INTERNATIONAL STANDARD

ISO 24617-8

First edition
2016-12-15

Language resource management — Semantic annotation framework (SemAF) —

Part 8: Semantic relations in discourse, core annotation schema (DR-core)

Gestion des ressources langagières — Cadre d'annotation sémantique (SemAF) —

Partie 8: Relations sémantiques dans le discours, schéma d'annotation de base (DR-core)

Reference number
ISO 24617-8:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 37, *Terminology and other language and content resources*, Subcommittee SC 4, *Language resource management*.

A list of all parts in the ISO 24617 series can be found on the ISO website.

Introduction

The last decade has seen a proliferation of linguistically annotated corpora coding many phenomena in support of empirical natural language research, both computational and theoretical. At the level of discourse, interest in discourse processing has led to the development of several corpora annotated for discourse relations. Discourse relations, also called “coherence relations” or “rhetorical relations”, are relations, expressed explicitly or implicitly, between situations mentioned in a discourse and are key to a complete understanding of the discourse, beyond the meaning conveyed by clauses and sentences. Discourse relations and discourse structure are considered to be key ingredients for NLP tasks such as summarization,[39][41] complex question answering,[74] natural language generation,[19][47][56] machine translation,[42] opinion mining and sentiment analysis,[11][12] and information retrieval.[38] A recent overview[76] includes a description of the state of the art in discourse and computation. Several international and collaborative efforts have resulted in annotated resources of discourse relations, across languages as well as genres, to support the development of such applications.

Existing annotation frameworks exhibit two major differences in their underlying assumptions, one of which concerns the representation of discourse structure, while the other has to do with the semantic classification of discourse relations. As a result, annotations constructed using one framework are not easily interpreted in another framework, and annotated resources are limited in their interoperability. Notwithstanding their differences, however, there are strong compatibilities between them that can be clarified and used as the basis for mappings and comparisons between the resources, as well as for use as a basis for future annotation.

In a coherent (written or spoken) discourse, the situations mentioned in the discourse, such as events, states, facts, propositions, and dialogue acts are semantically linked through causal, contrastive, temporal and other relations, called “discourse relations”, “rhetorical relations”, or “coherence relations”. Although discourse relations hold most prominently between the meanings of successive sentences or utterances in a discourse, they may also occur between the meanings of smaller or larger units (nominalizations, clauses, paragraphs, dialogue segments), and they may occur between situations that are not explicitly described but that can be inferred.

This document aims to specify an interoperable approach to the annotation of local semantic relations in discourse (DRels), following the Linguistic Annotation Framework (LAF, ISO 24612-2; see also Reference [23]) and the general principles for semantic annotation established in ISO 24617-6. It reflects the view that strong underlying compatibilities with respect to the semantic description of discourse relations can be observed in the various discourse relation frameworks being used to support data annotation, e.g. Rhetorical Structure Theory (RST),[40] Segmented Discourse Representation Theory (SDRT),[3] the Penn Discourse Treebank,[59] Hobbs’ Theory of Discourse Coherence (HTDC)[17][18] and the Cognitive Approach to Coherence Relations (CCR)[66]. This document aims to provide an explanation of these compatibilities and a loose mapping between definitions of individual discourse relations, as specified in the different frameworks that will benefit the community as a whole.

The main aims of this document are to (1) establish a set of desiderata for interoperable DRel annotation; (2) specify a way of annotating DRels that is compatible with existing and emerging ISO standard annotation schemes for semantic information; and (3) provide clear and mutually consistent definitions of a set of “core” discourse relations which are commonly found in some form in many existing discourse relation frameworks. Together, (2) and (3) form a “core annotation scheme” for DRels.

This document does not aim at providing a fixed and exhaustive set of discourse relations, but rather at providing an open, extensible set of core relations. The core annotation scheme also discusses certain issues in discourse relation annotation that it leaves open, as they require further study in collaboration with other efforts in multilingual discourse annotation, in particular the European COST action TextLink. A future part of ISO 24617 is envisaged that will complement this document by providing a complete interoperable annotation scheme for DRels, while also addressing the multilingual dimension of the standard. The issues to be taken up for this complementary part are listed in 4.16.

