

What Situational and Discourse Relations Entail

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Abstract

An account of discourse connectives is given which focusses on their entailments. It covers uses of such connectives both to express discourse-internal situational relations and to express meta-level discourse relations. Representing the second of these involves explicitly introducing utterance mood into the logical form. The entailments of both situational and discourse uses of connectives are captured in meaning postulates. Those for situational relations concern only entities in the common ground and are *presuppositional*. Those for discourse relations may also refer, beyond the common ground, to the beliefs and attitudes of speaker and hearer, and they are *informative* rather than presuppositional. We suggest that in many cases the situational and discourse interpretations of a single relation have extremely similar properties, and that this shows up when the meaning postulates for the relation are elaborated.

Keywords: discourse relations, common ground, belief, presupposition, entailmen

1 Introduction

In this paper we describe an account of discourse connectives which we have implemented in the system described in Ramsay and Seville [2000]. This has a number of key features. One of these is that we take as our starting point the speaker's choice of lexical items, rather than an abstract

theory of discourse relations such as Rhetorical Structure Theory Mann and Thompson [1988]. One reason for doing this is to avoid the problem of having to choose amongst the potentially large number of alternative analyses suggested by Rhetorical Structure Theory, as addressed by Marcu [2000]. At the same time we recognise that by focussing on explicit discourse markers we are potentially neglecting the problem of identifying unmarked discourse relations¹. A further feature of our approach is its emphasis on identifying discourse relations with their entailments. This again does away with the need to consider alternative labels for a discourse relation. If it is appropriate for two connectives to share a set of meaning postulates and so have the same entailments in the common ground, then they can be considered to represent the same discourse relation²; otherwise, they are instances of different discourse relations.

2 Situational vs. Discourse Relations

Because we take as our starting point particular lexical choices rather than particular discourse relations, we need to consider how the same word may be used to perform different kinds of functions within the discourse.

- (1) John hits Mary, so she left him.
- (2) John hits Mary, so he's a fool.
- (3) I'm ready, so are you coming?
- (4) We're already late, so hurry up.

We treat *so* as an instance of a relation we have termed *consequence*. We can paraphrase the examples above, in terms of this relation, as follows:

- (1') John hits Mary and as a consequence she left him.
- (2') John hits Mary and as a consequence *I'm claiming* he's a fool.
- (3') I'm ready and as a consequence *I'm asking* are you coming?
- (4') We're already late and as a consequence *I'm telling you to* hurry up.

In (1), a reported event, Mary's leaving John, is the consequence, and so we treat this use of *so* as a situational relation. In contrast, the consequence in cases (2)—(4) is a linguistic event, and so we treat these uses of *so* as

¹We can build the discourse structure in unmarked cases using referential cues, as described in Seville [1999]. However, this does not amount to recognising the discourse relations and their entailments.

²This need not imply that the connectives are synonyms. Like *but* and *however*, they may be found playing different syntactic roles.

discourse relations³. Where the consequence is a query, as in (3), or a command, as in (4), it is straightforward to recognise the use of the connective to express a discourse relation. The difficult case is determining whether a declarative consequence is an event, as in (1), or a claim, as in (2). A useful heuristic seems to be whether the meaning is altered (as in (1)) or preserved (as in (2)) if we explicitly mark the consequent as a belief:

- (1'') John hits Mary, so *I believe* she left him.
(2'') John hits Mary, so *I believe* he's a fool.

The rephrasing preserves the meaning in (2''), as making a claim is very like publicly asserting a belief. However, asserting you believe a reported event happened, as in (1''), only serves to cast doubt on the report⁴.

3 Representation

In order to deal with discourse as well as situational relations, we need to explicitly represent the claim, command or query conveyed by an utterance, in addition to its propositional content. To this end, we explicitly introduce into the logical form both the mood of the utterance and a term corresponding to the discourse move. The mood relates the discourse move to the proposition expressed, as illustrated by the logical form we obtain for the utterance ‘‘John slept’’:

$$\begin{aligned} \exists Amood(claim, A, \\ \wedge(\exists B : \{B \text{ is interval} \& (ref(\lambda C(now(C)))) < B\}) \\ \exists E : \{aspect(simple, B, E)\} \\ \theta(E, actor, ref(\lambda F(named(F, John)))) \\ \& sleep(E) \end{aligned}$$

Given this representation, connectives can relate either the proposition expressed, P , or the associated meta-proposition, $\exists Xmood(X, \wedge P)$ ⁵. We represent the distinction between situational and discourse uses in terms of a difference in the arguments of the connective. In situational uses both arguments are propositions expressed, as illustrated by the logical form we obtain for (1):

³Our distinction between situational and discourse relations is similar to the distinction between semantic and pragmatic sources of coherence Knott and Sanders [1998].

