases. Step 3 is practical.

Throughout these annotation guidelines, the factuality value that a given source assigns to an event is formally expressed as: $f(event, source) = value$. For example, source `author` characterizing event e_2 as a fact in the world is presented as: $f(e_2, author)$=CT+.[4]

E.3.3.1 Step 1: What eventuality?

Goal: Identify the full event that needs to be assessed in terms of its factuality.

1. First, determine what is the proposition, clause, or phrase that fully expresses the event in question. For example, the complete units for the event expressions in bold face in (226) are given in (227). As you can see, some eventualities are included as part of other eventualities (e.g., e_2 is part of e_1).

   (226) On the other hand, it's **turning**$_{e_1}$ out to be another very **bad**$_{e_2}$ financial week for Asia.

   (227) **turning (e_1):** *It's* **turning** *out to be another very bad financial week for Asia.*

   bad (e_2): *Another very* **bad** *financial week for Asia.*

2. Secondly, normalize the event expression. The normalized version will describe the event at focus in a neutral way; that is, without negative particles, markers of modality, etc. Such normalized version will be used in Step 3, for evaluating the factuality of the event.

   Negative polarity. If the event is expressed in a context of negative polarity, transform it into its correspondent positive version:

[4]The meaning of CT+ and other factual value abbreviations will be presented in section E.3.3.3.

(228) Original sentence: *He had no* **message** *from Baghdad.*
Normalized version: *He had a* **message** *from Baghdad.*

In the case of embedded predicates, this normalizing step is applied one embedding level at a time. Consider the following sentence:

(229) Al-Dosakee never **regretted**$_{e_1}$ [not **leaving**$_{e_2}$ Baghdad].

For evaluating the factuality status of event e_1, the normalizing step corresponds to that in (230), whereas for evaluating event e_2, it corresponds to that in (231).

(230) Original sentence: *Al-Dosakee never* **regretted**$_{e_1}$ *[not leaving Baghdad].*
Normalized version of e_1: *Al-Dosakee* **regretted**$_{e_1}$ *[not leaving Baghdad].*

(231) Original sentence: *Al-Dosakee never regretted [not* **leaving**$_{e_2}$ *Baghdad].*
Normalized version of e_2: *Al-Dosakee* **left**$_{e_2}$ *Baghdad.*

The normalization process aims at avoiding wrong factuality evaluations such as the following one:

(232) Original: *Al-Dosakee never* **regretted**$_{e_1}$ *not leaving Baghdad.*
Relevant sources: `author`.
Factual assignment: f(e_1,`author`) = CT+

In the example above, the annotator decided that source `author` evaluates event e_1 as a fact (CT+). The wrong judgement comes from taking the predicate expression, together with the negative polarity marker, as referring to the event in question. According to the annotator, it is true (or a fact, CT+) that *Al-Dosakee never regretted not leaving Baghdad.* Nonetheless, the correct annotation is the the one in (233), in which the event of *Al-Dosakee regretting not leaving Baghdad* is assessed as a counterfact (CT−) according to source `author`.

(233) Original: *Bangin Al-Dosakee never* **regretted**$_{e_1}$ *not leaving Baghdad.*
Relevant sources: `author`.
Factual assignment: f(e_1,`author`) = CT−

Note that this normalizing step is applied regardless of the predicate type. In the previous example, for instance, there were two events marked with negative polarity, the first of which was factive. Both events were transformed into their correspondent positive versions.[5]

Modal markers. If the eventuality is qualified by a modal marker of any sort (auxiliaries, adverbials like *likely*, *it is probable that*, verbs like *seem, appear*, etc.), express the event in a neutral way by removing that marker. If the marker is an auxiliary verb, add the tense that best expresses the temporal reference in the original sentence.

(234) a. Original: *They now* <u>*can*</u> **begin**$_{e_1}$ *a more productive relationship.*
b. Normalized e_1: *They now* <u>*will*</u> **begin**$_{e_1}$ *a more productive relationship.*

(235) a. Original: *Before, the president* <u>*could*</u> **call**$_{e_2}$ *up to 200,000 reservists for up to 180 days without seeking congressional approval.*
b. Normalized e_2: *The president* **call<u>ed</u>**$_{e_2}$ *up to 200,000 reservists ...*

Events expressed by untensed clauses. Find the subject of the event and make it explicit. Then, add tense to the main predication, converting the clause into a full sentence.

(236) a. Original: **Facing**$_{e_1}$ *U.S. and Arab troops at the Saudi border, Iraq sought peace on another front today.*
b. Normalized: *Iraq* **faced**$_{e_1}$ *U.S. and Arab troops at the Saudi border.*

[5]In the case of factive predicates, it can be argued that transforming negated predicates into their positive counterparts causes loosing their presuppositional effect. As just shown, however, the normalized version is only used to identify the event being referred to, not to determine its factuality value.

(237) a. Original: *The Sikh families received checks as* **compensation**$_{e_1}$ *for the riots.*

b. Normalized: *The Sikh families were* **compensated**$_{e_1}$ *for the riots.*

Events expressed by a noun phrase. Normalize the expression with the construction: *'NP is a fact'*, where NP stands for the NP headed by the event-denoting noun.

(238) a. Original: *With [new* **construction** *under way], ...*

b. Normalized: *[(The) new* **construction** *under way] is a fact.*

Note that differences in tense (i.e., *'NP is a fact', NP will be a fact'*) can lead to different factual values. Consider the following sentence:

(239) *There is no short-term hope for a diplomatic* **solution** *to the gulf crisis at least until economic sanctions force Saddam to withdraw his army.*

Event *solution* can be considered as a counterfact when evaluated in the present (*'The solution is a fact'*), but as a possibility when evaluated as an event in the coming future (*'The solution will be a fact.'*).

In the current research, evaluating the factual nature of nominals will remain restricted to a present time reference.

Events expressed by adjuncts to nouns, such as adjectival phrases (AP), prepositional phrases (PP), relative clauses, appositions, etc.

Normalize the expression with the construction: *'the N was/is/will be AC'*, where N corresponds to the noun being modified, and AC stands for the adjunct construction that denotes the event.

(240) a. Original: *With new construction [***under** *way], ...*

b. Normalized: *(The) new construction is [***under** *way].*

Note that sometimes the category of the element marked as the event (from the TimeML annotation) does not correspond to the category of the whole event expression. This is the case of event e_2 in (226) above. Even though the marked element is an adjective, we consider the event is expressed as an NP, and hence we will normalize it as: *Another very bad financial week for Asia is a fact.*

Events expressed in conditional constructions (*if...else...*). Separate each clause of the construction as independent propositions. In the case of the antecedent, remove the conditional marker (*if, when*, etc.).

