Enthymemes in Dialogue

A micro-rhetorical approach

Ellen Breitholtz

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Abstract

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In dialogue we frequently present arguments which are based on commonly accepted non-logical inferences. In rhetorical theory, this type of argument is called an *enthymeme*, and a pattern of reasoning that it is based on is called a *topos*. The main purpose of this thesis is to investigate the role that enthymemes play in natural language dialogue. The analyses focus on authentic dialogue material, and informal theories from linguistics and language philosophy are combined with formal theories in what can be considered a *micro-rhetorical* approach. This approach focuses on function in language, and the idea is that linguistic phenomena of the type studied by linguists are the micro-end of rhetorical phenomena. Formalisation is an important method in this thesis. The *information state* of a dialogue participant is modelled as a *dialogue gameboard* showing her current take on the dialogue and the cognitive resources currently activated. The formalisations are done in the semantic frame work *Type Theory with Records*. The first part of this thesis focuses on the linguistic and philosophical context of enthymeme and topos. In chapters 3–4 the formal model is developed, and in chapter 5 it is applied to a number of cases. Some of the main contributions of this thesis are that it points out that underpinning patterns of resoning are necessary to make pragmatic inferences, and suggests a precise way of formalising these patterns. Also, the concept of *Accommodation* is associated with enthymemes and topoi. Accommodation of enthymemes explains how agents can infer some types of rhetorical relations based on accessed topoi. Accommodation of topoi offers an explanation to some types of misunderstandings as well as a way of looking at learning of new topoi.

Keywords: enthymeme, topos, dialogue, TTR, gameboard semantics, dialogue modelling, accommodation, non-monotonic reasoning, micro-rhetoric

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Contents

Chapter 1

Micro-Rhetoric in Dialogic Interaction

1.1 Introduction

(1) Oh! I'm invited to a wedding that night. But the bride is pregnant so I might drop by in the wee hours!

The piece of discourse in (1) is taken from the facebook event page for a birthday party. The person who wrote (1) on the wall of the event did so to communicate that she would be busy on the night of the party, but that she might be able to stop by anyway. Many of us might find her communication quite clear and her reason for possibly being able to stop by quite reasonable. However, if we think of the argumentation in the last part of the example it does sound a bit strange:

(2) The bride (of the wedding I am going to) is pregnant, so I might drop by (at the party) in the wee hours.

We recognise this as an argument, but for it to be successful, that is for us to easily and smoothly accept that the bride being pregnant is a good reason for the guest to be able to stop by at the birthday party later on, we need access to some resources underpinning it. This might be a chain of inference like *If the bride is pregnant, she will be tired, and if she is tired the wedding might not go on for that long.* Moreover, it seems to be the case that, faced with a discourse like (1), which expresses an argument, we may tentatively accommodate some underpinning which would be necessary for the argument to make sense. Arguments like these, which require

knowledge of extra information to be acceptable, or even understandable, are important in rhetoric where they are called *enthymemes*. Crucial for the use of enthymemes in rhetorical discourse is that they are based on principles or notions which are so obvious to the audience that the argument seems to express necessity, rather than possibility. The basis for this seems to be cognitive – if we have to do less work to understand an argument, the content of it will appear more natural to us. Walker (1996) suggests that this is also true for dialogue. Despite this, very little work has been done on enthymemes in dialogue. In this work we aim to present a view of how enthymemes in dialogue interact with patterns of reasoning stored in our cognitive resources, in rhetorical theory referred to as *topoi*.

1.2 Problems in Analysis of Dialogue

Consider the interpretation of *rise* in (3):

(3)

Cherrilyn:	Yeah I mean ⟨pause⟩ dog hairs rise anyway so
Fiona:	What do you mean, rise?
Cherrilyn:	The hair ⟨pause⟩ it rises upstairs.

BNC file KBL, sentences 4201–4203

A snippet of dialogue such as (3) can be difficult to make sense of, and this difficulty lies in determining the meaning of particular lexical items (such as rise), but also – perhaps to a greater degree – in building hypotheses about situational and discursive contexts where the exchange in (3) would make sense. If we consider a larger excerpt from the same dialogue – (4) – we get a better idea of what is going on. From an analytical point of view, however, describing in a precise way how a speaker of English makes sense of (4) is challenging to say the least.

The dialogue in (4) is obviously an excerpt from a conversation regarding dogs, and whether or not they should be allowed in certain parts of the house, particularly upstairs. This is something that most people who have a moderate knowledge of English could determine in a few seconds after first seeing the text. However, there are many things we need to do before comprehension, or interpretation, can take place. We need to explain how we manage to interpret the contextual meaning of words, which is sometimes – as in the case of *rise* in (4) – ambiguous, and we need a theory for how words are combined to express propositions. However, we also need to account for

(4)

Cherrilyn:	Most dogs aren't allowed up ⟨pause⟩ upstairs.
	He's allowed to go wherever he wants ⟨pause⟩ do whatever he likes.
Fiona :	Too right!
	So they should!
	Shouldn't they?
Cherrilyn:	Yeah I mean ⟨pause⟩ dog hairs rise anyway so
Fiona:	What do you mean, rise?
Cherrilyn:	The hair ⟨pause⟩ it rises upstairs.
	I mean I, you know friends said it was, oh God I wouldn't allow mine upstairs because of all the ⟨pause⟩ dog hairs!
	Oh well ⟨pause⟩ they go up there anyway.
Fiona:	So, but I don't know what it is, right, it's only a few bloody hairs!

BNC file KBL, sentences 4196–4206

how utterances make sense in relation to other utterances. This includes things like anaphor resolution - how do we define, for example, to whom *they* in *Oh well ⟨pause⟩ they go up there anyway* refers? We also need to explain how speakers make inferences that are necessary for the dialogue to cohere. For example, how does Cherrilyn's utterance about what her friend said serve to clarify Fiona's clarification request *What do you mean, rise?* And how do we relate Fiona's final utterance *So, but I don't know what it is, right, it's only a few bloody hairs!* to the rest of the dialogue?

1.3 Dialogism and the Interactive Stance

One interesting aspect of the excerpt in (4) is that the dialogue does not run completely smoothly. Cherrilyn says something that Fiona obviously does not understand, and so Fiona makes a clarification request. The fact that we as language users sometimes fail to correctly interpret an utterance provides some clues to what it is that we do when our interpretation is actually successful. Also, how we manage to set the conversation straight

again, how we correct our mistakes, is also revealing.

One of the approaches to linguistics that emphasises the importance of dialogue is the *dialogical* tradition originating in the ideas of Bakhtin (1986). One of the most recent representatives of that tradition is ?Linell (2009). The umbrella of dialogism covers various types of research, philosophical as well as empirical. Common traits in dialogical research are *contextualism* and *interactionism*. Contextualism means that contexts are always viewed as relevant, and in fact a primary factor in communication. Interactionism means that dialogue, considered as a kind of interaction between agents, is central to the understanding of how language works. One aspect of this is a focus on features typical of dialogue like repairs, corrections and co-constructed sentences. Linell contrasts the dialogistic view with the *monologistic* view, which (in the case of linguistics and similar fields) is characterized by a conception of interaction as secondary in the understanding of communication. Linell concedes that a certain amount of monologistic analysis is necessary in linguistic research as in other research, However, Linell is generally skeptical of formal or semi-formal theories as he finds them too reductionistic. Linell also – not entirely without cause – criticises most cognitive and psycholinguistic theories, including the Chomskian tradition, for not paying sufficient attention to the interactive aspect of language.

Since the late nineties, however, a branch of formal semantics has emerged which takes interaction as its point of departure, and in fact shares many assumptions about the nature of language with dialogism. One notable representative of this line of research is Ginzburg, who has been developing it over the last fifteen years, culminating in the recent book *The Interactive Stance*, (Ginzburg, 2012). Ginzburg presents a theory for conversation oriented semantics – KoS – which pays much attention to non-sentential utterances. In contrast to traditional semantics, which focuses mainly on successful communicative episodes, Ginzburg emphasises misunderstanding and corrections/clarifications, and a central phenomenon is the practice of making clarification requests. Clarification requests and the subsequent clarifications expose different types of potential sources of misunderstanding in dialogue. Examples of such sources are mishearing, not being able to resolve a pronoun due to lack of contextual information, etc. There are also examples such as that found in the dialogue excerpt in (5) (originally from the British National Corpus) where the clarification request is taken to relate to the relevance of part of the content of the first utterance, (5a). The clarification in (5c) justifies the suggestion and thus helps Caroline to make sense of it.

(5) a. Unknown: Will you meet me in the drama studio?

b. Caroline: The drama studio?

c. Unknown: Yes, I've got an audition (**?**)Ginzburg2012
(Ginzburg, (2012) p.149)

Another important point which Ginzburg argues, is that interaction is built into grammar in the sense that the conventionalised linguistic patterns we call grammar are derived from language use.

1.4 A Micro-Rhetorical Approach to Linguistics

The interest in "imperfect" language use is something that Ginzburg and Linell have in common with Paul Hopper. In his paper *Linguistics and micro-rhetoric: A Twenty-First Century Encounter*, (Hopper, 2007), he argues that grammar essentially is an abstraction of the way we string together prefabricated fragments and fixed phrases, and that grammaticality as well as deviations from grammaticality can usually be explained by our tendency towards efficiency in communication – which is emphasised in rhetoric. Hopper argues that the interactive perspective with its focus on language as situated in time and space brings the disciplines of linguistics and rhetoric closer together:

> "...in fact (usage based) linguistics is nothing but the micro-end of rhetoric" Hopper (2007) p. 236

Hopper argues that a micro-rhetorical analysis would differ from the type of analysis usually applied in traditional rhetoric – if we want to find out things about words and phrases rather than debates, speeches and their contexts and effects, we have to look at smaller bits of language like utterances or short episodes. The linguistic phenomena which Hopper is interested in are mainly syntactic, like the case of *apo koinou* or pivot constructions, in utterances. *Apo koinou* is a construction where one constituent serves as the end of one grammatical sentence and the beginning of another, for example *That's what grabs their attention most is adverts* (Hopper, 2007).

However, If we apply a micro-rhetorical perspective to other areas of linguistics, there seem to be other language phenomena which are to some extent addressed in rhetoric, often from a different perspective than that applied to the same phenomena in linguistics. In semantics and pragmatics

for example, the notion of inference is essential. In semantics we look at inferences like presuppositions, which derive from the meanings of particular words – for example the word *lose* in a sentence such as *I lost the book*, triggers the presupposition that who ever *I*' refers to at some point had the book. This is due to the meaning of *lose* alone, and not context dependent. Other types of inferences, like conversational implicatures, are to a great extent dependent on context and on the assumption of some general expectations we have about communication. Inferences, however, are also central in rhetoric. In fact the art of rhetoric is much focused on how to lead an audience to make particular inferences, and thereby become convinced of the point which the speaker wishes to communicate.

In rhetorical theory the enthymeme is the type of evidence, or proof, which relates to reasoning and making inferences. In an article from the early eighties, Jackson & Jacobs (1980) show that enthymemes are related to conversational practices that we use continuously when we talk and communicate in other ways. They come to the reasonable conclusion that the rhetorical enthymeme is derived from more general principles of communication and interaction. While this seems likely, it is nevertheless the case that the connection between inferences and conversational phenomena such as turn taking and preference structure has not been a focus in linguistics. Inference like implicature and presupposition are mainly studied in language philosophy and pragmatics, while conversational practices and contextualised language use is mainly considered by conversation analysts. However, in rhetoric there is a focus on the inferential quality of language in use as well as on how we should use this quality to our advantage, that is, how we should employ inferences to make the communication run smoothly in a particular context.

It seems to us that the rhetorical perspective has not been considered enough in linguistics although it could contribute to the understanding of inference and coherence and other phenomena in dialogue and other types of linguistic communication. Thus, we aim in this work to look more closely at enthymematic reasoning and how it plays out in dialogue. In (1.7) we will state our aim in more detail, but let us first take a closer look at the concept of enthymeme.

1.5 The Aristotelian Enthymeme

Aristotle's rhetoric was intended as instruction on the art of public speaking, but in fact it is also a comprehensive introduction to a number of aspects

of linguistics which are relevant to the study of linguistic interaction. It does not deal with logic, but with the logic-like type of reasoning which frequently occurs in dialogue and other spoken discourse. The *Rhetoric* also discusses emotions and their cause and effects, as well as cognitive aspects of language and style. Thus Aristotelian rhetorical theory actually combines elements of what we would today call the pragmatics, psycholinguistics and sociolinguistics of dialogue.

For a modern day researcher who looks to the classics, it is important to know whether one is motivated by an interest in historical reconstruction, i.e. in trying to understand a text in its historical context and interpreting its original meaning, or in attempting to seek inspiration from the insights of classical theorists. Since our aim here is to use our interpretation of some Aristotelian notions to contribute to contemporary theories of dialogue semantics and pragmatics, this work is clearly a case of the latter. Therefore we will just give a brief account of the social and cultural context of the *Rhetoric*.

Aristotle's *Rhetoric* was written as a guide for students of rhetoric in a context where the ability to speak well in public was important to any free citizen. There were no professional lawyers or prosecutors, so anyone who wanted to take a case to court or who was summoned to court to meet an accusation had to stand up and speak for himself (for a full account, see Corbett & Connors, 1999). Also, in a democracy like Athens where ordinary people without much insight into public matters and state affairs were allowed to vote, it was essential for anyone aspiring to a political career to master the art of persuasion by referring to the likelihood of possibilities rather than to knowledge and facts alone. In the *Rhetoric*, book one, chapter one, section eleven[1], Aristotle explicitly states the importance of tapping into common beliefs and opinions when dealing with a crowd, rather than presenting the audience with facts and strictly logical reasoning:

> *Speech based on knowledge is teaching, but teaching is impossible with some audiences; rather, it is necessary for* pisteis *(proof) and speeches as a whole to be formed on the basis of common beliefs.* (*Rhet I 1.11*)

1.5.1 The syllogism and the enthymeme

Apart from the importance of adjusting the arguments to the audience, Aristotle claims that rhetoric should not (as it had in previous rhetorical

[1] All citations of the *Rhetoric* refers to Kennedy's translation (Aristotle, 2007)

handbooks) focus on external matters such as the different parts of a speech and in which order they should appear in the discourse, but rather on *logos*, reasoning (*Rhet. I 1.9*), which is also the aspect of rhetoric which is most relevant to our discussion.

Before we look further at Aristotle's view of rhetorical reasoning, let's say something about his view of the related field of logic. First, it is important to remember that Aristotelian logic is not equivalent to modern, formal logic, although it has been pointed out that the differences are perhaps less pronounced than what was thought to be the case in the early 20th century (Smith, 2012). One essential difference, however, is that while modern logic is an artificial language, Aristotle dealt only with natural language. A central concept in the Aristotelian theory of deduction is the *syllogism*. In the *Prior Analytics* Aristotle defines it as

> *An argument (logos) in which, certain things having been supposed, something different from the things supposed results of necessity because these things are so* (*Pr An I 1.24b 18-20*)

The phrase *certain things having been supposed* refers to the set of premises, and, being in the plural, *the things supposed* indicates, according to Keyt (2009), that there must be more than one premise. The rhetorical correlate of the syllogism – the deductive type of proof – in rhetoric is the *enthymeme*. The conclusion of an enthymeme does not – in contrast to that of a syllogism – need to follow of necessity. Neither is there a need for the set of premises to consist of more than one premise. These are formal requirements, but there are also some other ways in which syllogisms and enthymemes differ, mainly having to do with subject matter. While logical arguments should deal with general statements, enthymemes deal with particular cases. Thus in logic you argue for or against a general claim about the world, in rhetoric you seek to persuade someone of something regarding a particular case.

In (6a) we see an example of a syllogism, where the conclusion necessarily follows from the premises. In (6b) on the other hand, the conclusion depends on a notion that if someone has done something which is considered bad, then that person is likely to also have done less bad things. As Aristotle puts it: "if the lesser thing is true, then the greater is also, for people strike their fathers less than their neighbours".

(6)

a. Socrates is a man

   All men are mortal
   ∴ Socrates is mortal

b. a person had beaten his father

   ∴ he has also beaten his neighbour
   (*Rhet. II 23.4.*)

Presenting an argument based on implicit premises is possible since the members of an audience – just like people who partake in a conversation – have knowledge of and beliefs regarding the world around them. In this case Aristotle expected the audience to recognise, based on experience and previous input, that it is more common and a lesser crime to beat your neighbour than your father, so when they hear that someone is known to have beaten his father, they may find it quite reasonable that he is also guilty of beating his neighbour, if such charge has been made against him.

1.6 Topoi – the Underpinnings of Enthymemes

In order to be efficient, an enthymeme needs to draw on some commonly recognised notion that "fills in" the information that is lacking in the set of premises. This notion Aristotle refers to as the *topos* of the enthymeme. Some topoi may be applied to various subjects, while others are specific to a particular subject. An example of a general topos is the *topos of the more and the less*, of which Aristotle says

> *...to form syllogisms or speak enthymemes from this about justice is just as possible as about physics or anything else, although these subjects differ in species.* (*Rhet.I.2.21*)

An example of a general type of topos is that of *opposites*, on which the enthymeme in (7) is based.

(7) a. *..to be temperate is a good thing, for lack of self-control is harmful*
   (*Reth II 23.1.*)

b. lack of self-control is harmful

   ∴ to be temperate is a good thing

The enthymeme in (7) draws on the idea that since self-control and lack of self-control are opposites, the opposite of what is true of self-control is true of lack of self-control, or, more generally, if two things are opposites, the opposite of what is true of the first must (or is usually) true of the second. This example shows that the common notion of Aristotelian enthymemes as syllogisms with one hidden or silent premise, is not always correct. Strictly speaking, enthymemes based on the topos of opposites seem to require a set of additional premises to constitute a reasonable argument to an audience.

1.6.1 The topos in linguistics

The concept of topos is essential in the theory of *Echelles Argumentatives*, argumentative scales, presented by **?**Ducrot (1988), to an extent in collaboration with Anscombre (1995). The theory is based on the idea that between two utterances A and C where one of them is an assertion or a suggestion, exhortation, etc. and the other an assertion which functions as a support for the first, there is always a link which sanctions the interpretation of A and C as an argument. For example, imagine a situation where two people are at the cinema trying to decide which film to see. One of them utters (8), where (8b) is clearly an argument for the suggestion made in (8a).

(8) a. A: Let's not see a drama

b. B: I'm too tired

According to Ducrot (8) exploits a link which sanctions the interpretation that the drama genre should be avoided by tired people. This link could be the idea that dramas are complex and cognitively challenging compared to other genres. This seems reasonable and something that most adults would recognise. A link like this is referred to by Ducrot and Anscombre as *topos*.

Ducrot (1988) argues that topoi are notions which are *common*, that is they are assumed or taken for granted in a community, even before the conversation takes place in which they are employed. Topoi are also *gradual*, that is if I say "it's warm today, let's go to the beach", the topos – that warm weather makes the beach an attractive destination – is more true the warmer it is, and less true the less warm it is. A consequence of this would be that an enthymeme evoking a topos may be more or less convincing, depending on the context of utterance. They are also *general* in the sense that one topos can be employed in various arguments, in various situations. The opposite, that different topoi may be employed in similar situations is also true. Anscombre (1995) argues that when we say *Give a coin to the porter,*

he carried the bags all the way here, there is an obvious connection between the first and second proposition expressed in the utterance. However, the connection between *carrying luggage* and *getting a tip* is not linguistic, it's the common place principle that work should be rewarded, which is generally recognised, if not agreed upon in all situations. Interestingly, argues Anscombre, there are other, equally acceptable, principles which would lead to an opposite conclusion, such as principles that porters get paid to carry luggage already, and you should not get a tip for doing your job. Anscombre also makes the important observation that topoi, contrary to logical rules, do not constitute a monolithic system. Instead the system of topoi consists of principles which may be combined in different ways, like logical rules, but which may be inconsistent if combined in a specific situation. Anscombre (1995) suggests that this is because topoi are part of ideology, ways in which we perceive the world, and ideologies are not monolithic. Therefore, a principle like *opposites attract* and *birds of a feather flock together* may co-exist not only in one community, but in the set of topoi of one individual, and be applicable in different contexts.

1.6.2 Topoi as cultural indicators

The idea of a dichotomy of beliefs in episteme and doxa goes back to Plato. On the Platonic view, *episteme* is knowledge about the world of forms (world of ideas), while *doxa* represents our beliefs about the world of perception. For Plato, we cannot have *knowledge* about the world of perception – just beliefs. The concept of *doxa* is therefore on this view inferior to the concept of *episteme*. The concept of doxa has been connected to rhetoric in an interesting way. Rosengren (2008) argues that doxa is in some respects a more relevant concept than episteme: The difference, as Rosengren sees it, between traditional epistemology and the doxology he argues in favour of, is that while epistemology is concerned with (universally) true beliefs, doxology is concerned with what is *held* to be true, appropriate or right in a certain context – in other words – which topoi are applicable in that context. To be aware of what is consistent with the doxa – the topoi – of a certain community could thus be more relevant for a speaker constructing arguments than the beliefs which are *actually* true – it is possible to construct convincing arguments from false beliefs just as well as from true ones. The technique of adapting your arguments to the beliefs of the audience is well established in rhetorical theory, and Rosengren argues that rhetoric can be seen not only as a tool for *forming* arguments which are persuasive to a certain audience in a certain context, but also as a tool for *finding out* what

the speaker and the audience of a discourse believe to be true (or, in the case of the audience, what the speaker believes them to believe to be true), right and just. Rosengren follows Perelman & Olbrechts-Tycteca (1969) in declaring that the topoi which a speaker's arguments draw on to some extent define the world view of the speaker and the addressee. (Rosengren, 2002, p. 87), argues that in this terminology, it is possible to describe different societies by describing the topoi which are dominant within these societies. In the context of dialogue modelling, this would mean that modelling the topoi available to an agent is a way of modelling that agent's take on (a limited part of) its cultural context.

1.7 Aim and Outline of Thesis

In this chapter we have described a number of types of situations in dialogue where enthymematic structure seems to play a role, such as sense-making, coherence, repairs and clarifications. We also looked at a number of approaches to linguistics which we believe share many assumptions about how language works as well as how linguistics should be done. All of these – dialogism, KoS and the micro-rhetorical perpective – focus on accounting for phenomena such as the ones just mentioned, since they are typical for dialogue – in a conversation we often have adjacent utterances which are incoherent in terms of anaphora and other phenomena accounted for in dynamic semantics; we often say things wrong and repair our utterances; and we often give and ask for clarifications. Our aim is – in the spirit of the three aforementioned approaches to linguistics – to formulate a theory for how enthymemes and topoi play a role in dialogue. First, in chapter 2, we will look at a number of phenomena discussed in the literature which are in various ways related to enthymemes. In chapter 3 we will start sketching a model of information state updates including enthymemes and topoi which will elucidate how something like enthymemes and topoi is necessary to account for some dialogue examples. In chapter 4 we will make this model more precise by introducing types of information states and update rules cast in Type Theory with Records (TTR). Finally, in chapter 5 we will return to some issues and examples discussed in the previous chapters and give a more detailed account of these partly using the formalism introduced in chapter 4. In chapter 6 we will present our conclusions and discuss remaining problems and future work.

Chapter 2

Enthymemes, Topoi and Pragmatic Phenomena

2.1 Introduction

A common reaction to work on enthymemes and topoi is that the phenomenon of discourse where two propositions are connected by a non-explicit link is a case of presupposition, implicature or default reasoning. In this chapter we will relate relate enthymemes and topoi to these and other phenomena from the literature on pragmatics and artificial intelligence.

First, we will look at presupposition, (Strawson, 1950), (Stalnaker, 1974), (Karttunen, 1974), moving on to Grice's account of conversational implicature (Grice, 1975) in 2.3. In 2.4 we are still talking about inferences, but in Relevance Theory, (Sperber & Wilson, 1995) and the anti-inferentialist view of inference (Recanati, 2004) where the emphasis is more on the cognitive proceses of individuals engaged in dialogue. Sense-making of longer pieces of discourse and how we ascribe rhetorical relation between sentences or utterances is the focus in Segmented Discourse Representation Theory (SDRT) (Asher & Lascarides, 2003), which we discuss in 2.6. In 2.7 we look at enthymemes and topoi in relation to non-monotonic reasoning, and in 2.8 we consider cognitive aspects of enthymeme and topoi.

We do not claim that our account of topics related to enthymemes and topoi is exhaustive – it would probably be possible to fill a book with a relevant discussion on the relation between enthymemes and implicature alone. However, we hope that this chapter will give an overview and answer some questions, albeit raise many new ones. Some of the themes we discuss in this chapter will be revisited in Chapter 5 where some of the examples

will be accounted for in more detail.

2.2 Presupposition and Conventional Implicature

The classic, semantic, definition of presupposition is that it is an inference which survives embedding under negation (see for example Strawson, 1950). Stalnaker (1974) argued against the notion of semantic presupposition and diagnostics such as the negation test, in favour of a pragmatic analysis. In (9a) and (9b) we see Stalnaker's definition of semantic and pragmatic presupposition respectively.

(9) a. ...a proposition that P presupposes that Q iff Q must be true in order that P have a truth-value at all. (Stalnaker, 1974 p.48)

b. ...something like the background beliefs of the speaker – propositions whose truth he takes for granted, or seems to take for granted, in making his statement. (Stalnaker, 1974 p.48)

An example of an utterance that would carry a presupposition according to the definition in (9a) is (10), which presupposes that there is a queen of England regardless of whether the assertion is true or not.

(10) A: The queen of England is bald.

The presupposition of (10) would be the same regardless of which of the definitions in (9) we use. However, the pragmatic definition would include other types of inferences too, which would not fall under presupposition according to the semantic definition in (9b).

Let us consider one of the examples from Chapter 1, (11):

(11) The bride is pregnant, so I might drop by in the wee hours!

The example in (11) seems to carry a (pragmatic) presupposition that the bride of a wedding being pregnant is a reason for one of the wedding guests being able to stop by at another party in the wee hours. We could say then, that topoi are pragmatic presuppositions. However, we might want to be more specific than that. The example in (11), for example, is similar to that given by Grice (1975) to illustrate the notion of *conventional implicature*:

(12) a. S: He is an Englishman. He is, therefore, brave. Grice (1975)

b. Conventional implicature: If someone is an Englishman, he is brave.

Grice claims that the word *therefore* in (12a) gives rise to the implicature in (12b). From a micro-rhetorical point of view, we can see (12a) as an enthymematic argument that a particular person will be brave since he is an Englishman, based on a topos that if someone is an Englishman then that someone will be brave.

So, we have established that topoi are pragmatic presuppositions, and that some topoi could also be categorised as conventional implicatures. However, it does not seem clear that a topos is the exact same thing as a conventional implicature, since some enthymemes lack a lexical item that conventionally implicates a particular structure between the constituents. Let us consider, for example (13), an authentic dialogue example originally used in Walker (1996). The excerpt consists of two utterances produced by the same speaker[1] A – the speaker – and B – the addressee – are two colleagues on their way to work. They meet up somewhere along the way and continue their walk together. This is something they often do, and they are thus both familiar with the surroundings as well as the physical goal of the walk.

(13) A: Let's walk along Walnut Street. It's shorter

For this utterance to make sense to an addressee, he would have to assume that the speaker presupposes some kind of link between Walnut Street being shorter and the suggestion to walk along Walnut Street. However, since there is no specific word in (13) which warrants this assumption, this link cannot be a conventional implicature. Instead it seems to be the case that the rhetorical structure of (13) – and thereby part of its meaning – depends on the dialogue participants already having access to a notion that a route being short is a reason for choosing that route. In micro-rhetorical terms we would say that this notion is a topos or part of a more abstract topos having to do with convenience, efficiency, etc.

[1]The term *utterance* is sometimes defined as a string of words produced by a speaker while said speaker is holding the floor. In that view, (13) consists of one utterance, but for our current purpose, we are interested in units which convey atomic propositions – something like what Schlangen (2005) refers to as an *intentional unit*.

Accommodation

The process of adding a presupposition (semantic or pragmatic) to the discourse model is usually referred to as *accommodation*. This phenomenon was discussed by Stalnaker (1974) and Karttunen (1974), but the term was coined by Lewis (1979).

Lewis illustrates the notion of presupposition accommodation with the example (14), where (14a) is ok but (14b) seems odd.

(14) a. Fred has children, all Fred's children are asleep.

b. All Fred's children are asleep, and Fred has children

The reason for this, argues Lewis, is that the proposition *All Fred's children are asleep* presupposes that Fred has children. Thus, the belief that Fred has children is already integrated in the discourse model for speaker and addressee alike, and adding it a second time is redundant.

The presupposition in (14) is a semantic presupposition triggered by the possesive *Fred's children*, but Lewis' definition of presupposition accommodation in (15) seems to include any type of pragmatic presupposition.

(15) If at time t something is said that requires a presupposition P to be acceptable, and if P is not presupposed just before t, then - *ceteris paribus* and within certain limits - presupposition P comes into existence at t. (Lewis, 1979 p.340)

This means, for example, that if nobody in the discourse context objects when a speaker utters (13), the assumption of a link between the route being short and the advantage of choosing it will be accommodated in the conversation. However, if someone says something like *what do you mean the shorter - why would we want to choose the shortest route?*, this is evidence that the pragmatic presupposition – or topos – has not been accommodated in that person's discourse model. Stalnaker (1998) points out that in order for accommodation to work a speaker cannot expect controversial assumptions to be accommodated, and quotes Heim (1992) : "One may explicitly assert controversial and surprising things (in fact one should) but to expect one's audience to accept them by way of accommodation is not good conversational practice". In rhetorical terms we could say that it is not wise to choose an enthymeme which is not already associated with a suitable topos that the addressee has access to, or which evokes a topos which is acceptable to the audience.

Lewis shows that the principle of accommodation applies in the context of several linguistic phenomena, such as definiteness, modal expressions, etc. To that list we would like to add accommodation of topoi – when a topos which is necessary for an enthymematic argument to make sense is added to the discourse model – and accommodation of enthymemes – when a topos in the resources of an agent causes her to assign an enthymematic structure to the discourse.

Final remarks

In this section we have shown that topoi can be considered as pragmatic presuppositions, according to the definition in (Stalnaker, 1974). We have also seen that some topoi would be considered conventional implicatures, in the sense of Grice (1975). Whether a topos is conventionally implicated or not depends on whether the enthymematic structure is established by means of a lexical item signaling a causal relation between the premise and conclusion of the enthymeme.

We suggest that we could talk about accommodation of both topoi (as types of pragmatic presuppositions) and enthymemes (argumentative structure). We also suggest that the notion of unexpected presuppositions which Stalnaker (1998) and Heim (1992) argue should not be left to accommodation according to good conversation practices, are presuppositions which cannot be identified as belonging to a topos that is recognised by the agent in question.

2.3 Conversational Implicature

Grice's theory of conversational implicature is an attempt to systematically describe how it is possible for language users to convey (and mean) more – or something different – than the truth-conditional content of an utterance. Grice (1975) distinguishes between *what is said* and *what is implicated*. *What is said* corresponds to the truth-conditional meaning of an utterance and *what is implicated* to what a speaker conveys by uttering a certain string of words in a certain context, being aware of (though perhaps not in a meta-sense) the *principle of cooperation* and four *maxims* of rational and efficient communication. In the exchange in (16) below, B's reply that there is a garage round the corner would not be very helpful if B were lying about there being a garage, lying about where the garage is situated, aware of or had good reason to believe that the garage is closed, or aware that the garage does not sell petrol.

(16) a. *A*: I am out of petrol

b. *B*: There is a garage around the corner

c. + > The garage is open, it has petrol to sell, etc. (Grice, 1975)

Because of the above mentioned principle of cooperation – *make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged* (Grice, 1975) – *A* expects *B*'s utterance to be a relevant, truthful and complete reply. Grice specifies the assumptions of the cooperative principle further in the four *maxims of conversation* (paraphrased):

1 Quantity: Make your contribution informative enough, but do not say more than is required

2 Quality: Be truthful, or at least only say what you believe to be true

3 Relation: Be relevant

4 Manner: Be orderly, avoid ambiguity, etc.

By adhering to, or blatantly ignoring (*flouting*) the maxims and the cooperative principle, a speaker may express a lot more than the truth-conditional content of his/her utterance. So, Grice would say that we would interpret (16b) as implicating that the garage is open (or at least that the speaker believes this) due to the maxim of relation. Since the information that there is a garage around the corner would otherwise be irrelevant. Let us now consider (17), which we looked at in the previous section. In Gricean terms it could be analysed something like this:

(17) a. *A*: Let's walk along Walnut Street.

b. *A*: It's shorter.

c. + > Walnut Street being shorter is a good reason for choosing Walnut Street.

Due to the maxim of relation, we as language users want to interpret (17b) as a relevant contribution. One way of doing this would be to interpret

it as a relevant reason for choosing Walnut Street. However, it seems to us that we need something more than the principle of cooperation and the maxims to get at the correct implicature in (17). We can illustrate this by comparing (17) with the similar dialogue (18):

(18) a. *A*: Let's walk along Walnut Street.

b. *A*: It's longer.

c. + > ??

Now, by simply applying the cooperative principle and the maxims *B* might be able to infer that (18b) is relevant in relation to (18a). However, if the *B*'s resources do not include a topos underpinning (18b) as a premise in an argument for choosing Walnut Street – such as *longer routes are better* or *it is preferable to do spend longer time doing things* – it would be hard for *B* to arrive at a relevant interpretation. This is of course context dependent, there are some things that we like spending as long time as possible doing, and if walking is one of them, it is natural that a longer route is preferred. If *B* knew that *A* is always interested in getting exercise, which of course would be provided in greater meassures by a longer route, *B* might also be able to make a relevant interpretation of (18). However, considering the notions most of us have about comfort, efficiency, etc. (17) seems like less of a stretch unless the context is set up in a specific way. So, even if the maxims tell us that we should try to interpret contributions as relevant, true, etc. in order to do this we need some underpinning in the form of a pattern of reasoning – a topos – that fits in with the contribution we are trying to make sense of. If we consider yet another manipulation of our original example, this is even more clear:

(19) a. Let's walk along Walnut Street.

b. In the European Union, labour market conditions showed no signs of improvement during 2013.

c. + > ??