⁴It is only appropriate to claim you *know* something in a context where there is *doubt* as to its truth Wittgenstein [1974].

⁵Situational and discourse uses of a connective are obtained from alternative lexical entries.

$$\begin{aligned} &\exists Amood(claim, A, \\ &\quad \wedge(so(\wedge(\exists B : \{B \text{ is interval} \&(ref(\lambda E now(E)) > B)\} \\ &\quad \quad \exists G : \{aspect(H, B, G)\} \\ &\quad \quad \quad \theta(G, agent, ref(\lambda I(named(I, John)))) \\ &\quad \quad \quad \&hit(G) \\ &\quad \quad \quad \&\theta(G, object, ref(\lambda J(named(J, Mary))))), \\ &\quad \wedge(\exists D : \{D \text{ is interval} \&(ref(\lambda C now(C)) < D)\} \\ &\quad \quad \exists D : \{aspect(simple, D, D)\} \\ &\quad \quad \quad \theta(D, agent, ref(\lambda L(centred(L) \& f(L))) \\ &\quad \quad \quad \&leave(D) \\ &\quad \quad \quad \&\theta(D, object, ref(\lambda N centred(N) \& m(N)))))) \end{aligned}$$

However, in discourse uses one of the arguments is itself a claim, command or query, as the logical form for (2) serves to demonstrate:

$$\begin{aligned} &\exists Amood(claim, A, \\ &\quad \wedge(so(\wedge(\exists B : \{B \text{ is interval} \&(ref(\lambda D now(D)) > B)\} \\ &\quad \quad \exists F : \{aspect(simple, B, F)\} \\ &\quad \quad \quad \theta(F, agent, ref(\lambda G(named(G, John)))) \\ &\quad \quad \quad \&hit(F) \\ &\quad \quad \quad \&\theta(F, object, ref(\lambda H(named(H, Mary))))), \\ &\quad \wedge(\exists C \text{ mood } (claim, C, \\ &\quad \quad \wedge(\exists F : \{F \text{ is interval} \&ref(\lambda D now(D)) > F)\} \\ &\quad \quad \quad \exists I : \{aspect(simple, F, I)\} \\ &\quad \quad \quad \quad \exists J : \{fool(J)\} \\ &\quad \quad \quad \quad \quad \theta(I, topic, ref(\lambda K(m(K)))) \\ &\quad \quad \quad \quad \quad \&predication(I) \\ &\quad \quad \quad \quad \quad \&\theta(I, pred, \lambda M(M = J)))))) \end{aligned}$$

In order to move from logical forms to interpretations, we have, as ever, to back up the terms we introduce with ‘meaning postulates’. In the current paper we are principally concerned with the consequences of discourse markers and indicators of mood. The first such MP deals with the significance of the declarative mood, which is encoded by saying that the speaker has made a claim:

$\forall X \forall P : \{mood(claim, X, P)\}, true(P)$ ⁶

⁶This meaning postulate is highly intensional, involving quantification over a proposition and then use of a predicate which specifies the truth of its argument. We believe that this kind of intensionality is unavoidable when trying to characterise discourse relations,

This says that anything which is claimed (by the speaker) is entailed in the common ground. Updating the logical form for “John slept”, as given above, results in a single fact concerning a claim in the (top-level) discourse model. All of the other facts in the discourse model then follow from the application of the meaning postulate for claim:

Discourse state 1

mood(claim, #2, ^ (sleep(#4)&aspect(simple, #3, #4)&theta(#4, actor, #6)),
theta(#4, actor, #6)
sleep(#4)
aspect(simple, #3, #4)
 ...

4 Connectives and Relations

A number of further connectives, like *but* and *yet*, pattern with *so*. We term these *infix* connectives. Connectives including *because*, *although*, and *if* represent another class we term *adverbial* connectives.

- (7) Frogs become princes if they’re kissed.
- (8) If you’re a prince, I’ll eat my hat.
- (9) Follow me, if you’re ready.
- (10) If you’re so clever, why are you so poor?

In these examples, (7) represents a situational use, while (8)—(10) illustrate discourse uses. The final class of connectives we consider includes, for example, *therefore*, *however*, and *nevertheless*. We term these *referential*, as the relation in this case is with some previous utterance. For example:

- (11) John died. Nevertheless Mary lived.
- (12) Mary survived. Nevertheless, she’s a fool.