Language resource management — Semantic annotation framework (SemAF) —

Part 8: Semantic relations in discourse, core annotation schema (DR-core)

1 Scope

This document establishes the representation and annotation of local, "low-level" discourse relations between situations mentioned in discourse, where each relation is annotated independently of other relations in the same discourse.

This document provides a basis for annotating discourse relations by specifying a set of core discourse relations, many of which have similar definitions in different frameworks. To the extent possible, this document provides mappings of the semantics across the different frameworks.

This document is applicable to two different situations:

— for annotating discourse relations in natural language corpora;

— as a target representation of automatic methods for shallow discourse parsing, for summarization, and for other applications.

The objectives of this specification are to provide:

— a reference set of data categories that define a collection of discourse relation types with an explicit semantics;

— a pivot representation based on a framework for defining discourse relations that can facilitate mapping between different frameworks;

— a basis for developing guidelines for creating new resources that will be immediately interoperable with pre-existing resources.

With respect to discourse structure, the limitation of this document to specifications for annotating local, "low-level" discourse relations is based on the view that (a) the analysis at this level is what is well understood and can be clearly defined; (b) further extensions to represent higher-level, global discourse structure is possible where desired; and (c) that it allows for the resulting annotations to be compatible across frameworks, even when they are based on different theories of discourse structure.

As a part of the ISO 24617 semantic annotation framework ("SemAF"), the present DR-core standard aims to be transparent in its relation to existing frameworks for discourse relation annotation, but also to be compatible with other ISO 24617 parts. Some discourse relations are specific to interactive discourse, and give rise to an overlap with ISO 24617 Part 2, the ISO standard for dialogue act annotation. Other discourse relations relate to time, and their annotation forms part of ISO 24617-1 (time and events); still other discourse relations are very similar to certain predicate-argument relations ("semantic roles"), whose annotation is the subject matter of ISO 24617-4. Since the various parts are required to form a consistent whole, this document pays special attention to the interactions of discourse relation annotation and other semantic annotation schemes (see Clause 8).

This document does not consider global, higher-level discourse structure representation which involves linking local discourse relations to form one or more composite global structures.

This document is, moreover, restricted to strictly *semantic* relations, to the exclusion of, for example, presentational relations, which concern the way in which a text is presented to its readers or the way in which speakers structure their contributions in a spoken dialogue.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
discourse
sequence of clauses or sentences in written text or of utterances in oral speech

3.2
situation
eventuality, fact, proposition, condition, belief or dialogue act, that can be realized by a linguistically simple or complex expression, such as a clause, a nominalization, a sentence/utterance, or a discourse segment consisting of multiple sentences or utterances

3.3
discourse relation
relation between two *situations* (3.2) mentioned in a *discourse* (3.1)

EXAMPLE 1 “Peter came late to the meeting. He had been in a traffic jam.” The events mentioned in the two sentences are implicitly related through the discourse relation *Cause*.

EXAMPLE 2 “Peter was in a traffic jam, but he arrived on time for the meeting.” The events mentioned in the two clauses are related by the discourse relation *Concession*, expressed by the connective “but”.

EXAMPLE 3 “Peter did not manage to come to the meeting; he was held up in a terrible traffic jam.” The causal relation in this example is the same as in Example 1, but the argument expressed by the first clause is not an eventuality, but a proposition, formed by an event description with negative polarity.

Note 1 to entry: Quasi-synonyms for “discourse relation”, with small variations in meaning, are “coherence relation” and “rhetorical relation”.

3.4
discourse connective
word or multi-word expression expressing a *discourse relation* (3.3)

EXAMPLE Single-word discourse connectives include “but”, “since”, “and”, “however”, “because”. Multi-word discourse connectives include “as well as”, “such as”.

Note 1 to entry: Many of the words that can be used as discourse connectives can also be used as intra-clausal conjunctions, as with the use of “and” in “John and Mary are a lovely couple”.