(241) a. Original: *If the heavy outflows* **continue**$_{e_1}$*, fund managers will most probably* **face**$_{e_2}$ *increasing pressure to sell.*

b. Normalized e_1: *The heavy outflows will* **continue**$_{e_1}$*.*

Normalized e_2: *Fund managers will most probably* **face**$_{e_2}$ *increasing pressure to sell.*

Events expressed in interrogative clauses. Convert the expression into its corresponding declarative form. If it has a *WH* particle, substitute it with a generic referring pronoun.

(242) a. Original: *The question is who will Cubans* **believe***?*

b. Normalized: *Cubans will* **believe** *somebody.*

(243) a. Original: *Is it* **low** *enough?*

b. Normalized: *It is* **low** *enough.*

E.3.3.2 Step 2: According to what source?

Goal: Identify the sources that are assessing the factuality of the event at focus.

In other words, identify the relevant sources for that event. Relevant sources can consist of several sources in a nesting relation (refer to section E.2.3), so we conceive them as *relevant source chains* regardless of whether they are constituted by only one source (e.g., `author`) or more (e.g., `she_author`). For event e_3 in the example below,

normalized in (244b), there are three participants that have something to say about its factuality status: the author, Intel, and the customer who discovered the flaws:[6]

(244) a. Original: *Intel* said$_{e_1}$ *that last week a customer* discovered$_{e_2}$ *two* **flaws**$_{e_3}$ *in its 80486 microprocessor chip's floating-point unit.*

b. Normalized e_3: *It is a fact that there are two* **flaws**$_{e_3}$ *in its 80486 microprocessor chip's floating-point unit.*

The author is involved by default in the assessment of all events in a text. *Intel* and the *customer* are relevant here because they are the sources introduced by the SIPs *said* and *discover*, respectively, which are in an embedding relationship with e_3. Due to the nesting relation among these sources, the final relevant source chains for e_3 are: `author`, `intel_author`, `customer_author`, and `customer_intel_author`.

In the annotation tool, the relevant source chains for each event will already be given to you in the fourth column –hence, you don't need to understand how they are obtained. Furthermore, if they contain expressions that are explicit in the original sentence, you will see them marked in red in the text (in the third column).

The goal of this step is **understanding** the relation between the different sources in the chain (when it has more than one) and between these source and the event at focus. That is, understanding what it means for the factuality of event e to be assessed by the source chain $s_x_s_y_\ldots_s_z$. For that purpose, it is helpful to make explicit the nesting relation between each source in a chain. For instance, we can recognize the assessment relations between e_3 in (244b) and each of its relevant source chains, by phrasing them as follows:

(245)

Source chain:	Assessment relation:
`author`	*The* **author** *thinks/considers/says that* e_3.
`intel_author`	*According to the* **author**, **Intel** *thinks/considers/says that* e_3.
`customer_author`	*According to the* **author**, *the* **customer** *thinks/says that* e_3.
`customer_intel_author`	*According to the* **author**, **Intel** *is of the view that the* **customer** *thinks/considers/says that* e_3.

[6]From here onwards, the examples provided will present event expressions in bold face, and the strings denoting relevant sources for that event will be underlined.

The role of nesting sources. In a source chain, the *main source* is the first member of the chain (e.g., `customer` in the chain `customer_intel_author`), and the *nesting sources* are the remaining ones. Note that the factuality of the event is evaluated based on the main source. However, nesting sources are also important.

Take for example sentence (244) above. Source `customer` will assess the factuality of event e_3 differently depending on its nesting sources. Nested by `intel_author`, it will evaluate e_3 as certainly true (CT+), since it is the case that the customer takes e_3 to be a fact in the world, according to what Intel says, based on what is reported by the author:

(246) f(e_3, `customer_intel_author`) = CT+
i.e., *According to the* **author**, **Intel** *says the* **customer** *considers that it is a fact that there are two* **flaws**$_{e_3}$.

But embedded only under `author`, the factual value is underspecified (Uu). This is because the discovery of the flaws is reported by Intel, and therefore the author is uncommitted to it. In other words, if asked whether the customer discovered two flaws, the author can reply: *I don't know, this is what Intel says.* Since the author is uncommitted to the discovery of two flaws, he is also uncommitted to whether the customer thinks/considers/says that there are two flaws in the mentioned chip's floating-point unit, hence:

(247) f(e_3, `customer_author`) = Uu
i.e., *According to the* **author**, *the* **customer** *considers that it is a fact that there are two* **flaws**$_{e_3}$

We will come back to this in section E.3.4, on how to annotate SIP-embedded predicates.

Atypical sources. Certain types of sources require further consideration:

- **Generic sources:**

  Some source chains have `GEN` as one of their constituents (e.g., `GEN_author`). `GEN` refers to a non-explicit generic source, which can be rephrased as *everybody* or *somebody*, among similar expressions. In the example below, such source is implicitly introduced by the SIP *became clear*; i.e., it became clear to everybody.

(248) a. Original: *At one point, when it* **became**$_{e_1}$ *clear controllers could not* **contact**$_{e_2}$ *the plane, someone* **said**$_{e_3}$ *a prayer.*

b. Normalized e_2: *Controllers* **contacted**$_{e_2}$ *the plane.*

c. Relevant sources: `author, GEN_author`

- **Dummy sources:**

Some sentences are presented between quotation marks. If they are part of a longer quoted fragment, they will only have quotation marks at the beginning or ending:

(249) a. "There are no unsettled **problems**$_{e_1}$ anymore.

b. We have **solved**$_{e_2}$ them all."

Since the current annotation is applied at the sentence level, there is no explicit source for fragments like these above. However, it is clear that they are reported by somebody who is not the author and that is most probably introduced somewhere else in the text. A dummy source (abbreviated as `DUM`) is introduced in these cases. Hence, the relevant source chains for events e_1 and e_2 above are: `author` and `DUM_author`.

You will also find some sentences without quotation marks whose events may have dummy sources in their relevant chains. This is because the sentence is the continuation of a quotation opened at a previous sentence –and which will be closed at a posterior sentence.

- **Correferring sources:**

Some sources point to the same participant. Sometimes, two of the sources in a chain correfer. For instance, one of the relevant source chain for event e_3 in (250) is `she_Hanna_author`.

(250) a. Original: *Hanna* acknowledged$_{e_1}$ *she* told$_{e_2}$ *police interrogators that she* **prayed**$_{e_3}$ *for him to have a heart attack and die.*

b. Normalized e_3: *She* **prayed**$_{e_3}$ *for him to have a heart attack and die.*

Source chain `she_Hanna_author` presents the assessment of source *she* about e_3, according to what source *Hanna* acknowledged, based on what the `author` reported.

Strictly speaking, however, *she* refers to the same person identified as *Hanna*. In the chain, this will be represented by the equality symbol (=); e.g., `she=Hanna_author`.

E.3.3.3 Step 3. What factuality value?