The contribution in (19b) seems very difficult to make sense of and would probably be taken as relating to an earlier topos or as *A* abruptly changing the subject. However, even this contribution would probably – under particular circumstances – be possible to interpret as relevant.

So, it seems as if we use some notions corresponding to Grice's principle of cooperation and maxims to interpet enthymemes. However, even if we

strive to make a relevant interpretation of a contribution, we need access to some underpinning pattern or topos to actually make a relevant interpretation. If we do not have access to relevant topoi, or if the contribution contains too little information to point us in the right direction of a relevant topos we have difficulty making a relevant interpretation. In cases like these we may get additional information by making a clarification request. Imagine for example a context of (16) where B would be totally unaware that you can buy petrol in a garage. The dialogue in (16) could then play out like in (20):

(20) a. A: I am out of petrol

b. B: There is a garage around the corner

c. A: What do you mean garage – I need to buy petrol?

d. B: They sell petrol

e. A: ah – ok!

To conclude it seems like the principles suggested by Grice lead us in some cases to infer that a speaker means something more than what is said. However, if we have access to relevant topoi we can understand not only *that* something is implicated but *what* is implicated. If we, on the contrary, do not have access to a topos that fits the discourse, it is difficult for us to make sense of an utterance where part of the meaning is conversationally implicated.

2.4 Relevance Theory

Relevance theory (Sperber & Wilson, 1995; Wilson & Sperber, 2004), is a development of Grice's theory of meaning where the Gricean maxims have been reduced so that just the maxim of relevance (relation) remains. However, this principle of relevance is not first and foremost a communicative principle based on assumptions of cooperation and rationality, but rather perceived as a fundamental feature of human cognition.

Unlike Gricean pragmatics, which distinguishes between *what is said* – the truth-conditional content of an expression – and *what is implicated*, Relevance Theory distinguishes between *explicature* and implicature, where explicature refers to the explicit content of an utterance in a particular context. We would generally interpret (21) as Jack and Jill being married to

each other rather than to other people. According to Relevance Theory this is the explicit, truth-evaluable content or the *explicature* of the utterance, which is arrived at through disambiguation, reference resolution and other pragmatic processes.

(21) Utterance: Jack and Jill are married

Explicature: Jack and Jill are married to each other.

Meaning interpretation in Relevance Theory is not perceived as something that happens in steps where one step is executed after the other (primary and secondary processes). Instead, the interpretation process is incremental and hypotheses about explicatures, implicated premises and implicated conclusions are developed in parallel. According to Sperber and Wilson (2004) this is an inferential process, i.e. if we assume certain explicaturers, then certain implicated premises (intended contextual assumptions) and implicated conclusions (implicatures) follow necessarily, i.e. they are logical. This is illustrated very well by the example (22):

(22) a. Peter: Would you drive a Saab?

b. Mary: I wouldn't drive ANY Swedish car. (Sperber and Wilson, 1995 p.194)

Implicated premise: Saab is a Swedish car

Implicated conclusion: Mary wouldn't drive a Saab

In (22) the implicated conclusion (implicature) is that Mary would not drive a Saab, based on the implicated premise that a Saab is a Swedish car. If we consider this example from a rhetorical perspective, we could say that Mary's reply combined with a conclusion partly determined by the question in (22a) is an enthymeme as seen in (23):

(23)
Mary would not drive any Swedish car

∴ Mary wouldn't drive a Saab

On this view the premise that Saab is a Swedish car would be the topos of the enthymeme. According to Relevance Theory, this premise would present itself automatically due to the relevance assumption – If Saab were not a Swedish car, why would Mary answer the way she did? However, if Peter

thought that Saab is a German car, the implicated premise and conclusion might not be as obvious, despite the relevance assumption. And if Saab were not, in fact, a Swedish car, and Peter knew this, the relevance assumption alone would probably not be enough for the interaction to run smoothly.

The example in (23) is neat, since the relevance assumption seems to do the work unless one of the agents involved in the dialogue is uninformed. The situation in (24), an example taken from (Carston & Hall, 2012) is slightly different:

(24) a. Max: How was the party?

b. Amy: There wasn't enough to drink and everybody left early

Here we would probably infer the implicated conclusion that the party was not a success, based on implicated premises that there is a connection between guests leaving early and dull parties, as well as lack of alcohol and dull parties. This implicated premise differs from that in (22) in that it seems to be a combination of several notions or patterns of reasoning that most people in our society would, if not agree with, at least recognise as common ways of reasoning. So, we can assume that Max has access to topoi which connect *not enough alcohol* and *unsuccessful party*. This topos is instantiated as a hidden premise (contextual assumption) in Max's interpretation of Amy's utterance. However, it is not a precise connection, as *every party at which there is not enough alcohol is unsuccessful* would have been. This makes sense, if we assume that connections which are established in an agents cognitive resources may be weaker or stronger, and may vary according to context.

As in the case of Gricean maxims, the principle of relevance seems to be explaining why we interpret utterances like (24b) as conveying more than the truth-conditional content. However, none of these theories automatically generate the implicated inferences without some form of underpinning in terms of cognitive and contextual resources. Relevance Theory does have the concept of implicated premise, which, combined with the explicature of the discourse, leads to the implicated conclusion. However, in many cases it seems unlikely that these exact premises are part of our cognitive resources. Instead we suggest that we have access to more abstract patterns of reasoning in the form of topoi which may be combined and instantiated to underpin the discourse.

2.5 Anti-Inferentialism

Anti-inferentialism is a theory of pragmatic meaning suggested by Recanati in for example (Recanati, 2001, 2004). Unlike the relevance theoretical view, the anti-inferentialist view of meaning in context attributes many aspects of utterance meaning to processes that are not inferential. On this view, interpretation of an utterance happens in two steps - via *primary pragmatic processes* and *secondary pragmatic processes*, where the primary processes correspond to Relevance Theory's concept of explicature. However, the distinguishing characteristic of primary pragmatic processes is that they do not suppose the prior identification of some proposition. They are not conscious, in the sense that a "normal" interpretor is unaware of the processes through which the context-free meaning is enriched to fit the situation. Primary pragmatic processes may be bottom up, i.e. they are linguistically mandated, or top down, i.e. contextually driven. Recanati (2004) lists four different types of primary pragmatic processes:

> *Saturation*: Mandatory, linguistically motivated disambiguation e.g. anaphor resolution. (Bottom up)
>
> *Free enrichment*: The *She took out the key and opened the door* would generally be interpreted in a way such that the key that was taken out was the key used to open the door. Usually, free enrichment corresponds to the *specification* of some expression in the utterance by making it contextually more specific.
>
> *Loosening*: When a concept is used more generally than the literal interpretation allows, for example, in the utterance *the ATM swallowed my credit card* the aspects of swallowing that the speaker refers to are more general than what we connect with actual swallowing by a living creature.
>
> *Semantic transfer*: In the utterance *The ham-sandwich left without paying*, *the ham-sandwich* refers to the person who ordered the ham-sandwich - not to the dish itself. *I'm parked out back* does not mean that the person who performs the utterance is parked out back but that his or her car (or other vehicle) is.

The anti-inferentialist take on interpretation is characterized by the fact that all pragmatic processes which are necessary to arrive at a fully truth conditional interpretation are perceived as being non-inferential. Of the different types of primary processes mentioned above, all except saturation are

contextually mandated (top-down), and these are the ones that interest us most. Recanati proposes that "interpretation is as direct as perception" in these cases, and instead of looking to logic to explain for example enrichment, he turns to *association* between suitable *schemata* (Rumelhart, 1978) or *frames* (Fillmore, 1982) and context free utterance meaning in order to explain how we interpret contextual meaning.

The concept of schema has been around in cognitive science since the seventies at least, and can be described as a system for organising knowledge (or beliefs). Recanati (2004) sketches a picture of how schemata play a role in interpretation: An expression activates a cognitive schema, which is basically a connection between two (or more) semantic values that says that these values fit together. As an example, Recanati considers (25).

(25) John was arrested. He had stolen a wallet

Recanati attributes the reference resolution in (25) to the fact that (most of us) have access to a schema where "stealing" and "being arrested" are linked. Rumelhart (1980) describes the internal structure of a schema as the script of a play where actors who can fill the different roles of a play in different renditions correspond to variables which can be associated with different aspects of the schema on different instantiations of the schema.

If we think of (25) as rhetorical discourse, we see it as an enthymematic argument where the conclusion is that John was arrested, and the premise that he stole a wallet, as seen in (26a).

(26) a.
$$\frac{\text{John had stolen a wallet}}{\therefore\ \text{John was arrested}}$$

b.
$$\frac{x \text{ steals something}}{\therefore\ x \text{ is arrested}}$$

On this view, the argument would be underpinned by a topos saying that if someone steals, they get arrested, as seen in (26b).

Unlike Gricean theory of conversational implicature and Relevance Theory, anti-inferentialism emphasises the importance of context and cognitive resources for meaning interpretation. Recanati also suggests that these resources are organised in terms of schemas or frames, representing the knowledge or beliefs of an individual in particular domains, based on the experience of that individual. To some extent this notion is similar to that of

topoi which we draw on when producing and interpreting discourse. However, topoi, as they are traditionally perceived in rhetoric, tend to be more abstract and one topos would perhaps be relevant to one particular association within a schema but irrelevant to – or even inconsistent with – another. Also, one topos may be relevant to, or fit into, several schemas.

Recanati makes a point of primary pragmatic processes being non-inferential, and associative. He defines these processes as being as automatic as perception and unconscious for the "normal" interpretor, while inference to Recanati is something that the normal interpretor can reason about in a conscious way. Sperber and Wilson, on the other hand, perceive all steps of the interpretation process as inferential. However, there seems to be some evidence that a process which is conscious for an individual at one point in time can be unconscious at some later point in time. For example: A Swedish or English speaking student of French may at first have to think carefully every time he or she chooses which form of a verb to use. After a while this process will be quicker and less conscious, and eventually, as the student learns to master the language, it becomes more or less automatic. Dreyfus & Dreyfus (1980) describe the acquisition of skills in terms of five stages, where stage five (highly competent) involves a lot of tacit knowledge and routinized behaviour, while stage one (beginner) involves almost exclusively conscious reasoning.

It seems to us that if it were true that all enrichment which is necessary to reach the contextualised, fully enriched truth-conditional content of any sentence were associative (automatic) it would be difficult to explain language learning!

But, it would be possible to argue, anti-inferentialist theory is not about language learning, it is an account for the interpretation processes of a fully competent speaker of a language, so this objection is not relevant. However, we would like to argue that even a fully competent language user continues to incorporate new interpretations of expressions and is frequently faced with new types of contexts in which old (and new) expressions are to be interpreted — language change does not only happen between generations — it happens continuously, and the language of an individual develops and changes during the course of the individual's life.

2.6 Rhetorical Relations

We are interested in pieces of discourse which convey two propositions that are related in the sense that they can be seen as constituting an en-

thymematic argument underpinned by a topos or a set of topoi. We argue that this type of relation contributes to coherence. In this section, we look at what a prominent discourse theory – SDRT – has to say about the kind of examples we are interested in, and attempt to look at enthymemes and topoi in the context of rhetorical relations as described in SDRT.

2.6.1 Discourse coherence

Before we start looking at how particular theories account for discourse coherence we should say something about the phenomenon itself. Generally, coherence means how a discourse, text or conversation, "hangs together", and coherent refers to the property of being interpreted as belonging to the same unit. Leth (2011) suggests that the minimal requirement for coherence is *relation*. This means that when a number of discourse units are put in the same context, or considered in the same context, a relation between these units is automatically generated. The reason for this would be that we try to relate two expressions to each other in some meaningful way as soon as we are presented with them. Thereby we also assign a possible rhetorical relation between the two units. The view that our cognition is constantly seeking to create coherence, and that virtually any two constituents in discourse *could* be interpreted as coherent under the right circumstances seems reasonable. However, this does very little to narrow down the kind of predictions we could make regarding the ability of an agent to interpret a piece of discourse as coherent.

An example of a string uttered by one person in conversation that is relevant to this discussion is (27).

(27) a. *A*: It's cold in here.

b. *A*: Could you please close the window? (van Dijk, 1979)

In van Dijk (1979) (27) is uncontroversially described as an *assertion* followed by a *request*. Van Dijk suggests that (27a) could be seen as *ground* for the following request in (27b). If placed after (27b), however, (27a) would, according to van Dijk, constitute an *explanation*. In Conversation Analysis, the type of coherence that exists between parts of turns which express separate propositions, is referred to as a *sequence extension*. In this terminology, (27a) would be seen as a *pre-sequence* of (27b), which expresses the main point of the utterance. Conversation Analysis then, defines the constituents of a turn in terms of organisation rather than in terms of pragmatic function in relation to other parts of the turn. Approaches to discourse coherence

that are influenced by speech act theory on the other hand, focus on pragmatic function. Theories of rhetorical relations focus on pragmatic function but in addition take the order of constituents into account.

2.6.2 Segmented Discourse Representation Theory (SDRT)

Compared to classic pragmatic theories, which take their point of departure in speech acts or implicatures, theories of rhetorical relation like Rhetorical Structure Theory (RST) (Mann & Thompson, 1986, 1988) and Segmented Discourse Representation Theory (SDRT) (Asher & Lascarides, 2003) tend to be geared towards automatic discourse analysis, and therefore have a higher degree of formalisation. We are particularly interested in SDRT since it – in comparison to RST – focuses more on dialogue.

SDRT shares our assumption that rhetorical relations between sentences or utterances are sometimes necessary in addition to compositional or dynamic semantics to fully interpret discourse. According to Asher & Lascarides (2003) traditional dynamic semantics (Kamp & Reyle, 1993; Groenendijk & Stokhof, 1991), although capable of handling some coherence phenomena, cannot handle rhetorical relations adequately, and consequently not the phenomena accounted for by rhetorical relations alone. Asher and Lascarides also argue that the contribution to content made by rhetorical relations is sometimes distinct from the content that is inferable from other pragmatic information like domain knowledge. Some of the phenomena which Asher and Lascarides claim are not given a satisfactory analysis if we disregard rhetorical relations are bridging inferences, lexical ambiguity and conversational implicature. In this section we will look at some of the problems accounted for by SDRT and how an analysis drawing on rhetorical relations as presented in SDRT relates to enthymemes and topoi. We will also say something about the different discourse relation types in SDRT in relation to enthymemes and topoi.

Rhetorical relations in SDRT

The different types of rhetorical relations or discourse relations in SDRT are not based on rhetorical – or functional – criteria alone, but on a combination of rhetorical quality and other properties like tense, mood and discourse order. Apart from the division into main rhetorical relation types – such as *elaboration*, *narration* and *explanation* – there is also a separate division of relation types into six groups: Content-level relations, text-structuring relations, cognitive-level relations, divergent relations, and meta-talk rela-

tions. Some relation types have subtypes (there is, for example, one type called content-level explanation and one type called meta-level explanation), and these subtypes may also belong to different groups. However, this fine-grained division is not relevant to us at this point. Thus we will settle for distinguishing between categories whose rhetorical functions are clearly distinguishable. Above all we are interested in the two types of relation which are most easily associated with enthymemes – *result* and its counterpart *explanation*.

In (28) we see two utterances that are linked by the rhetorical relation *result*.

(28) *Result* (Asher and Lascarides, 2003 p. 463)
a. *A*: John pushed Max.

b. *A*: He fell.

The discourse in (28) corresponds to an enthymeme where the first utterance, (28a), constitutes the premise and the second utterance, (28b), constitutes the conclusion. We see this enthymeme in (29):

(29)

$$\frac{\text{John pushed Max}}{\therefore \text{ Max fell}}$$

In (28) the discourse order matches the order of events, and the premise is presented before the conclusion. In (30) – an example of an *explanation* – the situation is the opposite. Here the conclusion is presented first and the premise second, and the order of events does not match the discourse order.

(30) *Explanation* (Asher and Lascarides, 2003 p.)
a. Max fell.

b. John pushed him.

Thus, the difference between *explanation* and *result* is the order of constituents. We may say, then, that the two examples convey the same enthymeme and if we accept (30) and (28), as *explanation* and *result* respectively, we also have to accept that, according to these utterances, it was John who caused Max to fall by pushing him.

How do we assign the right relation?

Discourses where the textual order does not match the order of events described by the discourse is one example of a problem accounted for by SDRT. Asher and Lascarides, (2003) pp. 6–7, demonstrate the importance of rhetorical relations for correctly interpreting the examples in (31a) and (31b).

(31) a. Max fell. John helped him up.

b. Max fell. John pushed him.

(31a) and (31b) are similar in terms of tense and aspect, but we easily spot that in (31a) the textual order matches the order of events, while in (31b), the order is reversed.

Asher & Lascarides (2003) postulate a rhetorical relation *Narration* which relates two propositions only if the event described by the first proposition temporally precedes that of the second. This relation would describe for example the discourse structure in (31a). The fact that *Narration* applies to (31a) affects the truth conditional content of the discourse by implying that Max' falling precedes John's helping him up. As language users, our intuition about (31b), on the other hand, is that the falling happens after, and is caused by, the pushing. As we have seen in (30) Asher & Lascarides (2003) suggest the discourse relation type *Explanation* to describe this structure. Asher and Lascarides argue that rhetorical relations are necessary to capture the disctinct temporal content of (31a) and (31b), and that these relations are not derived from domain knowledge. They say, with regard to the example in (31b):

> If pushings typically cause fallings were part of domain knowledge, one might use it to construct the right logical form, but *this* proposition seems quite implausible and hence not part of domain knowledge. (Asher and Lascarides, 2003 p.7)

Instead, Asher and Lascarides suggest that we infer a causal link in virtue of the presence of a rhetorical link between the two propositions. This warrants a few questions: First, is it really inplausible that some notion that pushings cause, typically cause or may cause fallings is part of domain knowledge? Secondly, how do we as interpretors of (31b) know that we are supposed to infer a *causal* link and not, for example, a narrative link?

If we consider (31b), we have access to cognitive resources concerning pushings and fallings, among them a topos saying that the relation between

pushings and fallings is that pushings cause fallings – if x pushes y, y falls. On a micro-rhetorical view, we would say that the discourse in (31b) evokes this topos, and the topos helps us accommodate the enthymeme in (29), or – in the words of Asher and Lascarides – infer a causal link between the two utterances.

Now we hope to have established that some SDRT relations are indeed related to enthymemes, since discourses of these types contain some kind of claim or conclusion and one constituent which serves as support for that claim or conclusion. But what about other relations, which lack a causal link between utterances – are they unrelated to enthymemes and topoi? Consider the discourse in (32):

(32) a. Max came into the room

b. He sat down

c. He lit a cigarette

Asher and Lascarides present (32) as an example of *narration*. This SDRT-discourse relation is defined in terms of space and time in a way that distinguishes it from, for example, *continuation*. Narration holds between (32a) and (32b), and between (32b) and (32c). These relations do not seem to be enthymematic – that someone enters a room is not a *reason* for that person sitting down, neither is sitting down an explanation for lighting a cigarette. There is no enthymematic argument in this discourse which needs underpinning. However, there is still some kind of expected progression in (32). We would probably have a harder time interpreting (33) as coherent:

(33) a. Max sat down

b. He came into the room

c. He lit a cigarette

Another problem arrises if the content of the sentences are difficult to place in the same space and time for world-knowledge reasons. For example, if (32b) had been *he dived into the Caribbean sea* rather than *He sat down* the interpretation of the discourse as linked by *Narration* would be less obvious. This indicates that there is some kind of ordered domain knowledge underpinning *Narration*, *Elaboration*, *Continuation*, etc. as well as *Explanation Result*. However this domain knowledge may be organised in terms of, for example, frames or schemas rather than topoi.

Final remarks

We fully agree with the perspective presented in SDRT in that a rhetorical element is necessary to fully capture the content of causal discourse relations, like *Explanation* and *Result*. Asher and Lascarides reject domain knowledge as a direct means of deciding on which rhetorical relation we are dealing with in a particular discourse, since the principles which we draw on can often not be considerd defaults. For example, it is not the case that most pushings result in fallings. We would like to argue that domain knowledge can indeed supply us with an appropriate logical form to underpin a causal relation in discourse. In the next section we will look at the relation between enthymemes, topoi and default rules and consider possible advantages of a micro-rhetorical perpective on non-monotonic reasoning.

Discussing evidence for cognitive foundations for rhetorical relations, Asher and Lascarides refer to research according to which at least causal relations seem to help interpreters understand texts better (Asher and Lascarides p 450, Meyer and Freedle 1984, Flower and Hayes 1980). Since causal relations are what enthymemes are based on, this seems to support the view that enthymemes help us structure discourse in a coherent way. Asher and Lascarides claim that the discourse relations in SDRT have semantic contents that relate to "fundamental conceptual categories by means of which we organise our beliefs", for example causation, sequencing, part/whole. This seems reasonable, and these categories are somewhat reminiscent of Aristotle's "common topoi", topoi that may be used to underpin arguments within all domains.

2.7 Enthymemes, Topoi and Default Reasoning [2]

In the previous sections of this chapter we have considered how enthymemes and topoi relate to some influential theories of inference and coherence. We have noted that discourses containing evident enthymemes make addressees accommodate topoi and that topoi which are associated with the content of a particular discourse may help the addressee to accommodate an enthymematic rhetorical structure. In the previous section, we reported that Asher & Lascarides (2003) oppose the idea of world knowledge rules or principles underpinning SDRT-relations like *Explanation*, since in some cases, these principles could not be defaults. In this section we will address this problem and suggest a micro-rhetorical take on non-monotonic reasoning.

[2]This section is based on Breitholtz (2014)

2.7.1 Non-monotonic reasoning

An important feature of classical logic is that if a formula is derivable from a theory (a set of formulae), then it must also be derivable from an expansion of that theory. Let us say for example that Γ is a set of formulae and A is a formula and A is a logical consequent of Γ ($\Gamma \vdash A$). Then Γ, $B \vdash A$ is true as well.

In natural reasoning however, it is often the case that we draw a conclusion which we later have to retract in the light of new information. One reason for this is that we sometimes have to consider problems about which we have limited information. To handle cases like these various types of non-monotonic logic were proposed in the early eighties in for example McDermott & Doyle (1980), Reiter (1980) and McCarthy (1980). Approaches to non-monotonic logic often suggest we represent human reasoning in terms of *defaults* as suggested in Reiter (1980), with later followers such as Horty (2012). The principle of default logic is that there are rules which are usually true, but which may in some cases be overridden by other rules. We agree that this approach is adequate in cases where the non-monotonicity has to do with lack of information. However, in cases such as the (**?**) (Reiter & Criscuolo, 1981), we can no longer represent all accessible information as one consistent set of rules. This type of reasoning is not uncommon in conversation and other types of natural discourse, and research questions pertaining to it are sometimes addressed in conversation analysis and other approaches to dialogue.

Here we give a brief account of some of the topics and problems of default logic and of how we perceive default reasoning in terms of argumentation with enthymemes drawing on topoi. In this chapter our discussion will remain informal, but we will return to this topic in Chapter 5 to give a more precise analysis of the examples discussed.

The Tweety triangle

The classic "Tweety triangle" puzzle illustrates the principle of default reasoning. In short, the puzzle comes down to this: When we say that Tweety is a bird, and therefore Tweety flies, we draw on some rule saying that if something is a bird, then it flies. In classical logic this is expressed as in (34).

(34) $\forall x\ (\text{bird}(x) \rightarrow \text{fly}(x))$

We know, however, that there are some types of birds which do not fly,

like penguins and ostriches. So we also have access to rules like

(35) a. $\forall x\ (\text{penguin}(x) \rightarrow \neg\text{fly}(x))$

b. $\forall x\ (\text{penguin}(x) \rightarrow \text{bird}(x))$

This means that the rule in (34) has to be modified:

(36) $\forall x\ (\text{bird}(x) \wedge \neg\text{penguin}(x) \rightarrow \text{fly}(x))$

In most natural discourse, we allow for exceptions like this, but we do not necessarily have rules for every single exception. It would be possible to include more exceptions for other types of non-flying birds. However, this could be difficult since there might be species of birds that do not fly which we do not know of (but we know they *might* exist). Also, there might be individual birds which do not fly for various reasons. So, what we really want is a rule that expresses *under normal circumstances, birds fly* or *if we are not dealing with an exception, then birds fly.* This is usually done through *default rules* which could look like (37). (37) should be interpreted as *If x is a bird and there is nothing to contradict that x flies, then x flies.*

(37) $\dfrac{\text{bird}(x).\ \text{fly}(x)}{\text{fly}(x)}$

If we imagine the Tweety scenario as a dialogue situation where a speaker A claims: - Tweety flies – he's a bird!, A has expressed an enthymeme

(38) $\dfrac{\text{Tweety is a bird}}{\text{Tweety flies}}$

A's argument is underpinned by a topos saying that if we have a situation where something is a bird, we can assume that we also have a situation where that something flies. Let us then imagine that another speaker, B says in reply to A "No, Tweety can't fly – he's a penguin!", evoking a topos saying that if we have a situation where something is a penguin, then we have a situation where this something does not fly. The topos about penguins could be considered more reliable, and A would have to reconsider her judgement about Tweety. Horty (2012) suggests that this is due to that the rule saying that penguins do not fly is more specific than the one saying that birds do fly. The reason that it is more specific is that penguins are a type of bird, but birds are not a type of penguins, and a topos stating that is probably also evoked in a conversation like this.

The Nixon diamond

Another problem often discussed in the context of non-monotonic reasoning is the so called *Nixon Diamond* (see for example Reiter & Criscuolo, 1981). The situation described in this puzzle is the following:

(39) a. Nixon is a quaker

b. Nixon is a republican

c. Quakers are pacifists

d. Republicans are not pacifists

Since we have access to the information in (39), our theory contains rules which lead to inconsistent conclusions. If we apply (39a) and (39c) we arrive at the conclusion that Nixon is a pacifist. However, if we apply (39b) and (39d), we arrive at the opposite conclusion. One way to think about this problem is in terms of blocking inferences – if we know that Nixon is both a republican and a quaker, and if we start out by applying the default rule that quakers are pacifists, we would be blocking the inference that Nixon is not a pacifist. In natural discussions of this type we sometimes agree on the principles according to which we may reason, that is, share topoi. However, we might value these topoi differently. This might be because we already have clear opinions regarding the conclusion and the dialogue is aimed at justifying our respective positions rather than using default rules to reach a conclusion. So it seems to us that if we want to account for how conversational agents make inferences in natural language, or how some inferences (even logical inferences) may be more acceptable or appropriate than others, we benefit from focusing on the agent's point of view rather than facts about the world (or at least facts about the world other than those constituted by agents' beliefs and opinions about the world). Agents involved in interaction may have different takes on a situation or type of situation either because they have access to different information or different rules of thumb according to which they process that information, or because their goals differ. This seems to be very relevant to many of the problems addressed in the literature on non-monotonic reasoning – particularly puzzles of the "Nixon diamond" variety where two contradictory conclusions may be drawn based on a seemingly acceptable set of rules. We therefore suggest that we look at these problems differently – from a rhetorical perspective in a dialogue setting.

Final remarks

This far, we have sketched a picture of how enthymemes and topoi interact so that an enthymematic argument uttered by a person A, may tap into a topos recognised by B, or, if B does not recognise the topos, causes B to tentatively establish a topos that would support the argument. An agent's knowledge base is expanded with more and more ways in which people reason, and the agent continuously re-evaluates, specifies and generalises her topoi and thus develops resources that are compatible with input.

In this section we have shown how two classic problems from the literature on non-monotonic reasoning may be perceived in terms of enthymemes and topoi. Since they do not make up a monolithic system, topoi have the advantage of not having to be consistent within the resources of an individual or even within one context. From a dialogue perspective, this approach also emphasises the fact that agents engaged in natural reasoning have individual points of view. In chapter 5 we will revisit the examples discussed in this section and give a more detailed account.

2.8 Enthymemes and Cognitive Load [3]

In the previous sections of this chapter we have discussed enthymemes and topoi in the context of various theories on inference and coherence. In this section we will consider a possible connection between enthymemes and cognitive load in certain types of dailogue. In some cases the use of a conclusion, instruction, order or request being presented adjacent to a premise is quite understandable – as the SDRT-relation label *Explanation* implies, we want to explain to the addressee why he should believe or do that of which we are trying to convince him. In some cases however, the addressee is already aware of the content of the premise, but the instruction, order or statement is still given in the form of an enthymeme containing an IRU – informationally redundant utterance.

One principle according to which dialogue is managed is Grice's maxim of quantity Grice (1975), *do not make your contribution more informative than required*. This has often been interpreted as "make your contribution as short as possible", resulting in all utterances that may be deduced from the context or co-text being considered *Information Redundant Utterances* (IRUs). Walker (1996) points out that IRUs are often not redundant at all (thus actually adhering to the maxim of quantity rather than violating

[3] This section is based on Breitholtz & Villing (2008)

it) but instead serves to help lower the listener's cognitive load. In fact, many of the utterances which Walker refers to express enthymemes and are underpinned by topoi. In this section we take a closer look at the relationship between rhetorical structure and cognitive load.

A difficult question in this context is how to decide when to add an IRU and when not to. Some redundancy may help relieve the working memory of the user of a dialogue system or an agent in a human-human interaction, while too much information will only increase the cognitive load. We will discuss how a rhetorical perspective may be of use in this balancing act, and suggest that enthymemes, underpinned by topoi, may provide a model for analysing these utterances.

2.8.1 Information redundance in dialogue

A significant feature of natural dialogue is economy. This has been noted by many scholars in the fields of pragmatics and discourse studies, and given rise to some of the well known and generally accepted theories that we have discussed previously in this chapter. Walker (1996) mentions Grice's maxim of quantity as an example of a generally assumed *redundancy constraint*. Utterances that violate the redundancy constraint are referred to by Walker as IRUs. An utterance is considered an IRU if it expresses a proposition that the listener can retrieve from memory or infer. Walker argues that the redundancy constraint is based on four assumptions about dialogue:

1. Unlimited working-memory: everything an agent knows is always available for reasoning;

2. Logical omniscience: agents are capable of applying all inference rules, so any entailment will be added to the discourse model;

3. Fewest utterances: utterance production is the only process that should be minimised;

4. No autonomy: assertions and proposals by agent A are accepted by default by agent B.

According to Walker the principle of avoiding redundancy has often taken precedence in work on dialogue modelling and overshadowed other factors that affect communicative choice. Walker presents corpus data in which agents frequently violate the redundancy constraint, which indicates that the fewest utterance assumption is not correct – sometimes other aspects of communication are more important than economy.

Walker's analysis of corpus data leads her to formulate three main functions of IRUs:

- To provide evidence supporting beliefs about mutual understanding and acceptance.
- To manipulate the locus of attention of the discourse participants by making a proposition salient.
- To augment the evidence supporting beliefs that certain inferences are licenced.

Walker also accounts for experiments, which was designed according to the results of the corpus study. These experiments show that *iru*s do indeed contridbute to mitigate the effect of the agents resource limits. Let us now take a look at one of Walker's examples of IRUs. An utterance is produced by A to B while walking to work Walker (1996), previously discussed in chapter 2:

(40) a. A: Let's walk along Walnut Street

b. A: It's shorter. (Walker, 1996 p.188)

It is known to A that B knows that Walnut Street is shorter, so by the redundancy constraint A should only have said (40a). Walker claims that (40b) is considered an IRU based on the assumption of unlimited working memory, i.e. that all knowledge and information an agent has access to is equally available at all times. Walker hypothesises that the mentioning of the well-known fact that Walnut Street is shorter is a way for A to ease Bs cognitive load. Another example is (41), which is an excerpt of a discussion about individual retirement accounts.

(41) a. A: Oh no, individual retirement accounts are available as long as you are not a participant in an existing pension.

b. B: Oh I see. Well [...] I do work for a company that has a pension.

c. A: Ahh. Then you're not eligible for [the tax year of] eighty one. (Walker, 1996 p.187)

Walker's analysis of this example is that (41c) is considered an IRU based on the assumption that agents are logically omniscient, since B would have

to apply an inference rule to conclude (41c). The function of A's stating (41c) is, according to Walker, to augment the evidence supporting beliefs that certain inferences are licenced.

2.8.2 A rhetorical approach to informationally redundant utterances

In much of the literature on rhetorical relations, little attention is paid, as far as we know, to the way supposedly information redundant utterances serve to add new information to the discourse situation by pointing to a specific argument. We would like to suggest a way of looking at IRUs which elucidates Walker's ideas about their function, and offers an alternative to the four assumptions of the redundancy constraint. The three functions of IRUs in Walker's study have in common that they aim to lead the listener to a certain conclusion, either by supporting a belief the listener already has, or by directing, or even redirecting, the attention of the listener. In other words – IRUs are rhetorical. Examples (40) and (41) are both illustrations of this. The fact that (40b) is considered redundant according to the redundancy constraint seems to reflect not only the unlimited working memory assumption, but also the assumption that agents are non-autonomous and by default accept assertions and proposals by other agents. The relative autonomy of B makes it possible for B not to accept A's proposition. By providing a reason for choosing Walnut Street, A performs a rhetorical act that potentially increases the likelihood that the suggestion will be accepted by B. Example (41) also indicates that A wants to make sure that B draws a specific conclusion. It seems likely that A, if she did not find it of some importance that B draws the conclusion (41c), might not bother to make the inference explicit – B could still be expected to make the inference. However, for B to do that would not necessarily make her logically omniscient – the assumption Walker (1996) claims to be the reason for considering (41b) an IRU – just capable of making *some* inferences.

Interestingly, many of Walker's examples of IRUs and their respective antecedents constitute structures similar to that of an enthymeme. The mentioning of one carefully chosen premise directs the attention of the listener in the direction that the speaker wants, and makes the listener a bit more likely to accept the proposition presented in the conclusion. The enthymeme might of course serve to persuade or even mislead a listener, but the same mechanism can also make it easier for an agent A to accept an honest and constructive proposal made by another agent, which would be helpful when quick decisions need to be made, or when A has to focus on

some demanding parallel activity.