3.5
low-level discourse structure
representation of discourse structure that only specifies local dependencies between a discourse relation and its arguments, without further specifying any links or dependencies across these local structures

4 Basic concepts and metamodel

4.1 Overview

In a discourse, which comes into play when communication involves a sequence of clauses or sentences in a text, or utterances in a dialogue, a major aspect of the understanding comes from how the events, states, facts, propositions, and dialogue acts mentioned in the discourse are related to each other. Understanding such relations, such as Cause, Contrast, and Condition, contribute to what is called the "coherence" of the discourse, and they can be "realized" explicitly, by means of certain words and phrases (often called "connectives"), or they can be implicit, when they have to be inferred on the basis of the discourse context and world knowledge. Examples 1 to 3 illustrate the Cause relation realized with expressions from different syntactic classes. In Example 1, a subordinating conjunction "because" is used to connect some situation (here, the meaning of the subordinate clause) as the reason for the buying event mentioned in its matrix clause. In Example 2, an adverb "as a result" is used to relate two sentences to express the consequence of not seeing many signs about growth coming to a halt. In Example 3, an explicit phrase is again used, to explain the claim about the level of investor withdrawal, but here the phrase does not correspond to a well-defined single syntactic class such as a conjunction or adverb. Finally, Example 4 shows that although a causal relation can be inferred between the two sentences, with the second sentence offering an explanation for why some (investors) have raised their cash positions, there is no word or phrase in the text to express this inference. Rather, the discourse context needs to be used together with, cohesive devices and world knowledge to get at the relation. Often, when such relations are inferred, it is possible to insert a connective phrase[44] to express the relation, as shown here with the insertion of "because". In this document, the term "connective" is used in a broad sense, to refer to any word or phrase used to express a discourse relation, including both those drawn from well-defined syntactic classes as well as those that are not.

Example 1 Mr. Taft, who is also president of Taft Broadcasting Co., said *he bought the shares* because **he keeps a utility account at the brokerage firm of Salomon Brothers Inc., which had recommended the stock as a good buy.**

Example 2 *Despite the economic slowdown, there are few clear signs that growth is coming to a halt*. As a result, **Fed officials may be divided over whether to ease credit**.

Example 3 *But a strong level of investor withdrawal is much more unlikely this time around*, fund managers said. A major reason is that **investors already have sharply scaled back their purchases of stock funds since Black Monday**.

Example 4 *Some have raised their cash positions to record levels.* [implicit (because)] **High cash positions help buffer a fund when the market falls**.

Existing frameworks for describing and representing discourse relations differ along several lines. The remainder of this clause provides a comparison of the most important frameworks, focusing on those that have been used as the basis for annotating discourse relations in corpora, in particular the Theory of Discourse Coherence (HTDC)[1)] by Hobbs,[18] Rhetorical Structure Theory (RST) by Mann and Thompson,[40] the Cognitive Approach of Coherence Relations (CCR) by Sanders and others,[66] Segmented Discourse Representation Theory (SDRT) by Asher and Lascarides[3] and the annotation framework of the Penn Discourse Treebank (PDTB).[59][61] The comparison highlights and discusses the main issues that are considered relevant for developing the pivot representation in DR-core. For each issue, the discussion is followed by the ISO specification adopted for that issue. The clause ends with a summary of the key features of the DR-core specification, and the DR-core metamodel.

4.2 Representation of discourse structure

One important difference between existing DRel frameworks concerns the representation of discourse structure. For example, the RST Treebank,[10] based on the Rhetorical Structure Theory,[40] assumes a tree representation to subsume the entire text of the discourse. The Discourse GraphBank,[78] based on

1) "HTDC" as an acronym for Hobbs' theory is created for the purpose of this document and does not, thus far, appear elsewhere in the literature.

HTDC, allows for general graphs that permit multiple parents and crossing, and the DISCOR corpus[64] and the ANNODIS corpus,[1] based on SDRT, allow directed acyclic graphs that permit multiple parents, but not crossing. There are also frameworks that are pre-theoretical or theory-neutral with respect to discourse structure. These include the PDTB,[59] based loosely on a lexicalized approach to discourse relations and structure (DLTAG[16][75], and DiscAn,[65] based on CCR). In both of these frameworks, individual relations along with their arguments are annotated, without being combined with other relations to form a composite structure encompassing the entire text.