As mentioned in the introduction, we treat connectives which have similar entailments as encoding the same relations. The following table shows the names of the relations for which we currently have meaning postulates and their corresponding connectives.

which are, by definition, relations between propositions. We use a dynamic constructive version of Turner [1987]’s *property theory* as our language for expressing logical forms, and we use the theorem prover described in Ramsay [1995], Cryan and Ramsay [1997] for reasoning within this language.

Type	infix	adverbial	referential
consequence	so	because	therefore
contrast	but	?	however
paradox	yet	although	nevertheless
implication	?	if	then
addition	and	?	furthermore, moreover

The reason we treat different connectives as encoding the same relation is that, in writing meaning postulates for the connectives, the similarities in their entailments emerge. The reason we give both situational and discourse uses of a connective the same relation name is that we believe the meaning of the relation is very similar in each case. That is, we attribute the differences in entailments of situational and discourse relations, not to different relations encoded by the same connective, but to different argument types.

5 Relations and their Entailments

In this section, we will focus on how we can use meaning postulates for relations to tease out the differences in the entailments of their situational and discourse uses.

5.1 Consequence

We start by examining the entailments of consequence, as both a situational relation and a discourse relation. The examples we will use to illustrate these are (1) and (2), repeated here:

- (1) John hits Mary, so she left him.
- (2) John hits Mary, so he's a fool.

A simple meaning postulate is used to convert the connective *so* into the relation *consequence* which it shares with a number of other connectives:

$$\forall P\forall Q: \{so(P, Q)\}, relation(consequence, Q, P)$$

In the meaning postulates for the relation *consequence*, we want to capture the intuitive distinction between situational uses like (1) and discourse uses like (2). In the case of (1), in order for the utterance to be felicitous the hearer has to accept that the second proposition can be a consequence of the first one. So, while (1) is felicitous, (13) is less so, at least in the absence of any particular background knowledge concerning John and Mary's relationship:

- (13) John loves Mary, so she left him.
(14) John loves Mary, so he's a fool.

However, (2) and (14) are equally felicitous. We propose that this is because, in these cases, the hearer doesn't have to accept that the second proposition is a consequence of the first. The speaker is not offering an explanation so much as an opinion. We will say that the situational uses (1) and (13) assume the existence of some public knowledge about consequential relations in the common ground of speaker and hearer. The discourse uses (2) and (14), however, make no such assumptions; rather, they tell the hearer something about the beliefs and attitudes of the speaker. The hearer need not accept that that John is a fool is a consequence, but only that the speaker's *claim* that John is a fool is a consequence, of his hitting or loving Mary. Assuming that speakers' reasons for making claims are their own business, the relation between the first proposition and the second meta-proposition in (2) and (14) is *informative*.

The meaning postulate we use for *consequence* as a situational relation is as follows:

$$\begin{aligned} \forall P \forall Q: \{ &relation(consequence, Q, P)\}, \\ &true(P) \& true(Q) \\ &\& \forall EP : member(type(EP, event), P), \\ &\quad \forall EQ : member(type(EQ, event), Q), \\ &\quad \& presupposed(reason(EP, EQ)) \end{aligned}$$

In order for the meaning postulate's presupposition to succeed, we have to show that $reason(EP, EQ)$, e.g., that someone's hitting you is a reason for leaving them, is provable in the common ground. We represent this as general background knowledge in a meaning postulate:

$$\begin{aligned} \forall L : \{ &leave(L)\}, \\ \forall A : \{ &\theta(L, agent, A)\}, \\ \forall O : \{ &\theta(L, object, O)\}, \\ \forall H : \{ &hit(H) \& \theta(H, agent, O) \& \theta(H, object, A)\}, \\ &'DEFAULT'(reason(H, L)) \end{aligned}$$

By treating the rule as a default, we capture the notion that it's reasonable to assume, in the absence of information to the contrary, that such a hitting event and leaving event are connected. Our treatment of defaults means that $reason(H, L)$ will succeed so long as it is consistent with the common ground Reiter [1980]. Below we show part of the discourse model we obtain for (1):

<u>Discourse state 1</u>	<i>leave</i> (#18)
θ (#16, <i>object</i> , #94)	<i>aspect</i> (<i>simple</i> , #17, #18)
θ (#16, <i>agent</i> , #93)	
<i>hit</i> (#16)	<i>relation</i> (<i>consequence</i> ,
<i>reason</i> (#16, #18)	\wedge (<i>leave</i> (#18)&...),
<i>aspect</i> (<i>simple</i> , #15, #16)	\wedge (<i>hit</i> (#16)&...),
θ (#18, <i>object</i> , #93)	<i>presupposed</i> (<i>reason</i> (#16, #18))
θ (#18, <i>agent</i> , #94)	...