Let us go back to the colleagues walking to work. Example (40) above could easily be analysed within a rhetorical framework. Mentioning (40b) could be a way for A to point to the argument about the shortest route, perhaps because they are running late. There could be other reasons to walk along Walnut Street, perhaps that it is more quiet. A might know that B usually prefers a busy street, but that she does not particularly like to walk, which would make the short-argument more persuasive. If they were not in a hurry, and A wanted them to walk along Walnut Street because it is nicer to walk along a quiet street than a busy one, A would probably say 'Let's walk along Walnut Street. It's more quiet' thus validating her suggestion. But it is also possible that A would want to walk along Walnut Street for some reason that she does not want B to know about - for example because someone cute always walks his dog there at that time. So, even though she knows that B knows it is the shortest way to work, A still mentions it to point out the getting-to-work-on-time argument.

So, giving the premise "It's shorter" points to an argument drawing on certain topoi, without which the utterance would be difficult to make sense of. The "hidden premise", i.e. the premise that B adds to the argument, would be something that makes sense in the context, having to do with for example time (as above) or effort (we don't want to walk longer than necessary). The additional premise is necessary in order to make the enthymeme fit with the relevant topos. This is also true in the case of (41), where two premises are expressed, but the expressed premises do not logically entail the conclusion.

Individual retirement accounts are available
as long as you are not a participant in
an existing pension
I do work for a company that has a
pension

∴ (Then) you're not eligible for
eighty one

A rhetorical perspective that uses enthymematic arguments as an explanation model for how information is given and withheld, would be based on a different set of assumptions about dialogue than those Walker formulates as the basis of the redundancy constraint. Thus we propose the following rhetorical principles

1. Limited working-memory: suggestions help agents to reach a certain decision

2. Logical capacity: agents are capable of applying some inference rules, some entailments will be added to the discourse model;

3. Utterance production: should be balanced so as to maximise persuasion

4. Autonomy: assertions and proposals by agent A are not accepted by default by agent B, and different agents may or may not share goals and intentions.

2.8.3 Cognitive load and efficiency

As humans we need reasons to validate propositions we are presented with. We know this intuitively – it is difficult to complete a task if we are just presented with single pieces of information that do not seem to be connected. The same conclusion can be made based on different premises, and we often want to know which argument the speaker is referring to before we accept a proposition. There are situations where the standard way to instruct is by single utterances (or orders), such as in the military, or in other contexts where the roles are very well defined, and the *modus operandi* of the activity well rehearsed, such as in surgery. We agree with Walker's conclusion that IRUs serve to ease cognitive load in different ways. Our hypothesis is that the reason why they do this is often because the enthymematic structure helps the recipient of the IRU to make up her mind - if the provided premise fits into an argument she finds acceptable she will agree with the proposition, if not she will disagree.

2.8.4 Final remarks

In conversation the dialogue partners have strategies for dealing with distraction and increased cognitive load. One way of doing this, is to sometimes include utterances which are, according to one common view of information exchange, redundant. In the cases demonstrated by Walker, the dialogue situations where IRUs are added are often when the speaker wants to make a point, suggest something, give an instruction, etc. We suggest that one reason that these utterances seem to lower the cognitive load of an agent interpreting a piece of discourse, despite adding more input to process, is because IRUs point at rhetorical structure and at particular topoi with which

the dialogue participant is already familiar. The mechanisms that enable persuasion, can also be used in order to explain something in an easily comprehensible way, and thus make the processing of the information quicker despite there being more information to process.

2.9 Summary

In this chapter we have explored how enthymemes and topoi relate to a number of theories in pragmatics and artificial intelligence. We have noted that although there are general principles of inference like the maxim of relevance and assumptions of rationality and cooperation, these are not always enough to actually help an agent make an appropriate inference.

We suggested that we could talk about accommodation of both topoi and enthymemes (argumentative structure). The accommodation of topoi seems to be of two different kinds. First, we may accommodate a topos which is easily associated with the discourse. If this accommodation is successful we can draw on this topos to accommodate the rhetorical relation, if this was previously unknown. The discourse in (40) and (31b) are examples of this. Secondly, we may have an explicit enthymematic structure present in the discourse, as we have in (12a). In cases like this the structure already points at a topos, or at least at some instantiation of a topos, and the topos is thus more easily accommodated. However, in cases like this, we can still expect the dialogue to be disrupted if we force a dialogue participant to accommodate a topos which is alien to him.

We agreed to the anti-inferentialist view of cognitive resources underpinning pragmatic processes. However, we opposed the idea that these processes are either entirely associative, automatic and unconscious (as Recanati claims of primary pragmatic processes) or entirely inferential (as is claimed in Relevance Theory). Instead we argue that when dialogue participants make use of topoi which are established in the cognitive resources of the other dialogue participants, the pragmatic interpretations are more associative in nature, and when the dialogue participants are forced to accommodate novel or unexpected topoi, the process is mainly inferential.

We also considered the possibility of using topoi rather than default rules in problems of non-monotonic reasoning, and suggested that this approach would help solve the problem of having to introduce inconsistent rules in one logical system, since topoi may very well be inconsistent. Also, by using topoi we can explain how world-knowledge may underpin causal relations in discourse even if the inferential principle of the topos is not a

default. Finally, we discussed the possible cognitive functions of presenting enthymematic arguments in certain types of discourse. In the next chapter, we will consider many of the issues dicussed here in more detail, while integrating enthymemes and topoi in a game board style analysis of dialogue.

Chapter 3

Towards a Theory of Enthymemes in Dialogue

3.1 Introduction

In chapter 2 we pointed out a number of ways in which argumentative structure seems to play a role in linguistic interaction. We suggested that there are explicit enthymematic arguments in discourse and – perhaps more frequently – not fully explicit ones. Consider for example the difference between (42a) and (42b):

(42) a. Since I don't ski my favourite pass time [in the winter] is to be indoors. Villing & Larsson (2006)

b. Then I dunno if we shouldn't buy one of those vans rather than a bus...they're so much cheaper.[a]

[a]Sen vette sjutton om vi inte skulle köpa en sån där van istället för en buss...de är så mycket billigare. Ottesjö (2006)

The utterances in (42) can be seen as enthymematic arguments, or – in Aristotelian terms – as enthymemes. To distinguish between type and token, we would like to refer to the utterance or utterances which convey an enthymeme as *argument* or *enthymematic argument* and the type of argument as *enthymeme*. An argument, on this view, need not have one specific form. For example, it is just as acceptable to say (43a) as (43b).

(43) a. I don't want to go into the water – it's cold!

b. It's cold - I don't want to go into the water!

We would say that (43a) and (43b) are different arguments but that the convey the same enthymeme. In actual dialogues enthymematic arguments may look very different – they may be consist of utterances from two different speakers, and they may not even be made up of adjacent utterances. However, we still represent the enthymemes they convey in one way, namely with the premise "it's cold" and the conclusion "I don't want to go into the water", as in (44).

(44)

$$\frac{\text{It's cold}}{\therefore \text{ I don't want to go into the water}}$$

So, the argument in (42a) conveys the enthymeme in (45), and the argument in (42b) conveys the enthymeme in (46)

(45)

$$\frac{\text{I don't ski}}{\therefore \text{ My favourite pass time is to be indoors}}$$

(46)

$$\frac{\text{Vans are so much cheaper than busses}}{\therefore \text{ we should get a van instead of a bus}}$$

In (42a) the rhetorical structure is emphasised by the word *since*. In (42b) there is no such clue, but we still construe the argument in (46) when interpreting (42b). There is thus, on this view, a type/token relationship between enthymematic arguments and enthymemes since one enthymeme may be realised in different ways. However, it is important to point out that enthymemes are still instantiations of the more general inference rules which we call topoi. Agents involved in conversation need to draw on these in order to interpret enthymemes and produce enthymematic arguments. This does not mean that the agent must consider all of these rules true in every context – she might even consider some of them *false* in most contexts. For example, we might recognise many ways of reasoning in political

discourse without actually agreeing with the propositions expressed. However, in order to interpret enthymemes, an agent must recognise them, or the topoi that underpin them, as reasonable (not necessarily morally or ethically) ways of associating things or events. For example, the enthymeme in (44) is underpinned by principles like "if something is cold it is unpleasant to touch", and "if something is unpleasant, it should be avoided", or similar.

In this chapter we will work our way towards a more detailed way to account for enthymemes and topoi and the role they play in interaction. First, we will discuss some concepts which are important for the subsequent analysis, then we will move on to look at some data. We will take as our point of departure an information state update approach as described by Larsson & Traum (2000) and Larsson (2002) including questions under discussion (QUD), as developed in Ginzburg (1998) and Ginzburg (2012). We will look at how we can account for various types of examples involving enthymemes and topoi. Our analysis will especially focus on the different types of accommodation which are necessary for dialogue participants to be able to draw on rhetorical resources made up of sets of topoi.

3.2 The Dialogue Gameboard

The metaphor of language use, particularly conversation, as a game is frequent in the philosophy of language and linguistics. Most famous perhaps, is Wittgenstein's idea that human language is made up by a (potentially infinite) set of language games corresponding to the set of social activities. These language games each have certain rules, and we interpret utterances in accordance with these rules. For a more detailed discussion of Wittgenstein and language games, see for example Baker & Hacker (2009). The game metaphor was developed further by Lewis (1979), who claimed that the development of a conversation can be seen in terms of a score analogous to that of a game like baseball. In baseball the score consists of numbers, the number of strikes, runs, etc. In a language game the score is made up of sets of moves, questions, presuppositions, commitments, and other linguistic features which are relevant in the discourse. Lewis also introduces the idea of a score board which keeps track of the progress of the dialogue. Among the items included on such a score board would be the presuppositions that are part of common ground in the conversation. However, Lewis' account does not provide us with an answer of exactly how a score board for dialogue should be set up. Two questions we might have if we wanted to create an actual score board for conversation would be which features we want to

include, and whether we want our score board to show the score for some objective take on the conversation rather than to illustrate the individual user's view of the state of the dialogue. A more precise take on the score board approach to dialogue analysis is Ginzburg's *dialogue gameboard*, an important feature of his theory of dialogue semantics – KoS – which has been developed over the last fifteen years in for example Ginzburg (1996), Ginzburg (1998), and a current take is presented in Ginzburg (2012). In Ginzburg (1998), p 3-4, the dialogue gameboard is defined as being structured by three minimal attributes: The set of commonly agreed upon FACTS, the set of QUD (questions under discussion), which specifies the currently discussable questions, and LATEST-MOVE (L-M) which includes the content of the most recent dialogue move in terms of utterance type (speech act type), agent identity, and the string of words which constitute the utterance. One development of the dialogue gameboard is presented by Larsson & Traum (2000) who propose an information state update approach to dialogue modelling. In Larsson & Traum (2000), Larsson (2002) and Ericsson (2005), the QUD-component constitutes a stack rather than a set, accounting for the fact that some questions take precedence due to standard conversational practices. Ginzburg accounts for this by making the set of QUDs partially ordered. It seems to us that there is no set of features which necessarily need to be included or excluded in a set up of the dialogue gameboard – to a great extent the type and number of features need to be decided on depending on the linguistic problems we are interested in accounting for. We will illustrate our take on the dailogue gameboard by looking at a simple dialogue. We will start out with a very basic set of features, and add more if and when we find them useful.

3.3 Our version of the Dialogue Game Board

The version of the dialogue gameboard which we will use in this chapter to represent information states is a simplification of the version cast in Type Theory with Records (TTR, Cooper (2005b)) which we will ultimately use to represent information states. We are interested in how conversational and contextual features are introduced and integrated in the discourse model. Our focus is particularly on how individual agents draw on individual (and sometimes distinct) resources. The examples in this section will therefore be described and analysed using separate gameboards for each agent, representing their respective information states. Ginzburg (1998), Larsson (2002), Ericsson (2005), and Ginzburg (2012) have all chosen this approach. However,

Larsson & Traum (2000) suggest the possibility of one gameboard depicting an objective take on the development of the dialogue. Our account focuses on the shared (or rather believed to be shared) properties of dialogue. However, we want our gameboard to be able to accommodate private features as well as shared. Therefore we keep the basic divide between *private* and *shared* which we find in Ginzburg (1998), Ginzburg (2012), Ericsson (2005), and Larsson (2002).

(47) $\begin{bmatrix} \text{private: } [] \\ \text{shared: } [] \end{bmatrix}$

The information which would go under *shared* in (47) is that information which the agent whose information state is represented believes to be shared, and which has in some way been referred to in a dialogue, or is necessary for a dialogue contribution to be interpreted in a relevant way. For example, although a question may be of central relevance in the dialogue, it does not appear on the gameboard, as part of an agent's information state, until it has been made explicit, or until something has been said which has caused a question under discussion to be accommodated. Under *private* we have only one field – an *agenda* keeping track of the next dialogue move an agent intends to make. The agenda is related to the field *project*, which we introduce under *shared*. The term is inspired by Linell's 2009 (chapter 9) concept of *communicative project*, which is reminiscent of Wittgenstein's language game. On Linell's account, a communicative project is a jointly accomplished communicative action, typically carried out over several utterances. Linell relates it to the notion of communicative activity, as described in Allwood (2000), in that a communicative activity is a comprehensive communicative project tied to a socio-cultural situation type. On our account, we perceive activity types as part of agents' resources, where they are represented as types of re-occurring strings of events which aim to fulfil the same type of goal. Each instance of an activity also often follows a recognisable pattern. Examples of distinguishable activities are *board meeting*, *dinner conversation*, *medical consultation*, etc. The event types that make up the string of events which constitutes an actitvity can be more or less obligatory, both in terms of the type of events and in terms of the order in which the events occur. These events may themselves be described in terms of strings of events – communicative projects.

When we think of a project that is to be jointly carried out, we do not necessarily specify which dialogue participant is supposed to be responsible for carrying out specific parts of the project. For example, if Kay and Sam

are decorating their new house, the project of agreeing on where to place a specific armchair does not necessarily contain information about who is supposed to make what move. Rather, the project is associated with one or more *conversational games* specifying the type of moves that agents involved in the game are allowed to make in relation to each other (provided they keep playing the game). For example, if one dialogue participant makes a suggestion, the other should evaluate and respond. On the *agenda*, each agent keeps track of the next dialogue move the agent intends to make. The agenda is thus part of the agent's private gameboard.

For the purpose of accounting for our data it is sufficient to consider the communicative project as something which is perceived as shared information by all dialogue participants. There is, however, no reason why we could not expand the *private*-field to include private communicative projects to represent "hidden agendas", etc.

(48)
$$\begin{bmatrix} \text{private:} & \begin{bmatrix}\text{agenda:}[]\end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[] \\ \text{qud:}[] \\ \text{L-U:} & \begin{bmatrix}\text{speaker:}[] \\ \text{move type:}[] \\ \text{utterance:}[]\end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \end{bmatrix}$$

The figure in (48) shows our dialogue gameboard. The dialogue properties which are considered shared are qud (question under discussion), which consists of an ordered set of questions under discussion that have not yet been resolved. A qud may be an explicitly raised question or an accommodated question. The field L-M (latest move) keeps track of the last utterance made, in terms of speaker, move type and utterance content.

The term *facts* used by Ginzburg is associated with truth and falsity, which might not necessarily be desirable in the context of accounting for the progress of a dialogue - dialogue participants may believe something to be true which is false, and they may knowingly accept untrue things "for the sake of the argument". Larsson (2002) and Ericsson (2005) emphasise the aspect of agreement by introducing *commitments* instead of facts. We see problems with this term as well, since it implies that explicit commitments have been made. We want to emphasise the agent's perception of the state of affairs rather than the relation between this perception and truth and falsity. We therefore choose to call the field that keeps track of the things a dialogue participant accepts for the purpose of a particular dialogue *beliefs*

rather than facts.

Let us now explore the possibilities of the gameboard by considering a simple dialogue:

(49) a. Anne: Where do you want to go?

b. Bill: I want to go home

c. Anne: Let's take route R!

d. Bill: Why route R?

e. Anne: It's faster

f. Bill: OK.

In (50) we see Anne's information state before uttering (49a):

(50)

$$\begin{bmatrix} \text{private:} & \begin{bmatrix}\text{agenda:}\begin{bmatrix}\text{ask } B \text{ where he wants to go}\end{bmatrix}\end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}\begin{bmatrix}\text{decide where to go and how}\end{bmatrix} \\ \text{qud:}[] \\ \text{L-U:} \begin{bmatrix}\text{speaker:}[] \\ \text{move type:}[] \\ \text{utterance:}[]\end{bmatrix} \\ \text{beliefs:}[]\end{bmatrix}\end{bmatrix}$$

The information states (50) and (51), which depict the information states of Anne and Bill respectively before any utterance has been made, are empty apart from the project and Anne's agenda. It is obviously quite possible that Bill has some similar item on his agenda, since Anne and Bill have a similar idea about the communicative project they are about to carry out – decide where to go and which route to take. However, for the sake of clarity, we will reject that possibility for now.

(51) Bill's information state before utterance (49a):

$$\begin{bmatrix} \text{private:} & \begin{bmatrix}\text{agenda:}[]\end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}\begin{bmatrix}\text{decide where to go and how}\end{bmatrix} \\ \text{qud:}[] \\ \text{L-U:} \begin{bmatrix}\text{speaker:}[] \\ \text{move type:}[] \\ \text{utterance:}[]\end{bmatrix} \\ \text{beliefs:}[]\end{bmatrix}\end{bmatrix}$$

In (52) we see Anne's information state just after having uttered (49a). Anne's question is pushed onto qud, and an item is popped off the agenda and pushed onto L-U. All other fields are empty.

(52)

$$\begin{bmatrix} \text{private:} & [\text{agenda:}[]\ ] \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[\text{where does } B \text{ want to go?}] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}\textit{Question} \\ \text{utterance:}[\text{where do you want to go?}] \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \end{bmatrix}$$

In (53a) the same question in pushed on qud as for Anne in (52). This qud pushes an answer on Bill's agenda.

(53) Bill's information state after (49a)

$$\begin{bmatrix} \text{private:} & [\text{agenda:}[\text{answer question: where does } B \text{ want to go?}]] \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[\text{where does } B \text{ want to go?}] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}\textit{Question} \\ \text{utterance:where do you want to go?} \end{bmatrix} \\ \text{beliefs:} \end{bmatrix} \end{bmatrix}$$

After having uttered (49b), Bill's agenda is again empty, and since the question under discussion is resolved, it is popped off qud. A new item is also pushed on beliefs. (54a) represents Bill's information state after (49b), and (54b) Anne's information state at the same point in time.

(54) a.
$$\begin{bmatrix} \text{private:} & [\text{agenda:}[]] \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[\,] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[B] \\ \text{move type:}\textit{Assertion} \\ \text{utterance:I want to go home} \end{bmatrix} \\ \text{beliefs:}[B \text{ wants to go home}] \end{bmatrix} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:} \begin{bmatrix} \text{answer question:} \\ \text{where does } B \text{ want to go?} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[\,] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[B] \\ \text{move type:}\textit{Assertion} \\ \text{utterance:I want to go home} \end{bmatrix} \\ \text{beliefs:}[B \text{ wants to go home}] \end{bmatrix} \end{bmatrix}$$

Now we want an item *propose route* or similar to be pushed onto Anne's agenda. If we look at this dialogue as an interaction between a dialogue system (Anne) and a user (Bill), we could simply state a rule saying that if the user expresses the wish to go somewhere which is recognised by the system, then the system should suggest a route to that place. The matter of which route to suggest is a bit trickier. However, we could just state that the system always should suggest for example the shortest route, but if we want the system to be a bit more flexible, we might want it to be able to recognise a number of possible reasons for choosing a route – for example fast, scenic, where you can drive in a way which minimises fuel consumption, etc. We then need some kind of rules stating the relationship between all of these qualities which may adhere to routes, and the instruction to propose them to the user.

If we pause for a moment, and consider the dialogue in (49) as a conversation between two human agents whose dialogue behaviour we want to account for, it seems obvious that there are several of these "rules" around, and that sometimes the reason we present for doing something may have impact on our dialogue partner's willingness to accept our proposal. For example, if Anne were to suggest a scenic, but longer, route without justifying it, Bill might think that she just does not know what she is doing. If she, on the other hand, were to say *Let's take route M, it's more scenic*, Bill might accept the proposal even if he himself would have preferred the fastest possible route. It seems like the topoi we described in chapter 1 and 2 are exactly

the kind of rules that we need here, for the speaker (system) to know why he/she/it proposes a certain route, and for the listener/user to interpret the proposal. We therefore introduce *private topoi*, for producing and evaluating proposals, suggestions, etc. and *shared topoi* for keeping track of the rules of thumb a dialogue participant counts on being accessible in a conversation, either by being common ground to begin with or by being accommodated. To keep track of the enthymemes which are explicit in or can be construed from the dialogue we also introduce the eud (enthymeme under discussion). It is parallel to questions under discussion in some ways. However, where questions tend to be resolved through the course of a dialogue, enthymemes are rather collected, compared and evaluated. For example, you might agree to an enthymeme in principle, but present another enthymeme which you for some reason consider more important in the context. Arguments in the dialogue which refer to enthymemes appear in the information state under eud.

So, Bill's statement that he wants to go home pushes *propose route* on Anne's agenda. Let's say for argument's sake that there are two routes to choose from. To know which one to suggest, Anne needs to match one of these with the most convincing reason for proposing a route. Anne's resources (topoi) tell her that a good reason for proposing a particular route is that it is faster than other available routes. Her resources make it apparent that this reason for proposing a route is in fact many times more likely to be accepted than other possible reasons. For example, she might find one saying *if you want to get somewhere fast, choose the shortest route* and one saying *always try to save time* or similar. She then proposes a route accordingly: (55) represents Anne's information state just before she utters (49c).

(55)
$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:} \left[\text{propose route: Route R}\right] \\ \text{topoi:} \begin{bmatrix} \text{“if you are going somewhere,} \\ \text{choose the fastest route”} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:} \left[\text{decide where to go and how}\right] \\ \text{qud:}[] \\ \text{eud:}[] \\ \text{L-U:} \begin{bmatrix} \text{speaker:} \left[B\right] \\ \text{move type:} \textit{Assertion} \\ \text{utterance:I want to go home} \end{bmatrix} \\ \text{beliefs:} \left[B \text{ wants to go home}\right] \\ \text{topoi:}[] \end{bmatrix} \end{bmatrix}$$

When Anne has uttered (49c), Bill does not know anything about route R,

and thus he cannot access any topoi by which he may evaluate the proposal. Therefore, a clarification question is pushed onto qud.

(56)
$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[\text{why choose route R?}] \\ \text{eud:}[] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}\textit{Proposal} \\ \text{utterance:let's take route R!} \end{bmatrix} \\ \text{beliefs:}[B \text{ wants to go home}] \\ \text{topoi:}[] \end{bmatrix} \end{bmatrix}$$

After Bill has uttered (49d), Anne has to consider a reason which would make proposing a route acceptable, alternatively, she must present the reason she herself had for proposing route R. A relevant topos is already loaded on her gameboard, and a reply is pushed on the agenda. After the utterance (49) the item is popped off the agenda and pushed onto L-U. The question is resolved and an enthymeme stating Anne's suggestion and her justification for that suggestion is pushed on eud. Also, since Anne presents the argument she does, she expects a topos underpinning that argument to be shared after her utterance. (57) represents Anne's information state after she has uttered (49e)

(57)
$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:} & \begin{bmatrix} \text{“if you are going somewhere,} \\ \text{choose the fastest route”} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide where to go and how}] \\ \text{qud:}[] \\ \text{eud:}[\text{“Route R is faster, therefore, choose route R”}] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}\textit{Assertion} \\ \text{utterance:it's faster} \end{bmatrix} \\ \text{beliefs:}[B \text{ wants to go home, route R is faster}] \\ \text{topoi:}[\text{“if you are going somewhere,} \\ \text{choose the fastest route”}] \end{bmatrix} \end{bmatrix}$$

Bill happens to have the same rhetorical resources as Anne regarding fast routes, and he therefore recognises faster(x) $\rightarrow$ choose(x) as an argument for choosing R, and this appears in his information state as well.

Now that we have introduced topoi and enthymemes on the dialogue gameboard we will move on to see how enthymemes and topoi interact in some authentic dialogues. We will consider examples which illustrate different types of situations where enthymemes and topoi are relevant. In order to focus on the issues that are central to the points we want to illustrate, we sometimes make simplifying assumptions regarding peripheral aspects of agents' information states. However, we try to point out when and how things could have been done differently.

3.4 Updating the Dialogue Gameboard

We now have an idea of what a dialogue gameboard should look like in order to include topoi and enthymemes. Before we move on to look at some authentic examples illustrating a number of dialogue phenomena relating to enthymemes and topoi, let us consider how the dialogue gameboard is updated.

3.4.1 Conversational games and updates

In order to formulate update rules for dialogue, we need to consider the type of units which make up dialogues and the type of units which dialogues are part of. When we described the set up of our dialogue gameboard, we mentioned *communicative project* and related it to *communicative activity*. Activity type may play a role for the analysis of dialogue in that expectations linked to roles and general goals may impact the moves made in the dialogue and how these are interpreted. However, we will focus mainly on lower level units of interaction, since these are more directly relevant for the micro-rhetorical perspective we are interested in.

When an activity is carried out, it is made up of a number of *communicative projects*, the goals of which are ideally fulfilled during the course of the interaction. For example, the activity type *medical consultation* typically includes a number of projects which need to be carried out, such as establishing the patient's symptoms, diagnosing the patient and explaining to the patient how his condition should be treated. The activity *chatting with neighbour while gardening* is less formal, and it is not strongly associated with particular projects to be carried out in a specific order. However, if we were to examine data from this activity, we would be likely to identify communicative projects like *agreeing on ideal lawn mower*, and *discussing the best time to prune roses*. This does not mean that the agents involved in the conversation have anticipated both of these projects, which would

probably be the case in the medical consultation scenario. Activity types also differ in terms of how set or institutionalised the roles are. In the case of medical consultation, certain behaviour in the carrying out of a project is closely related to an activity role like *patient*. In many activity types however, activity roles do not play an important part for the order in which dialogue participants are expected to make their contributions. Neither do they always affect the type of contribution which we excpect from a particular dialogue participant. However, even in an informal activity there are role related requirements for participating in the activity. For example, for participating in an informal conversation between friends, you have to know the other conversational participant, and the role *friend* comes with certain obligations like being honest, supportive and kind. However, assuming the role of *friend* is not associated with a particular pattern of conversation, as is the case in a conversation between a doctor and a patient. As we mentioned briefly in (3.3), we consider the carrying out of a communicative project to be associated with a set of *conversational games*. The notion of dialogue game is well established in research on dialogue and the notion is described for example in Carlson (1982) and Levin & Moore (1977). The descriptions of dialogue games in the literature do not generally distinguish between games that only lay down the rules for how to perform very general communicative functions, and rules stating which sub-projects need to be realised in order to carry out a communicative project.

In Cooper (in preparation) a type of conversational game is described as a type of string of events where each event is expected by the agents involved in the realisation of the string. This description alone does not really separate a conversational game from a communicative project. *Activity*, *project* and *conversational game* may all be described as strings of events, but activities tend to be domain specific. They often involve particular roles which are strongly associated with specific rights, obligations, etc. Projects tend to be less domain specific - for example *agreeing on something* is a communicative project which may occur in various activity types. Conversational games are even more general, and reflect conversational practices which are or could be part of most communicative activities. We define a conversational game as the minimal set of linguistic actions that need to be performed in order to realise a communicative project – similar to *speech act sequence* in van Dijk (1979). Examples of conversational games could be *request game*, *suggestion game* and *clarification game*. To illustrate, let us imagine that two people, Sam and Kay, are visiting Rome as tourists. They are spending the day strolling around trying to see some famous sights. The activity in which they engage is *sightseeing*. A communicative project that

could be part of this activity is the project of *deciding which sight to see*. Let us assume that both Sam and Kay believe that this is the project at hand, and that this is a shared belief. We represent this as the project being on both participants' shared gameboard at a particular time. For this project to be successfully carried out, a particular sight must be indicated – for example through one of the dialogue participants suggesting it – and the other dialogue participant must in some way acknowledge the suggestion, either by accepting or rejecting it. This string of moves could be described as a *suggestion game*. Note that a suggestion followed by a rejection would constitute a successful round of the suggestion game. It would not, however, resolve the communicative project *deciding which sight to see*. An interaction in which this communicative project would be carried out (by playing the suggestion game) is the interaction in (58).

(58) a. *Sam*: Let's go to the Colosseum!

b. *Kay*: OK!

3.4.2 Towards update rules

Let us now try to establish which moves would be necessary to play the *suggestion game*. Taking our point of departure in the conversation in (58), we may suggest one set of moves that would account at least for this particular conversation

- Preconditions:
  - The suggestion game is played by at least two players, though more players are possible.
  - The players have a shared project which they intend to carry out together.
- Moves
  - A dialogue participant makes a suggestion. For the sake of the game it does not matter which player this is, but after he has made the first move, we refer to him as player a.
  - Another player (who is then player b) acknowledges the suggestion and makes a move which constitutes a negative or positive response. Note that this move does not necessarily have to be

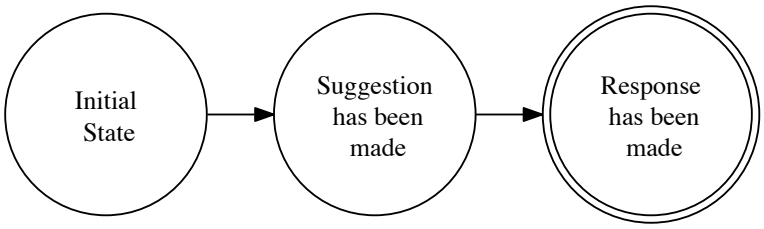

Figure 3.1: The Suggestion game

an actual response. Depending on the level of grounding we are willing to accept, abstaining from protesting might be enough to signal acceptance of a given suggestion.

– We could describe the suggestion like this, as illustrated in 3.1: Playing the suggestion game is a player a suggesting ϕ to a player b, who then responds something in relation to ϕ to a.

  * Suggestion(a, ϕ, b) Response(b, ϕ, a)

The rules above would suffice to account for the interaction in (58): Player a (Sam) makes a suggestion ϕ (Let's go to the Colosseum) to player b (Kay), who acknowledges it and agrees. However, a general set of rules that would account for the suggestion game would also have to allow for a less straightforward carrying out of the project *deciding which sight to see*. There could be questions, for example clarification questions or questions regarding other aspects of the context (time, place etc.) or the suggested sight. Another possibility is that player b might ask for a motivation for choosing the suggested sight. This is perfectly acceptable dialogue behaviour and players must be allowed, within the suggestion game, to move into other games like the *clarification game* or the *motivation game*. We see the ability to move between games as a general rule for all conversational games. This reflects the expectations we have when engaging in dialogue – if you ask someone a question, you know that it is likely that you will get a reply. However, we can still account for dialogue behaviour which does not conform to one particular game, since we allow for dialogue participants to introduce new

games – and even new projects – and we also allow for dialogue participants to simply not play the game.
So, we want rules which allow for the suggestion game to be played in a number of different ways, including detours into other games. But let us leave that aside for the moment, and just consider the possibilities realised in (58). If we want to represent this dialogue in terms of updates of information states, we need rules handling not only the explicit moves represented in 3.1, but also updates of the dialogue gameboard which are *tacit*. Tacit moves within a game represent inferences and other internal processes. We will now have a look at Kay's and Sam's information states throughout (58) and the rules which update them. Let us first consider the information states of Sam and Kay at the beginning of this interaction. As we said above, we assume that both dialogue participants consider the same project as shared.

(59) Initial information state (identical for Sam and Kay). All fields are empty apart from "project".

$$\begin{bmatrix} \text{private: } \begin{bmatrix} \text{game:[]} \\ \text{agenda:[]} \end{bmatrix} \\ \text{shared: } \begin{bmatrix} \text{project:[decide which sight to see]} \end{bmatrix} \end{bmatrix}$$

Now, since the notion of conversational game is intimately linked to the acceptable moves in a conversation rather than to the concrete results we want from interacting (as in a communicative project) we introduce a new field – *games* – onto the gameboard.
In order to start a conversation, an agent searches her resources for a conversational strategy (conversational game) to carry out the project. In this case a relevant game seems to be one where one player makes a suggestion and the other player accepts or refuses. We refer to this as the *suggestion game*. A representation of this game is pushed onto *private: games*. It is not until the first move is made and the agent may consider it shared information that this is the game which is being played, that the game is pushed onto *shared: games*. The rule at work is *Update private games*, 3.2.

- *Update private games*: If an agent has a project on her gameboard, and no games, search resources for relevant game and push it onto private games".

For *games* on the gameboard we keep track of the player who is to make the next move. In this case, Sam plans to make a suggestion and thereby take on the role of suggestor. Thus, on Sam's gameboard, the player making the next move is "self". We also denote at which state of the game we are (cf.

$$\begin{bmatrix}\text{shared} = \begin{bmatrix}\text{project}=(\text{project})\ \end{bmatrix} \\ \text{private} = \begin{bmatrix}\text{games}=\text{-}\ \end{bmatrix}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{shared} = \begin{bmatrix}\text{project}=(\text{project})\ \end{bmatrix} \\ \text{private} = \begin{bmatrix}\text{games}=(\text{game})\ \end{bmatrix}\end{bmatrix}$$

Figure 3.2: Update private games

3.1). The notation in (60) should thus be interpreted as: The game played is the suggestion game, the current state of the game is state 2, that is a suggestion has been made and the player who is going to make the next move is player b, who is the dialogue participant whose information state is being represented.