These widely different views about the structural representation for discourse are difficult to reconcile with each other. *In the DR-core specification, a pre-theoretical stance involving low-level annotation of discourse relations is adopted*, with the idea that individual relations can be more reliably annotated and that they can be further annotated to project a higher-level tree or graph structure, depending on one's theoretical inclination. From the point of view of interoperability, the low-level annotation can also serve as a pivot representation when comparing annotations of different resources grounded in different theories.

4.3 Semantic description of discourse relations

A second difference among existing frameworks relates to whether the meaning of a discourse relation is described in "informational" term, i.e. in terms of the "meaning" of the relation's arguments, or in "intentional" terms, i.e. in terms of the intentions of the speaker/writer (W) and intended effects on the hearer/reader (R). While SDRT, HTDC, PDTB and CCR describe the meaning in informational terms, RST provides definitions in intentional terms. For instance, Example 5 shows the definition for the (non-volitional) Cause relation in RST (N = nucleus, S = satellite, W = writer, R = reader), while Example 6 presents the definition for the same relation in HTDC (where it is called Explanation).

Example 5 *Non-Volitional Cause (RST)*

Constraints on N: presents a situation that is not a nucleus

Constraints on the N + S *combination*: S presents a situation that, by means other than motivating a volitional action, caused the situation presented in N; without the presentation of S, R might not know the particular cause of the situation; a presentation of N is more central than S to W's purposes in putting forth the N-S combination

The effect: R recognizes the situation presented in S as a cause of the situation presented in N

Locus of the effect: N and S.

Example 6 *Explanation (HTDC)*

Infer that the state/event asserted by S_1 causes or could cause the state/event asserted by S_0.

Despite the different ways of describing DRel semantics, it is important to note that in many cases, the differences lie in the "level" at which the relation is described, especially when the situations being related are the same. Thus, for example, a DRel defined in informational terms in one framework can be effectively mapped to a DRel in another framework where it may be defined in intentional terms. With this in mind, *DRel meaning in the DR-core specification is described in "informational" terms,* but in 6.9, a mapping is provided from the core relation types (presented in Clause 5) to the relations present in existing classifications, including those that define relations in intentional terms.

4.4 Pragmatic variants of discourse relations

With the exception of HTDC, all frameworks also distinguish relations when one or both of the arguments involve an implicit belief or a dialogue act[2] that takes scope over the semantic content of the argument. The motivation for this distinction comes from examples like Example 7, where it should *not* be inferred that John's sending of the message somehow led to him being absent from work, but

2) The concept of a dialogue act, as used in ISO 24617-2, can be seen as an empirically based and computationally well-defined interpretation of the traditional notion of a "speech act".

rather that it causes the speaker/writer to believe that John is not at work. In other words, the meaning of the subordinate clause provides evidence supporting the claim made by the main clause. Similarly, in Example 8, the inference should be made that the explanation is being provided not for the content of the question but for the (dialogue) act of questioning itself.

Example 7 *John is not at work today*, because **he sent me a message to say he was sick**.

Example 8 *What are you doing tonight?* Because **there's a good movie on**.

This kind of distinction has been given various names in the literature, for example the "semantic-pragmatic" distinction,[73][66][46] the "internal-external" distinction,[17][44] the "ideational-pragmatic" distinction[63] and the "content-metatalk" distinction.[37] In other cases, such as in RST, the distinction, while not being explicitly named, is evidently taken into account in the classification (e.g. Cause vs. Evidence/Justify in RST distinguishes the semantic and pragmatic interpretations, respectively). What is difficult to reconcile about the treatment of this distinction across the various frameworks is that while some, like CCR, allow for it for all relation types, others, like the PDTB and RST, only admit it for some relations (e.g. Cause, Condition, Contrast, Concession in PDTB). It must be noted, however, that there doesn't seem to be any a priori reason for such a restriction to only some relation types, and the choice is in the end found to result from what was observed in the corpus that was analysed and/or annotated. *In DR-core, the "semantic-pragmatic" distinction is allowed for all relation types, with the general aim of not being overly restrictive in the absence of well-defined criteria. At the same time, the scheme does not encode this distinction on the relation, but rather on the arguments of the relation*, the main reason being that in all cases involving either a belief or a dialogue act, what is different is not the relation, but rather the semantic status of the arguments. A further motivation comes from recognizing that representing the distinction on the relation would not distinguish cases where the belief or dialogue act is implicit (as in Examples 7 and 8) from those where they are made explicit with performative verbs or propositional attitude verbs, as in Examples 9 and 10. Pragmatic interpretations are therefore represented on arguments using a feature indicating the argument to be of the type "belief" or the type "dialogue act". Note that in cases exemplified by Examples 9 and 10 the belief or dialogue act aspect of the meaning is entirely obtained from the explicit content of the arguments, rather than from a contextually motivated inference.