Our meaning postulate for consequence as a situational relation treats it as *presuppositional*. Similar causal relations are also treated as presuppositional by Kehler [1995] and Knott and Mellish [1996]. However, we recognise that the idea the reason Mary left John is *presupposed* is in fact too strong. Indeed, if the reason were presupposed, the connective would be redundant, adding nothing to discourse coherence. This is why we treat the background knowledge about hitting and leaving events as defeasible⁷. However, this is a less than ideal solution. What we really want to be presupposed is not a reason at all but shared knowledge about the existence of plausible *kinds of reasons*.

The meaning postulate for *consequence* as a discourse relation and the discourse model we obtain for (2) are given below:

$$\forall P \forall Q \forall X : \{relation(consequence, \hat{mood}(claim, X, Q), P)\},$$

$$true(P) \& mood(claim, X, Q)$$

$$\& \forall S : \{speaker(S)\},$$

$$\exists B (believe(B) \& \theta(B, agent, S) \& \theta(B, event, Q)$$

$$reason(P, B))$$

<u>Discourse state 1</u>	θ (#84, <i>topic</i> , #51)
θ (#79, <i>object</i> , #57)	<i>predication</i> (#84)
θ (#79, <i>agent</i> , #51)	<i>aspect</i> (<i>simple</i> , #85, #84)
<i>hit</i> (#79)	
<i>aspect</i> (<i>simple</i> , #80, #79)	θ (#90, <i>event</i> ,
	\wedge (<i>predication</i> (#84)
<i>fool</i> (#51)	& <i>fool</i> (#51) & ...)
θ (#84, <i>pred</i> , $\lambda(A, A = \#51)$)	θ (#90, <i>agent</i> , #66)

⁷Knott and Mellish [1996] also views presuppositions as involving defeasible rules. Kehler [1995] alludes to Hobbs' scheme for abductive interpretation Hobbs et al. [1993] as a possible framework within which to resolve such presuppositions.

believe(#90) $\hat{mood}(claim, \#83,$
 $\hat{(predication(\#84)$
mood(*claim*, #83, $\&fool(\#51)\&\dots),$
 $\hat{(hit(\#79)\&\dots)}$
 $reason(\hat{(hit(\#79)\&\dots}), \#90)$
relation(*consequence*,

The meaning postulate for *consequence* as a discourse relation differs in two ways from the situational version: firstly, it is informative rather than presuppositional, and, secondly, it concerns the reasons underlying the speaker's beliefs rather than relations between reported events. The difference between the discourse model for (2) and that for (1) is that, here, John's hitting Mary is only a reason for the speaker's *belief* that John is a fool. There is no relation between John's hitting Mary and his being a fool. Note, however, that in the model John is indeed a fool. This follows from our factive treatment of both *so* and *claim*. That John is a fool has been added to the common ground because the speaker has claimed it, in the same way that any other proposition claimed by the speaker made would have been added to the common ground. This means that we have to be careful to distinguish between the common ground as a public domain of propositions and any *beliefs* of the speaker and hearer, as it is clear in this case that the *hearer* needn't share the speaker's belief that John is a fool.

5.2 Paradox as a Situational Relation

We treat the situational relation *paradox*, like the situational version of *consequence*, as presuppositional. However, in this case the presupposition is, not that some kind of relation holds, but that the conjunction of events is unexpected, as in (15):

(15) Mary loves John although he hits her.

Our meaning postulate for the relation *paradox* is given below:

$$\begin{aligned}
\forall P\forall Q: \{relation(paradox, \{Q, Q\}, \{P, P\})\}, \\
\forall EP : \{member(type(EP, event), P)\}, \\
\forall EQ : \{member(type(EQ, event)Q)\}, \\
presupposed(reason(EP, \hat{\neg}EQ))
\end{aligned}$$

5.4 Implication

Finally we consider *implication*, which differs from the relations discussed above in that it is *non-factive*, i.e., the propositions related needn't be true. The meaning postulate for situational uses of *implication* is given below:

$$\forall P\forall Q : \{relation(implication, Q, P)\}(true(P) \rightarrow true(Q))$$

This simply says that the truth of the consequent is dependent on the truth of the antecedent. Unlike the other situational relations examined, *implication* is not presuppositional, as the felicity of the first utterance in (17) is not dependent on something being entailed in the common ground of speaker and hearer:

(17) If John sleeps he dies. He sleeps.