Goal: Determine the stance of the relevant source with regard to the factuality of the event. You can think it as the task of identifying what the source's answer would be if asked whether it is the case that such event took or will take place in the world. This is the step where the annotation for the task is finally carried out.

Factuality values. The set of the factuality values is presented in Table E.1, where *Committed* and *Uncommitted Values* are evaluating the source attitude towards the factuality of the event, while the values grouped under *Other Values* are indications that will help me in the final design of the specification scheme.

Table E.1: Factuality values

Value	Descriptor	Use
		Committed Values
CT+	Certainly positive	According to the source, it is **certainly** the case that X.
PR+:	Probably positive	According to the source, it is **probably** the case that X.
PS+	Possibly positive	According to the source, it is **possibly** the case that X.
CT-	Certainly negative	According to the source, it is **certainly not** the case that X.
PR-	Probably negative	According to the source it is **probably not** the case that X.
PS-	possibly negative	According to the source it is **possibly not** the case that X.
		(Partially) Uncommitted Values
CTu	Certainly positive or negative	The source knows whether it is the case that X or that not X.
PRu	Probably positive or negative	The source knows whether it is probably the case that X or that not X.
PSu	Possibly positive or negative	The source knows whether it is possibly the case that X or that not X.
Uu	Fully underspecified	The source does not know what is the factual status of the event, or does not commit to it.
		Other Values
Other	Other	Covering the following two situations - A different value is required here (e.g., U+, U-). - The annotator does not know what value to assign.
NA	Non-applicable	The factuality nature of the eventuality cannot be evaluated.

Committed and uncommitted values express two different but complementary types of information: **epistemic modality** and **polarity**. Epistemic modality refers to the degree of certainty of a given source about whether an event is (or will be) a fact in the world. In the current work, it is systematized into the following categories, expressed as the initial part of the factuality value tag (e.g., CT+, Uu).

CT: The source is certain; i.e., the source thinks the event took (or will take) place.

PR: The source thinks it is probable the event took (will take) place.

PS: The source thinks it is possible the event took (will take) place.

U: The source is uncertain (doesn't know), or uncommitted (doesn't have or doesn't express a view).

The second parameter, event polarity, expresses whether the event is presented as positive (happening) or negative (not happening). It occupies the second part of factuality value tags:

+: The event is seen as (certainly/probably/possibly) happening (factual).

−: The event is seen as (certainly/probably/possibly) NOT happening (counterfactual).

u: The polarity of the event is unknown or uncommitted.

Uncommitted values can sometimes be referred to as underspecified values as well because they are used when the source presents the event with some degree of underspecification: partial (CTu, PRu, PSu) or total (Uu). Partial underspecification describes the factuality of events like e_2 in the context below, evaluated according to source `john_author`.

(251) Original: *John knows*$_{e_1}$ *whether Mary* **came**$_{e_2}$.
Normalized e_2: *Mary* **came**$_{e_2}$.
Factual assignment: f(e_2, `john_author`) = CTu

John is totally certain about the factual nature of e_2 (CT); it is not clear, however, what is the polarity he assigns to it: does he consider that Mary came (+), or that she didn't come (−)? Hence, the polarity remains underspecified (u).

Finally, the fully uncommitted (or underspecified) value (Uu) is used when:

- The source does not know the factual status of the event (252a),
- The source is not aware of the possibility of the event (252b), or
- The source does not overtly commit to it (252c).

The following examples illustrate each of these situations for e_2 when evaluated by source `john_author`:

(252) a. *John does not know*$_{e_1}$ *whether Mary* **came**$_{e_2}$.

b. *John does not know*$_{e_1}$ *that Mary* **came**$_{e_2}$.

c. *John knows*$_{e_0}$ *that Paul said*$_{e_1}$ *that Mary* **came**$_{e_2}$.

Choosing the correct factual value. To select the factuality value of each event, we will use both its *normalized expression*, obtained from Step 1, and the *original sentence* where it appears. The normalized version gives a neutral definition of the event, whereas the original sentence provides the event as presented by the relevant source(s).

Given the event expressed in the normalized version, decide whether, in the original sentence, the source is characterizing it as: certainly happening (CT+), not happening (CT−), possibly/probably happening (PS/PR+), possibly/probably not happening (PS/PR−), or if, alternatively, the source presents it under some degree of underspecification –partial (CTu, PRu, PSu) or total (Uu).

Take for example event e_2 in (253b). We evaluate whether it is a fact according to source `author` and based on the information provided by the original sentence (253a):

(253) a. Original: *Women, children and invalids will be permitted*$_{e_1}$ *to* **leave**$_{e_2}$ *Iraq.*

b. Normalized e_2: *Women, children and invalids will* **leave**$_{e_2}$ *Iraq.*

The process of assessing the factuality of an event can be guided by expressing the normalized event as a question according to the relevant source. For example:

(254) According to source `author`, will women, children and invalids **leave**$_{e_2}$ Iraq?

Assumptions on the evaluation context. The factuality value of events will be evaluated applying the two assumptions that follow:

I. **The naïve assumption:** As readers, we can assign different degrees of reliability to different sources. for example, experts are generally taken as highly trustworthy when informing about their field of expertise (255). On the other hand, politicians we dislike, or countries whose policies are questionable from our perspective, appear as less reliable (256).

(255) a. Original: *<u>Experts</u> say*$_{e_1}$ *China is not* **able**$_{e_2}$ *to contain bird flu.*

b. Normalized e_2: *China is not* **able**$_{e_2}$ *to contain bird flu.*

(256) a. Original: *<u>China</u> says*$_{e_1}$ *it is* **able**$_{e_2}$ *to contain bird flu.*

b. Normalized e_2: *It (China) is* **able**$_{e_2}$ *to contain bird flu.*

We will however assume that all sources have the same degree of reliability. Hence, in spite of the difference of opinion about the same event e_2 in examples (255)-(256), source `author` will believe both sources equally.

II. **Locally-based knowledge assumption:**

When evaluating the factuality of a given event, try to base your assessment uniquely on the knowledge available in the sentence expressing the event. Do not use either (i.) your personal knowledge about what happened in the world, or (ii.) other knowledge from sentences surrounding the one at focus.

The following sentence provides a good example of an event that can be easily (but uncorrectly) evaluated using knowledge from the previous context.

(257) a. Original: *Iraq said it* **invaded**$_{e_1}$ *Kuwait because of disputes over oil and money.*

b. Normalized e_2: *Iraq* **invaded**$_{e_1}$ *Kuwait because of disputes over oil and money.*

It appears at the end of a document discussing the possible ways out of the crisis initiated by Iraq's invasion to Kuwait. Hence, it seems reasonable to analyze that source `author` commits to event e_1 (Iraq's invasion of Kuwait) as a fact in the world (CT+).