Example 9 *I believe John is not at work today* because **he sent me a message to say he was sick**.

Example 10 *I'm asking you what you are doing tonight* because **there's a good movie on**.

4.5 Hierarchical classification of discourse relations

In all existing frameworks, discourse relations are grouped together semantically to a greater or lesser degree; where they differ is in how the groupings are done. For example, while PDTB groups Concession together with Contrast under the broader Comparison class, CCR places Concession under the Negative Causal relation group, while placing Contrast under the Negative Additive group. Reconciliation with respect to these groupings is not possible, since they stem from basic differences in what is taken to count as semantic closeness. *The solution adopted in the DR-core specification is to use a "flat" set of core relations* that can be used in an annotation scheme as just that, or mapped to the appropriate type within a particular hierarchical scheme adopted. In 6.9, these mappings from the DR-core relations to the schemes in different frameworks are provided.

4.6 Inference of multiple relations between two segments

Among the various frameworks, the PDTB is unique in allowing multiple relations to be inferred between two given situations. The connective "since", for example, can have both temporal and causal interpretations, as in Example 11.

Example 11 *MiniScribe has been on the rocks* since **it disclosed earlier this year that its earnings reports for 1988 weren't accurate**.

The DR-core specification provides for representing multiple relations inferred between two given situations, both when the relations are realized explicitly as well as implicitly.

4.7 Representation of (a)symmetry of relations

Whether or not a discourse relation is symmetric or asymmetric is a distinction embodied in the representation of all frameworks. That is, given a relation REL and its arguments A and B, all frameworks distinguish whether or not (REL, A, B) is equivalent to (REL, B, A). For example, the Contrast relation is taken to be symmetric whereas the Cause relation is considered asymmetric. Where frameworks differ is in how this distinction is captured in the scheme. Most classifications, such as RST, CCR, HTDC and PDTB, encode asymmetry in terms of the textual linear ordering and/or the syntax of the argument realizations. Thus, in the CCR classification, where the argument span ordering is one of the basic "cognitive" primitives underlying the scheme, the relation Cause-Consequence captures the "basic" order for the semantic causal relation, with the cause appearing before the effect, whereas the relation Consequence-Cause captures the "non-basic" order, with the effect appearing before the cause. In the PDTB, argument spans are first named as Arg1 and Arg2 according to syntactic criteria, including syntactic dependency and linear order, and the asymmetrical relations are then defined in terms of the Arg1 and Arg2 labels (for example, in Cause:Reason, Arg2 is the cause and Arg1 the effect, while in Cause:Result, Arg1 is the cause and Arg2 is the effect). GraphBank, on the other hand, utilizes a different mechanism to capture the asymmetry. Rather than making reference to linear order, it makes use of directed arcs in the annotation, with definitions provided for how to interpret the directionality for each relation type (for example, for the relation Cause-Effect, the arc is directed from the span stating the cause to the span stating the effect; for the relation Violated Expectation, the arc is directed from the span stating the cause to the span stating the absent effect; and so on).

In the DR-core specification, representation of asymmetry abstracts over the linear ordering and syntactic structure, not only because these are not semantic in nature but also because they may not be good criteria from the viewpoint of interoperability, given the wide variation in cross-linguistic syntax, including clause-combination. Instead, *asymmetry is represented by specifying the argument roles in the definition of each relation*. Arguments are named Arg1 and Arg2, but they bear relation-specific semantic roles. For example, in the Cause relation, defined as "Arg2 serves as an explanation for Arg1" (see Table 1), the text span named Arg2 always provides the reason in the Cause relation, irrespective of linear order or syntax, and Arg1 always constitutes the result. For human annotators, mnemonic labels indicating the semantic roles, like "reason" and "result", are more convenient than "Arg2" and "Arg1", therefore the ISO specification also allows the use of these semantic role labels. Table 2 provides the mapping between Arg1 and Arg2 labels and the corresponding semantic role labels for asymmetric relations. *In symmetric relations, on the other hand, where both arguments play the same semantic role, arguments are named Arg1 and Arg2 following their linear order in the text*.