However, it does share with other situational relations entailments which are dependent on something being provable in the common ground. In this case, Q as an entailment only follows if (or when) P can be proved. By the time we come to update the second utterance in (17), the first has already resulted in the kind of shared knowledge which triggers the entailment that John dies. The discourse model we obtain for this discourse is given below:

<u>Discourse state 1</u>	<i>aspect</i> (<i>simple</i> , #62, #63)
<i>relation</i> (<i>implication</i> ,	(#57 > #62)
$\wedge(\theta(\#63, agent, \#34) \& die(\#63) \& \dots)$	
$\wedge(\theta(H, actor, \#34) \& sleep(H) \& \dots)$	$\theta(\#67, actor, \#34)$
	<i>sleep</i> (#67)
<u>Discourse state 2</u>	<i>aspect</i> (<i>simple</i> , #68, #67)
$\theta(\#63, agent, \#34)$	(#57 > #68)
<i>die</i> (#63)	...

In order to obtain the rule which is triggered in Discourse State 2, we have done some extra work in updating Discourse State 1. Having updated the nested propositions related by *if*⁸, we replace indexicals with referring expressions and existentials in the antecedent with universally quantified variables (justified by the fact that $(\exists xP) \rightarrow Q$ is equivalent to $\forall x(P \rightarrow Q)$ if x does not occur free in Q), to give us the relation shown in Discourse State 1.

⁸This is necessary to ensure that any context-dependent referring expressions in them are anchored, i.e. for dealing with donkey sentences.

In the case of *implication* as a discourse relation, we have a meaning postulate which may apply even when P is not part of the common ground⁹:

$$\begin{aligned} \forall P \forall Q \forall Y : \{ &relation(implication, \hat{mood}(claim, Y, Q), P) \}, \\ \forall B : \{ &believe(B) \&\theta(B, event, P) \}, \\ \forall H : \{ &\theta(B, agent, H) \}, \\ \exists B1 (&believe(B1) \&\theta(B1, agent, H) \&\theta(B1, event, Q)) \end{aligned}$$

As in the case of other discourse relations, this meaning postulate concerns the beliefs of the conversants.

(18) If you believe Mary, you are a fool.

The speaker can exploit this feature so that their claim that the hearer of (18) is a fool need never explicitly enter into the common ground! Rather, the speaker puts the onus on the hearer to make the appropriate inference *in their own beliefs*, should they accept the antecedent of the conditional.

6 Conclusions

We have offered an account of connectives which has a number of distinctive features. We take as our starting point the speaker’s lexical choices, rather than some abstract theory of discourse relations, and we identify connectives with their entailments. We represent both situational and discourse uses of connectives, explicitly introducing mood into our logical forms for this purpose. Our approach to connectives is implemented in the system of language understanding described in Ramsay and Seville [2000], from which all of the logical forms and discourse models in this paper were obtained.

As some connectives have similar entailments, we arrive at a number of abstract relations. Some of these relations can be used to express either situational or discourse relations, depending on their argument types, with their situational and discourse uses having very similar entailments. However, because there are also the differences between situational and discourse uses which we discuss below, we do define separate meaning postulates for situational and discourse uses of our abstract relations.

The meaning postulates for situational uses of different relations and for discourse uses of different relations share some interesting features. Situational relations relate entities in the common ground of speaker and hearer and may be presuppositional, relying on or exploiting certain pieces of information which are shared by the conversants. Discourse relations, however,

⁹This is in addition to the basic truth-conditional one.

concern the beliefs and attitudes of conversants and reasons for holding (or not holding) them, and are informative. While situational relations are “objective” relations holding between events and other entities in the common ground, discourse relations don’t presuppose shared knowledge and so have a “subjective” flavour to them.

Our representation of referential connectives gives us the power to encode complex hierarchies of these situational and discourse relations. Together with our treatment of transitive relations, it enables us to obtain the entailments of global as well as local relations. However, an issue which remains to be explored is, given a claim which encodes a discourse relation, i.e., which contains a further claim nested within it, which is the appropriate referent to which a subsequent referential connective should be dereferenced?

Another future task is to extend our treatment to unmarked relations. The defaults we use to resolve the presuppositions of marked situational relations could also be used to deal with unmarked situational relations¹⁰, such as that in (26):

(26) John hit Mary. She left him.

However, caution is required as not marking the relation can be seen as deliberately leaving it underspecified; for instance, in this case it could be *consequence* but it could equally be some non-causal relation like *narration*. Furthermore, it does seem that other relations, like *paradox*, really do need to be marked if they are to be felicitous:

(27) John hits Mary. She loves him.

However, this is itself something we could exploit in determining unmarked relations, including unmarked discourse relations.

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¹⁰Our defaults are very like the defeasible causal laws used by Lascarides and Oberlander [1993]. for this purpose.

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