(258) Factual assignment: f(e_1, `author`) = CT+

This is however a judgement extrapolated from the previous text in the article, and not directly derived from the meaning of the sentence itself. We see that by placing, in the very same context, a sentence referring to an event not mentioned in the previous context (as e_2 below). In this case, source `author` can be clearly appreciated as uncommitted:

(259) a. Original: *Iraq said it* **deserved**$_{e_2}$ *Kuwait because of historical rights.*

b. Normalized e_2: *Iraq* **deserved**$_{e_1}$ *Kuwait because of historical rights.*

c. Factual assignment: f(e_1, `author`) = Uu

Discriminatory tests. What follows provides some guidance in distinguishing among the different values. It is mainly focussed on determining the *epistemic modality* value. *Polarity* can be added after the former is established.

1. **Underspecification (U) versus different degrees of certainty (CT/PR/PS):**

   The underspecified value (U) must be selected in the following cases:

   - **Uncommitted source.** Some events are presented by a given source as being witnessed, affirmed, denied, or thought to hold by somebody else. This *somebody else* can be fully committing to the event, but the former source is not.

In (260), the source Sanders (i.e., `sanders_author`) commits to e_2, but `author` remains uncommitted since she is only presenting Sanders' opinion. Example (261) illustrates an equivalent case with e_2 in a context of belief.

(260)a. Original: *<u>Sanders</u>* said$_{e_1}$ *he'd* **double**$_{e_2}$ *his money.*
b. Normalized e_2: *Sanders will* **double**$_{e_2}$ *his money.*
c. Relevant sources: `author, sanders_author`.
d. Factual assignments: f(e_2, `author`) = Uu
f(e_2, `sanders_author`) = CT+

(261)a. Original: *Many <u>experts</u>* thought$_{e_1}$ *it would not be* **modified**$_{e_2}$ *soon.*
b. Normalized e_2: *It will be* **modified**$_{e_2}$ *soon.*
c. Relevant sources: `author, experts_author`.
d. Factual assignments: f(e_2, `author`) = Uu
f(e_2, `experts_author`) = CT−

- **Ignorant source.** The source does not know what the factual nature of the event is (262), or does not know about the event (263). Events falling in this classification are generally presented embedded under the predicate *know* (or similar ones; e.g., *discover, remember*) used in a context of negative polarity.

  In the examples below, the ignorant source is properly `john_author`. In (262), source `author` also assesses the factuality of e_2 as underspecified (Uu), but not beacuse he is ignorant about it, but because he is uncommitted (cf. *Uncommitted sources* above).

(262)a. Original: *John does not know*$_{e_1}$ *whether Mary* **came**$_{e_2}$.
b. Normalized e_2: *Mary* **came**$_{e_2}$.
c. Factual assignments: f(e_2, `author`) = Uu
f(e_2, `john_author`) = Uu

(263)a. Original: *John does not know*$_{e_1}$ *that Mary* **came**$_{e_2}$.
b. Normalized e_2: *Mary* **came**$_{e_2}$.
c. Factual assignments: f(e_2, `author`) = CT+
f(e_2, `john_author`) = Uu

- **Prospective event.** Prospective events are those expressed in a context of wish, promise, plan, decision, order, among many others. They are so called because, if they take place, they do so at a point in time after the event embedding them; namely, the event expressing the wish, promise, plan, etc.

  Prospective events are generally presented without any judgement regarding its degree of certainty. Contrast sentence (264) with sentence (265). In both of them there is a reference to the same normalized event e_3. Nonetheless, e_3 in (265) is explicitly qualified as a possible fact, whereas in (264) it is not.

  (264) Original: *Iraq has agreed*$_{e_1}$ *to allow*$_{e_2}$ *Soviets in Kuwait to* **leave**$_{e_3}$.
  Normalized e_3: *Soviets in Kuwait will* **leave**$_{e_3}$.
  Relevant sources: `author`.
  Factual assignment: f(e_3,`author`) = Uu

  (265) Original: *Soviets in Kuwait will possibly* **leave**$_{e_3}$.
  Normalized e_3: *Soviets in Kuwait will* **leave**$_{e_3}$.
  Relevant sources: `author`.
  Factual assignment: f(e_3,`author`) = PS+

To confirm the uncommitted nature of a given event, the following *copredication test* can be applied:

Check whether it is possible to copredicate it with both a context of positive certainty (CT+) and a context of negative certainty (CT−). Sentence (264) can be continued by either fragment in (266) (the first one presenting e_3 as certain, CT+, and the second, as false, CT−), whereas (265) does not.

(266) a. *... They will take the plane tomorrow early in the morning.* (CT+)
b. *... However, most of them decided to remain there.* (CT−)

2. **Absolute certainty (CT) versus degrees of uncertainty (PR, PS):**

Eventualities presented as certain (CT) cannot at the same time be assessed as *possible* (PS) in a context of *opposite polarity*. In the examples below, the symbol # is used to express that there is some sort of semantic anomaly.

(267) a. *Hotels are only* **thirty** (CT+) *percent full.*

b. *#... but it is possible that they aren't* (PS−).

(268) a. *Nobody* **believes** (CT−) *this anymore.*

b. *#... but it is possible that somebopdy does* (PS+).

On the other hand, eventualities that are characterized with some degree of uncertainty (PS or PR) allow it:

(269) a. *I* think *it's not going to* **change**$_{e_2}$ (PR−) *for a couple of years.*

b. *... but it* could *happen otherwise.* (PS +)

(270) a. *He* probably **died** (PR+) *within weeks or months of his capture.*

b. ...but it is also possible that the kidnappers kept him alive for a while. (PS-)

In (269), the source `I_author` characterizes e_2 as PR− by presenting it under the scope of the predicate *think* used in 1st person. The fragment in (269b) can be added without creating any semantic anomaly. A similar situation is presented in (270): the adverb *probably* is characterizing the event as PR+, and the additional fragment presents the possibility of things being otherwise.

3. **Probable (PR) versus possible (PS):**

Distinguishing between the two shades of uncertainty is not always easy. The following hints can help in the task.

- **Presence of factualty markers.** Use the markers of modality that are present in the context, if any.

  POSSIBILITY (PS): *possibly, it's possible, maybe, perhaps; may, might, could.*

  PROBABILITY (PR): *probably, likely, it's probable, it's likely.*

- **Copredication with PR in contexts of opposite modality.** As seen, both degrees of uncertainty (PS and PR) accept copredication with PS in a context of opposite polarity (cf. the test to distinguish between CT

and PR/PS above). However, only the lowest degree of uncertainty (PS) accepts copredication with PR in a context of opposite polarity.