It is important to note that this representation can be effectively mapped to other schemes for representing asymmetry and in no way obfuscates the differences in linear ordering of the arguments, which can be easily determined by pairing the argument roles with the text span annotations. The ISO scheme acknowledges that linear ordering has a bearing for claims that different versions of an asymmetric relation may not have the same linguistic constraints, for example, with respect to linguistic predictions for the following discourse.[3]

4.8 Representation of the relative importance of arguments for discourse meaning/structure

Beyond the representation of asymmetry, some frameworks, namely RST, HTDC, and SDRT also explicitly represent the "relative importance" of DRel arguments, taking this relative importance to impact the meaning or structure of the text as a whole. In RST, one argument of an asymmetric relation is labelled the "nucleus" whereas the other is labelled "satellite", based on the following criteria:[40] (a) The nucleus is more essential to the writer's purpose than the satellite; (b) In comparison to the nucleus, the satellite is more easily substitutable without much change to the apparent function of the text (or discourse) as a whole, and (c) Without the nucleus, the content of the satellite is incomprehensible (in the text as a whole), a non sequitur. HTDC has a similar approach, using the term "dominance", with the goal of deriving a single assertion from a discourse relation connecting two segments, and distinguishing relations in terms of how this single assertion should be derived. In subordinating relations, in particular, the assertion associated with the relation is obtained from the "dominant" segment, as specified in the relation definitions. SDRT, on the other hand, classifies a relation as "subordinating" or "coordinating",

depending on what structural configuration the arguments create in the discourse graph.[4] *In the DR-core specification, the relative importance of arguments for the text (meaning or structure) as a whole is not represented directly*. However, because of the explicit identification of the roles of arguments in each relation definition (as described in 4.7), a layer of representation capturing the arguments" relative importance can be easily derived. For example, a mapping from ISO categories to RST categories for Cause would label the Arg2 (corresponding to the reason) argument as the satellite and the Arg1 (corresponding to the result) argument as the nucleus, because there is a one-to-one mapping in RST between the semantic roles of arguments and their respective functional roles for relative importance, for each relation. A similar mapping can be shown for SDRT relations as well.

4.9 Arity of arguments

Except RST, all frameworks assume that a discourse relation has two and only two arguments. In RST, the constraints on the number of arguments for a relation are captured via multinuclear relations,; the relations Joint and Sequence (among others) allow for more than two arguments. *In the DR-core specification, a discourse relation is restricted to two and only two arguments*, with the understanding that a mapping from binary relations to n-ary relations is possible where necessary. For example, two identical binary relations with shared arguments, R(A, B) and R(B, C), can be collapsed into a single ternary relation R(A, B, C), if the given framework allows for the relation R to be n-ary.

4.10 Syntactic form, extent, and (non-)adjacency of argument realizations

Three important considerations for annotating the arguments of a discourse relation are the following. The first has to do with the kinds of syntactic forms the realization of an argument can have. That is, what are the minimal allowable syntactic units corresponding to an argument? While all frameworks agree that the *typical* syntactic realization of an argument is a "clause", some allow for certain non-clausal phrases as well. In the end, the differences emerge because of different views on the information status of different syntactic forms in discourse and their relevance to discourse coherence. Also to be considered are languages like Turkish where nominalizations (noun phrases denoting eventualities) are very common.[79] *In the DR-core specification, what counts as a DRel argument is constrained by its semantic status rather than its syntactic form.* In particular, a DRel argument must denote a situation as defined in 3.2, that is, the situation must be one of the following types: event, state, fact, proposition, or dialogue act[2][68].