(60)
$$\begin{bmatrix}\text{games:} \begin{bmatrix}\text{game:suggestion game} \\ \text{current state:1} \\ \text{next player:suggestor(self)}\end{bmatrix}\end{bmatrix}$$

(61) Sam's information state after application of update rule *Update private games*, (3.2):
$$\begin{bmatrix}\text{private:} \begin{bmatrix}\text{games:} \begin{bmatrix}\text{game:suggestion game} \\ \text{current state:1} \\ \text{next player:suggestor(self)}\end{bmatrix}\end{bmatrix} \\ \\ \text{shared:} \begin{bmatrix}\text{project:}[\text{decide which sight to see}]\end{bmatrix}\end{bmatrix}$$

Now, Sam has an idea of what project he and Kay are to carry out (and he believes this idea to be shared with Kay) and he also has an idea of which conversational strategy they should employ to realise the project (the suggestion game). What we need now is a rule which pushes the move that Sam intends to make onto the agenda. First however, Sam needs to decide exactly which type of suggestion he should make. To do this he needs to access information in his resources. We represent this information as topoi – principles of reasoning– and beliefs about the state of the world. One topos which could be relevant here is *if you choose between two destinations, choose the nearest one*. This topos would cause the agent to search her resources for a relevant destination that fits the description of being *the nearest*. Another topos which could be relevant here is a topos saying that *if you want something, you should do it*. In combination with a belief that you want a particular thing – for example to see the Colosseum – this topos would sanction a move suggesting the Colosseum. It seems as if in some cases we have a topos in mind and choose what to suggest according to

$$\begin{bmatrix} \text{private}= \begin{bmatrix} \text{games} = (\text{game}) \\ \text{agenda}= - \\ \text{topoi} = - \\ \text{beliefs} = - \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{private}= \begin{bmatrix} \text{games} = (\text{game}) \\ \text{agenda}= - \\ \text{topoi} = (\text{topos}) \\ \text{beliefs} = (\text{belief}) \end{bmatrix} \end{bmatrix}$$

Figure 3.3: *Update private topoi & beliefs*

that topos, sometimes we have a particular suggestion in mind and look for a topos to justify it. Thus, we suggest an update rule that searches the agent's resources for all relevant information and pushes it onto the gameboard[1].

- *Update private topoi & beliefs*: If an agent has a game on the gameboard in which she is supposed to make the next move, but no item on the agenda, search resources for relevant topoi and other relevant information and push them onto private topoi and private beliefs.

(62) Sam's information state after update with *Update private topoi & beliefs*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{games:} & \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:1} \\ \text{next player:}a\text{(self)} \end{bmatrix} \\ \text{topoi:} & \left[\text{if you want to do something, do it!}\right] \\ \text{beliefs:} & \left[\text{Sam wants to go to the Colosseum}\right] \end{bmatrix} \\ \text{shared:} & \left[\text{project:}\left[\text{decide which sight to see}\right]\right] \end{bmatrix}$$

At this point a game is specified on Sam's gameboard and there is also relevant information to licence the pushing of the first move of the game onto the agenda – in this case a move of type *suggestion*. The topos "if you want something – do it!" in combination with the belief that Sam wants to see the Colosseum would sanction a move suggesting the Colosseum. The

[1]It could be argued that private topoi and private belief may not necessarily be loaded onto the gameboard at the same time, and that we therfore should have two separate update rules where one depend on the other. However, there are cases where the topos appears to come first – for example if an agent when presented with a suggestion evaluates it in the context of a specific topos such as *If you are going somewhere, pick the shortest route'*– and there are cases where a belief regarding a certain quality of an object seems to be the basic reason for choosing to act in a certain way. Also, it seems to be hard to tell which of the two depends on the other – from the linguistic data as well as for a speaker reflecting on her own behaviour.

$$\left[\text{private}=\left[\begin{array}{l}\text{games} = (\text{game})\\ \text{agenda}= -\\ \text{topoi} = (\text{topos})\\ \text{beliefs} = (\text{belief})\end{array}\right]\right] \Rightarrow$$
$$\left[\text{private}=\left[\begin{array}{l}\text{games} = (\text{game})\\ \text{agenda}= (\text{move type})\\ \text{topoi} = (\text{topos})\\ \text{beliefs} = (\text{belief})\end{array}\right]\right]$$

Figure 3.4: *Update agenda*

result is the information state represented in (63). Note that the agenda may be updated for any person involved in the dialogue, since more than one person may intend to initiate a conversational game to carry out the communicative project at hand. However if A intends to make the first move in game X, and B intends to make the first move in a game X, A and B are not playing the same round of the game. To keep things as straightforward as possible, let us assume for now that Sam is the only one who intends to make a first move in the suggestion game.

- *Update agenda* : If the agenda is empty and a player has a game on *private:games* in which he is to make the next move, and there is sufficient information on the gameboard to formulate an utterance, then push an utterance of the same type as is specified in *games* onto the gameboard.

(63) Sam's information state after update with *Update agenda* (3.4):

$$\left[\begin{array}{l}\text{private:} \left[\begin{array}{l}\text{agenda:}\left[\text{suggestion:Let's go to the colosseum}\right]\\ \text{games:}\left[\begin{array}{l}\text{game:suggestion game}\\ \text{current state:1}\\ \text{next player:}a\text{(self)}\end{array}\right]\\ \text{topoi:}\left[\text{if you want to do something, do it }\right]\\ \text{beliefs:}\left[\text{Sam wants to go to the Colosseum}\right]\end{array}\right]\\ \text{shared:}\ \left[\text{project:}\left[\text{decide which sight to see}\right]\right]\end{array}\right]$$

- *Make move* If there is a move type on an agent's agenda, the agent can realise that move by uttering the string specified on the agenda. This is represented by update rule 3.5.

$$\left[\text{private}=\left[\text{agenda}=\text{ (move type) }\right]\ \right] \Rightarrow \text{Linguistic move(self)}$$

Figure 3.5: *Make move*

$$\text{Linguistic move(self)} \Rightarrow \left[\begin{array}{l}\text{private}=\left[\text{agenda}=\ -\ \right] \\ \text{shared}=\left[\begin{array}{l}\text{L-U}\ \ =\text{ (move)} \\ \text{games}=\text{ (current game)}\end{array}\right]\end{array}\right]$$

Figure 3.6: *Update L-U*

When the move is made, we can assume that the speaker believes that the conversational game he has in mind is shared. We will take an optimistic approach here and assume that the other conversational participant is also able to identify the latest utterance as a move in a particular context relevant conversational game, and thus push that game onto her shared gameboard. The states of the game on the gameboard also need to be adjusted to the state of the conversation. To update the dialogue participants' gameboards after an utterance, we need two rules: One which, after the utterance of a string by self, downdates the agenda, updates private games in accordance with the state of the conversation, pushes the latest utterance on L-U and pushes the current game onto *shared:games*. We also need a rule which, after the utterance of a string by another dialogue participant, pushes the utterance onto L-U, and the current game onto *shared:games*.

- *Update L-U*: When an utterance has been made by self, the move is popped off the agenda and pushed onto L-U. The game on private games is popped off and pushed onto *shared:games*.

- *Update L-U′*: When an utterance has been made by other, the move is pushed onto L-U and the current game is pushed onto *shared:games* and adjusted to the stage of the conversation.

$$\text{Linguistic move(other)} \Rightarrow \left[\text{shared}=\left[\begin{array}{l}\text{L-U}\ \ =\text{ (move)} \\ \text{games}=\text{ (current game)}\end{array}\right]\ \right]$$

Figure 3.7: *Update L-U′*

(64) Sam's information state after update with update *Make move* (3.5) and *Update L-U* (3.6):

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[\text{suggestion:Let's go to the colosseum}] \\ \text{games:}[] \\ \text{topoi:}[\text{if you want to do something, do it }] \\ \text{beliefs:}[\text{Sam wants to go to the Colosseum}] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide which sight to see}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:2} \\ \text{next player:answerer(other)} \end{bmatrix} \\ \text{L-U:} \begin{bmatrix} \text{speaker:[Sam]} \\ \text{move type:[}\textit{suggestion}\text{]} \\ \text{utterance:[Let's go to the Colosseum]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

(65) Kay's information state after update with update rule *Update L-U′* (3.7):

$$\begin{bmatrix} \text{private: } [] & \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide which sight to see}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:2} \\ \text{next player:answerer(self)} \end{bmatrix} \\ \text{L-U:} \begin{bmatrix} \text{speaker:[Sam]} \\ \text{move type:[}\textit{suggestion}\text{]} \\ \text{utterance:[Let's go to the Colosseum]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Before we are done with the updates following the first move of the suggestion game, we need to introduce two more rules. A suggestion to do something could be seen as an answer to a question regarding what to do. The resolving of this question can eventually be linked to the integration of new common ground, that is integration of new information on shared beliefs. Also, this question under discussion enables the responding dialogue participant to question the suggestion. We therefore want a rule that when we have a L-U of type suggestion "Let's go to x" on the gameboard, a question "Are we going to x?" is accommodated and pushed onto qud.

- *Update qud*: If there is a suggestion- request- or question move on *L-U*, a corresponding question may be pushed onto *qud*.

$$\left[\text{shared}=\left[\begin{array}{l}\text{qud}= -\\ \text{L-U}= \text{(suggestion move)}\end{array}\right]\right] \Rightarrow \left[\text{shared}=\left[\begin{array}{l}\text{qud}= \text{(question)}\\ \text{L-U}= \text{(suggestion move)}\end{array}\right]\right]$$

Figure 3.8: *Update qud*

(66) Sam's information state after update with *Update qud* (3.8):

$$\left[\begin{array}{ll}\text{private:} & \left[\begin{array}{l}\text{agenda:[]}\\ \text{topoi:[if you want to do something, do it]}\end{array}\right]\\ \text{beliefs:[]} & \\ \text{shared:} & \left[\begin{array}{ll}\text{project:[decide which sight to see]} & \\ \text{games:} & \left[\begin{array}{l}\text{game:suggestion game}\\ \text{current state:2}\\ \text{next player:answerer(other)}\end{array}\right]\\ \text{qud:} & \text{[Are we going to the Colosseum?]}\\ \text{L-U:} & \left[\begin{array}{l}\text{speaker:[Sam]}\\ \text{move type:[}\textit{suggestion}\text{]}\\ \text{utterance:[Let's go to the Colosseum]}\end{array}\right]\end{array}\right]\end{array}\right]$$

(67) Kay's information state after update with update rule *Update qud* (3.8):

$$\left[\begin{array}{ll}\text{private:} & \text{[]}\\ \text{shared:} & \left[\begin{array}{ll}\text{project:[decide which sight to see]} & \\ \text{games:} & \left[\begin{array}{l}\text{game:suggestion game}\\ \text{current state:2}\\ \text{next player:answerer(self)}\end{array}\right]\\ \text{qud:} & \text{[Are we going to the Colosseum?]}\\ \text{L-U:} & \left[\begin{array}{l}\text{speaker:[Sam]}\\ \text{move type:[}\textit{suggestion}\text{]}\\ \text{utterance:[Let's go to the Colosseum]}\end{array}\right]\end{array}\right]\end{array}\right]$$

Now Kay knows in which game she is participating, and that she, in order to play the game, is to make the next move. To do that she must evaluate the other dialogue participant's suggestion and respond according to her evaluation. Now, we could object that she could evaluate and then still say something not in accordance with this evaluation. However, for now we will try to stick to a straightforward version of the suggestion game

and assume that Kay is evaluating the suggestion in the context of her resources, and that she responds affirmatively if her resources allow it. So Kay searches her resources for information relevant to the suggestion to go to the Colosseum. (In this dialogue, this suggestion is still on *L-U* at the time of evaluation. However, in a dialogue where the evaluation does not take place immediately, a question corresponding to the suggestion would still be on *qud*.) A relevant topos could be for example that if you have a choice between several destinations, pick the nearest one. It could be argued that Kay might just choose to go along with what Sam suggests, in which case no evaluation is needed. We would suggest that there is a topos underpinning such behaviour as well – a topos which says that if someone says something the speaker has a rational reason for saying it, is sincere, etc. (similar to Grice's principle of cooperation). Let us assume then that Kay chooses to go along with what Sam has suggested. We apply the rule *Update private topoi & beliefs*.

(68) *Kay*'s information state after update with *Update private topoi & beliefs* (3.3):

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:} \begin{bmatrix} \text{trust that a speaker has a rational reason} \\ \text{for making a suggestion} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide which sight to see}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:2} \\ \text{next player:answerer(self)} \end{bmatrix} \\ \text{qud:}[\text{Are we going to the Colosseum?}] \\ \text{L-U:} \begin{bmatrix} \text{speaker:[Sam]} \\ \text{move type:[}\textit{suggestion}\text{]} \\ \text{utterance:[Let's go to the Colosseum]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Now Kay has all the necessary information to update the agenda. However, the rule we have introduced to do that takes its input from private topoi and beliefs, and from private games, whereas the game currently on Kay's gameboard is shared. We introduce a new rule, *Update agenda′*.

- *Update agenda′*: If there is a game on shared games where agent a is to make the next move, and there is relevant information on private topoi and beliefs, a move of the type indicated in the game may be pushed onto the agenda of a's gameboard.

$$\begin{bmatrix} \text{private}= \begin{bmatrix} \text{agenda}= - \\ \text{topoi} = (\text{topos}) \\ \text{belief} = (\text{belief}) \\ \text{games} = (\text{game}) \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{private}= \begin{bmatrix} \text{agenda}= (\text{move type}) \\ \text{topoi} = (\text{topos}) \\ \text{belief} = (\text{belief}) \\ \text{games} = (\text{game}) \end{bmatrix} \end{bmatrix}$$

Figure 3.9: *Update Agenda′*

(69) *Kay*'s information state after update with update rule *Update agenda′* (3.9):

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:OK} \\ \text{topoi:} \begin{bmatrix} \text{trust that a speaker has a rational reason} \\ \text{for making a suggestion} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:[decide which sight to see]} \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:2} \\ \text{next player:answerer(self)} \end{bmatrix} \\ \text{qud:} \left[\text{Are we going to the Colosseum?}\right] \\ \text{L-U:} \begin{bmatrix} \text{speaker:[Sam]} \\ \text{move type:[}\textit{suggestion}\text{]} \\ \text{utterance:[Let's go to the Colosseum]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

For the actual making of the move we apply rule *Make move* (3.5), and for the relevant updates of the gameboard we apply rule *Update agenda′* (3.9).

(70) *Kay*'s information state after update with *Make move*, (3.5) and *Update L-U* (3.4):

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:[]} \\ \text{topoi:} \begin{bmatrix} \text{trust that a speaker has a rational reason} \\ \text{for making a suggestion} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:[decide which sight to see]} \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:} \end{bmatrix} \\ \text{qud:} \left[\text{Are we going to the Colosseum?}\right] \\ \text{L-U:} \begin{bmatrix} \text{speaker:[Kay]} \\ \text{move type:[}\textit{response}\text{]} \\ \text{utterance:[OK]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Now that the suggestion has been made and agreed to, the beliefs the dialogue participants are committed to in the conversation must be updated.

$$\begin{bmatrix} \text{shared}= \begin{bmatrix} \text{qud} & = (\text{question}) \\ \text{beliefs} & = \ldots \\ \text{L-U} & = (\text{move}) \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{shared}= \begin{bmatrix} \text{qud} & = - \\ \text{beliefs} & = (\text{new belief}) \\ \text{L-U} & = (\text{move}) \end{bmatrix} \end{bmatrix}$$

Figure 3.10: *Downdate qud update shared beliefs*

We introduce a rule *Downdate qud/update shared beliefs*.

- *Downdate qud/update shared beliefs*: If there is a question on qud and a move on L-U which resolves the question on *qud*, the question is popped off *qud*, and *shared beliefs* is updated accordingly.

(71) *Sam*'s information state after update with update rule *Update L-U'* 3.7 and *Downdate qud/update shared beliefs* (3.10)

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:}[\text{if you want to do something, do it}] \\ \text{beliefs:}[\text{Sam wants to go to the Colosseum}] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide which sight to see}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:} \end{bmatrix} \\ \text{qud:}[] \\ \text{L-U:} \begin{bmatrix} \text{speaker:}[\text{Kay}] \\ \text{move type:}[\textit{response}] \\ \text{utterance:}[\text{OK}] \end{bmatrix} \\ \text{beliefs:}[\text{Sam and Kay are going to the Colosseum}] \end{bmatrix} \end{bmatrix}$$

Now both dialogue participants have a representation of the belief that they are going to the Colosseum on their gamboard. They also have the representation of a shared game which has reached its final stage, that is a round of the game has been completed. To move on we need an update rule which downdates *games*. We introduce rule *Downdate games*:

- *Downdate games*: If there is a game anywhere on the gameboard that has reached its final stage, the game is popped off the gameboard.

(72) *Kay*'s information state after update with rule *Downdate games*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:} \\ \text{games:}[] \\ \text{topoi:} & \begin{bmatrix} \text{trust that a speaker has a rational reason} \\ \text{for making a suggestion} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide which sight to see}] \\ \text{games:}[] \\ \text{qud:}[] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[\text{Kay}] \\ \text{move type:}[\textit{response}] \\ \text{utterance:}[\text{OK}] \end{bmatrix} \\ \text{beliefs:} & [\text{Sam and Kay are going to the Colosseum}] \end{bmatrix} \end{bmatrix}$$

Finally, we need an update rule which, if the *project* has been carried out, pops the item off *projects*. So, how do we know that a project has been carried out? This seems to be a problem which is not entirely linguistic. However, in this case, we assume that the agents involved in conversation have some kind of definitions of various projects in their resources, similar to the description of the suggestion game in (3.1). Instead of having separate update rules for different types of projects, we could have one general update rule, *Downdate project* which simply states that when there is a shared belief on the gameboard that the goal of the project has been fulfilled, the project is completed and may be popped off the gameboard.

- *Downdate project*: If there is a shared belief on the gameboard that the goal of the project has been fulfilled, the project may be downdated.

(73) *Sam*'s information state after update with rule *Downdate games* and *Downdate project*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{games:}[] \\ \text{topoi:} & [\text{if you want to do something, do it}] \\ \text{beliefs:} & [\text{Sam wants to go to the Colosseum}] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[] \\ \text{games:}[] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[\text{Kay}] \\ \text{move type:}[\textit{response}] \\ \text{utterance:}[\text{OK}] \end{bmatrix} \\ \text{beliefs:} & [\text{Sam and Kay are going to the Colosseum}] \end{bmatrix} \end{bmatrix}$$

Now Sam and Kay have completed the project of deciding which sight to see, through a round of the suggestion game. We have introduced a number of informal update rules which would enable two agents to carry out a short conversation which we interpret as a possible realisation of the suggestion game. However, there are many other ways in which a conversation of this type could play out which would require a modified set of update rules. In the following sections we will gradually extend the set of update rules so that we can handle more types of conversations. The idea is not that the set of rules we end up with can be applied to predict exactly how a conversation will play out. Rather, at some points in the conversation, we have options to apply different rules which lead to different conversational patterns.

3.4.3 Enthymeme accommodation

Our first examples in this chapter were constructed in order to demonstrate, as simply as possible, our take on the dialogue gameboard, to introduce enthymeme and topos in a gameboard analysis of dialogue, and to introduce the notion of conversational game as a feature on the dialogue gameboard. Our next example, however, is an authentic corpus example, which well illustrates how common place enthymematic arguments and underlying topoi are in conversation. As we discussed in chapter 1, we often draw on topoi when interpreting or producing utterances without actually paying attention to the topoi themselves – perhaps even without being consciously aware of them. In chapter 1 we also discussed the relevance of *mistakes* in dialogue for telling us how dialogue works when no mistakes are made. We suggested that enthymemes and topoi interact so that established topoi sometimes licence the interpretation of an utterance pair as an enthymeme, hence contributing to the rhetorical structure of the discourse. We also suggested that enthymemes, when they are obvious, in turn may help us identify topoi already in our resources, or help to tentatively construe relevant topoi. In the following section we will look at this in more detail. By going through updates of the information states of the agents involved in conversation, we will show that topoi do contribute to coherence by licensing the interpretation of enthymematic relations between utterances, a phenomenon we refer to as *enthymeme accommodation*.

(74) a. *A*: Let's walk along Walnut Street

b. *A*: it's shorter.

An important aspect of interpreting (74) is to assign a rhetorical relation

between (74a) and (74b). In this case, it seems reasonable to assume that (74b) conveys a reason or motivation for the proposal or suggestion made in (74a). One reason for this is conversational practice. When suggesting something it is not unusual to back up the suggestion with some information that makes following the suggestion seem like an attractive option. Therefore, suggestion/motivation is a common adjacency pair. So, there is a certain expectation regarding the relation between (74a) and (74b). But there is also a common sense notion – a topos – regarding which qualities are desireable in a route – particularly the route to work in the morning. This common sense notion happens to be compatible with the assertion in (74b). Considering this, it is likely in this particular situation, that A and B both consider (74) an argument like the enthymeme in (75).

(75)

$$\frac{\text{shorter(Walnut Street)}}{\therefore \text{ Let's walk along (Walnut Street)}}$$

Before we start looking at how the dialogue in (74) can be described in terms of updates of dialogue gameboards,

When we go through the development of the dialogue in (74) we will think of it as moves of a game that aims at fulfilling a communicative project. These moves will be visible on the gameboard, as will also other changes caused by dialogue update rules associated with particular moves and games. The conversational game played here is – initially – the suggestion game. Just like in our previous example, one conversational participant makes a suggestion. However, even though the game expected by conversational participants who perceive the first part of the utterance (Let's walk along Walnut Street) is the same (3.1), the second utterance, a motivation by the suggestor supporting the suggestion, is hardly surprising to the other dialogue participant. Thus, it seems as if we want to extend the suggestion game to include the possibility for the suggestor to keep the turn after the suggestion is made and motivate the suggestion, as illustrated in (3.11). After the motivation the game continues as we described in the previous section.

We will now go through the development of the information states of A and B during the course of the discourse. We assume that the agents have the same communicative project in mind – to decide which route they should take to work.

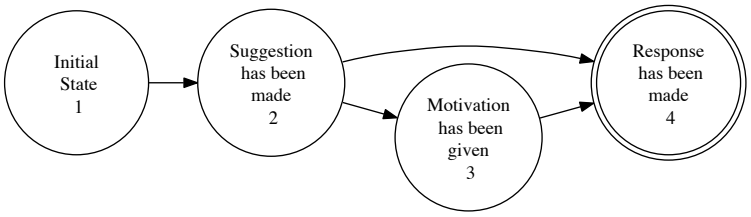

Figure 3.11: Suggestion game including motivation

Like in our previous example, the project in this dialogue seems to be possible to carry out by means of the *suggestion game*. We therefore assume that *Update private games* is applied, and the suggestion game is pushed onto *games* on A's gameboard. As for B, we assume that his information state is not updated until A's utterance is complete.

(76) A's information state after update with rule *Update private games*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:1} \\ \text{next player:suggestor, self} \end{bmatrix} \\ \text{topoi:}[] \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:[decide on route to work]} \\ \text{games:}[] \\ \text{qud:}[] \\ \text{L-U:} \begin{bmatrix} \text{speaker:}[] \\ \text{move type:}[] \\ \text{utterance:}[] \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \end{bmatrix}$$

After rule *Update private games* has been applied, A consults her resources in order to formulate a suggestion. Now, we have at least two possible scenarios:

1 A has a topos in mind saying that they should pick the shortest route, and based on that and her beliefs about the possible routes, A suggests

Walnut Street.

2 *A* has a particular route in mind, and the reason for wanting to choose that particular route is either just that she "feels like it" or that she has some reason which is not conveyed and we therefore know nothing about.

Whichever of these scenarios we choose, the update rule we apply next is *Update private topoi & beliefs*. The result is the gameboard in (77).

(77) *A*'s information state after update with rule *Update private topoi & beliefs*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{games:} & \begin{bmatrix} \text{next game:suggestion game} \\ \text{current state:1} \\ \text{player:suggestor, self} \end{bmatrix} \\ \text{topoi:}[] \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:[decide on route to work]} \\ \text{games:}[] \\ \text{qud:}[] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[] \\ \text{move type:}[] \\ \text{utterance:}[] \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \end{bmatrix}$$

Now all necessary information to update the agenda can be found on *A*'s gameboard, and her information state is updated with rule *Update agenda*. The information state after the update is represented in (78):

(78) *A*'s information state after update with rule *Update agenda*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}
\text{agenda:} & [\text{Let's walk along Walnut Street}] \\
\text{games:} & \begin{bmatrix}\text{next game:suggestion game}\\ \text{current state:1}\\ \text{player:suggestor, self}\end{bmatrix} \\
\text{topoi:} & [\text{If there is a choice between two routes,}\\ & \text{choose the shortest one}] \\
\text{beliefs:} & \begin{bmatrix}\text{Walnut Street is shorter than}\\ \text{the other possible route}\end{bmatrix}
\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:} & [\text{decide on route to work}] \\
\text{games:} & \begin{bmatrix}\text{game:suggestion game}\\ \text{current state:1}\\ \text{player:suggestor, self}\end{bmatrix} \\
\text{qud:} & [] \\
\text{L-U:} & \begin{bmatrix}\text{speaker:}[]\\ \text{move type:}[]\\ \text{utterance:}[]\end{bmatrix} \\
\text{beliefs:} & []
\end{bmatrix}
\end{bmatrix}$$

When the intended move type is on *A*'s agenda, we apply update rules *Make move*, *Update L-U* and *Update qud*. The result is the information state represented in (79). The agenda is downdated, the private game is popped off *private: games* and pushed onto *shared:games*, L-U is updated and a question is pushed onto *qud*.

(79) *A*'s information state after update with rules *Make move*, *Update L-U*, and *update qud*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}
\text{agenda:} & [] \\
\text{topoi:} & [\text{If there is a choice between two routes,}\\ & \text{choose the shortest one}] \\
\text{beliefs:} & \begin{bmatrix}\text{Walnut Street is shorter than}\\ \text{the other possible route}\end{bmatrix}
\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:} & [\text{decide on route to work}] \\
\text{games:} & \begin{bmatrix}\text{game:suggestion game}\\ \text{current state:2}\\ \text{next player:motivation giver, self}\end{bmatrix} \\
\text{qud:} & [\text{Shall we walk along Walnut Street?}] \\
\text{L-U:} & \begin{bmatrix}\text{speaker:}[A]\\ \text{move type:}[\textit{suggestion}]\\ \text{utterance:}[\text{Let's walk along Walnut Street}]\end{bmatrix} \\
\text{beliefs:} & []
\end{bmatrix}
\end{bmatrix}$$

When A's gameboard is updated, the gameboard of the dialogue partner, B, is also updated, with *Make move*, *Update L-U′* and *Update qud*. The first update of B's gameboard is an update of *L-U*. Based on the utterance on L-U and the current project, the suggestion game is pushed onto *games*, and the first move of the game is subsequently popped off. The suggestion "Let's walk along Walnut Street", pushes a corresponding question onto *qud*.

(80) B's information state after update with rules *Make move*, *Update L-U′* and *Update qud*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:}[] \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} & \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:2} \\ \text{next player:answerer, self} \end{bmatrix} \\ \text{qud:}[\text{shall we walk along Walnut Street?}] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{suggestion}] \\ \text{utterance:}[\text{Let's walk along Walnut Street}] \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \end{bmatrix}$$

The next move to be made according to the game on A's gameboard is "give motivation". Now, we know that this must be the intended version of the suggestion game for A, however, we cannot be sure which version of the game B has in mind. Since the motivation move made by A does not affect the number or order of moves B is expected to make in the playing of the game, we assume that B has the "regular" type of suggestion game in mind up until the point when A motivates the suggestion. In order for A to make a motivation move, her agenda must be updated. Since there is already relevant information on private topoi and private beliefs regarding which route to choose, we can apply *Update agenda′*:

(81) A's information state after update with rules *Update agenda′*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}
\text{agenda:} & [\text{it's shorter}] \\
\text{topoi:} & \begin{bmatrix}\text{If there is a choice between two routes,}\\ \text{choose the shortest one}\end{bmatrix} \\
\text{beliefs:} & \begin{bmatrix}\text{Walnut Street is shorter than}\\ \text{the other possible route}\end{bmatrix}
\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:} & [\text{decide on route to work}] \\
\text{games:} & \begin{bmatrix}\text{game:suggestion game}\\ \text{current state:2}\\ \text{next player:motivation giver, self}\end{bmatrix} \\
\text{qud:} & [\text{shall we walk along Walnut Street?}] \\
\text{L-U:} & \begin{bmatrix}\text{speaker:}[A]\\ \text{move type:}[\textit{suggestion}]\\ \text{utterance:[Let's walk along Walnut Street]}\end{bmatrix} \\
\text{beliefs:} & []
\end{bmatrix}
\end{bmatrix}$$

We can now apply rules *Make move* and *Update L-U*:

(82) A's information state after update with rules *Make move* and *Update L-U*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}
\text{agenda:} & [] \\
\text{topoi:} & \begin{bmatrix}\text{If there is a choice between two routes,}\\ \text{choose the shortest one}\end{bmatrix} \\
\text{beliefs:} & \begin{bmatrix}\text{Walnut Street is shorter than}\\ \text{the other possible route}\end{bmatrix}
\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:} & [\text{decide on route to work}] \\
\text{games:} & \begin{bmatrix}\text{game:suggestion game}\\ \text{current state:3}\\ \text{next player:answerer, other}\end{bmatrix} \\
\text{qud:} & [\text{shall we walk along Walnut Street?}] \\
\text{L-U:} & \begin{bmatrix}\text{speaker:}[A]\\ \text{move type:}[\textit{motivation}]\\ \text{utterance:[It's shorter]}\end{bmatrix} \\
\text{beliefs:} & []
\end{bmatrix}
\end{bmatrix}$$

As stated earlier, our view of *shared:beliefs* is that it should contain resolved questions and propositions which have not been questioned in the dialogue. For example, when A says "It's shorter", we want the information that Walnut Street is shorter to be pushed onto shared beliefs. Suggestions, requests, questions etc. do not, however, end up on shared beliefs, but their

$$\left[\text{shared}=\left[\begin{array}{ll}\text{beliefs}= & - \\ \text{L-U} & =(\text{move})\end{array}\right]\right] \Rightarrow \left[\text{shared}=\left[\begin{array}{ll}\text{beliefs}= & (\text{belief}) \\ \text{L-U} & =(\text{move})\end{array}\right]\right]$$

Figure 3.12: *Update shared beliefs*

content is represented on *qud* and a related belief will not appear as shared before the question is popped off *qud*.

- *Update beliefs*: If there is a statement on *L-U*, for example a motivation, explanation or justification, a corresponding shared belief is integrated.

(83) *A*'s information state after update with rules *Update beliefs*:

$$\left[\begin{array}{ll}\text{private:} & \left[\begin{array}{ll}\text{agenda:} & [] \\ \text{topoi:} & \left[\begin{array}{l}\text{If there is a choice between two routes,} \\ \text{choose the shortest one}\end{array}\right] \\ \text{beliefs:} & \left[\begin{array}{l}\text{Walnut Street is shorter than} \\ \text{the other possible route}\end{array}\right]\end{array}\right] \\ \text{shared:} & \left[\begin{array}{ll}\text{project:} & [\text{decide on route to work}] \\ \text{games:} & \left[\begin{array}{l}\text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other}\end{array}\right] \\ \text{qud:} & [\text{Shall we walk along Walnut Street?}\ ] \\ \text{L-U:} & \left[\begin{array}{l}\text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's shorter}]\end{array}\right] \\ \text{beliefs:} & [\text{Walnut Street is shorter} \\ & (\text{than other possible routes})]\end{array}\right]\end{array}\right]$$

When *A* has given a motivation for why they should walk along Walnut Street, the belief that "it's shorter" is popped off private beliefs:

- *Downdate private beliefs*: If there is a belief on *private beliefs* which is also represented on *shared beliefs* , the belief on *private beliefs* is popped off.

(84) *A*'s information state after update with rules *Downdate private beliefs*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:} \begin{bmatrix} \text{If there is a choice between two routes,} \\ \text{choose the shortest one} \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other} \end{bmatrix} \\ \text{qud:}[\text{Shall we walk along Walnut Street?}] \\ \text{L-U:} \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's shorter}] \end{bmatrix} \\ \text{beliefs:} \begin{bmatrix} \text{Walnut Street is shorter} \\ \text{than the other possible route} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

What also happens when A makes the motivation "it's shorter" is that she expresses an enthymematic argument which – assuming the topos that if there is a choice between two routes we should take she shortest one – would make a case for choosing Walnut Street. Thus, in A's view, an enthymeme under discussion has been accommodated. But what would an update rule look like that would take the information state in (84) and turn it into one with an enthymeme under discussion on *eud*? On A's private gameboard is a topos according to which we should take the shortest of the possible routes, and on her *shared beliefs* and *qud* are items saying that she has made a suggestion to walk along Walnut Street, and that Walnut Street is shorter. This enables her to construe an enthymeme: Walnut Street is shorter, therefore we should walk along Walnut Street.

- *Update eud*: If there is a topos on *private topoi*, and items on *shared beliefs* and *qud* which enable us to instantiate the topos, an enthymeme is pushed onto *eud*.

$$\begin{bmatrix}\text{private}=\begin{bmatrix}\text{topoi}=\text{(relevant topos)}\end{bmatrix}\\ \text{shared}=\begin{bmatrix}\text{beliefs}=\text{(relevant belief)}\\ \text{qud}\quad=\text{(relevant question)}\\ \text{eud}\quad=-\end{bmatrix}\end{bmatrix}\Rightarrow$$
$$\begin{bmatrix}\text{private}=\begin{bmatrix}\text{topoi}=\text{(relevant topos)}\end{bmatrix}\\ \text{shared}=\begin{bmatrix}\text{beliefs}=\text{(relevant belief)}\\ \text{qud}\quad=\text{(relevant question)}\\ \text{eud}\quad=\text{(enthymeme)}\end{bmatrix}\end{bmatrix}$$

Figure 3.13: *Update eud*

(85) A's information state after update with rules *Update eud*:

$$\begin{bmatrix}\text{private:}&\begin{bmatrix}\text{agenda:}[]\\ \text{topoi:}\begin{bmatrix}\text{If there is a choice between two routes,}\\ \text{choose the shortest one}\end{bmatrix}\\ \text{beliefs:}[]\end{bmatrix}\\ \text{shared:}&\begin{bmatrix}\text{project:}[\text{decide on route to work}]\\ \text{games:}\begin{bmatrix}\text{game:suggestion game}\\ \text{current state:3}\\ \text{next player:answerer, other}\end{bmatrix}\\ \text{qud:}[\text{Shall we walk along Walnut Street? }]\\ \text{eud:}\begin{bmatrix}\text{Walnut Street is shorter,}\\ \text{therefore, Let's walk along Walnut Street}\end{bmatrix}\\ \text{L-U:}\begin{bmatrix}\text{speaker:}[A]\\ \text{move type:}[\textit{motivation}]\\ \text{utterance:}[\text{It's shorter}]\end{bmatrix}\\ \text{beliefs:}\begin{bmatrix}\text{Walnut Street is shorter}\\ \text{than the other possible route}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

Since A considers that she has expressed an enthymeme, she also expects the topos which she has on her private gameboard to be accommodated, either because it is easily available in B's resources, in which case the topos would help B to accommodate the enthymeme, or since B recognises the two utterances as an enthymematic argument, and thereby is able to abstract the topos from the enthymeme. In both of these scenarios however, A has reason to expect the topos now to be shared. This is done by means of the update rule *Update shared topoi & downdate private topoi*, (3.14)

- *Update shared topoi & downdate private topoi*: If there is a topos on

$$\begin{bmatrix}\text{private}=\begin{bmatrix}\text{topoi}=\text{(topos)}\ \end{bmatrix}\\ \text{shared}=\begin{bmatrix}\text{eud}=\text{(enthymeme)}\ \end{bmatrix}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{shared}=\begin{bmatrix}\text{topoi}=\text{(topos)}\\ \text{eud}\ \ =\text{(enthymeme)}\end{bmatrix}\ \end{bmatrix}$$

Figure 3.14: *Update shared topoi & downdate private topoi*

private topoi which is instantiated on eud, it may be popped off private topoi and pushed onto shared topoi.