(271) a. *I* think *it's not going to* **change**$_{e_2}$ (PR−) *for a couple of years.*
b. *#... but it* probably *will.* (PR+)

(272) a. *It may not* **change**$_{e_2}$ (PS−) *for a couple of years.*
b. *... but it most* probably *will.* (PR+)

- **Highest degree of uncertainty (PR).** See if the highest degree of uncertainty is possible.
  (a) Qualify the event with the modifiers *most probably* (PR) and *possibly* (PS), and choose the one that preserves the original meaning of the sentence.
  (b) If the event accepts to be qualified by at least one of the constructions below while preserving the meaning, select the highest uncertainty degree; that is, PR.
    - *not only possible but also probable*
    - *possibly, if not likely*
    - *possibly, and in fact likely*

4. **Other Values:**

Other: Select the option *Other* if *a.* it seems that a different combination value should be assigned (e.g., U+ or U−), or *b.* it is not clear what the value should be.

NA: Select *NA* if it seems that the event cannot be assessed in terms of factuality.

Discriminatory tests in a table. Table E.2 summarizes the different copredication tests presented above in order to identify the degree of epistemic modality of a given event. Recall that copredication tests consist of testing whether the source in question could continue the sentence with another fragment where the event is placed in a context with modality or polarity values different from those in the original sentence.

Table E.2: Tests for discriminating epistemic modality degrees

	CT$_=$	**CT***op*	**PR***op*	**PS***op*
U	ok	ok	ok	ok
PS	ok	#	ok	ok
PR	ok	#	#	ok
CT	ok	#	#	#

In the table, the resulting epistemic modality values assigned to events are listed in the rows, while the tests are presented in the columns, abbreviated as EM$_{subindex}$. EM expresses the epistemic modality value of the context to be copredicated to the original sentence, whereas *subindex* indicates its polarity: = means context of the same polarity, and *op*, context of opposite polarity. For example, given an event e presented under a context of negative polarity in its original sentence, test PR$_{op}$ requires creating a new fragment in which e is used in a context where the modality degree is *probable* and the polarity is positive: PR+.[7]

(273) Original: *I* think *it's not going to* **change**$_{e_2}$. (PR−)
Testing e_2 with PR$_{op}$: #... but it probably will. (PR+)

E.3.4 Annotated examples

This final section provides annotated examples of some very specific cases.

E.3.4.1 Events in future tense

Events in future tense will be evaluated in the same way as other tensed events. Hence, its normalized version will keep the tense as in the original. When assessing its factuality, the question to ask is whether the source commits to that event as a fact in the future.

(274) Original: *A lawsuit in Germany will* **seek**$_{e_1}$ *a criminal prosecution of the outgoing Defense Secretary.*

[7]Note that test CT= is non-discriminative. It is included because, combined with CP*op*, it allows identifying U values from the rest.

Normalized e_1:	Same as the original.
Relevant sources:	`author`.
Factual assignment:	f(e_1,`author`) = CT+

Events embedded under certain SIPs (e.g., *predict, forecast*) can be evaluated in a similar way as events presented in future tense:

(275)

Original:	*<u>Scientists</u> predict*$_{e_1}$ *that invisibility will* $\mathbf{be}_{e_2}$ *possible for any object.*
Normalized e_2:	*Invisibility will* $\mathbf{be}_{e_2}$ *possible for any object.*
Relevant sources:	`author, scientists_author`.
Factual assignment:	f(e_1,`author`) = Uu
	f(e_1,`scientists_author`) = CT+

The source being the agent of the prediction (*scientists*; that is: `scientists_author`) commits to the embedded event, but the source reporting the prediction by the scientists (i.e., `author`) remains uncommitted. Differences in the factual commitment of sources triggered by SIPs will be addressed in more detail in section E.3.4.4.

E.3.4.2 Prospective events

The notion of *prospective event* was already introduced. They are events embedded under predicates belonging to any of the classes listed below, among others.

- Volition: *want, wish, expect.*
- Commissive: *promise, commit, propose.*
- Imperative: *order*
- Planning: *plan, decide.*
- ...

Due to the selection restrictions that these predicates impose on their embedded clauses, prospective events tend to be expressed by *to*- or *ing*-clauses.

The relevant source of a prospective event remains uncommitted as to whether it will happen or not (Uu). This is proved by the fact that the event accepts to be copredicated with contexts of both positive and negative absolute certainty (CT+ and CT−), as is the case with event e_1 in (278). The sentence can be continued with both fragments in (279).

(276) Original: *The UN ordered*$_{e_1}$ *Iran to* **halt**$_{e_2}$ *its nuclear activities.*
Normalized e_2: *Iran* **halted**$_{e_2}$ *its nuclear activities.*
Relevant sources: `author`.
Factual assignment: f(e_3, `author`) = Uu

(277) a. *... Iran stopped its nuclear agenda one month later.* (CT+)
b. *... but Iran disregarded the order.* (CT−)

A second example:

(278) a. Original: *So for Sanders, it's time to* **express**$_{e_1}$ *his opinion.*
b. Normalized e_1: *Sanders will express his opinion.*
c. Relevant chain: `author`
d. Factual assignments: f(e_1,`author`) = Uu

(279) a. *... although we all know that won't happen.* (CT−)
b. *... which he will do in the next meeting.* (CT+)

E.3.4.3 Temporal clauses

Temporal clauses are introduced by adverbials like *when, as soon as , until*, etc. In a temporal clause, the tense of the main event has an effect on its factual nature.

Past tense: The event is presupposed as a fact in the world.

(280) Original: *As soon as he* **arrived**$_{e_1}$ *at the institution, he was placed under guard.*
Normalized e_1: *He* **arrived**$_{e_1}$ *at the institution.*
Factual assignment: f(e_1, `author`) = CT+

Present tense: The event is situated at a future point in time. As illustrated in the following two examples, the factual degree assigned by the relevant sources may vary in each case. Apply your best judgement to decide.

(281) Original: *As soon as he* **arrives**$_{e_1}$ *at the institution, he will be placed under guard.*
Normalized e_1: *He will* **arrive**$_{e_1}$ *at the institution.*
Factual assignment: f(e_1, `author`) = CT+

(282) Original: *He won't be under control until he is* **committed**$_{e_2}$ *to an institution.*
Normalized e_1: *He will be* **committed**$_{e_2}$ *to an institution.*
Factual assignment: f(e_2, `author`) = PS+

E.3.4.4 SIP-embedded events

They are events under contexts of report, belief, knowledge, inference, witnessing, etc., created by SIPs like *tell, see, think*, or *know*. The complexity of the annotation task depends on the number of embeddings.

One level of embedding. There are two events to assess: the SIP and its embedded event. Consider:

(283) *AT&T* **said**$_{e_1}$ *it would* **double**$_{e_2}$ *its assets.*

Event e_1, a SIP, is assessed as shown below. That is, its relevant source (`author`) considers that the saying event did certainly happen (CT+).

(284) Normalized e_1: *AT&T* **said**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant source: `author`.
Factual assignments: f(e_1,`author`) = CT+

The second event, e_2, is embedded under e_1. As an embedded event, it will have more than one relevant source chain: the text author (`author`), but also *AT&T* according to the previous established relevant source (i.e., `AT&T_author`).