The second issue has to do with the extent of arguments. All frameworks allow for argument spans to be arbitrarily complex, composed of multiple clauses in coordination or subordinate relations, as well as multiple sentences, as long as they are required for interpreting the relation in which they participate. PDTB further stipulates that argument spans must contain the "minimal" amount of information needed to interpret the relation, which is closely related to the third issue concerning the (non-)requirement for the adjacency of argument spans. Some frameworks, such as RST, require the text spans of the related arguments to be textually adjacent, whereas others such as the PDTB impose this constraint only for implicit discourse relations. To a large extent, these differences arise because of differences in assumptions about the global structure of a text, and the reflection of such assumptions in the annotation. As with the issue of syntactic form, it is difficult to reconcile these differences. However, in contrast to the constraint specification for syntactic form, *the DR-core specification remains neutral on the issues of the extent and adjacency of argument spans and does not specify any constraints.* It is important to note, however, that for a fully interoperable annotation scheme, consensus-based constraints must be established for these arguments related features as well. These issues deserve further study and will be addressed in the evisaged second part of the project in which DR-core has been developed.

4.11 Triggers of discourse relations

It is generally agreed that DRels can be realized explicitly in text but can also be implicit, as illustrated in Examples 1 to 4. When explicit, the phrases are typically found to belong to well-defined syntactic classes, such as subordinating conjunctions, coordinating conjunctions, adverbials and prepositional phrases. But some frameworks such as the PDTB also allow for DRels to be realized with other phrase types that don't necessarily correspond to a single syntactic class,[55] such as the subject-verb sequence

in Example 3. Following this idea, Reference [55] distinguishes DRel expressions based on whether they are frozen closed-class expressions or more productive expressions allowing substitution (cf. "A major reason is" vs. "A most convincing reason is"). Indeed, many connectives from the well-defined and commonly recognized syntactic classes can also be said to be productive if one considers the possibility of their modification (cf. "because" vs. "at least presumably because"). The treatment of modification and negation of discourse relations, as in "not because" and "perhaps because", is beyond the scope of the DR-core annotation scheme. ISO 24617-6 mentions the possibility of applying qualifiers like "uncertain", introduced for the annotation of dialogue acts in ISO 24617-2, also to discourse relations and semantic roles. This issue is expected to be taken up in the follow-up of the DR-core project (see 4.16).

Aside from the question of which expression types are taken to be DRel triggers, frameworks still differ in whether the annotation scheme includes the explicit identification or marking of DRel triggers or not. In this respect, only the PDTB and RST currently include the marking of the explicit triggers of discourse relations. In the PDTB, the triggers are marked during the annotation of the discourse relations, whereas in RST, the triggers are added as an additional annotation layer after the annotation of the discourse relations.[70]

With respect to implicit DRels, frameworks differ in whether these inferences are allowed only in adjacent contexts or also in non-adjacent contexts. Here, the framework of GraphBank stands out as the only one to allow implicit DRels between non-adjacent units.

In the DR-core specification, it is considered important to explicitly mark expressions seen as the textual triggers of DRels, since these are valuable clues for inducing models for discourse processing. *However, the scheme is flexible about the inference sites for implicit DRels, that is, whether implicit DRels are allowed only between adjacent discourse units or between non-adjacent units as well.*

The representation of implicit DRels can also include the insertion of a connective that *could* have been used to express the inferred relation. While all frameworks agree that this is possible, only the PDTB explicitly includes such insertions in its annotation scheme. *In the DR-core specification, insertion of connectives to express inferred DRels is allowed, but not required.*

4.12 Representation of attribution as a discourse relation

Attribution is a relation between agents and situations[77][57] and in many text genres, especially newswire, is observed to occur frequently and in close syntactic interaction with discourse relations and their arguments. In some cases, the relation and its arguments may be attributed to the writer (Example 12) or some other agent introduced in the text (Example 13); in other cases, the relation is established by the writer, with one or both arguments attributed to others (Examples 14 and 15).

NOTE Explicit attributions in the text are shown in courier font for illustration.

Example 12 Since *the British auto maker became a takeover target last month*, **its ADRs have jumped about 78 %**.

Example 13 "*The public is buying the market* when **in reality there is plenty of grain to be shipped**," `said Bill Biedermann, Allendale Inc. director.`

Example 14 *Factory orders and construction outlays were largely flat in December* while `purchasing agents said` **manufacturing shrank further in October**.