(86) *A*'s information state after update with rules *Downdate private topoi/update shared topoi*:

$$\begin{bmatrix}\text{private:}\ \begin{bmatrix}\text{agenda:[]}\\ \text{topoi:[]}\\ \text{beliefs:[]}\end{bmatrix}\\ \text{shared:}\ \begin{bmatrix}\text{project:[decide on route to work]}\\ \text{games:}\ \begin{bmatrix}\text{game:suggestion game}\\ \text{current state:3}\\ \text{next player:answerer, other}\end{bmatrix}\\ \text{qud:[shall we walk along Walnut Street?]}\\ \text{eud:}\ \begin{bmatrix}\text{If W St is the shortest of the available routes,}\\ \text{choose Walnut Street}\end{bmatrix}\\ \text{L-U:}\ \begin{bmatrix}\text{speaker:[}A\text{]}\\ \text{move type:[}\textit{motivation}\text{]}\\ \text{utterance:[It's shorter]}\end{bmatrix}\\ \text{beliefs:}\ \begin{bmatrix}\text{Walnut Street is shorter than}\\ \text{the other possible route}\end{bmatrix}\\ \text{topoi:}\ \begin{bmatrix}\text{If there is a choice between two routes,}\\ \text{choose the shortest one}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

After A's utterance "it's shorter", *B*'s gameboard has been updated with the update rules *Update L-U′*, *Update qud* and *Update shared beliefs*. *B*'s information state after these updates is represented in (87):

(87) B's information state after update with rules *Update L-U′*, and *Update shared beliefs*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:}[] \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, self} \end{bmatrix} \\ \text{qud:}[\text{shall we walk along Walnut Street?}] \\ \text{eud:}[] \\ \text{L-U:} \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's shorter}] \end{bmatrix} \\ \text{beliefs:} \begin{bmatrix} A \text{ suggests Walnut Street} \\ \text{Walnut Street is shorter than the other} \\ \text{possible route} \end{bmatrix} \\ \text{topoi:}[] \end{bmatrix} \end{bmatrix}$$

In order for B to interpret A's utterance, he must assign a relation between the two propositions of A's utterance. There could be many different clues regarding this – intonation and context being two of them. One such clue is the extent to which we recognise a topos that could be at the core of an argument made up of the two propositions expressed in the utterance. If B recognises that a route being short is generally considered a good reason for choosing it, then B is likely to recognise the argument and thus accommodate the enthymeme under discussion. What we need are two rules – one licencing the pushing of a topos on shared topos, and one pushing an enthymeme which is an instantiation of that topos onto *eud*. Let us call the first one *Update shared topoi′* and the second *Accommodate eud*.

- *Update shared topoi′*: If there is a topos accessible in an agent's resources that could serve as a second premise in an argument made up by one or more previous utterances, and the topos is not already on the gameboard, push the topos onto *shared topoi*.

- *Accommodate eud*: If there is a topos on shared topoi and no instantiation of that topos on eud, update eud with an instantiation of the topos.

(88) B's information state after update with rules *Update shared topoi'*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}\text{agenda:}[] \\ \text{topoi:}[] \\ \text{beliefs:}[]\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:}[\text{decide on route to work}] \\
\text{games:} \begin{bmatrix}\text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, self}\end{bmatrix} \\
\text{qud:}[\text{shall we walk along Walnut Street?}] \\
\text{eud:}[] \\
\text{L-U:} \begin{bmatrix}\text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's shorter}]\end{bmatrix} \\
\text{beliefs:} \begin{bmatrix}\text{Walnut Street is shorter than} \\ \text{the other possible route}\end{bmatrix} \\
\text{topoi:} \begin{bmatrix}\text{If one route is shorter} \\ \text{than other possible routes,take it.}\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

(89) B's information state after update with rules *Accommodate eud*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}\text{agenda:}[] \\ \text{topoi:}[] \\ \text{beliefs:}[]\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:}[\text{decide on route to work}] \\
\text{games:} \begin{bmatrix}\text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, self}\end{bmatrix} \\
\text{qud:}[\text{shall we walk along Walnut Street?}] \\
\text{eud:} \begin{bmatrix}\text{Walnut Street is shorter,} \\ \text{therefore, we shall take Walnut Street}\end{bmatrix} \\
\text{L-U:} \begin{bmatrix}\text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's shorter}]\end{bmatrix} \\
\text{beliefs:} \begin{bmatrix}A \text{ suggests Walnut Street} \\ \text{Walnut Street is shorter than the other possible route}\end{bmatrix} \\
\text{topoi:} \begin{bmatrix}\text{If one route is shorter} \\ \text{than other possible routes, take it.}\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

After having accommodated an enthymeme under discussion, the next step

is *evaluation*. Does B accept the argument and that the explicit premise and the topos lead to the given conclusion? If yes (acceptance), he might want to signal this by giving signs of acceptance/understanding (compare Clark´s 1996 p. 228 signals of grounding). If not, B can choose to raise an objection, or he can signal acceptance/understanding anyway. It is also possible of course that B does not find a suitable topos, but still wants to come across as having understood. In this case he may choose to signal acceptance/understanding anyway (although perhaps not the strongest degree of grounding).

3.4.4 Accommodating topoi

The rhetoric involved in (74) is perhaps too ordinary to be conspicous. If we change the example slightly, however, the necessity of a topos linking the two propositions becomes evident. Let's assume that A, after having said *Let's walk along Walnut Street* instead of *It's shorter* utters *It's longer*. The utterance *Let's walk along Walnut Street. It's longer* might not so readily evoke a topos which licences B to construe an acceptable enthymeme under discussion. We come into the dialogue at the point where A has uttered "it's longer". Her utterance is based on a topos that longer routes provide more exercise and a belief that Walnut Street is longer.

(90) A's information state after update with rules *Make move* and *Update L-U*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[\,] \\ \text{topoi:} & \begin{bmatrix} \text{if you take a longer route} \\ \text{you'll get more exercise} \end{bmatrix} \\ \text{beliefs:} & \begin{bmatrix} \text{Walnut Street is longer than} \\ \text{the other possible route} \end{bmatrix} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} & \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other} \end{bmatrix} \\ \text{qud:} & [\text{Shall we walk along Walnut Street?}\ ] \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's longer}] \end{bmatrix} \\ \text{beliefs:} & \begin{bmatrix} \text{Walnut Street is longer than} \\ \text{other possible routes} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Next, we apply rules *Update shared beliefs* and *Downdate private beliefs*:

(91) *A*'s information state after update with rules *Update shared beliefs* and *Downate shared beliefs*:

$$\begin{bmatrix}
\text{private:} & \begin{bmatrix}
\text{agenda:}[\,] \\
\text{topoi:} \begin{bmatrix}\text{if you take a longer route} \\ \text{you'll get more exercise}\end{bmatrix} \\
\text{beliefs:}[\,]
\end{bmatrix} \\
\text{shared:} & \begin{bmatrix}
\text{project:}[\text{decide on route to work}] \\
\text{games:} \begin{bmatrix}\text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other}\end{bmatrix} \\
\text{qud:}[\text{Shall we walk along Walnut Street? }] \\
\text{L-U:} \begin{bmatrix}\text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's longer}]\end{bmatrix} \\
\text{beliefs:}[\text{Walnut Street is longer than other possible routes}]
\end{bmatrix}
\end{bmatrix}$$

A has a belief that Walnut Street is longer – which she considers shared – a private topos saying that longer routes provide more exercise, and a question under discussion relating the two. *A* assumes, either because she believes it obvious that the two propositions in her last utterance constitute an argument, or because she believes that the topos regarding exercise is easlily available for *B*, that the enthymeme under discussion *Walnut Street is longer, therefore, Let's walk along Walnut Street* is shared. We apply rule *Update eud*. *A* also expects *B* to be able to accommodate a relevant topos, or – perhaps more likely – she expects the topos to be readily available to *B* in the context.

(92) *A*'s information state after update with rules *Update eud*, *Update shared topoi* and *Downdate private topoi*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[] \\ \text{topoi:} & \begin{bmatrix} \text{if you take a longer route} \\ \text{you'll get more exercise} \end{bmatrix} \\ \text{beliefs:}[] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} & \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other} \end{bmatrix} \\ \text{qud:}[\text{Shall we walk along Walnut Street? }] \\ \text{eud:} & \begin{bmatrix} \text{Walnut Street is shorter,} \\ \text{therefore, let's walk along Walnut Street} \end{bmatrix} \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's longer}] \end{bmatrix} \\ \text{beliefs:}[\text{Walnut Street is longer than} \\ \text{other possible routes}] \\ \text{topoi:}[\text{longer routes provide more exercise}] \end{bmatrix} \end{bmatrix}$$

Now, if we assume that the topos A has in mind is not readily available to B, we cannot apply *Update shared topoi'*. Therefore, we cannot either apply *Accommodate topoi*, since it demands a topos on *shared topoi*. B could then

(93) *B*'s information state after update with rules *Accommodate eud*, *Update shared topoi* and *Downdate private topoi*:

$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{agenda:}[\,] \\ \text{topoi:} \begin{bmatrix} \text{if you take a longer route} \\ \text{you'll get more exercise} \end{bmatrix} \\ \text{beliefs:}[\,] \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{project:}[\text{decide on route to work}] \\ \text{games:} \begin{bmatrix} \text{game:suggestion game} \\ \text{current state:3} \\ \text{next player:answerer, other} \end{bmatrix} \\ \text{qud:}[\text{Shall we walk along Walnut Street? }] \\ \text{eud:} \begin{bmatrix} \text{Walnut Street is shorter,} \\ \text{therefore, let's walk along Walnut Street} \end{bmatrix} \\ \text{L-U:} \begin{bmatrix} \text{speaker:}[A] \\ \text{move type:}[\textit{motivation}] \\ \text{utterance:}[\text{It's longer}] \end{bmatrix} \\ \text{beliefs:} \begin{bmatrix} \text{Walnut Street is longer than} \\ \text{other possible routes} \end{bmatrix} \\ \text{topoi:}[\text{longer routes provide more exercise}] \end{bmatrix} \end{bmatrix}$$

B may still be able to accommodate the enthymeme under discussion due to clues other than the topos. However, in order to evaluate the enthymeme *B* would still need access to a topos other than a mere abstraction of *Walnut Street is longer, therefore, let's walk along Walnut Street*, such as "If a route is longer, we should walk along it". Let us assume, then, that we have applied rule *Accommodate eud*, and a new rule *Accommodate shared topoi*, which, if an agent has an eud on his gameboard, may push a topos which is an abstraction of the eud onto shared topoi. In (94) we see a representation of the information state which is the result of this operation:

Since *B* cannot make sense of *A*'s utterances s/he might ask a clarification request:

(94)
$$\begin{bmatrix} \text{private:} & \begin{bmatrix} \text{project:[decide on route to work]} \\ \text{agenda:[make clarification request: longer?]} \\ \text{topoi:[]} \end{bmatrix} \\ \text{shared:} & \begin{bmatrix} \text{qud:[why longer?} \\ \text{?Shall we walk along Walnut Street?]} \\ \text{eud:[]} \\ \text{L-U:} & \begin{bmatrix} \text{speaker:}[B] \\ \text{move:}[\textit{question}] \\ \text{utterance:[what do you mean it's longer?]} \end{bmatrix} \\ \text{belief:} & \begin{bmatrix} \text{topos:[]} \\ \text{other:[]} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

A might then point out the advantages of excercise and that you get more exercise if you walk longer. When the topos is pointed out, *B* forms an eud which can be evaluated and possibly accepted.

3.5 Summary

In this chapter we have introduced the dialogue gameboard and the information state update approach to dialogue. We have also defined a number of gameboard features which enable us to include enthymemes and topoi in a gameboard analysis of dialogue. In section (3.4.2) we introduced informal update rules. In section (3.4.3) and (3.4.4) we returned to the idea of accommodation of enthymemes and topoi introduced in chapter 2, and presented an informal gameboard analysis of these phenomena.

The update rules we have stipulated in this chapter are approximate. In chapter 4 we will make our account of the dialogue in (74) more precise. We will also introduce a new set of update rules. The nature of these rules and the order in which they apply will differ somewhat from the account in this chapter.

Chapter 4

Enthymemes and Topoi in Dialogue – a TTR Account

4.1 Type Theory with Records and Micro-Rhetoric

In this chapter we will take the data analysis from chapter 3 further by casting some of the dialogue excerpts in Type Theory with Records (TTR) (Cooper, 2005b), (Cooper & Larsson, 2009), (Cooper, 2012), (Ginzburg, 2012) (Cooper, 2013). In this case formalisation serves a double purpose. First, it makes our discussion about rhetorical elements in dialogue more precise. This inevitably leads to some aspects of the informal account in chapter 3 being not only too coarse grained, but sometimes not the best way to do certain things at all. Therefore, the account in this chapter is not merely a specification of the account in chapter 3, but a development of that account. The second reason for choosing the method of formalisation is that a precise description facilitates the relating of our theory to research on dialogue systems where implicit meaning is an area where many problems are yet to be solved. We are interested in an aspect of dialogue which has previously been mostly discussed in rhetoric, and rhetoric exploits the fact that our individual takes on dialogues in which we are involved usually match - we usually have access to the topoi which are necessary to interpret and evaluate arguments. However, sometimes our individual takes on the conversation do not match, and this is when we get evidence that something similar to the processes we describe are actually (in some form) taking place. Therefore it is important to us to model the information states of individual dialogue participants rather than a shared common ground. There are several reasons for choosing Type Theory with Records for cognitive modelling.

(Cooper, 2005b) shows how important aspects of semantic theories such as DRT (Kamp & Reyle, 1993), situation semantics (Barwise & Perry, 1983), as well as work in the Montague tradition (Montague, 1973) may be cast in TTR. This means that the problems that these theories were designed to solve, may be solved within one framework. Thus, choosing TTR for the theory presented here means we can relate enthymemes and topoi to the issues addressed in some important semantic and grammatical theories. Also, as pointed out by Ginzburg (2012), TTR has the advantage of being able to handle utterances as well as utterance types, which is crucial for analysing meta-communicative aspects of interaction. This is a great advantage for us as well since we are sometimes simultaneously interested in the meaning conveyed by a particular utterance and the role which that utterance plays in an enthymematic argument as a representative of a particular type of utterance. The notion of subtyping is also important for our account of how we employ topoi in different kinds of enthymemes through operations like restriction, generalisation and composition. In TTR we have a convenient way of doing this since we have record types – structured types where we can easily add and remove fields. Another advantage of TTR which is not directly relevant to us is that it offers a way to formally account for natural language without employing the concept of possible worlds. (Cooper, 2005a), (Cooper & Ginzburg, 2012), (Fine, 2012), (Lappin, 2013; **?**) and (Larsson, 2011), among others, point out problems with possible world accounts of meaning. These objections are of a philosophical as well as a computational nature. The computational issues might not be immediately relevant to us, but they would be relevant if we wanted to take our analysis further and implement aspects of it.

4.2 The Dialogue Gameboard Cast in TTR

Gameboard style dialogue semantics cast in TTR can be found in Ginzburg (2012), Cooper & Ginzburg (2012), Cooper (in prep). However, in this body of work there are no suggestions regarding how to handle the kind of thing we are treating here. Since our main objective is to account for the role enthymemes and topoi play in dialogue, we do not commit to any particular TTR-gameboard from previous literature. However, we do not claim that our way of doing things is necessarily better in general – we merely suggest a version of the dialogue gameboard which includes enthymemes and topoi and accounts for how they may interact with each other and various contextual and co-textual factors. For background to TTR and a detailed introduction

we recommend the literature referred to above, particularly Cooper (2012) and Cooper (in prep). However, before we return to our Walnut Street-example, we will say some things about TTR and how we use it to model dialogue. As in chapter 3, we model the progress of dialogue in terms of the information states of the dialogue participants and the updates of these states. Following Cooper (in prep) we say that the dialogue gameboard of an agent A is the type of agent A's information state. The gameboard is divided into "shared" and "private" fields, where shared information is information which the agent whose information state is represented believes to be shared, for example because it has been referred to in a dialogue, or is necessary for a dialogue contribution to be interpreted in a relevant way. For example, although a topos may be of central relevance in the dialogue, it does not appear on the gameboard, as part of an agent's shared information state, until it has been made explicit, or until something has been said which has caused it to be accommodated. Private information is believed to be private by the agent, and includes things like beliefs which have not been made public through explicit reference or through accommodation. In (95) we see a basic dialogue gameboard. The type in (95) is made up of more than one field. Such structured types we refer to as *record types*. Record types consist of a set of pairs of labels and types. In (95) "private" and "shared" are labels and the objects associated with them in a record of this type will themselves be records. Any other label introduced on the gameboard will also have a type.

(95) $\begin{bmatrix} \text{private}:Rec \\ \text{shared}:Rec \end{bmatrix}$

In a record type the label and the type are separated by a colon. If the label has a value rather than a type, the label and the value are separated by an equals sign. We refer to such structures as *Records*. In (96a) we see a record where there is a label x with the value a, a constraint c_{dog} with the value s_1 and a constraint c_{run} with the value s_2. In (96b) is a record type representing the *type of situation* where a dog runs. The label x in (96b) is of type *Ind*, and there are two *constraints*, one saying that x runs, and one saying that x is a dog. Now, (96a) is of type (96b) only if a is of type *Ind* (a:*Ind*), s_1 is of type dog(a) (s_1:dog(a)) and s_2 is of type run(a) (s_2 is of type run(a)).

(96) a. $\begin{bmatrix} \text{x} & = a \\ \text{c}_{dog} & = s_1 \\ \text{c}_{run} & = s_2 \end{bmatrix}$

b. $\begin{bmatrix} \text{x}:Ind \\ \text{c}_{dog}:\text{dog(x)} \\ \text{c}_{run}(\text{x}):\text{run(x)} \end{bmatrix}$

Let us assume that we want to talk about a type of situation where a particular dog – dog_{55} – runs. We can do that by making a field in our record type *manifest*. This means that we let a label be associated with both a value and a type, as illustrated in (97).

(97) $\begin{bmatrix} \text{x}=\text{dog}_{55}:Ind \\ \text{c}_{dog}:\text{dog(x)} \\ \text{c}_{run}(\text{x}):\text{run(x)} \end{bmatrix}$

For an in-depth introduction to records and record types including formal definitions, see Cooper (2012), Cooper (2005b).

We will now return to one of the dialogues discussed in chapter 3 – the Walnut Street dialogue (98). We will go through the dialogue and gradually introduce new concepts by describing for each update how the relevant features of the gameboard and the necessary update rules may be cast in TTR. This way we hope to make clear how we perceive the various features of the gameboard in terms of types, while hopefully elucidating some points regarding the dynamics of enthymemes and topoi in this kind of interaction.

4.3 Updates of the Dialogue Gameboard

We will return now to one of the examples from chapter 3, the situation where two colleagues are on their way to work and one of them suggests they walk along Walnut Street since it is shorter, as we see in (98).

(98) U_1 *A*: Let's walk along Walnut Street

U_2 *A*: it's shorter.

We will now work our way through a set of updates of the dialogue participants' information states which would lead to the dialogue behaviour in (98). At the beginning of the interaction the gameboard is empty apart from *project*. As we remember from chapter 3, a communicative project

is a limited task or activity which is being carried out at least to some extent by means of communication. We represent a project as a record type which includes information about the communicative project at hand. For the purposes of this dialogue, only one communicative project needs to be carried out. However, on the gameboard the type of *project* is *list of record types*, we are also able to model several projects which should be carried out one after the other to fulfil some goal (linguistic or other), as well as projects which suddenly appear in the information states of dialogue participants due to sudden events. (99) shows the type of A's information state at the beginning of the interaction. For now we are only interested in the information state of dialogue participant A, and we say nothing of the information state of dialogue participant B until after A's utterance.

4.3.1 Update of private games

The first update of the dialogue gameboard is an update of *private games* depending on *project*. Before we present the TTR-version of the rule *Update private games*, let us have a look at the nature of projects and games in terms of types. As illustrated in (98) we perceive a project as a record type representing the type of an event where a number of individuals (in this case A and B), jointly perform some action (in this case making a decision) regarding some non-decided-upon issue. In this case, the issue which is being deliberated is which route to take to work. A general representation of a project would thus be the record type in (99):

(99) $\left[\text{e:predicate } (\{A_1, ..A_n\}, Issue)\right]$

As we discussed in chapter 3, we could see the development of a conversation as a finite state automaton where the arrows leading from one state to another correspond to the linguistic moves of the conversation, as represented in (4.1). Instead of focusing on the states between the moves, we could focus on the sequence of moves themselves when defining a conversational game. We would then get a string of move types. The type in (100) for example, is of strings of moves comprising the suggestion game – a suggestion by player 1 followed by an optional motivation by player 1, followed by a response (acceptance or rejection) by player 2. We represent move types as record types.

(100) $\left[\text{e:suggest(player1)}\right]^\frown\left[\text{e:motivate(player1)}\right]^{\leqslant 1}{}^\frown(\left[\text{e:acceptance(player2)}\right] \vee \left[\text{e:rejection(player2)}\right])$

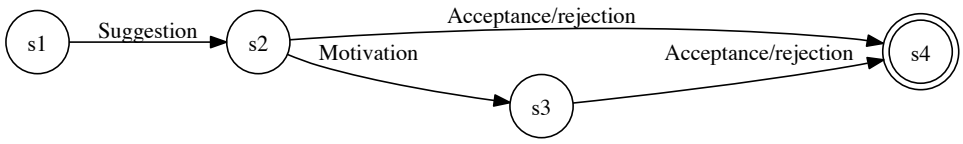

Figure 4.1: *Suggestion game*

However, the string in (100) does not represent the type of the actual game. for a complete game type we also need to allow for an assignment of roles to the individuals in the context. Thus, the suggestion game can be characterised by the dependent type $\mathcal{T}_{sg}$ in (101):

(101) $\mathcal{T}_{sg}{=}\lambda r{:}\ \begin{bmatrix}\text{player1}{:}Ind\\ \text{player2}{:}Ind\end{bmatrix}\ .$
$\big[\text{e:suggest}(r.\text{player1})\big]^\frown\big[\text{e:motivate}(r.\text{player1})\big]^{\leqslant 1\frown}$
$\big(\big[\text{e:}r.\text{response}(\text{player2})\big]\big)$

In chapter 3 we defined the rule *Update private games* like this: *If an agent has a project on her gameboard, and no games, search resources for a relevant game and push it onto private games.* For a more precise account of this update rule we would want to define what it means to be a relevant game in relation to a particular project. One way of describing this would be in terms of licences in an agent's resources. If an agent has in her resources an associative link between a type of project T_p and a type of game $\mathcal{T}_g$, she has a licence to carry out a communicative project of type T_p by means of an instantiation of the type of conversational game $\mathcal{T}_g$, and may load it onto *private.games* on her gameboard. However, in the limited model we are looking at here we only have one game which is relevant to the project at hand. Moreover, it seems to us as if a limited set of project types and game types would be enough to account for a large number of dialogue situations. Thus, we will be satisfied here with formulating an update rule specifically for the project type $\big[\text{e:decide}(\text{A}_1...\text{A}_n, \text{Issue})\big]$ applying to the context at hand, which says that decision projects are carried out by means of the suggestion game. When we talk about integration of topoi and beliefs in the discourse model, we will discuss other options for selecting resources which might be relevant for games as well.

We represent the update rule *update private games* as a function from an information state where an agent has a decision project on her gameboard and not the game suggestion game on private games, to an information state where the agent has a decision project and a suggestion game on private games. The type of *games* is a list$Game \vee InstGame$, which means that we can have more than one item on *games* and these items could be either of type *Game*, or of type *InstGame*. By letting the games field be made up of either games or instantiated games, we allow for an agent having a game on private game which has been instantiated but which the agent has not yet started playing, and then load additional games onto *private.games*. The update function *Update private games* is represented in (102).

$$(102)\quad f = \lambda r{:}\ \begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{games}{:}\text{list}(Game \vee InstGame))\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{project}{=}[\begin{bmatrix}\text{e:decide}\\ (\{A_1, ..., A_n\},\ Issue)\end{bmatrix}\ ]{:}\text{list}(RecType)\end{bmatrix}\end{bmatrix}.$$
$$\begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{games}{=}[\mathcal{T}_{sg}\|r.\text{private.games}\ ]{:}\text{list}(Game \vee InstGame))\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{project}{=}[\begin{bmatrix}\text{e:decide}\\ (\{A_1, ..., A_n\},\ Issue)\end{bmatrix}]{:}\text{list}(RecType)\end{bmatrix}\end{bmatrix}$$

The function in (102) is of the same kind as the update functions discussed by Cooper (in prep, pp. 24–26). In order to get our update we need to apply f to the current information state, a record of type T_{icurr}.

$$(103)\quad T_{icurr} = \begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{games}{=}[\ ]{:}\text{list}(Game \vee InstGame))\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{project}{=}[\begin{bmatrix}\text{e:decide}\\ (\{A_1, ..., A_n\},\ Issue)\end{bmatrix}\ ]{:}\text{list}(RecType)\end{bmatrix}\end{bmatrix}$$

Before we apply the function we need to make sure that the type of the current information state is a subtype of the domain type of f. We should point out here that T_{icurr} might very well have other fields such as a shared game, a latest utterance, shared beliefs, etc, and still be a subtype of the domain type of f. In this case, however, the gameboard representing the type of the current information state is empty. We refer to this record as i_{curr} and we see it represented in (104).

$$(104)\quad \begin{bmatrix}\text{private}{=}\begin{bmatrix}\text{games}{=}[\ ]\end{bmatrix}\\ \text{shared}{=}\begin{bmatrix}[\text{e:decide}(\{A_1, ..., A_n\},\ Issue)]\end{bmatrix}\end{bmatrix}$$

In (105) we see the application of f to i_{curr}.[1]

[1]For space reasons we will sometimes use the abbreviations "pr" for "private" and"sh" for "shared"

(105) a. $f(\begin{bmatrix}\text{private}=\left[\text{games}=[\ ]\right]\\ \text{shared}=\left[\text{[e:decide}(\{A_1,...,A_n\},\ \mathit{Issue})\text{]}\right]\end{bmatrix}\ )=$

b. $\begin{bmatrix}\text{pr}:\begin{bmatrix}\text{games}=[\mathcal{T}_{sg}|\ \begin{bmatrix}\text{pr}=\left[\text{games}=[\ ]\right]\\ \text{sh}=\left[\text{[e:decide}(\{A_1,...,A_n\},\ \mathit{Issue})\text{]}\right]\end{bmatrix}.\\ \text{pr.games }]:\text{list}(\mathit{Game}\vee\mathit{InstGame})\end{bmatrix}\\ \text{sh}:\left[\text{project}=[\left[\text{e:decide}(\{A_1,...,A_n\},\ \mathit{Issue})\right]\ ]:\text{list}(\mathit{RecType})\right]\end{bmatrix}$

c. $=\begin{bmatrix}\text{pr}:\left[\text{games}=[\mathcal{T}_{sg}]:\text{list}(\mathit{Game}\vee\mathit{InstGame})\right]\\ \text{sh}:\left[\text{project}=[\left[\text{e:decide}(\{A_1,...,A_n\},\ \mathit{Issue})\right]]:\text{list}(\mathit{RecType})\right]\end{bmatrix}$

When we apply the function (102) to our information state i_{curr} of type T_{icurr}, we get a type T' which is a subtype of the range type of the update function. In this case it is actually equivalent to the type of the range of the update function, however, in many cases the current information state may be more specified.

Instantiation of game

When we apply the update rule in 102 we push the suggestion game onto *private.games*. For any instantiation of a particular type of game we also need to apply an assignment to roles to the dependent type representing the type of game, in this case $\mathcal{T}_{sg}$, in (106a). For dialogue participant A in our current example this assignment would be that in (106b). In (106c) we see an instantiation of the suggestion game equivalent to that on dialogue participant A's gameboard after a full update of *private.games*.

(106) a. $\mathcal{T}_{sg}{=}\lambda r{:}\begin{bmatrix}\text{player1}{:}\mathit{Ind}\\ \text{player2}{:}\mathit{Ind}\end{bmatrix}\ .\ \left[\text{e:suggest}(r.\text{player1})\right]^\frown \left[\text{e:motivate}(r.\text{player1})\right]^{\leqslant 1}{}^\frown\left[\text{e:response}(r.\text{player2})\right]$

b. $\text{a}=\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix}$

c. $\mathcal{T}_{sg}(a)=\left[\text{e:suggest}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix}.\text{player1})\right]^\frown \left[\text{e:motivate}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix}.\text{player1})\right]^\frown \left[\text{e:response}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix}.\text{player2})\right]=$
$\left[\text{e:suggest(SELF)}\right]^\frown\left[\text{e:motivate(SELF)}\right]^\frown\left[\text{e:response(OTHER)}\right]$

4.3.2 Update agenda

An important aspect of the notion of *conversational game* is that players (conversational participants), by identifying an utterance as being part of a particular game, get an idea of the moves that are likely to follow and what part they are expecting to play over the next few turns of the dialogue. In this sense conversational games may be seen as engines driving dialogues forward. Once the game is loaded onto the gameboard and roles are assigned to individuals in the context, the agent may at any stage of the game look at her gameboard and know what options she has if she wants to keep playing the game. Before the update of the agenda, agent A, if playing the suggestion game, has on her private games the game (with role assignment) that we see in (107).

$$(107)\quad \mathcal{T}_{sg}\left(\begin{bmatrix}\text{player1 =SELF}\\ \text{player 2=OTHER}\end{bmatrix}\right)=\begin{bmatrix}\text{e:suggest}\\ \text{actor:SELF}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}\frown\begin{bmatrix}\text{e:motivate}\\ \text{actor:SELF}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}\leqslant^{1}\frown\begin{bmatrix}\text{e:respond}\\ \text{actor:OTHER}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}$$

Now, we want an update rule that would load the first available move of the game which is to be carried out by SELF, onto the agenda. We have a set of rules pertaining to the suggestion game that govern the pushing and popping of agenda items, which is really inherent in the suggestion game in (107). This set of rules is similar to that used to update the agenda in (Cooper, in preparation). However, in (Cooper, in preparation) there are rules pushing moves onto the agenda which are to be made by agents other than "SELF". We have chosen to use the agenda only for moves that are to be made by the agent whose agenda they are on, since we have a game present on the gameboard specifying what we expect of others and ourselves in the employment of a particular conversational game. The agenda part of the *private*-field of an agent's gameboard, and is represented as a record type (move type). Each move type has a label "e" which could be of one of a set of functional utterance types like *Suggestion*, *Question*, *Assertion*, etc. There are a number of constraints on this move type, for example c_{actor}, having to do with the roles of the agents involved in dialogue. There could also be more constraints. Further, there is a label "ctnt" for content.

The first rule to be employed of the rules of the suggestion game is a "starting rule" in (108), stating that if a player has an empty agenda and a suggestion game on his private gameboard, he may, within the suggestion

game, push a suggestion onto the agenda. We refer to this rule as *Update agenda*$_{sg}$. The content of the move type that ends up on the agenda is unspecified.

$$(108)\quad \lambda r{:}\ \begin{bmatrix} \text{agenda}=[]{:}\text{list}(\mathit{RecType}) \\ \text{games}=\mathcal{T}_{sg}(\begin{bmatrix}\text{player1 }=\text{SELF}\\ \text{player 2}=\text{OTHER}\end{bmatrix}){:}\text{list}(\mathit{Games}\vee\mathit{InstGame}) \end{bmatrix}.$$
$$\begin{bmatrix}\text{agenda}=\begin{bmatrix}\text{e:suggestion(SELF)}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}{:}\text{list}(\mathit{RecType})\end{bmatrix}$$

We apply it to the type of the current information state following the same procedure as we used for (102), and in (109b) we see A's information state after the rule has been applied.

$$(109)\quad \begin{bmatrix} \text{private:}\begin{bmatrix} \text{agenda}=\begin{bmatrix}\text{e:suggestion(SELF)}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}{:}\text{list}(\mathit{RecType}) \\ \text{games}=\begin{bmatrix}\text{e:suggestion game}(\begin{bmatrix}\text{player 1=SELF}\\ \text{player 2=OTHER}\end{bmatrix})\\ \text{list(string}(\mathit{RecType}))\end{bmatrix}{:} \end{bmatrix} \\ \text{shared:}\big[\text{project}=\big[\text{e:decide}(\{A,B\}\text{ route to work})\big]{:}\text{list}(\mathit{RecType})\big] \end{bmatrix}$$

The next update rule provided by the conversational game (although this rule is actually general and applicable to any conversational game) is a rule saying that if we have an item on the agenda which is to be performed by SELF and whose content is specified, that is the label "ctnt" has one specific value (ctnt=T:*RecType*), then the agent is allowed to make that move and push the next move onto the agenda (we will get back to this rule soon). However, at the moment the item on the agenda is not specified in terms of content – the label is just typed *RecType* (ctnt:*RecType*). In order to get a content specific move onto the agenda, the agent needs to search her resources for relevant facts and ways of reasoning about the situation and the project at hand.