(285) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant sources: `author, AT&T_author`.
Factual assignments: f(e_2, `author`) = Uu
f(e_2, `AT&T_author`) = CT+

Event e_2 is directly reported by *AT&T* according to what the author says. Hence, source `AT&T_author` is committed towards that event as being a fact (CT+). This is however not the case of source `author`: if asked whether AT&T will double its assets, he can say *I don't know, I'm reporting only what AT&T says.*

We can apply the test for uncommitted factuality (copredication with contexts of positive and negative certainty, CT+ and CT−) by checking whether both fragments in (286) could be an adequate continuation of (283), according to source `author`. We see that it is the case.

(286) a. *... and so it did.*
b. *... but it didn't happen.*

Other types of SIPs can result in different distributions of the factual values. This is the case of events embedded under the so-called factive predicates: predicates expressing knowledge (*know, discover, remember*) or some sort of psychological reaction (*regret, be glad that*):

(287) Original: <u>*AT&T*</u> **knew**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*

The assessment of the main predicate proceeds in the same way as example (284):

(288) Normalized e_1: <u>*AT&T*</u> **knew**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant source: `author`.
Factual assignments: f(e_1,`author`) = CT+

Note however that, due to the different semantics of *know*, the factual status of its embedded predicate will also be assessed as a fact (CT+) by the embedding source (`author`):

(289) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant sources: `author, AT&T_author`.
Factual assignments: f(e_2, `author`) = CT+
f(e_2, `AT&T_author`) = CT+

Interaction with polarity and modality particles also plays a role:

(290) Original: <u>*AT&T*</u> *did not* **know**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*

(291) Normalized e_1: *<u>AT&T</u>* **knew**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant source: `author`.
Factual assignments: f(e_1,`author`) = CT−

(292) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant sources: `author, AT&T_author`.
Factual assignments: f(e_2, `author`) = CT+
f(e_2, `AT&T_author`) = Uu

Several levels of embedding. The previous examples contained only one level of embedding, but due to the recursive property of language, more levels are also possible. Additional layers of embedding can introduce new sources, and that makes the analysis a bit more complex.

(293) *The <u>newspaper</u>* **reported**$_{e_0}$ *that <u>AT&T</u>* **said**$_{e_1}$ *it would* **double**$_{e_2}$ *its assets.*

The source `author` is committing to event e_0 as a fact:

(294) Normalized e_0: *The <u>newspaper</u>* **reported**$_{e_0}$ *that <u>AT&T</u> said*$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant chains: `author`.
Factual assignments: f(e_0,`author`) = CT+

On the other hand, `author` is uncommitted with regards to the factuality of e_1, since it has not been reported by him but by a different source, the *newspaper* (i.e., `newspaper_author`). This is in fact the same situation illustrated in (285).

(295) Normalized e_1: *<u>AT&T</u>* **said**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant sources: `author, newspaper_author`.
Factual assignments: f(e_1, `author`) = Uu
f(e_1, `newspaper_author`) = CT+

In this case, there are 4 relevant source chains for event e_2 (*It will* **double**$_{e_2}$ *its assets*). They are: `author, newspaper_author, AT&T_author, AT&T_newspaper_author`.

(296) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant sources: `author, newspaper_author, AT&T_author, AT&T_newspaper_author`.

What are the factual values that each of these source chains assign to event e_2? We start by those chains that have as its first member the participant most immediately connected to the factual assessment of the event –here, *AT&T*. There are two of them: `AT&T_author` and `AT&T_newspaper_author`.

One possibility is to consider both chains as equivalent, and hence return the same factual value. Since it is clear from the sentence that *AT&T* commits to e_2 as a fact in the future, the factual values assigned by these two chains would be:

(297) Factual assignments: f(e_2,`AT&T_author`) = CT+
f(e_2, `AT&T_newspaper_author`) = CT+

There is however a difference between `AT&T_author` and `AT&T_newspaper_author`. The first chain expresses the commitment of *AT&T* according to what the author knows or thinks. Put in other words, it expresses the factual value that the author considers *AT&T* assigns to e_2. On the other hand, `AT&T_newspaper_author` expresses the factual value that the author considers that *newspaper* sustains the *AT&T* assigns to e_2. Let's analyze each case in detail:

- `AT&T_author`: Expressing the factual value that the author believes *AT&T* assigns to e_2.

  The author cannot say what this value is, since he is uncommitted about whether *AT&T* said anything about doubling its assets (event e_1) –as seen in (295), it was the *newspaper* that commited to that as a fact. Hence, the factual value assigned by source chain `AT&T_author` to e_2 is underspecified: f(e_2,`AT&T_author`)=Uu.

- `AT&T_newspaper_author`: Expressing the factual value which the author thinks that *newspaper* considers the *AT&T* assigns to e_2.

  We already agreed that *AT&T* commits to e_2 as a fact in the future. This is according to what the *newspaper* reported, which at the same time, was reported by the author. Hence, f(e_2,`AT&T_newspaper_author`)=CT+.

Now it's time to see what factual values are assigned to e_2 by the two remaining relevant source chains:

- `newspaper_author`: Expressing the factual value that the author believes *newspaper* assigns to e_2.

  Event e_2 was reported by *AT&T*. Whether it will be a fact or not is a piece of information that the *newspaper* may not have access to. All it knows (at least, according to the evidence we have from the current sentence), is what AT&T reported.

  Hence, this source remains uncommitted: f(e_2,`newspaper_author`)=Uu.

- `author`: Expressing the factual value that the author assigns to e_2.

  The author was already uncommitted regarding the factuality of e_1. He then remains also uncommitted regarding e_2: f(e_2,`author`)=Uu.

For reference, the final analysis is as follows:

(298) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant sources: `author, newspaper_author, AT&T_author, AT&T_newspaper_author`.
Factual assignments: f(e_2, `author`) = Uu
f(e_2, `newspaper_author`) = Uu
f(e_2, `AT&T_author`) = Uu
f(e_2, `AT&T_newspaper_author`) = CT+

As we saw earlier, the use of other predicates (e.g., the so-called factive predicates, such as *know* or *discover*) may result in different distributions of committed and uncommitted values:

(299) *The* <u>*newspaper*</u> **discovered**$_{e_0}$ *that* <u>*AT&T*</u> **said**$_{e_1}$ *it would* **double**$_{e_2}$ *its assets.*

(300) Normalized e_0: *The* <u>*newspaper*</u> **discovered**$_{e_0}$ *that* <u>*AT&T*</u> *said*$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant chains: `author`.
Factual assignments: f(e_0, `author`) = CT+

(301) Normalized e_1: *AT&T* **said**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant chains: `author, newspaper_author`.
Factual assignments: f(e_1, `author`) = CT+
f(e_1, `newspaper_author`) = CT+