Example 15 When *Mr. Green won a $240,000 verdict in a land condemnation case against the State in June 1983*, `he says` **Judge O'Kicki unexpectedly awarded him an additional $100,000**.

Although Examples 13 to 15 suggest that the attributions in these sentences do not contribute to the discourse relations identified therein, the close textual coupling of the two has led almost all annotation schemes to annotate attributions in one way or another. Perhaps motivated by the need to not leave any part of the text unconnected, frameworks such as RST, SDRT and GraphBank have in fact treated attribution as a discourse relation, marking a relation called "Attribution" between the attribution phrase (including the agent and attributive predicate) and the attributed content. It is worth noting that none of the original discourse coherence theories on which these annotation frameworks

are based suggest attribution as a discourse relation. Indeed, the original RST formulation argues against the treatment of attributions as rhetorical relations: "Passages that present who said what or attribute information to certain sources rarely relate to other text spans in such a way that relational propositions arise"[40]. Attribution is annotated in the PDTB as well, but it is not regarded as a discourse relation. Rather, the goal of annotating attribution in the PDTB is to capture semantic interactions of attributions with discourse relations,[57] the most striking of which is exemplified by Example 16. In this example, the negation associated with the attribution phrase, "I don't think", is interpreted lower, with Arg2 of the Contrast relation, so that Arg2 should then be read as "it's not a main consideration". Thus, while treating attribution as a different kind of relation, its annotation in the PDTB scheme allows it to be factored out of the discourse relation description while at the same time utilizing its semantic interactions with DRels, via the use of features as described in Reference [57].

Example 16 "*Having the dividend increases is a supportive element in the market outlook*, but `I don't think` **it's a main consideration**," he says.

The DR-core specification does not treat attribution as a discourse relation, but also does not provide for its annotation. According to ISO 24617-6, the annotation of attribution is recommended as a separate layer, to be undertaken according to a separate annotation scheme. Interactions of attributions with discourse relations can then be utilized by merging the two layers of annotation. Work in this direction can draw on schemes developed in the context of discourse relation annotation,[57] as well as schemes focusing exclusively on attribution.[51][52][53][77]

4.13 Representation of entity-based relations

There are a few types of connections between segments in discourse that don't involve a relation between situations in the same way as for other relations such as Cause or Concession. These are connections that different frameworks have variously called "Entity-Elaboration", "Object-Attribute Elaboration", "Continuation", "Circumstance", "Background", "Ground-Figure", "Frame", "EntRel", etc. Although there are some fine-grained differences in the exact semantic description across frameworks, they all refer to how the relation affects the narrative or the flow of discourse rather than to a direct relation between the situations denoted by the segments. Moreover, recognition of the connection seems to rest on recognizing a coreferential link between the segments, with one segment providing a description or attribute about an entity mentioned in the other. A striking feature of such relations, that also sets them apart from other relations, is that in all languages studied so far, they defy expression with any kind of connective. Examples 17 to 20 illustrate such relations. In each example, the coreferential entities are highlighted in boldface, and the rough inference of the relation in each case is that the second sentence says something *more* about the co-referring entity. No stronger relation is inferred between the segments, and no connective can be inserted between them.

Example 17 Traders said Goldman Sachs, **Shearson Lehman Hutton** and Salomon Brothers were the main force behind the futures buying at the pivotal moment.

Shearson Lehman Hutton declined to comment.

Example 18 Among the new issues was Massachusetts's $230 million of **general obligation bonds**.

The bonds were won by a Goldman, Sachs and Co. group with a true interest cost of 7,17 %.

Example 19 Shortly after the UAL opening, program traders started selling stocks in the **Major Market Index** and S&P 500 index.

The 20-stock **MMI** mimics the Dow Jones Industrial Average.

Example 20 Adding to the junk market's jitters were reports that Donaldson, Lufkin and Jenrette Securities Corp. is having trouble structuring a $1,6 billion offering for **TW Food Services Inc.** and will postpone or even cancel the issue.

TW is the largest franchisee of Hardee's, a fast-food restaurant, and operates several other food chains.