4.3.3 Update private topoi and beliefs

In order to be able to update the agenda with a content specific move type, A needs to access relevant information in her resources. The update we are looking for is an update of *private topoi and beliefs*. This update rule should push onto private beliefs and topoi information in the agent's resources which is relevant to the project at hand. The relevance of the project is

slightly different here than for pushing a private game onto the gameboard. In the latter case the relation between the project *decide(which route to choose)* and the suggestion game clearly has more to do with the fact that a decision is to be made than with what the decision concerns. In the case of topoi and relevant beliefs (which may or may not include true beliefs, that is facts) however, it seems more likely that the choice of topoi has to do with the issue that is to be decided upon. The simplest way of doing this is to have a rule saying that if you have an information state that includes a particular project P and an unspecified item on the agenda, then you can load a particular set of topoi and beliefs onto the gameboard.
Before we move on to present a more detailed account of this update rule, let us consider τ – representing the type of the topos. Following Breitholtz & Cooper (2011) and Breitholtz (2014) we represent topoi and enthymemes as functions from records to record types. To illustrate this, we will look at a very simple example:

(110) If something is an orange, then it is a fruit.

Note that (110), unlike most topoi and enthymemes, is true by virtue of the meaning of the words, whereas topoi and enthymemes are usually true or true in some contexts or situations. However, we want to keep this example as simple as possible. The sentence in (110) can be seen as a function which takes a record representing a situation, S_1 where something, let's call it obj_1, is judged to be an orange at a perceiving event p_1. We represent S_1 as the record in (111).

(111) $$S_1 = \begin{bmatrix} \mathrm{x} & = \mathrm{obj}_1 \\ \mathrm{c}_{\mathrm{orange}} & = \mathrm{p}_1 \end{bmatrix}$$

S_1 is of type T_1, the type where an object is an orange.

(112) $$T_1 = \begin{bmatrix} \mathrm{x}{:}\mathit{Ind} \\ \mathrm{c}_{\mathrm{orange}}{:}\mathrm{orange(x)} \end{bmatrix}$$

When we encounter – or imagine – a situation where an object is an orange, we know that we will also have a type of situation where obj_1 is a fruit. Let's call it T_2.

(113) $$T_2 = \left[\mathrm{c}_{\mathrm{fruit}}{:}\mathrm{fruit(obj}_1\mathrm{)}\right]$$

Now, we can represent 110 as the function

(114) $\lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{orange}}{:}\text{orange(x)}\end{bmatrix}\ .\ [\text{c}_{\text{fruit}}{:}\text{fruit}(r.\text{x})]$

Now we can apply the function in (114) to S_1:

(115) a. $\lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{orange}}{:}\text{orange(x)}\end{bmatrix}\ .\ [\text{c}_{\text{fruit}}{:}\text{fruit}(r.\text{x})]$
$.\begin{bmatrix}\text{x} & =\text{obj}_1\\ \text{c}_{\text{orange}} & =\text{p}_1\end{bmatrix}=$

b. $\left[\text{c}_{\text{fruit}}{:}\text{fruit}(\left[\text{x}{:}\text{obj}_1\right])\right]$

So, the type of the topos which is loaded onto the private field of A's gameboard should capture the notion that if we have a choice between a shorter route and a longer route, we take the shorter one. This rule of thumb is not absolute – a shorter route might take much longer because of road works, or be lined with hungry lions and therefore not preferable. The agents involved in the situation might also for some reason prefer a longer walk. In many cases however, the rule of thumb that we should choose shorter routes applies. Informally, we can say that the domain type includes two routes of which one is shorter than the other, one agent (or set of agents) who has to make a choice between two routes of which one is shorter. The result type is the type of situation where the agents walk along the shorter route. In (116) we see this topos which we refer to as τ_1.

(116) $\tau_1{=}\lambda r{:}\ \begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{y}{:}\mathit{Ind}\\ \text{z}{:}\mathit{Ind}\\ \text{c}_{\text{agent}}{:}\text{agent(z)}\\ \text{c}_{\text{route}}{:}\text{route(x)}\\ \text{c}_{\text{route}_1}{:}\text{route(y)}\\ \text{c}_{\text{shorter\_than}}{:}\text{shorter\_than(x, y)}\\ \text{c}_{\text{choose\_between}}{:}\text{choose\_between(z, x, y)}\end{bmatrix}$
$(\text{c}_{\text{walk\_along}}{:}\ \text{walk\_along}(r.\text{z},\ r.\text{x}))$

Beliefs we model simply as record types. The relevant belief in this case would be that Walnut Street is shorter than the other possible route – let us call it Maple Street. We refer to this belief, represented by the record type in (117), as b_1

(117)
$$\begin{bmatrix} \text{x=Walnut Street:}\mathit{Ind} \\ \text{y=Maple Street:}\mathit{Ind} \\ \text{c}_{\text{shorter\_than}}\text{:shorter\_than(x, y)} \end{bmatrix}$$

Before we move on to look at the gameboard representing the information state of A after update of private topoi and beliefs, let us look at the update rule itself. We want the rule *update private topoi & beliefs* to apply when an agent has a move type on the agenda which is not specified for content, and no items on private topoi and private beliefs. The rule should capture that the agent considers available information and context relevant ways of reasoning about this information, as represented by the function in (118):

(118)
$$f = \lambda r_1 \text{:} \begin{bmatrix} \text{private:} \begin{bmatrix} \text{agenda=}[\begin{bmatrix} \text{e:suggestion} \\ \text{ctnt:}\mathit{RecType} \end{bmatrix}]\text{:list}(\mathit{RecType}) \\ \text{games=}\ [\mathcal{T}_{sg}(\begin{bmatrix} \text{player1=SELF} \\ \text{player2=OTHER} \end{bmatrix})] \\ \qquad\qquad \text{:list}(\mathit{Game} \vee \mathit{InstGame}) \\ \text{topoi:list}(\mathit{Topos}) \\ \text{beliefs:list}(\mathit{RecType}) \end{bmatrix} \\ \text{shared:}\left[\text{project=}\left[\text{e:decide}(\{A, B\}, \mathit{Issue})\right]\text{:}\mathit{list(RecType)}\right] \end{bmatrix}. \\ \begin{bmatrix} \text{private:} \begin{bmatrix} \text{agenda=}\begin{bmatrix} \text{e:suggestion} \\ \text{ctnt:}\mathit{RecType} \end{bmatrix}\text{:list}(\mathit{RecType}) \\ \text{games=}\left[\mathcal{T}_{sg}(\begin{bmatrix} \text{player1=SELF} \\ \text{player2=OTHER} \end{bmatrix})\right]\text{:list}(\mathit{Game} \vee \mathit{InstGame}) \\ \text{topoi=}\left[\tau_1 \| \text{r.private.topoi}\right]\text{:list}(\mathit{Topos}) \\ \text{beliefs=}\left[b_1 \| \text{r.private.beliefs}\right]\text{:list}(\mathit{RecType}) \end{bmatrix} \\ \text{shared:}\left[\text{project=}\left[\text{e:decide}(\{A, B\}, \mathit{Issue})\right]\text{:}\mathit{list(RecType)}\right] \end{bmatrix}$$

In (119) we apply our update rule to an information state of the type represented in the domain type of (118).

$$(119)\quad f\left(\begin{bmatrix}\text{private}=\begin{bmatrix}\text{agenda}=\begin{bmatrix}\text{e:suggestion}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}\\ \text{topoi}\ =[\,]\\ \text{beliefs}=[\,]\end{bmatrix}\\ \text{shared}=\left[\text{project}=\left[\text{e:decide}(\{A,B\},\mathit{whichroutetotake})\right]\ \right]\end{bmatrix}\right)=$$

$$=\begin{bmatrix}\text{pr:}\begin{bmatrix}\text{agenda}=[\begin{bmatrix}\text{e:suggestion}\\ \text{ctnt:}\mathit{RecType}\end{bmatrix}]\text{:list}(\mathit{RecType})\\ \text{games}=[\mathcal{T}_{sg}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix})]\text{:}\\ \qquad\qquad\text{list}(\mathit{Game}\vee\mathit{InstGame})\\ \text{topoi}=\left[\tau_1\right]\text{:list}(\mathit{Topos})\\ \text{beliefs}=\left[b_1\right]\text{:list}(\mathit{RecType})\end{bmatrix}\\ \text{sh:}\begin{bmatrix}\text{project}=\left[\text{e:decide}(\{A,B\},\mathit{which\_route\_to\_take})\right]\text{:}\\ \qquad\qquad\mathit{list(RecType)}\end{bmatrix}\end{bmatrix}$$

In the rule above in (118) we have ignored the fact that there might be cases where a topos alone is sufficient to sanction an update of the agenda. This would be the case for example if one agent makes a suggestion and the other agent accepts for the reason that people usually have a good reason for making a suggestion. This could possibly lead to the other agent accepting without having taken any additional information into account.

4.3.4 Specify content of agenda

We have one more update left until we reach the update where a linguistic move is actually made, and that is another update of the *agenda*. Unlike the update rules for private games and private topoi & beliefs, the rule for specifying the agenda is not about loading information from an agent's resources onto her gameboard, but about assembling information already on the gameboard and turning it into a content-specific type and pushing it onto the agenda. We will not go into the issue of natural language generation. Thus, we do not present any theory of how the information on the gameboard is turned into actual utterances. We will just say that the information on topoi and beliefs affect the content of the utterance. Everything that is on topoi and beliefs is relevant to the move the agent is about to make. The update function would thus be a function from a record where there is a project, a game, a topos and a set of beliefs – but no specified content on the agenda – to a type of information state where there is a move type on the agenda where the label ctnt is associated with a specific content. This rule is represented below in (120):

(120) $f = \lambda r$:
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{ag=[} \begin{bmatrix} \text{e:suggestion} \\ \text{ctnt:}\mathit{RecType} \\ \text{c}_{\text{actor}}\text{:actor(SELF)} \\ \text{c}_{\text{addressee}}\text{:addressee(OTHER)} \end{bmatrix}\text{]:list}(\mathit{RecType}) \\ \text{topoi=}\left[\tau_1\right]\text{:list}(\mathit{Topos}) \\ \text{beliefs=}\left[b_1\right]\text{:list}(\mathit{RecType}) \end{bmatrix} \end{bmatrix}.$$
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{ag=[} \begin{bmatrix} \text{e:suggestion} \\ \text{ctnt=} \begin{bmatrix} \text{e:walk\_along} \\ (\{\text{SELF,OTHER}\},\text{W.St}) \end{bmatrix}\text{:}\mathit{RecType} \\ \text{c}_{\text{actor}}\text{:actor(SELF)} \\ \text{c}_{\text{addressee}}\text{:addressee(OTHER)} \end{bmatrix}\text{]:list}(\mathit{RecType}) \\ \text{topoi=}\left[\tau_1\right]\text{:list}(\mathit{Topos}) \\ \text{beliefs=}\left[b_1\right]\text{:list}(\mathit{RecType}) \end{bmatrix} \end{bmatrix}$$

In (121) we see the application of f to A's information state directly after *Update private topoi & beliefs*.

(121) a. $f($
$$\begin{bmatrix} \text{pr=} \begin{bmatrix} \text{agenda=[} \begin{bmatrix} \text{e:suggestion} \\ \text{ctnt:}\mathit{RecType} \end{bmatrix}\text{]} \\ \text{topoi} = \left[\tau_1\right] \\ \text{beliefs} = \left[b_1\right] \end{bmatrix} \end{bmatrix}) =$$

b.
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{ag=[} \begin{bmatrix} \text{e:suggestion} \\ \text{ctnt=} \begin{bmatrix} \text{e:let's\_walk\_along} \\ (\text{W.St}) \end{bmatrix}\text{:}\mathit{RecType} \\ \text{c}_{\text{actor}}\text{:actor(SELF)} \\ \text{c}_{\text{addressee}}\text{:addressee(OTHER)} \end{bmatrix}\text{]:list}(\mathit{RecType}) \\ \text{topoi=}\left[\tau_1\right]\text{:list}(\mathit{Topos}) \\ \text{beliefs=}\left[b_1\right]\text{:list}(\mathit{RecType}) \end{bmatrix} \end{bmatrix}$$

The type we get out when we apply the function to the current information state, i_{curr}, is a type T', which is identical to the range type of the function f. However, this type cannot be the type of the updated information state since the type of i_{curr} had more information in it. To reach the type of our updated information state, we must combine the type of the information state at the start of the update, $T_{i_{curr}}$, and the result type of the function application, T', so that everything that is on the gameboard before the update and is not downdated, carries over to the new information state. In Cooper (in prep) this operation is referred to as an *asymmetric merge*. In (122) we see the asymmetric merge of $T_{i_{curr}}$ and T', resulting in the type of A's information state after the application of rule *specify agenda*

(122) $T_{i_{curr}} \wedge_{\cdot} T' =$

$$\left[\begin{array}{l} \text{pr:} \left[\begin{array}{l} \text{agenda=[} \left[\begin{array}{l} \text{e:suggestion} \\ \text{ctnt=} \left[\begin{array}{l} \text{e:let's\_walk\_along} \\ \text{(W.St)} \end{array}\right] \text{:} \mathit{RecType} \\ \text{c}_{\text{actor}}\text{:actor(SELF)} \\ \text{c}_{\text{addressee}}\text{:addressee(OTHER)} \end{array}\right] \text{]:list(} \mathit{RecType} \text{)} \\ \text{games=[} \mathcal{T}_{sg} \text{(} \left[\begin{array}{l} \text{player1=SELF} \\ \text{player2=OTHER} \end{array}\right] \text{)]:list(} \mathit{Game} \vee \mathit{InstGame} \text{)} \\ \text{topoi=} \left[\tau_1\right] \text{:list(} \mathit{Topos} \text{)} \\ \text{beliefs=} \left[b_1\right] \text{:list(} \mathit{RecType} \text{)} \end{array}\right] \\ \text{sh:} \left[\text{project=} \left[\left[\text{e:decide}(\{A, B\}, \text{ which\_route\_to\_take})\right]\right] \text{:list(} \mathit{RecType} \text{)}\right] \end{array}\right]$$

4.3.5 Update latest utterance

At this point in the dialogue it is time for A to make her first move in the conversation. Like *update agenda*, *update latest utterance*$_{sug}$ is a rule that is inherent to the suggestion game. In chapter 3 we had two kinds of update rules involving linguistic moves – one called *Make move* (3.5), which said that when there is a move type on an agent's agenda, the agent can make that move, and one (3.6) saying that if a move is made, *shared.L-U* and *shared.games* are updated. However, our game specific functions allows us to take care of the downdating of agenda, the making of the move and the consequent updates using only one rule. Generally, we could say that rules for updating latest utterance are functions from information states to functions from utterances to types of information states. Thus there are two rules which could be applied to an information state with a content specified suggestion on the agenda. One of these, f_1 as seen in (123), results in a type of information state where the type on the agenda is a *motivation*. We refer to this rule as *update latest utterance*$_{sg}$. The other possible rule – *update latest utterance*$_{sg'}$ – is identical to (123) with the exception that the resulting type has an empty agenda. At this point, there is nothing in our theory that tells us under which circumstances an agent would choose one or the other, all we know is that both of these rules are available. In the example we are accounting for, however, agent A chooses the update rule in (123).

(123) $$f = \lambda r_1\text{:}\begin{bmatrix}\text{pr:}\begin{bmatrix}\text{ag=}[\begin{bmatrix}\text{e:suggestion}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:actor(OTHER)}\\ \text{ctnt=}\begin{bmatrix}\text{e:Let's\_walk\_along}\\ \text{(W.St.)}\end{bmatrix}\text{:}\\ \qquad\qquad RecType\end{bmatrix}]\text{:list}(RecType)\\ \text{games=}[\mathcal{T}_{sg}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix})]\text{:}\\ \qquad\qquad \text{list}(Game \vee InstGame)\end{bmatrix}\end{bmatrix}.$$

$$\lambda r_2\text{:fst}(r_1\text{.pr.ag }).\begin{bmatrix}\text{private:}\begin{bmatrix}\text{agenda=}[\begin{bmatrix}\text{e:motivation}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:OTHER}\\ \text{ctnt:}RecType\end{bmatrix}]\text{:list}RecType\end{bmatrix}\\ \text{shared:}\begin{bmatrix}\text{games=}[r_1\text{.pr.games}]\text{:list}(InstGame)\\ \text{L-U=}r_2\text{:}\begin{bmatrix}\text{e:suggestion}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:actor(OTHER)}\\ \text{ctnt=}\big[\text{e:Let's\_walk\_along(W.St.)}\big]\text{:}RecType\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

In (124a) we see a record which is of the type of the information state of dialogue participant A before the application of the update function. The type of L-U in the result type of f, could be a record such as the one in (124b).

(124) a. $$r_1=\begin{bmatrix}\text{pr=}\begin{bmatrix}\text{agenda=}[\begin{bmatrix}\text{e:suggestion}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:OTHER}\\ \text{ctnt=}\begin{bmatrix}\text{e:Let's\_walk\_along}\\ \text{(W.St.)}\end{bmatrix}\text{:}RecType\end{bmatrix}]\\ \text{games }=[\mathcal{T}_{sg}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix})]\end{bmatrix}\end{bmatrix}$$

b. $$r_2=\begin{bmatrix}\text{e} & =\text{suggestion}\\ \text{c}_{actor} & =\text{actor(SELF)}\\ \text{c}_{addressee} & =\text{OTHER}\\ \text{ctnt} & =\big[\text{e:walk\_along(\{SELF,OTHER\}, W.St.)}\big]\end{bmatrix}$$

4.3.6 Update qud

When A has uttered the first sentence, a record of the type which was on the agenda in (124a) is pushed onto L-U. Ginzburg (2012) distinguishes locutionary and illocutionary propositions and represents both on the gameboard in order to account for example for different types of clarification requests – ones having to do with the subject matter as well as meta-linguistic ones. This would definitely be useful in an account of enthymemes and topoi, since rhetorical sequences often stretch over many turns. Several premises uttered in a conversation may relate to an initial claim, proposal or suggestion. Therefore, it is not only relevant for the beliefs of the dialogue participants to be updated in terms of facts about the discourse universe, but also about the moves made in the past discourse. However, generally, during a conversation dialogue participants gradually forget the exact forms of earlier utterances, and sometimes even their content, so it seems unintuitive to keep all meta-communicative beliefs – such as "A suggests x" – on the gameboard. One way to solve this would be having a dialogue history component outside of the gameboard which could be accessed during the dialogue. As we discussed in chapter 3, we have chosen to integrate some meta-communicative information on the gameboard by interpreting utterances which carry the illocutionary force of a proposal, order or other type of exhortation as answers to potential questions. By pushing a corresponding question onto *qud* we enable the responding dialogue participant not only to accept or reject a suggestion, but also to question it. The update rule *Update qud* is represented by the function in (125), where L-U.e $\sqsubseteq$ *Suggestion* $\vee$ *Order* $\vee$ *Request* $\vee$ *Question* .

$$(125)\quad \lambda r{:}\left[\text{shared:}\left[\begin{array}{l}\text{qud:list}(\mathit{RecType})\\ \text{L-U=}\left[\begin{array}{ll}\text{e} & =\text{suggestion}\\ \text{c}_{\mathit{actor}} & =\text{actor(SELF)}\\ \text{c}_{\mathit{addressee}} & =\text{addressee(SELF)}\\ \text{ctnt} & =T_{\mathit{ctnt}}\end{array}\right]{:}\mathit{Rec}\end{array}\right]\right].$$
$$\left[\text{e:?}r.\text{shared.L-U.ctnt}\right]$$

4.3.7 Update L-U′

Let us now look at the development of agent B's dialogue gameboard. When A has made her first utterance, the suggestion "Let's walk along Walnut Street", B's gameboard is updated. In (126) we see this rule which is a function from the current information state to a function from a move made

by "OTHER" to a type of information state where the latest utterance is of the same type as that move. Since any utterance made in the interaction will update L-U for any participant in the dialogue, it does not matter what the current information state is. We assume here that it is empty, but it might as well have an utterance on L-U which will be popped off when we apply the update function.

$$(126)\quad \lambda r_1{:}[].\ \lambda r_2{:}\begin{bmatrix}\text{e:}\mathit{move}\\ \text{c}_{\mathit{actor}}\text{:actor(OTHER)}\end{bmatrix}.\ \big[\text{shared:}\big[\text{LU=}r_2\text{:}\mathit{Rec}\big]\big]$$

4.3.8 Update shared games

We also want our updates to capture that B, upon integrating a latest utterance which is a suggestion, is able to register it as the latest utterance, but also that he is able to infer which conversational game he is being invited to play. This update rule is obviously specific to a game, we therefore refer to it as "update shared games$_{sg}$. We see the rule in (127).

$$(127)\quad \lambda r{:}\ \begin{bmatrix}\text{shared:}\begin{bmatrix}\text{L-U:}\big[\text{e:suggestion}\big]\\ \text{games:list(}\mathit{Games}\vee\mathit{InstGames}\text{)}\end{bmatrix}\end{bmatrix}.\\ \big[\text{shared:}\big[\text{Games=}[\mathcal{T}_{sg}]\text{:list(}\mathit{Game}\vee\mathit{InstGame}\text{)}\big]\big]$$

When the suggestion game is pushed onto B's shared game, it also has to be instantiated. This is done like in (**??**), but with a different assignment, as seen in (128).

$$(128)\quad \begin{bmatrix}\text{player1=OTHER}\\ \text{player2=SELF}\end{bmatrix}$$

4.3.9 Update agenda′

In (4.3.2) we discussed the kind of rule that pushes the first move type pertaining to a conversational game onto the agenda of the agent who intends to make a move of that type. Now we are interested in the an update of the agenda based on a game on shared. games. The rule *Update agenda*$'_{sugg.}$ is a function which takes an information state where a suggestion game is on shared.games, a suggestion by OTHER on L-U and an empty agenda, and returns a type of information state where the move type *response* is on the agenda.

(129) $$\lambda r{:}\begin{bmatrix}\text{private}{:}\left[\text{agenda}{=}[]{:}\text{list}(\mathit{RecType})\right]\\ \text{shared}{:}\begin{bmatrix}\text{games}{=}\mathcal{T}_{sg}{:}\text{list}(\mathit{Game}\vee\mathit{InstGame})\\ \text{L-U}{=}\begin{bmatrix}\text{e} & {=}\text{suggestion}\\ \text{c}_{actor} & {=}\text{actor(OTHER)}\\ \text{c}_{addressee} & {=}\text{addressee(SELF)}\\ \text{ctnt} & {=}T_{ctnt}\end{bmatrix}{:}\mathit{Rec}\end{bmatrix}\end{bmatrix}.$$
$$\left[\text{pr}{:}\left[\text{agenda}{=}[\begin{bmatrix}\text{e}{:}\mathit{Response}\\ \text{c}_{actor}{:}\text{actor(SELF)}\\ \text{c}_{addressee}{:}\text{addressee(OTHER)}\\ \text{ctnt}{:}\mathit{RecType}\end{bmatrix}]{:}\text{list}(\mathit{RecType})\right]\right]$$

We know that B does not respond to A's suggestion before A has motivated it. (In fact, our excerpt does not tell us whether B gives any reply at all, nor whether A and B end up walking along Walnut Street or not.) However, we do not know anything about the temporal relation between the update of B's latest utterance, the pushing of the suggestion game on B's agenda and the updates that lead up to A's second move. It may be the case that B has a specified response move ready before A makes her response move, or it might be the case that B does not know what to reply even after A's motivation has been given. However, considering the very short intervals between moves in a normal exchange of this type, it is perhaps not that relevant to even try to fix each update in time. Also, conversations including overlaps seem to provide evidence that, even though conversation is cooperative in nature, there are some internal processes which may cause the turn taking not to be perfectly synchronised. Thus, the order in which we present the updates of tacit moves should not be seen as a claim regarding the temporal relation between A's and B's updates. We merely introduce the updates in what we perceive as an intuitive order. Thus we choose to introduce the update of B's agenda before we return to dialogue participant A, since it seems reasonable that B knows after A's first move that his next move should be a response, no matter if A goes on to motivate her suggestion or not. We will now return to the next few updates of dialogue participant A.

Specify content of agenda

Since A already has the relevant enthymemes and the relevant beliefs loaded onto his gameboard, we can move straight onto the specification of the agenda. This update happens much like the update in (4.3.4). In (130) we see the resulting information state.

(130)
$$\begin{bmatrix}
\text{pr:} & \begin{bmatrix}
\text{agenda=}[\begin{bmatrix}\text{e:}\mathit{Motivation}\\ \text{c}_{\mathit{actor}}\text{:actor(SELF)}\\ \text{c}_{\mathit{addressee}}\text{:addressee(OTHER)}\\ \text{ctnt=}\left[\text{e:shorter(W.St.)}\right]\text{:}\mathit{RecType}\end{bmatrix}\text{]:list(}\mathit{RecType}\text{)}\\
\text{games:list(}\mathit{Game}\vee\mathit{InstGame}\text{)}\\
\text{topoi=}[\tau_1]\text{:list(}\mathit{Topos}\text{)}\\
\text{beliefs=}[b_1]\text{:list(}\mathit{RecType}\text{)}
\end{bmatrix}\\
\text{sh:} & \begin{bmatrix}
\text{project=[]:list(}\mathit{RecType}\text{)}\\
\text{games=}[\mathcal{T}_{sg}(\begin{bmatrix}\text{player1=SELF}\\ \text{player2=OTHER}\end{bmatrix})\text{]:list(}\mathit{Game}\vee\mathit{InstGame}\text{)}\\
\text{qud=}[\left[\text{e:?walk_along(\{SELF,OTHER\},W.St.)}\right]\text{]:list(}\mathit{RecType}\text{)}\\
\text{L-U:}\begin{bmatrix}\text{e:suggestion}\\ \text{c}_{\mathit{actor}}\text{:actor(SELF)}\\ \text{c}_{\mathit{addressee}}\text{:addressee(SELF)}\\ \text{ctnt:Let's_walk_along_W.St.}\end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$

Update latest utterance$_{mot}$

This update rule is similar to *update latest utterance$_{sugg}$*, (4.3.5). It is a function from an information state where there is a specified motivation move on the agenda to a function from a move of the same type to the type of a new information state where a move of that type is on latest utterance and there is no move on the agenda. We see this function in (131). That there is no move on the agenda means that player1 after having made this update knows that his last move in the suggestion play is made. The IS a player arrives at after having applied this rule is different from the state before the first move on the agenda is added in that a state of the resulting type of this function has a motivation move on latest utterance.

(131)
$$\lambda r_1\text{:}\begin{bmatrix}\text{pr:}\begin{bmatrix}\text{agenda=}[\begin{bmatrix}\text{e:motivation}\\ \text{c}_{\mathit{actor}}\text{:actor(SELF)}\\ \text{c}_{\mathit{addressee}}\text{:addressee(OTHER)}\\ \text{ctnt:}\left[\text{e:It's shorter}\right]\end{bmatrix}\text{]:list(}\mathit{RecType}\text{)}\end{bmatrix}\end{bmatrix}.$$
$$\lambda r_2\text{:}r_1\text{.private.agenda.}$$
$$\begin{bmatrix}\text{private:}\left[\text{agenda=[]:list(}\mathit{RecType}\text{)}\right]\\ \text{shared:}\begin{bmatrix}\text{L-U=}r_2\text{:}\begin{bmatrix}\text{e:motivation}\\ \text{c}_{\mathit{actor}}\text{:actor(SELF)}\\ \text{c}_{\mathit{addressee}}\text{:addressee(OTHER)}\\ \text{ctnt:}\left[\text{e:shorter(W.St.)}\right]\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

4.3.10 Update shared beliefs

We specified in 4.3.6 that an update of qud happens only when the L-U is a suggestion, an order, a request or a question. When the L-U is a statement, we assume that it is integrated as a shared belief.

(132) $$\lambda r{:}\left[\text{shared}{:}\left[\begin{array}{l}\text{L-U}{:}\left[\begin{array}{l}\text{e:motivation}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:addressee(OTHER)}\\ \text{ctnt}{:}\left[\text{e:It's shorter}\right]\end{array}\right]\\ \text{beliefs}{:}\mathit{RecType}\end{array}\right]\right].$$
$$\left[\text{shared}{:}\left[\text{beliefs}{=}\left[\begin{array}{l}\text{prev}{:}r\text{.shared.beliefs}\\ \text{curr}{:}r\text{.shared.L-U.ctnt}\end{array}\right]{:}\mathit{RecType}\right]\right]$$

After having applied the function *Update shared beliefs* in (132) we also need to merge r.L-U.ctnt and [prev:r.shared.beliefs]. The type of the resulting information state would be (133)

(133) $$\left[\text{shared}{:}\left[\text{beliefs}{:}\left[\begin{array}{ll}\text{prev}{:}\mathit{RecType} & \\ \text{curr}{:} & \left[\begin{array}{l}\text{x=W.St.}{:}\mathit{Ind}\\ \text{y}{:}\mathit{Ind}\\ \text{c}_{route1}\text{:route(x)}\\ \text{c}_{route2}\text{:route(y)}\\ \text{c}_{shorter\_than}\text{:shorter\_than(x,y)}\end{array}\right]\end{array}\right]\right]\right]$$

4.3.11 Update eud

In uttering *it's shorter A* evokes the argument *(We should) walk along Walnut Street, since Walnut Street is shorter* underpinned by the premise that shorter routes are preferable, if you have a choice between two routes of which one is shorter than the other, you should pick the shorter one, etc. As far as *A* is concerned, what she has just said constitutes an argument and thus expects an enthymeme to be under discussion. Qud contains information regarding the first utterance (*Let´s walk along Walnut Street*) and L-U contains information regarding the recent motivation (it's shorter). Now, the topos which *A* drew on when formulating the enthymematic argument, τ_1, says that if we have a situation where we have a route which is shorter, then we also have a type of situation where we walk along that route. We see this topos in (134a). One difference between enthymemes and topoi, apart from the fact that enthymemes exist on the discourse level, is that

enthymemes are usually more specified – or *restricted* – than topoi. Let's take for example the topos that if you work hard, you will reach your goals. This is obviously not a logical truth - in fact it is not even true that we necessarily cannot reach our goals even if we do not work hard. Nevertheless, this is a topos we live by. So, when a father encourages his child to practice her guitar playing if she wants to be admitted in the school band, he might say something like *if you practice a lot, you'll get to play in the band*. The argument he presents is thus restricted in terms of the individual whom it concerns, the type of work that needs to be done and the goal that is to be achieved. In our example, the route is specified to Walnut Street, and the agents that are to walk along the route are specified to SELF and OTHER. We see a representation of such a specification – the enthymeme ϵ_1 – in (134b).

(134) a. $\tau_1 = \lambda r$: $\begin{bmatrix} \text{x:}Ind \\ \text{y:}Ind \\ \text{z:}\{Ind\} \\ \text{c}_{\text{agent}}\text{:agent(z)} \\ \text{c}_{\text{route}}\text{:route(x)} \\ \text{c}_{\text{route}_1}\text{:route(y)} \\ \text{c}_{\text{shorter\_than}}\text{:shorter\_than(x, y)} \\ \text{c}_{\text{choose\_between}}\text{:choose\_between(z, x, y)} \end{bmatrix}$
($\text{c}_{\text{walk\_along}}$: walk_along($r$.z, r.x))

b. λr: $\begin{bmatrix} \text{x=Walnut Street:}Ind \\ \text{y:}Ind \\ \text{z=\{SELF,OTHER\}:}\{Ind\} \\ \text{c}_{\text{agent}}\text{:agent(z)} \\ \text{c}_{\text{route}}\text{:route(x)} \\ \text{c}_{\text{route}_1}\text{:route(y)} \\ \text{c}_{\text{shorter\_than}}\text{:shorter\_than(x, y)} \\ \text{c}_{\text{choose\_between}}\text{:choose\_between(z, x, y)} \end{bmatrix}$
($\text{c}_{\text{walk\_along}}$: walk_along($r$.z, r.x))

We define an enthymeme as belonging to a topos if its domain type is a subtype of the domain type of the topos. However, all of the constraints are not necessarily explicit in the discourse – A does not state that Walnut Street is a route or that there is a choice to be made between a number of routes (that there are at least two routes involved is ,however, communicated through the use of the comparative form of the adjective *short*).

In (135a) we see the update rule "update eud" which is a function from an information state where an agent has some topos on private topos and relevant information on qud and L-U from which an enthymeme may be construed which is consistent with the topos on private topoi, to the type of information state where we have such an enthymeme on shared.eud. In (135b) we see the update rule *Update eud*$_{\epsilon_1}$, which is specific to the update of enthymeme ϵ_1 based on the topos τ_1 and the content of the discourse as represented in the rule by information on qud and L-U.