(302) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant chains: `author, newspaper_author, AT&T_author, AT&T_newspaper_author`.
Factual assignments: f(e_2, `author`) = Uu
f(e_2, `newspaper_author`) = Uu
f(e_2, `AT&T_author`) = CT+
f(e_2, `AT&T_newspaper_author`) = CT+

And similarly, the interaction with particles of modality and polarity also plays a role:

(303) *The newspaper did* NOT **discover**$_{e_0}$ *that AT&T* **said**$_{e_1}$ *it would* **double**$_{e_2}$ *its assets.*

(304) Normalized e_0: *The newspaper* **discovered**$_{e_0}$ *that AT&T said*$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant chains: `author`.
Factual assignments: f(e_0, `author`) = CT−

(305) Normalized e_1: *AT&T* **said**$_{e_1}$ *it would double*$_{e_2}$ *its assets.*
Relevant chains: `author, newspaper_author`.
Factual assignments: f(e_1, `author`) = CT+
f(e_1, `newspaper_author`) = Uu

(306) Normalized e_2: *It will* **double**$_{e_2}$ *its assets.*
Relevant chains: `author, newspaper_author, AT&T_author, AT&T_newspaper_author`.
Factual assignments: f(e_2, `author`) = Uu
f(e_2, `newspaper_author`) = Uu
f(e_2, `AT&T_author`) = CT+
f(e_2, `AT&T_newspaper_author`) = Uu

Embedded contexts such as those above are a fundamental part of the current research. In real text, sentences may be more complex than the ones presented here. Please, take your time to annotate them well.

E.3.4.5 Modalized events

Events can be modalized by different types of markers: modal auxiliaries (*may, can,* etc.), modal adverbs (*possibly, certainly,...*), or predicates like *seem* or *appear*. Here we focus on some of the issues that each of these kinds of markers may trigger.

Modal auxiliaries: They can lead to ambiguity. Sometimes they depict the event as a fact in the world (307); in some others, as a possible fact (308); and in others they present it in a completely uncommitted way (309).

(307) Original: *As Dr. Snyderman manipulated the endoscope, the surgeon <u>could</u> finally* **see**$_{e_1}$ *the tumor.*
Normalized e_1: *The surgeon finally* **saw**$_{e_1}$ *the tumor.*
Factual assignments: f(e_1,`author`) = CT+

(308) Original: *In the current situation, foreigners <u>could</u>* **become**$_{e_2}$ *hostages.*
Normalized e_2: *In the current situation, foreigners will* **become**$_{e_2}$ *hostages.*
Factual assignments: f(e_1,`author`) = PS+

(309) Original: *In the past, the president <u>could</u>* **call**$_{e_3}$ *up to 200,000 reservists without seeking congressional approval.*
Normalized e_3: *In the past, the president* **called**$_{e_3}$ *up to 200,000 reservists without seeking congressional approval.*
Factual assignments: f(e_1,`author`) = Uu

The tests in Table E.2 confirm that event e_1 in (307) is seen as certainly a fact (CT+):

(310) a. **Test CT$_=$:** (CT+) *... And sure he saw it. It was huge.*
b. **Test CT$_{op}$:** (CT−) *#... But he didn't see it.*
c. **Test PR$_{op}$:** (PR−) *#... But probably he didn't see it.*
d. **Test PS$_{op}$:** (PS−) *#... But possibly he didn't see it.*

The distinction between the two remaining cases is more subtle, but again, the tests proposed in the previous section justify the different factuality values in each case. The test set in (311) validates PS+ as the factual value for e_2 in (308), and the test set (312), the value Uu for e_3 in (309).

(311) a. **Test CT$_=$:** (CT+) *... and that is what will happen.*
b. **Test CT$_{op}$:** (CT−) *#... but that won't ever happen.*
c. **Test PR$_{op}$:** (PR−) *... but it won't probably happen.*
d. **Test PS$_{op}$:** (PS−) *... but it's also possible it won't happen.*

(312) a. **Test CT$_=$:** (CT+) *... And he used that right three times.*
b. **Test CT$_{op}$:** (CT−) *... But he never did.*

Verbal predicates: Events can also be modalized by means of verbal predicates such as *seem* or *appear*. In this case, both the modal predicate and the modalized event will be assessed in terms of their factuality:

(313) Original: *Saddam* **appeared**$_{e_1}$ *to* **accept**$_{e_2}$ *a border demarcation treaty.*

(314) Normalized e_1: *It* **appears** *that Saddam accepted*$_{e_2}$ *a border demarcation treaty.*
Factual assignments: f(e_1,`author`) = CT+

(315) Normalized e_2: *Saddam* **accepted**$_{e_2}$ *a border demarcation treaty.*
Factual assignments: f(e_1,`author`) = PR+

Another frequent predicate modalizing the event is *expect* used in passive voice.

(316) Original: *It is* **expected**$_{e_1}$ *that the mounting will be* **completed**$_{e_2}$ *in April 1887.*

As with the previous cases, both the predicate *expected* and its embedded event will be evaluated in terms of its factual nature. The evaluation of *expected* in sentence (316) is as follows:

(317) Normalized e_1: *It is* **expected**$_{e_1}$ *that the mounting will be completed*$_{e_2}$ *in April 1887.*
Factual assignments: f(e_1,`author`) = CT+

Now consider the embedded event. Note that *expected* introduces and additional generic source, causing the embedded complement to have two relevant sources: `author` and `GEN_author`. We will assume that, in general, the factual value assigned by these sources is PR+ in both cases, although specific sentences may require different choices. As always, use your best judgement based on the tests provided in the previous section.

(318) Normalized e_2: *The mounting will be* **completed**$_{e_2}$ *in April 1887.*
Factual assignments: f(e_2,`author`) = PR+
f(e_2,`GEN_author`) = PR+

Adverbials: Typical adverbs of epistemic modality (e.g., *possibly, probably, certainly*) explicitly express the degree of certainty of the event, and hence they offer no problem. There are however other adverbs of evidential nature, such as *reportedly* and *apparently*, which also have an effect on the factuality of events.

The adverb *reportedly* has a purely evidential interpretation, equivalent to attributing a proposition to somebody else (e.g., *somebody said that...*). Because of that, the source of the sentence will always be evaluated as uncommitted:

(319) Original: *Apple Geniuses are* <u>*reportedly*</u> **unbricking**$_{e_1}$ *iPhones.*
Normalized e_1: *Apple Geniuses are* **unbricking**$_{e_1}$ *iPhones.*
Factual assignment: f(e_1, `author`) = Uu

The adverb *apparently*, on the other hand, adds also a nuance of epistemic modality on top of its evidential interpretation. That is, in addition to expressing that the source of the information is somebody else (evidential), it also conveys some degree of certainty (*it is possible/probable...*) by the text source.

(320) Original: *Apple Geniuses are* <u>*apparently*</u> **unbricking**$_{e_1}$ *iPhones.*
Normalized e_1: *Apple Geniuses are* **unbricking**$_{e_1}$ *iPhones.*
Factual assignment: f(e_1, `author`) = PR+

E.3.4.6 Negation

Negated events can be expressed in several ways. The following list reviews the most common means.

Negating the predicate expressing the event:

(321) Original: *She did*<u>*n't*</u> **follow**$_{e_1}$ *the rules.*
Normalized e_1: *She* **followed**$_{e_1}$ *the rules.*
Factual assignment: f(e_1, `author`) = CT−

Negating the subject:

(322) Original: *<u>No</u>body* **followed**$_{e_1}$ *the rules.*
Normalized e_1: *Somebody* **followed**$_{e_1}$ *the rules.*
Factual assignment: f(e_1, `author`) = CT−

Negating the object:

(323) Original: *She* **followed**$_{e_1}$ *<u>no</u> rules.*
Normalized e_1: *She* **followed**$_{e_1}$ *the rules.*
Factual assignment: f(e_1, `author`) = CT−

Embedded contexts provide additional strategies:

The negation is expressed as part of the lexical semantics of the embedding predicate:

(324) Original: *She <u>failed</u> to* **follow**$_{e_1}$ *the rules.*
Normalized e_1: *She* **followed**$_{e_1}$ *the rules.*
Factual assignment: f(e_1, `author`) = CT−

The embedding predicate is negated: This phenomenon applies to a restricted group of SIPs (*think, believe, expect*, etc.). A negation on the main predicate (the SIP) actually negates the event in the complement proposition.

(325) Original: *He does <u>not</u>* **think**$_{e_0}$ *[she* **followed**$_{e_1}$ *the rules].*

The annotation involves both the event expressed by the SIP (326) and the one in its complement (327).

(326) Original: *He does <u>not</u>* **think**$_{e_0}$ *[she followed*$_{e_1}$ *the rules].*
Normalized e_0: *He* **thinks**$_{e_0}$ *she followed*$_{e_1}$ *the rules.*
Factual assignment: f(e_0, `author`) = CT−

(327) Original: *He does <u>not</u> think*$_{e_0}$ *[she* **followed**$_{e_1}$ *the rules].*
Normalized e_1: *She* **followed**$_{e_1}$ *the rules.*
Factual assignment: f(e_1, `author`) = Uu
f(e_1, `he_author`) = PR−

E.3.4.7 Hypothetical constructions

By hypothetical constructions I refer to constructions involving 2 events: a first one, that is presented as absolutely uncertain (Uu), and a second one, whose possibility of becoming a fact depends on the first one being a fact as well. The prototypical structures following this pattern are ***if... else...*** conditional constructions. In the example below, only the relevant events are marked:

(328) Original: *<u>If</u> the heavy outflows* **continue**$_{e_1}$*, fund managers will most probably* **face**$_{e_2}$ *increasing pressure to sell.*

(329) Normalized e_1: *The heavy outflows will* **continue**$_{e_1}$.
Relevant chains: `author`
Factual assignments: f(e_1, `author`) = Uu

Source `author`, the only relevant source here, is not asserting neither negating there will be a continuation of heavy outflows (e_1). Hence, f(e_1,`author`) = Uu. And since the factuality of e_1 is underspespecified, e_2 must be so as well. Note that this is the case even if that second clause has modality markers indicating a specific commitment of the source. Event e_2, for example, is qualified as *most probable.*

(330) Normalized e_2: *Fund managers will most probably* **face**$_{e_2}$ *increasing pressure to sell.*
Relevant chains: `author`
Factual assignments: f(e_2,`author`) = Uu

Other hypothetical constructions are for example sentences with the structure: ***not... until/unless*** . In this case, the uncertain event is the one in the *until/unless* clause, and the dependent one, the one in the first clause. The same factuality analysis as for *if... else...* constructions holds:

(331) Original: *He wo<u>n't</u>* **do**$_{e_1}$ *it <u>until</u> Bloomberg* **is**$_{e_2}$ *within eight points or so in the polls.*

(332) Normalized e_1: *He will* **do**$_{e_1}$ *it.*
Relevant chains: `author`
Factual assignments: f(e_1,`author`) = Uu

(333) Normalized e_2: *Bloomberg* **is**$_{e_2}$ *within eight points or so in the polls.*
Relevant chains: `author`
Factual assignments: f(e_2,`author`) = Uu

It is important to notice, however, that past tense can lead to different factual judgments:

(334) Original: *He didn't* **do**$_{e_1}$ *it until Bloomberg* **was**$_{e_2}$ *within eight points in the polls.*

(335) Normalized e_1: *He* **did**$_{e_1}$ *it.*
Relevant chains: `author`
Factual assignments: f(e_1,`author`) = CT+

(336) Normalized e_2: *Bloomberg* **was**$_{e_2}$ *within eight points in the polls.*
Relevant chains: `author`
Factual assignments: f(e_2,`author`) = CT+

E.3.4.8 Interrogative constructions

Interrogative constructions include both interrogative sentences (337a) and indirect interrogative clauses (337b).

(337) a. *Why did Mr. Phillips* **invent**$_{e_1}$ *a new type of head for screws?*

b. *John knows*$_{e_0}$ *[why Mr. Phillips* **invented**$_{e_1}$ *a new type of head for screws].*

In some cases, the factuality of the event can be assessed as a fact or possibility:

(338) Original: *Why did Mr. Phillips* **invent**$_{e_1}$ *a new type of head for screws?*
Normalized e_2: *Mr. Phillips* **invented**$_{e_1}$ *a new type of head for screws.*
Relevant chains: `author`
Factual assignments: f(e_2,`author`) = CT+

(339) Original: *John knows*$_{e_0}$ *why Mr. Phillips* **invented**$_{e_1}$ *a new type of head for screws?*
Normalized e_1: *Mr. Phillips* **invented**$_{e_1}$ *a new type of head for screws.*
Relevant chains: `author, john_author`
Factual assignments: f(e_2,`author`) = CT+
f(e_2,`john_author`) = CT+

In some other cases, however, the factuality remainse underspecified:

(340) Original: *What did the president* **know**$_{e_1}$ *before declaring the war.*
Normalized e_2: *The president* **knew**$_{e_1}$ *something before declaring the war.*
Relevant chains: `author`
Factual assignments: f(e_2,`author`) = Uu

(341) Original: *The country wonders*$_{e_0}$ *what the president* **knew**$_{e_1}$ *before declaring the war?*
Normalized e_1: *The president* **knew**$_{e_1}$ *something before declaring the war.*
Relevant chains: `author, country_author`
Factual assignments: f(e_2,`author`) = Uu
f(e_2,`country_author`) = Uu

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