(135) a. λr:
$$\begin{bmatrix}\text{private:}\begin{bmatrix}\text{topoi}=\tau:\end{bmatrix}\\ \text{shared:}\begin{bmatrix}\text{qud}=[?\text{Q}]:\text{list}(\textit{Question})\\ \text{L-U:}\begin{bmatrix}\text{e:motivation}\\ \text{c}_{\textit{actor}}:\text{actor(SELF)}\\ \text{c}_{\textit{addressee}}:\text{addressee(OTHER)}\\ \text{ctnt:}\textit{RecType}\end{bmatrix}\end{bmatrix}\end{bmatrix}.$$
$$\begin{bmatrix}\text{shared:}\begin{bmatrix}\text{eud}=[\epsilon]:\text{list}(\textit{Enthymeme})\end{bmatrix}\end{bmatrix}$$

b. λr:
$$\begin{bmatrix}\text{private:}\begin{bmatrix}\text{topoi}=\tau_1:\end{bmatrix}\\ \text{shared:}\begin{bmatrix}\text{qud}=[?\text{Walk\_along(W.St.)}]:\text{list}(\textit{Question})\\ \text{L-U:}\begin{bmatrix}\text{e:motivation}\\ \text{c}_{\textit{actor}}:\text{actor(SELF)}\\ \text{c}_{\textit{addressee}}:\text{addressee(OTHER)}\\ \text{ctnt}=\begin{bmatrix}\text{e:walk\_along(W.St.)}\end{bmatrix}:\textit{RecType}\end{bmatrix}\end{bmatrix}\end{bmatrix}.$$
$$\begin{bmatrix}\text{shared:}\begin{bmatrix}\text{eud}=[\epsilon_1]:\text{list}(\textit{Enthymeme})\end{bmatrix}\end{bmatrix}$$

4.3.12 Update shared topoi

Now A considers the enthymeme shared, and she assumes that the topos she had in mind as underpinning for the enthymeme will be accommodated by B, and thus also be shared. Intuitively, we could say that the update rule *Update shared topoi* takes an information state with an enthymeme on eud and an underpinning topos on private.topoi and returns a type of information state where the topos has been popped off private.topoi and pushed onto shared.topoi. A general rule for that could look like the one in (136), where the relation between ϵ and τ is that τ should be able to serve as underpinning for ϵ.

$$(136)\quad \lambda r{:}\begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{topoi}{=}[\tau]{:}\text{list}(\mathit{Topos})\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{eud}{=}[\epsilon]{:}\text{list}(?)\\ \text{topoi}{:}\text{list}(\mathit{Topos})\end{bmatrix}\end{bmatrix}.\\ \begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{topoi}{=}[]{:}\text{list}(\mathit{Topos})\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{topoi}{=}\tau{:}\text{list}(\mathit{Topos})\end{bmatrix}\end{bmatrix}$$

Unfortunately, the relevance relation between τ and ϵ is difficult to define in a general way. Since an enthymeme based on a topos is not necessarily just a restricted version of the topos. There are enthymemes where there is a subtype-supertype relation between various concepts referred to in the discourse. Take for instance the enthymeme in (1.6.1) – *Give a coin to the porter, he carried the bags all the way here*, where carrying bags could be identified as a type of work, and we can hence infer that the enthymeme is based on a topos saying something like *work should be rewarded*. Considering the imprecise distinction between enthymemes and topoi in this respect, it also seems probable that the ability to recognise a specific enthymeme as belonging to, or being based on, a particular topos would vary in a population, and that a argument which looks very much like a well established topos would be recognised by more people as belonging to that topos than one which is manipulated in various ways. This is obviously also hugely dependent on contextual features such as knowledge of cultural references and character, but it should be possible to establish some kind of gradual relevance relation between enthymemes and topoi based on subjects ability to recognise enthymemes and interpret them correctly. For now, however, we just say that agent A has a rule in her resources for pushing τ_1 onto private.topoi. We see this rule – *Update shared topos*$_{\tau_1}$ – in (137).

$$(137)\quad \lambda r{:}\begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{topoi}{=}[\tau_1,|...]{:}\text{list}(\mathit{Topos})\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{eud}{=}[\epsilon_1]{:}\text{list}(?)\\ \text{topoi}{:}\text{list}(\mathit{Topos})\end{bmatrix}\end{bmatrix}.\\ \begin{bmatrix}\text{private}{:}\begin{bmatrix}\text{topoi}{=}[|...]{:}\text{list}(\mathit{Topos})\end{bmatrix}\\ \text{shared}{:}\begin{bmatrix}\text{topoi}{=}\tau_1{:}\text{list}(\mathit{Topos})\end{bmatrix}\end{bmatrix}$$

Before we return to the dialogue gameboard of dialogue participant B, let us take a look at A's gameboard after the update of shared.topoi.

(138)
$$\left[\begin{array}{l}
\text{pr:}\left[\begin{array}{l}\text{agenda=[ ]:list}(\mathit{RecType})\\ \text{games:list}(\mathit{Game}\vee\mathit{InstGame})\\ \text{topoi:list}(\mathit{Topos})\\ \text{beliefs:list}(\mathit{RecType})\end{array}\right]\\
\text{sh:}\left[\begin{array}{l}\text{project=[]:list}(\mathit{RecType})\\ \text{games=}[\mathcal{T}_{sg}(\left[\begin{array}{l}\text{player1=SELF}\\ \text{player2=OTHER}\end{array}\right])]\text{:list}(\mathit{Game}\vee\mathit{InstGame})\\ \text{qud=}[\left[\begin{array}{l}\text{e:?walk_along}\\ (\{\text{SELF,OTHER}\},\text{W.St.})\end{array}\right]]\text{:list}(\mathit{RecType})\\ \text{L-U:}\left[\begin{array}{l}\text{e:suggestion}\\ \text{c}_{actor}\text{:actor(SELF)}\\ \text{c}_{addressee}\text{:addressee(SELF)}\\ \text{ctnt:}[\text{:Let's_walk_along_W.St.}]\end{array}\right]\\ \text{eud=}[\epsilon_1]\text{:list}(\mathit{Enthymeme})\\ \text{topoi=}\tau_1\text{:list}(\mathit{Topos})\\ \text{beliefs=}\left[\begin{array}{ll}\text{prev:}\mathit{RecType}&\\ \text{curr:}&\left[\begin{array}{l}\text{x=W.St.:}\mathit{Ind}\\ \text{y:}\mathit{Ind}\\ \text{c}_{route1}\text{:route(x)}\\ \text{c}_{route2}\text{:route(y)}\\ \text{c}_{shorter_than}\text{:shorter_than(x,y)}\end{array}\right]\end{array}\right]\text{:}\mathit{RecType}\end{array}\right]\end{array}\right]$$

4.3.13 Accommodating topoi and enthymemes

The update rules we have left to consider in relation to our "Walnut Street" example, (98), are the updates of B's gameboard which – if they are successful – represent the integration of a rhetorical relation on B's gameboard and B's recognising A's discourse as being an instance of a more general principle of reasoning.

In chapter 3 (73) we introduced three rules corresponding to three different situations for updates of eud and shared topoi on the dialogue gameboard of an agent who is to interpret a piece of discourse. The cases we considered were

- *Update shared topoi*: The agent recognises the topos (which is already in the agent's resources) and may thus push it onto shared.topoi
- *Accommodate eud*: The agent has a topos loaded onto the gameboard and is now able to establish the enthymematic structure of an utterance or a couple of utterances.

- *Accommodate shared topoi*: The agent does not recognise the topos but identifies the enthymeme as an argument and may thereby accommodate a topos which is similar, or even identical, to the enthymeme.

In all of these cases we would say that accommodation occurs, according to Lewis' definition of accommodation (2.2). However, in the second case we not only accommodate a topos, we also add something to our resources that was not there before. We will thus refer to an update rule that updates shared topoi based on a topos which is not in the agent's resources as *learning topos* rather than "update" or "accommodate" topos. We will now go through the rules for these updates. First we will look at a schematic rule and consider the circumstances under which we can apply it, we will then look at the specific rules that are needed to update our example.

Accommodate topos

The prerequisite for this rule being applied is that we have an information state where there is information on qud and L-U which taps into a topos already in the agent's resources. This topos may then be loaded onto the gameboard. In (139a) we see a general representation for the rule *accommodate topos*.

(139) a. λr: $\begin{bmatrix} \text{shared:} \begin{bmatrix} \text{qud=[?Q]:list(}\textit{Question}\text{)} \\ \text{L-U:}\left[\text{e:}\textit{Motivation}\right] \\ \text{topoi:list(}\textit{Topos}\text{)} \end{bmatrix} \end{bmatrix}$.
$\left[\text{shared:}\left[\text{topoi=}[\tau]\text{:list(}\textit{Topos}\text{)}\right]\right]$

b. λr: $\begin{bmatrix} \text{shared:} \begin{bmatrix} \text{qud=[?Walk\_along (SELF,OTHER,W.St.)]:list(}\textit{Question}\text{)} \\ \text{L-U:} \begin{bmatrix} \text{e:}\textit{Motivation} \\ \text{c}_{\textit{actor}}\text{:actor(OTHER)} \\ \text{c}_{\textit{addressee}}\text{:addressee(OTHER)} \end{bmatrix} \\ \text{topoi:list(}\textit{Topos}\text{)} \end{bmatrix} \end{bmatrix}$.
$\left[\text{shared:}\left[\text{topoi=}[\tau]\text{:list(}\textit{Topos}\text{)}\right]\right]$

In (139b) we see a specific rule for the topos τ_1 – *accommodate topos*$_{\tau_1}$. when B has been presented with the suggestion to walk along Walnut Street and the statement that it is shorter, he interprets the two propositions as making sense due to some extralinguistic information that can be found in B's resources.

Accommodate eud

Now we have come to the rule wich leads to the final update of B's gameboard in our analysis of the Walnut Street example. The topos that shorter routes are preferable licences the interpretation of the suggestion *Let's walk along Walnut Street'* and the statement *It's shorter* as an argument, thus B may now accommodate the enthymeme under discussion. The accommodation of an enthymeme under discussion based on a topos already on the gameboard adds information about the rhetorical structure of the previous discourse. (140a) describes a schematic rule for update of eud based on a topos and other information on the dialogue gameboard, while (140b) is a rule specifically for updating an information state where τ_1 is on shared.topoi to a state where the enthymeme ϵ_1 is on eud.

(140) a. $\lambda r{:}\left[\text{shared}{:}\left[\begin{array}{l}\text{qud}{=}[?\text{Q}]{:}\text{list}(\textit{Question})\\ \text{L-U}{:}\left[\text{e}{:}\textit{Motivation}\right]\\ \text{eud}{:}\text{list}(\textit{Enthymeme})\\ \text{topoi}{=}[\tau]{:}\text{list}(\textit{Topos})\end{array}\right]\right].$
$\left[\text{shared}{:}\left[\text{eud}{:}\text{list}(\textit{Enthymeme})\right]\right]$

b. $\lambda r{:}\left[\text{shared}{:}\left[\begin{array}{l}\text{qud}{=}[?\text{Walk\_along}\\ (\text{SELF},\text{OTHERW.St.})]{:}\text{list}(\textit{Question})\\ \text{L-U}{:}\left[\begin{array}{l}\text{e}{:}\textit{Motivation}\\ \text{c}_{\textit{actor}}{:}\text{actor}(\text{OTHER})\\ \text{c}_{\textit{addressee}}{:}\text{addressee}(\text{SELF})\\ \text{ctnt}{:}\left[\text{e}{:}\text{shorter}(\text{W.St.})\right]\end{array}\right]\\ \text{eud}{:}\text{list}(\textit{Enthymeme})\\ \text{topoi}{=}[\tau]{:}\text{list}(\textit{Topos})\end{array}\right]\right].$
$\left[\text{shared}{:}\left[\text{eud}{=}[\epsilon]{:}\text{list}(\textit{Enthymeme})\right]\right]$

Learn topos

The last rule we will introduce is in fact not involved in the update rules required to account for (98). However, if we consider – as we did in chapter 3 – a situation where A's motivation for suggesting Walnut Street is not that it's shorter but that it is longer, we potentially have a situation where B does not "get" the argument. For accommodation of a topos to happen in this case, we need the eud to have been accommodated. This may seem contradictory since we just introduced the rule *accommodate eud* according to which the *topos* is what causes the eud to be accommodated. In fact, it

is probably the case that many factors contribute to the accommodation of the eud. In the Walnut Street example, (98), we have a lexically encoded imperative or exhortation that clearly indicates that we are dealing with a suggestion. Thus, the conversational game that can be expected involves the possibility of a move of type *motivation* to follow upon the suggestion move. Therefore, even though (98) does not include a term explicitly signaling that an enthymeme is under discussion, knowledge of basic conversational practice would give this away. The topos, however, supports this interpretation and might in some cases be the only clue. We will consider some examples like this in chapter 5, but let us now return to our revised Walnut Street example where the agent suggesting a walk along Walnut Street motivates this suggestion with the statement that Walnut Street is longer. Let us assume that the other dialogue participant, B, has just heard this and accommodated the enthymeme without the support of a topos. His information state would then be of the type in (141).

(141)
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{agenda=} \begin{bmatrix} \text{[e:}\mathit{Reply} \\ \text{c}_{\mathit{actor}}\text{:actor(SELF)} \\ \text{c}_{\mathit{addressee}}\text{:addressee(OTHER)} \\ \text{ctnt:}\mathit{RecType} \end{bmatrix} \text{:list(}\mathit{RecType}\text{)} \\ \text{games:list(}\mathit{Game}\vee\mathit{InstGame}\text{)} \\ \text{topoi:list(}\mathit{Topos}\text{)} \\ \text{beliefs:list}\mathit{RecType} \end{bmatrix} \\ \text{sh:} \begin{bmatrix} \text{project:list(}\mathit{RecType}\text{)} \\ \text{games=[}\mathcal{T}_{sg}\text{(}\begin{bmatrix}\text{player1=OTHER}\\ \text{player2=SELF}\end{bmatrix}\text{)]:} \\ \text{list(}\mathit{Game}\vee\mathit{InstGame}\text{)} \\ \text{qud=[?Walk\_along} \\ \text{({SELF,OTHER},W.St.)]:list(}\mathit{Question}\text{)} \\ \text{L-U:} \begin{bmatrix} \text{e:}\mathit{Motivation} \\ \text{c}_{\mathit{actor}}\text{:actor(OTHER)} \\ \text{c}_{\mathit{addressee}}\text{:addressee(SELF)} \\ \text{ctnt:}\big[\text{e:longer(W.St.)}\big] \end{bmatrix} \\ \text{eud=[}\epsilon_1\text{]:list(}\mathit{Enthymeme}\text{)} \\ \text{topoi:list(}\mathit{Topos}\text{)} \\ \text{beliefs=} \begin{bmatrix} \text{prev:}\mathit{RecType} \\ \text{curr:} \begin{bmatrix} \text{x=W.St.:}\mathit{Ind} \\ \text{y:}\mathit{Ind} \\ \text{c}_{\mathit{route1}}\text{:route(x)} \\ \text{c}_{\mathit{route2}}\text{:route(y)} \\ \text{c}_{\mathit{shorter\_than}}\text{:shorter\_than(x,y)} \end{bmatrix} \end{bmatrix} \text{:}\mathit{RecType} \end{bmatrix} \end{bmatrix}$$

In (141) we see that B has identified the game and the role he is playing in it, and he has been able to accommodate the enthymeme. Now, before B gives a reply, he evaluates the argument that they should walk along Walnut Street since it is longer. Now, the enthymeme might make sense by fitting into a topos about fresh air or exercise, but if it does not make sense, B could still accommodate a topos which is identical to the enthymeme, or which is a generalisation of the enthymeme under discussion. This generalisation is the opposite of the restriction or specification we discussed in (134) where some fields in the record type representing the domain type of the topos were made manifest. In addition to accommodating a topos which is identical to or a generalisation of the eud, B could tentatively incorporate the topos in his resources. This means that the next time he is presented with a similar argument, he may adjust the topos in his resources so that it works as underpinning for this argument as well. The more B would encounter an

argument belonging to this topos, the more established it will become in his resources as a way of reasoning. In (142) we see a rule for the update of the dialogue gameboard which is associated with the learning of topoi.

$$(142)\quad \lambda r{:}\left[\text{shared}{:}\begin{bmatrix}\text{eud}{=}[\epsilon]{:}\text{list}(\textit{Enthymeme})\\ \text{topoi}{:}\text{list}(\textit{Topos})\end{bmatrix}\right].\\ \left[\text{shared}{:}\left[\text{topoi}{=}[\tau]{:}\text{list}(\textit{Topos})\right]\right]$$

For the update in (142) to take place, ϵ must be a specification of τ, ϵ.

4.4 Summary

In this chapter we presented a formal representation of the "Walnut Street" dialogue in (73). We introduced TTR and a revised version of the dialogue gameboard. We noted that rhetorical phenomena like enthymemes have not been included in any previous work in dialogue semantics cast in TTR.

In 4.3 we revised the update rules introduced in chapter 3. In order to represent our update rules formally, we had to let go of some of the generality of the rules in chapter 3. We introduced game specific update rules, in this case particular to the *suggestion game*. We also introduced update rules that are specific to particular topoi and beliefs, which allow agents to load topoi and beliefs from their resources onto their dialogue gameboards, where they may draw on them to formulate dialogue contributions. We defined topoi and enthymemes as objects of essentially the same type, which enables agents to recognise a sequence of utterances as an instantiation (specification) of a particular topos, and thereby accommodate an enthymeme under discussion.

Finally, we formulated rules for different types of accommodation of enthymemes and topoi. We pointed out the difference between an agent accommodating a topos already in his resources, and tentatively accommodating a topos based on the enthymeme under discussion. The first corresponds to adding a well known but implicit topos to the discourse model, the second to adding a non-recognised topos. We suggested that for an agent to add a previously unrecognised topos to the discourse model is the first step to integrating it into her cognitive resources.

Chapter 5

Reasoning with Enthymemes and Topoi

In the previous chapter we looked at the general principles for updating our TTR-gameboard by defining a set of update rules which would enable the dialogue in (98). We will now look at a few examples that illustrate discourse situations where enthymematic structure plays a role. First, we will look at a case of enthymeme accommodation which is more clear-cut than the Walnut Street example. In the following section we will show an example of how the accommodation of the "wrong" enthymeme may lead to misunderstandings in dialogue. We will then move on to look at how we reason in dialogues by looking in more detail at the examples of non-monotonic reasoning discussed in chapter 2 (2.7.1). Finally, we will return to the dialogue about dogs and dog hairs in chapter 1, (4) and consider how the topoi accessed in the resources of the dialogue participants could be manipulated and combined to underpin the enthymematic arguments in this dialogue.

5.1 Inferring rhetorical structure through enthymeme accommodation

In chapter 4 we introduced the rules *Accommodate topos* and *Accommodate enthymeme* which together represent how we update our information states with an enthymematic relation between two propositions based on a topos in our resources. In the example in (98) the accommodation of the rhetorical relation does not necessarily have to be based on an underlying topos – the expectations on the dialogue created by the first move being a suggestion

would probably contribute just as much. However, in the example from Asher and Lascarides (30) we are not helped by the first move being a suggestion, imperative etc. In Asher and Lascarides' presentation the discourse is represented as two sentences and no particular context is described. We assume that (143) is made up of two consecutive moves by an agent – A – involved in a dialogue.

(143) a. A: Max fell

b. A: John pushed him

The problem with accounting for how we interpret this discourse, as pointed out by Asher and Lascarides, is that the temporal order does not match the discourse order, and yet we have no problem recognising (143b) as an explanation to (143a). That is as a reason for the event reported in (143a) to happen. In (144) we see the type of B's information state just after A has uttered (143a). Since we do not know anything about the project, and the discourse itself does not indicate which conversational game is being played, we omit the game and project fields for now.

(144)
$$\begin{bmatrix} \text{private}{:}\mathit{RecType} & \\ \text{shared}{:} & \begin{bmatrix} \text{L-U}{:} & \begin{bmatrix} \text{e}{:}\mathit{Assertion} \\ \text{c}_{\text{actor}}{:}\text{actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}{:}\text{(e,}B\text{)} \\ \text{ctnt}{=}\left[\text{e:fell(Max)}\right]{:}\mathit{RecType} \end{bmatrix} \\ \text{beliefs}{=} & \begin{bmatrix} \text{x}{=}\text{Max}{:}\mathit{Ind} \\ \text{c}_{\text{person}}{:}\text{person(x)} \\ \text{c}_{\text{fall}}{:}\text{fell(x)} \end{bmatrix}{:}\mathit{RecType} \\ \text{eud}{:}\text{list}(\mathit{Enthymeme}) \\ \text{topoi}{:}\text{list}(\mathit{Topos}) \end{bmatrix} \end{bmatrix}$$

When A has uttered (143b), B's gameboard is updated with a new L-U and beliefs is extended with a record type representing a situation where Jack pushed Max. In (145) shared.beliefs is set up as to indicate the textual order, that is the order in which these beliefs were added to the discourse model.

(145)
$$\begin{bmatrix}\text{private:}\mathit{RecType} \\ \text{shared:}\begin{bmatrix}\text{L-U:}\begin{bmatrix}\text{e:}\mathit{Assertion} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:(e,}B\text{)} \\ \text{ctnt=}\big[\text{e:pushed(Max,John)}\big]\text{:}\mathit{RecType}\end{bmatrix} \\ \text{beliefs=}\begin{bmatrix}\text{prev:}\begin{bmatrix}\text{x=Max:}\mathit{Ind} \\ \text{c}_{\text{fell}}\text{:fell(x)}\end{bmatrix} \\ \text{x=Max:}\mathit{Ind} \\ \text{y=John:}\mathit{Ind} \\ \text{c}_{\text{person}_1}\text{:person(x)} \\ \text{c}_{\text{person}_2}\text{:person(y)} \\ \text{c}_{\text{pushed}}\text{:pushed(y,x)}\end{bmatrix}\text{:}\mathit{RecType} \\ \text{eud:list(}\mathit{Enthymeme}\text{)} \\ \text{topoi:list(}\mathit{Topos}\text{)}\end{bmatrix}\end{bmatrix}$$

The gameboard in (145) represents the type of information state where the agent, B, has integrated the latest utterance and the belief conveyed by that utterance alone. However, in order to fully interpret (143b), as well as the whole discourse in (143), B needs to assign a relation between its first and second part. B thus searches his rhetorical resources and finds a topos concerning pushing and falling which seems to fit, as seen in (146).

(146)
$$\lambda r\text{:}\begin{bmatrix}\text{x:}\mathit{Ind} \\ \text{y:}\mathit{Ind} \\ \text{c}_{\mathit{person}_1}\text{:person(x)} \\ \text{c}_{\mathit{person}_2}\text{:person(y)} \\ \text{c}_{\mathit{pushed}}\text{:push(x,y)}\end{bmatrix}.\big[\text{c}_{\mathit{fall}}\text{:fall(}r\text{.y)}\big]$$

For the topos in (146) to be accommodated, there must be information in B's resources connecting the content of the shared gameboard with this topos. We could formulate this information as a rule similar to that in (73). B can now accommodate the enthymeme by simply restricting the topos to the individuals mentioned in the discourse. The domain type of this enthymeme, seen in (147), is a subtype of the domain type of the topos.

(147)
$$\lambda r\text{:}\begin{bmatrix}\text{x=Max:}\mathit{Ind} \\ \text{y=John:}\mathit{Ind} \\ \text{c}_{\mathit{person}_1}\text{:person(x)} \\ \text{c}_{\mathit{person}_2}\text{:person(y)} \\ \text{c}_{\mathit{pushed}}\text{:push(x,y)}\end{bmatrix}.\big[\text{c}_{\mathit{fall}}\text{:fall(}r\text{.y)}\big]$$

B has now established that the topos fits the discourse, integrated the topos on his gameboard and accommodated the enthymeme under discussion, since he counts on this topos being the intended underpinning of *A*'s utterance. This could of course be wrong – it is possible that *A* was not aware of the topos of pushings and fallings, and thus did not intend the argumentative structure to be accommodated, but it is still reasonable to assume that *A* also has this topos on his shared gameboard. If we think of this account in the context of SDRT, we also want to assign a rhetorical relation between (143a) and (143b). We could then say that in cases where we have an enthymematic relation between two discourse constituents, and the textual order and order of events are reversed, we have an *explanation*. If we can accommodate an enthymeme and the temporal order matches the order of events, we are dealing with a *background*.

5.2 Accommodation of the Wrong Topos

We will now move on to another example where the rhetorical aspect is even more pronounced. This example differs from the last example in the respect that in this case we have a situation where it is made explicit that one of the dialogue participants had expected a different continuation of the first utterance. This indicates that topoi can be evoked even before we actually have an argument conveying an enthymeme. The context is a radio show where the Swedish hip hop artist Petter is being interviewed by two journalists. Interview segments are mixed with music which they also discuss. Just after a song has been played which can be considered to be of the musical genre *metal*, the following exchange takes place:

(148) a. P: Metal was actually one of the reasons that I started doing Hiphop.. (pause)..

b. P: ...cause I hated metal!

c. B: Oh, I thought you were going to say something COMPLETELY different!

Now, there seem to be (at least) two salient ways in which Petter's first utterance would make sense, either based on some principle that if you like one type of something (like music) you might get inspired by this type to try another type. This could have to do with some type similarity, either in terms of supertype (like music) or in terms of common features between different types (for example someone listening to a certain type of music who

starts dressing in a way associated with that particular musical genre). Or, a combination of the two – you like one type of music, especially one aspect of it like, let's say that it is energetic, and you consequently get interested in other types of music that share this trait. We see a topos like this in (149).

$$(149)\quad \lambda r{:}\begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{y}{:}\mathit{Ind} \\ \text{z}{:}\mathit{Ind} \\ \text{c}_{\mathit{person}}{:}\text{person(x)} \\ \text{c}_{\mathit{like}}{:}\text{like(x,y)} \\ \text{c}_{\mathit{s\_c\_t}}{:}\text{share\_common\_trait(y,z)} \end{bmatrix}.\left[\text{c}_{\mathit{like}}{:}\text{like}(r.\text{x},r.\text{z})\right]$$

The other way to understand Petter's utterance is in terms of a topos saying that if you have two things to choose from and you more or less have to choose one and you hate one, then you are likely to choose the other one. It is possible that the first of these alternatives is more salient because of politeness reasons - we tend to try to interpret things in a positive way, and if so there would be an expectation in all conversational participants to orient to this and any utterance should be made taking recipient design into account. However, the two topoi (149) and (150) both seem like principles according to which we may reason in everyday life.

$$(150)\quad \lambda r{:}\begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{y}{:}\mathit{Ind} \\ \text{z}{:}\mathit{Ind} \\ \text{c}_{\mathit{hate}}{:}\text{hate(x,y)} \\ \text{c}_{\mathit{m\_c\_b}}{:}\text{must\_choose\_between(x,y,z)} \end{bmatrix}.\left[\text{c}_{\mathit{like}}{:}\text{like}(r.\text{x},\ r.\text{z})\right]$$

When Petter has made the first utterance his information state is of the type below in (151). We assume that we have a way of interpreting *Metal was the reason I started doing hip hop* to a form where the argument is explicit, like *I started doing hip hop because of metal*.

$$(151)\quad \begin{bmatrix} \text{pr}{:}\begin{bmatrix} \text{topoi}{=}[\lambda r{:}\begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{y}{:}\mathit{Ind} \\ \text{z}{:}\mathit{Ind} \\ \text{c}_{\mathit{hate}}{:}\text{hate(x,y)} \\ \text{c}_{\mathit{m\_c\_b}}{:}\text{must\_choose\_between(x,y,z)} \end{bmatrix}. \\ \left[\text{c}_{\mathit{like}}{:}\text{like}(r.\text{x},\ r.\text{z})\right]]{:}\text{list}(\mathit{Topos}) \end{bmatrix} \\ \text{sh}{:}\begin{bmatrix} \text{eud}{=}[\lambda r{:}\left[\text{x}{=}\text{metal}{:}\mathit{Ind}\right]. \\ \left[\text{e}{:}\left[\text{c}_{\mathit{start\_doing}}{:}\text{start\_doing}(r.\text{x},\ r.\text{z})\right]\right]]{:}\text{list}(\mathit{Enthymeme}) \\ \text{topoi}{=}[]{:}\text{list}(\mathit{Topos}) \end{bmatrix} \end{bmatrix}$$

In chapter 4 we said that an enthymeme is an instantiation of the underpinning topos, and that the domain type of the enthymeme is a subtype of the topos since it is more restricted. In this case, however, the enthymeme is actually more general than the topos, since there are no constraints on the domain type of the enthymeme other than the instantiation of x. We can say then, that P cannot expect the enthymeme to be fully accommodated by J, since no actual proposition is being expressed in the premise of the enthymeme. However, J might still be able to infer an applicable topos if she has it in her resources, and thereby accommodate a full enthymeme. In (152) we see the type of J's information state after P has uttered (148a).

(152)
$$\begin{bmatrix} \text{pr:}\mathit{RecType} \\ \text{sh:}\begin{bmatrix} \text{eud=}[\lambda r\text{:}[\text{x=metal:}\mathit{Ind}]. \\ \qquad [\text{c}_{\mathit{start\_doing}}\text{:start\_doing(hiphop)}]]\text{:list}(\mathit{Enthymeme}) \\ \text{topoi:list}(\mathit{Topos}) \end{bmatrix} \end{bmatrix}$$

Now, J interprets Petter's utterance as an enthymeme, however, it is not clear to her exactly what enthymeme. However, she probably recognises *metal* and *hiphop* as two music genres. This can be seen as a subtype/supertype relation. This is illustrated in (153) – (153a) and (153b) are both subtypes of (153c) since they are more specified.

(153) a.
$$\begin{bmatrix} \text{x:Ind} \\ \text{c}_{\text{music}}\text{:music(x)} \\ \text{c}_{\text{metal}}\text{:metal(x)} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{x:Ind} \\ \text{c}_{\text{music}}\text{:music(x)} \\ \text{c}_{\text{music}}\text{:hiphop(x)} \end{bmatrix}$$

c.
$$\begin{bmatrix} \text{x:Ind} \\ \text{c}_{\text{music}}\text{:music(x)} \end{bmatrix}$$

If J considers *hiphop* and *metal* as subtypes of *music*, the enthymeme in J's information state in (152) is a less specified version of the topos (149) saying that if you like something of one type you might become interested in/start doing something else which shares some traits with the first thing. Thus, J accommodates this topos. However, when P has uttered (148b), she has to update her eud, and now the eud and the topos on J's shared gameboard do not match. J acknowledges this by uttering (148c). Note that restrictions of both (149) and (150), where x=metal, have domain types

that are subtypes of the domain type of the enthymeme on J's gameboard in (152), which is why both interpretations are possible.

5.3 Topoi as Rhetorical Resources

In chapter 4 (4.3.11) we learned how we can move from topos to enthymeme by making fields manifest (instantiation, a form of restriction), and in (5.2) how processes of specification and generalisation of topoi and enthymemes are important in reasoning. We will now examine these processes more closely and also introduce some other types of manipulations of topoi and enthymemes, focusing on the interplay between enthymemes conveyed in discourse and the rhetorical resources from which we may infer the topoi that underpin enthymemes in conversation. We will do this first by analysing two puzzles often discussed in the context of non-monotonic reasoning, and finally by considering a longer and more complex authentic dialogue excerpt than the Walnut Street example examined in Chapter 4, 4.2. We will show that enthymematic relations are important for cohesion and interpretation of meaning in this dialogue, and that these relations are underpinned by topoi. We will also see that several manipulations of enthymemes and topoi are necessary to account for the way enthymemes and topoi fit together.

The notion of rhetorical resources is inspired by work on other types of linguistic resources, such as Larsson (2007), Cooper & Ranta (2008), Larsson & Cooper (2009), Cooper & Larsson (2009), Cooper (2012). The leading idea of this work is that linguistic agents have various language resources available which they can use to construct a particular language suitable to the purposes of the dialogue at hand. They include traditional linguistic components such as grammar, lexicon and semantics. In addition to these, we propose to add rhetorical resources made up of collections of topoi. An important part of a theory of resources, is that resources are dynamic and may be affected by speech events occurring during the course of a dialogue. This is particularly apparent in language acquisition situations as discussed, for example, in Larsson and Cooper (2009). We believe that the ability to adapt to and coordinate with our interlocutors is important not only for language acquisition but for everyday language as well, since we frequently find ourselves in situations where the ability to handle innovative utterances is a great advantage. Our view is that linguistic agents do not have one monolithic collection of resources, but rather that different resources can be applied in different domains and situations. Resources can be local to one particular dialogue as we struggle to make sense of what our dialogue part-

ners are saying or to convey concepts for which we do not yet have linguistic expressions. Certain ad hoc resources may not survive a particular conversation. Others may be limited to a small set of interlocutors or particular subject matter. They may progress to be part of our more general linguistic resources which we feel we can use with any speaker of the language. In fact, this perspective on topoi is very much in line with the view of topoi in Ducrot (1988) and Anscombre (1995), who emphasise that a system of topoi - even that accessed by one individual - will most likely include conflicting propositions. This would, as we discussed in chapter 2 (2.7), present a problem in classical logic, and for any monolithic logical system, like various non-monotonic logics. For a system of topoi, however, it does not. We will first illustrate the basics of reasoning with topoi by returning to some of the issues raised in (2.7) regarding non-monotonic reasoning. We will then move on to take a closer look at how reasoning with enthymemes and topoi can actually look in an authentic dialogue situation, by returning to the conversation about dog hairs which we started out with in chapter 1.

5.4 A Rhetorical Approach to Non-Monotonicity[1]

In chapter 2 (2.7) we discussed two classic puzzles often used as examples in literature on non-monotonic logic – the *Tweety triangle* and the *Nixon diamond*. We suggested that these problems could be treated in terms of enthymemes and topoi. We will now specify this account.

It seems to us that non-monotonic reasoning is often situated, which means that there are agents involved who have certain beliefs and have access to certain topoi affecting the way they reason. Also, the context of the reasoning situation may cause some of these beliefs and topoi to be more salient than others. We will look at these examples situated in dialogues where arguments are underpinned by rhetorical resources in the form of topoi modelled in TTR.

5.4.1 The Tweety triangle

Let's assume that A and B for some reason need to agree on whether Tweety flies or not, and the following exchange takes place:

[1]This section is based on Breitholtz (2014)

(154) a. *A*: Tweety flies – he is a bird!

b. *B*: No, he doesn't – he's a penguin!

If we think of the exchange in (154) as two enthymematic arguments – (154a) using the proposition that Tweety is a bird as a premise for the conclusion that Tweety flies, and (154b) using the proposition that Tweety is a penguin as a premise for the conclusion that he does not fly – *A* and *B* are obviously appealing to different topoi. *A*'s argument is underpinned by a topos saying that if something is a bird, then it flies, corresponding to a sentence with a bare plural *birds fly*. We represent this topos as the dependent type τ_1[2] in (155):

(155) $\tau_1 = \lambda r{:}\begin{bmatrix} \mathrm{x}{:}\mathit{Ind} \\ \mathrm{c_{bird}}{:}\mathrm{bird(x)} \end{bmatrix}.\ \begin{bmatrix} \mathrm{c_{fly}}{:}\mathrm{fly}(r.\mathrm{x}) \end{bmatrix}$

Let us first take a look at the information state of *A* before this exchange. The project which *A* has in mind is to agree on whether Tweety flies or not. This project is similar to the one in the Walnut Street-dialogue accounted for in Chapter 4, and would be associated with a conversational game similar to the suggestion game. However, in this case we would have to adjust the game so that it, directly after the suggestion by player 1, would allow player 2 to start a new round of the game. However, in our account below we will not pay much attention to the *project*, the *conversational game* and other properties of the dialogue gameboard apart from *topoi*, *enthymemes* and *beliefs*.

On the topic of Tweety *A* has access to a set of relevant resources – the topos in (155), which is loaded onto private topoi on the game board, and a belief about Tweety, we could call it a "Tweety type", like the one in (156). Record types representing contextually relevant individuals which are accessed during a dialogue are reminiscent of file cards representing referents of definite noun phrases in (Heim, 1983), and the mental files in (Recanati, 2012).

(156) $\begin{bmatrix} \mathrm{x}{=}\mathrm{Tweety}{:}\mathit{Ind} \\ \mathrm{c_{bird}}{:}\mathrm{bird(x)} \end{bmatrix}$

[2]When necessary we will use abbreviations for specific enthymemes and topoi in the record types to make them more readable.

(157)
$$\begin{bmatrix} \text{private:} \begin{bmatrix} \text{agenda=}[\ ]\text{:list}(\mathit{RecType}) \\ \text{topoi=}[\ \begin{bmatrix} \lambda r\text{:}\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \end{bmatrix} \\ (\begin{bmatrix} \text{c}_{\text{fly}}\text{:fly}(r.\text{x}) \end{bmatrix}) \end{bmatrix}\ ]\ \text{:list}(\mathit{Topos}) \\ \text{beliefs=}\begin{bmatrix} \text{x=Tweety:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \end{bmatrix}\text{:}\mathit{RecType} \end{bmatrix} \\ \text{shared:}\mathit{RecType} \end{bmatrix}$$

The topos (155) on A's gameboard together with the beliefs A has about Tweety pushes the proposal "Tweety flies" onto the agenda.

(158)
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{agenda=}[\ \begin{bmatrix} \text{e:}\mathit{Proposal} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)} \\ \text{ctnt=}\begin{bmatrix} \text{e:fly} \\ \text{(Tweety)} \end{bmatrix}\text{:}\mathit{RecType} \end{bmatrix}\ ]\text{:list}(\mathit{RecType}) \\ \text{topoi=}\ \begin{bmatrix} \lambda r\text{:}\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \end{bmatrix} \\ (\begin{bmatrix} \text{c}_{\text{fly}}\text{:fly}(r.\text{x}) \end{bmatrix}) \end{bmatrix}\ \text{:list}(\mathit{Topos}) \end{bmatrix} \\ \text{sh:} \begin{bmatrix} \text{eud:}\mathit{Enthymeme} \\ \text{topoi:}\mathit{Topos} \\ \text{beliefs:}\mathit{RecType} \end{bmatrix} \end{bmatrix}$$

After A has uttered (154a), the item is popped from the agenda[3]. The rules of the suggestion game and the topos and belief on A's private gameboard pushes another item on the agenda, the motivation that Tweety is a bird.

(159)
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{agenda=}\ \begin{bmatrix} \text{e:}\mathit{Motivation} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)} \\ \text{ctnt=}\begin{bmatrix} \text{e:bird} \\ \text{(Tweety)} \end{bmatrix}\text{:}\mathit{RecType} \end{bmatrix}\ \text{:list}(\mathit{RecType}) \\ \text{topoi=}[\lambda r\text{:}\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \end{bmatrix} \\ (\begin{bmatrix} \text{c}_{\text{fly}}\text{:fly}(r.\text{x}) \end{bmatrix})]\ \text{:list}(\mathit{Topos}) \end{bmatrix} \\ \text{sh:} \begin{bmatrix} \text{eud:}\mathit{Enthymeme} \\ \text{topoi:}\mathit{Topos} \\ \text{beliefs:}\mathit{RecType} \end{bmatrix} \end{bmatrix}$$

[3]Note that corresponding items will be pushed on *Latest Utterance* for A and B, and on *beliefs* for A. For convenience we do not represent that here.

Now, A expects the enthymeme (160), ϵ_1 saying that Tweety is a bird, therefore, Tweety flies, and the topos τ_1 (155) to be accommodated.

$$(160) \quad \epsilon_1 = \lambda r{:}\begin{bmatrix} \text{x=Tweety:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \end{bmatrix}. \begin{bmatrix} \text{c}_{\text{fly}}\text{:fly}(r.\text{x}) \end{bmatrix}$$

We could imagine a few different scenarios here, the first being that B does not recognise the topos at all. Unlikely as this may seem, if it were to occur she could make a clarification request along the lines of "what do you mean he's a bird", questioning the relevance of the premise, to which A could reply by pointing to the topos he has in mind – "if something is a bird, then it flies". B could agree or disagree with this, and if B objects, A would have to provide some evidence that birds do indeed fly, at least most of the time. If B agrees, she could evaluate the argument and possibly object, but in this case not to the topos that birds generally fly, but to the argument that the individual Tweety flies.

The second scenario is that B does have access to the topos that birds fly, τ_1, and that she thereby is able to accommodate the enthymeme *Tweety is a bird, therefore he flies*. So, B agrees to the topos, it is loaded onto shared.topoi on her dialogue gameboard, and the enthymeme ϵ_1 is loaded onto eud. Thus, B agrees that this enthymeme is indeed under discussion. B then evaluates the enthymeme by searching her resources for the type "Tweety". We assume that B's Tweety-type looks like (161):

$$(161) \quad \begin{bmatrix} \text{x=Tweety:}\mathit{Ind} \\ \text{c}_{\text{bird}}\text{:bird(x)} \\ \text{c}_{\text{penguin}}\text{:penguin(x)} \end{bmatrix}$$

Note that the type in (161) might have many other constraints, such as "black and white", "eats fish", etc. However, we restrict ourselves now to those aspects of B's Tweety-type which are relevant for this dialogue. Now, B continues the evaluation by searching her resources for a topos which is relevant to the enthymeme on one hand and to the type of Tweety on the other. She finds such a topos, namely τ_2"If something is a penguin, then it is a bird". This rule, represented in (162), tells us that *penguin* is a subtype of *bird*.

$$(162) \quad \tau_2 = \lambda r \begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c}_{\text{penguin}}\text{:penguin(x)} \end{bmatrix}. \begin{bmatrix} \text{c}_{\text{bird}}\text{:bird}(r.\text{x}) \end{bmatrix}$$

B also accesses a topos τ_3 which says that penguins do not fly, (163):

(163) $$\tau_3 = \lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{penguin}}{:}\text{penguin(x)}\end{bmatrix}.\ \big[\text{c}_{\text{don't fly}}{:}\text{don't fly}(r.\text{x})\big]$$

In (164) we see B's information state at this point:

(164)
$$\begin{bmatrix}\text{private:} & \begin{bmatrix}\text{agenda:list}(\mathit{RecType})\\ \text{topoi}=[\lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{penguin}}{:}\text{penguin(x)}\end{bmatrix}.\ \big[\text{c}_{\text{bird}}{:}\text{bird}(r.\text{x})\big],\\ \lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{penguin}}{:}\text{penguin(x)}\end{bmatrix}.\ \big[\text{c}_{\text{don't fly}}{:}\text{don't fly}(r.\text{x})\big]\ ]{:}\mathit{Topos}\\ \text{beliefs}=\begin{bmatrix}\text{x=Tweety}{:}\mathit{Ind}\\ \text{c}_{\text{bird}}{:}\text{bird(x)}\\ \text{c}_{\text{penguin}}{:}\text{penguin(x)}\end{bmatrix}{:}\mathit{RecType}\end{bmatrix}\\ \text{shared:} & \begin{bmatrix}\text{eud}=[\lambda r{:}\begin{bmatrix}\text{x=Tweety}{:}\mathit{Ind}\\ \text{c}_{\text{bird}}{:}\text{bird(x)}\end{bmatrix}.\ \big[\text{c}_{\text{fly}}{:}\text{fly}(r.\text{x})\big]\ ]{:}\text{list}(\mathit{Enthymeme})\\ \text{topoi}=[\lambda r{:}\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{bird}}{:}\text{bird(x)}\end{bmatrix}.\ \big[\text{c}_{\text{fly}}{:}\text{fly}(r.\text{x})\big]]{:}\text{list}(\mathit{Topos})\\ \text{beliefs}=\begin{bmatrix}\text{x=Tweety}{:}\mathit{Ind}\\ \text{c}_{\text{bird}}{:}\text{bird(x)}\end{bmatrix}{:}\mathit{RecType}\end{bmatrix}\end{bmatrix}$$

Now B may compare the topos on shared.topoi, which was evoked and accommodated by A's enthymematic argument, with the topoi she herself has loaded onto her private gameboard. On the one hand we have *if something is a bird, it flies*, on the other *if something is a penguin, it does not fly* and *if something is a penguin, it is a bird*. The two later topoi may be *composed*.

To compose two topoi or enthymemes, we first need to talk about fixed-point types for dependent types like topoi and enthymemes. If τ_2 is the topos in (162), then a fixed-point type for τ_2 is a type T such that $a : T$ implies $a : \tau_2(a)$. We can obtain such a type by merging the domain type and the result type adjusting the references to r in the dependencies, as in (165).

(165) $$\begin{bmatrix}\text{x}{:}\mathit{Ind}\\ \text{c}_{\text{penguin}}{:}\text{penguin(x)}\\ \text{c}_{\text{bird}}{:}\text{bird(x)}\end{bmatrix}$$

We will refer to this type as $\mathcal{F}(\tau_2)$. We may combine $\mathcal{F}(\tau_2)$ and τ_3 (163). Note that $\mathcal{F}(\tau_2)$ is a subtype of the domain type of τ_3. This is a condition which must be fulfilled in order to be able to compose τ_2 with τ_3. The composition of τ_2 and τ_3, $\tau_2 \circ \tau_3$, is τ_4 a topos saying that penguin birds do not fly, as seen in (166).

$$(166) \quad \tau_4 = \lambda r{:}\begin{bmatrix} \mathrm{x}{:}\mathit{Ind} \\ \mathrm{c_{bird}}{:}\mathrm{bird(x)} \\ \mathrm{c_{penguin}}{:}\mathrm{penguin(x)} \end{bmatrix}. \begin{bmatrix} \mathrm{c_{don'tfly}}{:}\mathrm{don'tfly}(r.\mathrm{x}) \end{bmatrix}$$

Now B has access to two topoi which are relevant for evaluating Tweety's ability to fly, one according to which he can fly because he is a bird, and one according to which he cannot fly because he is a penguin. Since the domain type in (166) is more specified, or restricted, than the one in τ_1 (155), (166) constitutes a stronger argument as long as it is applicable to Tweety.

So, B has evaluated the enthymeme under discussion and does not agree. An item is pushed on her agenda to refute A's argument (the assertion "Tweety can't fly") followed by the assertion "He's a penguin!" (167) represents B's information state after this utterance. The topos B would expect A to accommodate is at least τ_3, (163), since that is what is needed to make the enthymeme coherent.

$$(167) \quad \begin{bmatrix} \text{private:} \begin{bmatrix} \text{agenda=} [] : \mathrm{list}(\mathit{RecType}) \\ \text{topoi=}[\lambda r{:}\begin{bmatrix} \mathrm{x}{:}\mathit{Ind} \\ \mathrm{c_{bird}}{:}\mathrm{bird(x)} \\ \mathrm{c_{penguin}}{:}\mathrm{penguin(x)} \end{bmatrix}. \begin{bmatrix} \mathrm{c_{don'tfly}}{:}\mathrm{don'tfly}(r.\mathrm{x}) \end{bmatrix}] : \mathrm{list}(\mathit{Topoi}) \end{bmatrix} \\ \text{shared:} \begin{bmatrix} \text{eud=}[\lambda r{:}\begin{bmatrix} \mathrm{x=Tweety}{:}\mathit{Ind} \\ \mathrm{c_{bird}}{:}\mathrm{bird(x)} \\ \mathrm{c_{penguin}}{:}\mathrm{penguin(x)} \end{bmatrix}. \begin{bmatrix} \mathrm{c_{don'tfly}}{:}\mathrm{don'tfly}(r.\mathrm{x}) \end{bmatrix}] : \mathrm{list}(\mathit{Enthymeme}) \\ \text{L-U:} \begin{bmatrix} \mathrm{e}{:}\mathit{Assertion} \\ \mathrm{c_{actor}}{:}\mathrm{actor(e,}B\mathrm{)} \\ \mathrm{c_{addressee}}{:}\mathrm{e,}A \\ \mathrm{cnt=e}{:}\mathrm{bird(Tweety)}{:}\mathit{RecType} \\ \mathrm{c_{cnt}}{:}\mathrm{content(e,cnt)} \end{bmatrix} \\ \text{topoi=}[\lambda r{:}\begin{bmatrix} \mathrm{x}{:}\mathit{Ind} \\ \mathrm{c_{penguin}}{:}\mathrm{penguin(x)} \end{bmatrix}. \begin{bmatrix} \mathrm{c_{don'tfly}}{:}\mathrm{don'tfly}(r.\mathrm{x}) \end{bmatrix}] : \mathrm{list}(\mathit{Rec}{\rightarrow}\mathit{RecType}) \end{bmatrix} \end{bmatrix}$$

Let's assume that A accommodates this topos. A then has to evaluate the latest enthymeme under discussion in relation to the enthymeme he himself produced, and the activated topoi. If A has access to the same type for Tweety as B has, or at least a type which shares the constraint that Tweety is a penguin, and topos which says that penguin is a subtype of bird, A will be able to evaluate B's argument and his own argument in the light of B's argument, and come to the conclusion that B's argument is stronger since it is more specific (c.f. Horty (2012)). However, if C would enter the discussion and say that Tweety actually flies, since he has a pair of artificial wings, both A and B would have to reevaluate their position. The type of "Bird who is a penguin who has artificial wings" is more specific than "Bird" or "Penguin-bird", and therefore a topos stating that someone who has artificial wings flies would be stronger, in case the constraint "has artificial wings" is in the Tweety-type.

5.4.2 The Nixon Diamond

The Nixon diamond-puzzle is slightly different from the puzzle discussed in section 5.4.1. In the the case of the Tweety triangle we have an entailment relationship between *penguin* and *bird*, which means that *penguin* is a subtype of *bird*. The consequence of this is that the topoi τ_1 (*birds fly*, (155)) and τ_3 (penguins do not fly, (163)) are hierarchical. Therefore, in the case of Tweety, we can follow the principle that a more specified rule takes precedence over a less specified rule.

In the case of the Nixon diamond there is no entailment relation between *Quaker* and *Republican*, instead the problem arises from two types being subtypes of contradicting types (pacifist and non-pacifist respectively) while both being applicable to one individual. This is usually illustrated as in figure 5.1.

One way to think about this problem is in terms of blocking inferences – if we know that Nixon is both a Republican and a Quaker, and if we start out by applying the default rule that Quakers are pacifists (the equivalent of following the arrow from Nixon to Quaker to pacifist in figure 5.1) – we would be blocking the inference that Nixon is not a pacifist. However, if we apply the rule that Republicans are not pacifists, we would be blocking the inference that Nixon is not a pacifist.

In section 2.7 we suggested that we consider this problem from a micro-rhetorical point of view and analyse it as a dialogue excerpt.

In discussions of this type we sometimes agree on the same principles of reasoning, topoi or default rules, but weight them differently. Sometimes

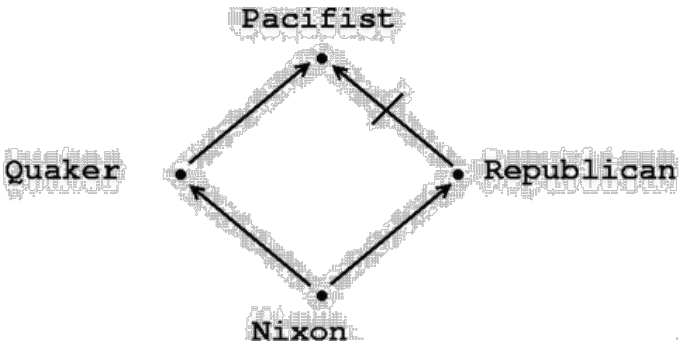

Figure 5.1: Nixon Diamond

agents involved in a discussion do this since they already have clear opinions regarding the conclusion and the dialogue is aimed at justifying their respective positions rather than using reasoning to arrive at a conclusion.

So, let us imagine again a conversation, between two people discussing whether Nixon is (or was) a pacifist or a non-pacifist. Two of the arguments presented by the dialogue participants are the following:

(168) a. *A*: Nixon is not a pacifist

b. *A*: He's a Republican!

c. *B*: He's a pacifist

d. *B*: He's a Quaker!

Initially in this conversation, *A* has in mind a type of Richard Nixon which may be restricted in a number of ways, but it has at least the restriction *Republican*. We see this type in (169).

(169) $\begin{bmatrix} \text{x=Nixon:}\mathit{Ind} \\ \text{c}_{\text{Republican}}\text{:Republican(x)} \end{bmatrix}$

A also has access to a topos regarding Republicans which says that they are non-pacifists. We refer to this topos, (170), as τ_1.

(170) $\tau_1 = \lambda r{:}\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c}_{\text{Republican}}\text{:Republican(x)} \end{bmatrix}.$
$\left[\text{c}_{\text{not\_pacifist}}\text{:not\_pacifist}(r.\text{x})\right]$

In (171) we see A's information state just before she produces the utterance (168a). On the agenda is a claim that Nixon is not a pacifist, and on her private topoi the topos τ_1, saying that Republicans are not pacifists.

(171)
$$\left[\begin{array}{l} \text{pr:} \left[\begin{array}{l} \text{agenda=}[\ \left[\begin{array}{l} \text{e:}\mathit{Claim} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)} \\ \text{cnt=}\left[\begin{array}{l}\text{e:not\_pacifist}\\ \text{(Nixon)}\end{array}\right]\text{:}\mathit{RecType} \\ \text{c}_{\text{cnt}}\text{:content(e,cnt)} \end{array}\right]\ ]\ \text{:list(}\mathit{RecType}\text{)} \\ \text{topoi=}[\lambda r\text{:}\left[\begin{array}{l}\text{x:}\mathit{Ind}\\ \text{c}_{\text{republican}}\text{:Republican(x)}\end{array}\right]. \\ \qquad \left[\text{c}_{\text{not\_pacifist}}\text{:not\_pacifist(}r\text{.x)}\right]]\ \text{:list(}\mathit{Topos}\text{)} \\ \text{beliefs=}\left[\begin{array}{l}\text{x=Nixon:}\mathit{Ind}\\ \text{c}_{\text{Republican}}\text{:Republican(x)}\end{array}\right]\ \text{:}\mathit{RecType} \end{array}\right] \\ \text{sh:}\mathit{Rec} \end{array}\right]$$

We assume that A has a conversational game similar to the suggestion game (4.1) loaded onto her gameboard. This game – let us call it the *claim game* – allows for a player to make a claim followed by a move to support this claim, corresponding to the *motivation* of the suggestion game. After this move the other player may either agree, disagree, or refute the argument by means of a new round of the claim game.

In order to completely account for the dialogue in (168) we would have to make further adjustments to the update rules presented in Chapter 4. However, as in our account of the Tweety puzzle, we have omitted some steps of our analysis in order to focus on the dynamics of enthymemes, topoi and beliefs. We will return to this matter in the closing paragraph of this section.

After (168b) has been uttered, shared.beliefs is updated through the update rule *update shared beliefs* and an enthymeme is pushed onto eud on A's dialogue gameboard, through update rule *update eud*. This enthymeme, (172), says that Nixon is a Republican and therefore not a pacifist, and we refer to it as ϵ_1.

(172)
$$\epsilon_1 = \lambda r\text{:}\left[\begin{array}{l}\text{x=Nixon:}\mathit{Ind}\\ \text{c}_{\text{Republican}}\text{:Republican(x)}\end{array}\right]. \\ \left[\text{c}_{\text{not\_pacifist}}\text{:not\_pacifist(}r\text{.x)}\right]$$

In (173) we see the type of A's information state after the update of shared.beliefs and eud.

(173)
$$\left[\begin{array}{l}\text{pr:}\left[\begin{array}{l}\text{agenda=[] :list(}\mathit{RecType}\text{)}\\ \text{topoi=}[\tau_1]\text{ :list(}\mathit{Topos}\text{)}\\ \text{beliefs:}\mathit{RecType}\end{array}\right]\\ \text{sh:}\left[\begin{array}{l}\text{eud=}[\epsilon_1]\text{:list(}\mathit{Enthymeme}\text{)}\\ \text{L-U:}\left[\begin{array}{l}\text{e:}\mathit{Assertion}\\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)}\\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)}\\ \text{ctnt=}\left[\text{e:Republican(Nixon)}\right]\text{:}\mathit{RecType}\end{array}\right]\\ \text{topoi=[]:list(}\mathit{Topos}\text{)}\\ \text{beliefs=}\left[\begin{array}{l}\text{prev:[]}\\ \text{x=Nixon:}\mathit{Ind}\\ \text{c}_{\text{Republican}}\text{:Republican(x)}\end{array}\right]\text{:}\mathit{RecType}\end{array}\right]\end{array}\right]$$

Now, since A knows that she is presenting an enthymeme, and that there thus is a causal link between (168a) and (168b), A assumes that the topos she perceived as underpinning for ϵ_1 is now shared. Thus, her game board is updated once more, we see this update in (174).

(174)
$$\left[\begin{array}{l}\text{pr:}\left[\begin{array}{l}\text{agenda=[] :list(}\mathit{RecType}\text{)}\\ \text{topoi=[] :list(}\mathit{Topos}\text{)}\\ \text{beliefs:}\mathit{RecType}\end{array}\right]\\ \text{sh:}\left[\begin{array}{l}\text{eud=}[\epsilon_1]\text{:list(}\mathit{Enthymeme}\text{)}\\ \text{L-U:}\left[\begin{array}{l}\text{e:}\mathit{Assertion}\\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)}\\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)}\\ \text{ctnt=}\left[\text{e:Republican(Nixon)}\right]\text{:}\mathit{RecType}\end{array}\right]\\ \text{topoi=}[\tau_1]\text{:list(}\mathit{Topos}\text{)}\\ \text{beliefs=}\left[\begin{array}{l}\text{prev:}\mathit{Rec}\\ \text{x=Nixon:}\mathit{Ind}\\ \text{c}_{\text{Republican}}\text{:Republican(x)}\end{array}\right]\text{:}\mathit{RecType}\end{array}\right]\end{array}\right]$$

Let us now focus on the information state of dialogue participant B. When A has uttered (168b) B integrates the belief that Nixon is a republican, accommodates the topos τ_1 as well as the enthymeme ϵ_1. The claim (168a) is represented on B's game board as a question on qud.

In Chapter 4 we defined the update rule *update qud* as a function which takes any latest utterance of type *Suggestion*, *Order*, *Request* or *Question* and pushes a corresponding question onto qud. To account for this discourse we would have to adjust that rule so that also utterances of type *Claim* push a corresponding question onto qud.

At the point in the dialogue where A has just uttered (168b), we thus assume that B's information state is of the type in (175).

(175)
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{agenda=[]} :\text{list}(\mathit{RecType}) \\ \text{topoi:list}(\mathit{Topos}) \\ \text{beliefs:}\mathit{RecType} \end{bmatrix} \\ \text{sh:} \begin{bmatrix} \text{qud=[?pacifist(Nixon)]:list}(\mathit{Question}) \\ \text{eud=[]:list}(\mathit{Enthymeme}) \\ \text{L-U:} \begin{bmatrix} \text{e:}\mathit{Assertion} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)} \\ \text{ctnt=}\big[\text{e:Republican(Nixon)}\big]\text{:}\mathit{RecType} \end{bmatrix} \\ \text{topoi=[]:list}(\mathit{Topos}) \\ \text{beliefs=} \begin{bmatrix} \text{prev:[]} \\ \text{x=Nixon:}\mathit{Ind} \\ \text{c}_{\text{Republican}}\text{:Republican(x)} \end{bmatrix} :\mathit{RecType} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

We assume that B is familiar with the topos τ_1 and easily accommodates that as well as the enthymeme it underpins. Thus τ_1 as well as ϵ_1 are part of B's shared gameboard.

(176)
$$\begin{bmatrix} \text{pr:} \begin{bmatrix} \text{agenda=[]} :\text{list}(\mathit{RecType}) \\ \text{topoi=[]} :\text{list}(\mathit{Topos}) \\ \text{beliefs:}\mathit{RecType} \end{bmatrix} \\ \text{sh:} \begin{bmatrix} \text{eud=[}\epsilon_1\text{]:list}(\mathit{Enthymeme}) \\ \text{L-U:} \begin{bmatrix} \text{e:}\mathit{Assertion} \\ \text{c}_{\text{actor}}\text{:actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}B\text{)} \\ \text{ctnt=}\big[\text{e:Republican(Nixon)}\big]\text{:}\mathit{RecType} \end{bmatrix} \\ \text{topoi=[}\tau_1\text{]:list}(\mathit{Topos}) \\ \text{beliefs=} \begin{bmatrix} \text{prev:[]} \\ \text{x=Nixon:}\mathit{Ind} \\ \text{c}_{\text{Republican}}\text{:Republican(x)} \end{bmatrix} :\mathit{RecType} \end{bmatrix} \end{bmatrix}$$

In order to evaluate the enthymeme ϵ_1 B has to access his knowledge of Nixon, represented as the type in (177). This type has, among others, the constraint *Quaker*. Since the belief that Nixon is also a Republican is already shared, this is also a constraint on (177).

(177)
$$\begin{bmatrix} \text{x=Nixon:}\mathit{Ind} \\ \text{c}_{\text{Quaker}}\text{:Quaker(x)} \\ \text{c}_{\text{Republican}}\text{:Republican(x)} \end{bmatrix}$$

For some reason, either because B wants to argue that Nixon is a pacifist, or because *Quaker* is simply a more salient quality of Nixon for him than *Republican*, the topos which is pushed onto B's private topoi is τ_2, as seen in (178).

(178) $$\tau_2 = \lambda r \begin{bmatrix} \text{x}:\mathit{Ind} \\ \text{c}_{\text{quaker}}:\text{Quaker(x)} \end{bmatrix} \left(\left[\text{c}_{\text{pacifist}}:\text{pacifist}(r.\text{x})\right]\right)$$

We see the type of B's information state at this point in (179).

(179) $$\begin{bmatrix} \text{pr}: \begin{bmatrix} \text{agenda}=[] :\text{list}(\mathit{RecType}) \\ \text{topoi}=[\tau_2] :\text{list}(\mathit{Topos}) \\ \text{beliefs}= \begin{bmatrix} \text{x}=\text{Nixon}:\mathit{Ind} \\ \text{c}_{\text{Quaker}}:\text{Quaker(x)} \\ \text{c}_{\text{Republican}}:\text{Republican(x)} \end{bmatrix} :\mathit{RecType} \end{bmatrix} \\ \text{sh}: \begin{bmatrix} \text{eud}=[\epsilon_1]:\text{list}(\mathit{Enthymeme}) \\ \text{L-U}: \begin{bmatrix} \text{e}:\mathit{Assertion} \\ \text{c}_{\text{actor}}:\text{actor(e,}A\text{)} \\ \text{c}_{\text{addressee}}:\text{addressee(e,}B\text{)} \\ \text{ctnt}=\left[\text{e}:\text{Republican(Nixon)}\right]:\mathit{RecType} \end{bmatrix} \\ \text{topoi}=[\tau_1]:\text{list}(\mathit{Topos}) \\ \text{beliefs}= \begin{bmatrix} \text{prev}:[] \\ \text{x}=\text{Nixon}:\mathit{Ind} \\ \text{c}_{\text{Republican}}:\text{Republican(x)} \end{bmatrix} :\mathit{RecType} \end{bmatrix} \end{bmatrix}$$

B now has to take into account on the one hand two topoi – one saying that Republicans are not pacifists, and one saying that Quakers are pacifists – on the other the type of an individual who is both a Quaker and a Republican. In the case of the "Tweety triangle", we had a situation where a conclusion which can generally be drawn regarding individuals of one type (birds) cannot be drawn regarding individuals of a particular subtype of that type (penguins). Here, however, the situation is different - *Quaker* is not a subtype of *Republican* or the other way around. In fact they are each subtypes of types which are each other's negation – pacifist and not pacifist. In order for B to make his point, he therefore has to generalise his Nixon type. On private topoi in (179) we thus find a topos saying that Quakers are pacifists (τ_2), and on shared topoi a topos saying that Republicans are not pacifists (τ_1). The topos saying that Quakers are pacifists pushes a move type onto B's agenda which is the claim of an enthymematic argument refuting the claim made by A.

When B has uttered (168d) he counts on the topos τ_2 to be accommodated, and thereby also an enthymeme saying that Nixon is not a pacifist, since he is a Republican. We refer to this enthymeme as ϵ_2.

$$(180) \quad \epsilon_2 = \lambda r{:}\begin{bmatrix} \text{x=Nixon:}\mathit{Ind} \\ \text{c}_{\text{republican}}\text{:republican(x)} \end{bmatrix}. \begin{bmatrix} \text{c}_{\text{non-pacifist}}\text{:non-pacifist}(r.\text{x}) \end{bmatrix}$$

In (181) we see B's information state after uttering (168d)

$$(181) \quad \begin{bmatrix} \text{private:} \begin{bmatrix} \text{agenda=[] :list}(\mathit{MoveType}) \\ \text{topoi=[] :list}(\mathit{Topos}) \end{bmatrix} \\ \text{shared:} \begin{bmatrix} \text{eud=}[\epsilon_2, \epsilon_1]\text{:list}(\mathit{Enthymeme}) \\ \text{L-U:} \begin{bmatrix} \text{e:}\mathit{Assertion} \\ \text{c}_{\text{actor}}\text{:actor(e,}B\text{)} \\ \text{c}_{\text{addressee}}\text{:addressee(e,}A\text{)} \\ \text{ctnt=}\begin{bmatrix}\text{e:Quaker(Nixon)}\end{bmatrix}\text{:}\mathit{RecType} \end{bmatrix} \\ \text{topoi=}[\tau_2, \tau_1]\text{:list}(\mathit{Topos}) \end{bmatrix} \end{bmatrix}$$

So, now B's take on the state of the dialogue is that there are two enthymemes under discussion - Nixon is a quaker and therefore a pacifist, and Nixon is a republican and therefore a non-pacifist. B also assumes that topoi underpinning both arguments have been evoked in the dialogue. Since "pacifist" and "non-pacifist" can never be in a subtype – supertype relation to each other, A and B has to evaluate the arguments based on how general they take the rules expressed in the topoi to be and whether they think that one of the rules is more committing than the other. One could for example say that if someone is a quaker, that person has to be a pacifist, otherwise he would no longer be a quaker, while being a republican could mean nothing having voted for a republican candidate – not necessarily embracing all political views typically taken by republicans. It obviously also be possible to reason in favour of the conclusion that Nixon is a non-pacifist in a similar way. Traditionally problems like the Nixon diamond are being treated either skeptically (no inference is accepted) or credulously (all inferences are accepted). Usually the skeptical approach is chosen in order to avoid contradictory inferences. However, if we perceive that the object of artificial intelligence is to capture human reasoning, and if we think of a natural situation in which this problem could occur, it seems quite evident that the credulous approach is closer to actual human reasoning.

5.5 Returning to the "Dog Hairs" Dialogue[4]

Let us now take the excerpt in (182) as our point of departure for going through various manipulations on enthymemes and topoi which may account for the dialogue behaviour in this particular dialogue. We are not claiming that we can determine the exact resources which any particular dialogue participant would have at their disposal when taking part in this dialogue. Rather we set ourselves the task of describing what topoi and could be accessed in by an agent in order for the dialogue to play out the way it does. Thus the questions tackled by our theory are more like those which would have to be approached by a dialogue system implementor who wants to design an agent that could take part in this dialogue. There are an unlimited number of topoi through which the same result could be achieved. What is important is to show that our theory enables us to formulate at least one of these.

Let us first have a look at the dialogue again:

(182)

Cherrilyn:	Most dogs aren't allowed up ⟨pause⟩ upstairs.
	He's allowed to go wherever he wants ⟨pause⟩ do whatever he likes.
Fiona :	Too right!
	So they should!
	Shouldn't they?
Cherrilyn:	Yeah I mean ⟨pause⟩ dog hairs rise anyway so
Fiona:	What do you mean, rise?
Cherrilyn:	The hair ⟨pause⟩ it rises upstairs.
	I mean I, you know friends said it was, oh God I wouldn't allow mine upstairs because of all the ⟨pause⟩ dog hairs!
	Oh well ⟨pause⟩ they go up there anyway.
Fiona:	So, but I don't know what it is, right, it's only a few bloody hairs!

BNC file KBL, sentences 4196–4206

[4]This section is based on Breitholtz & Cooper (2011)

The dialogue in (182) is essentially about whether dogs should be allowed everywhere in the house, or – more specifically – upstairs. Important for the analysis of this conversation is the notion of *communicative project*. The overall project seems to be to establish and expand common ground regarding where dogs should be allowed and why, and the argumentation orients either in favour of or against dogs being allowed upstairs. However, it is possible to distinguish sub-projects, like the clarification sequence after Cherrilyn's utterance *Yeah I mean, dog hairs rise anyway so*. We will look at the enthymemes and topoi available to the dialogue partners at some points in time throughout the dialogue, starting with Cherrilyn just after she has uttered *He is allowed to go wherever he wants, do whatever he likes*.

We see the type of Cherrilyn's information state represented in (183). As in the previous analyses in this chapter we will omit several fields of the gameboard and focus on enthymemes, topoi and beliefs. We also keep L-U on the gameboard to make it easier for the reader to keep track of what part of the dialogue we are currently looking at. On L-U in (183) we have the last utterance made, the content of which is also on shared.beliefs. On shared.beliefs we also find the information conveyed in the previous utterance *Most dogs aren't allowed upstairs*. Integrating this utterance in our TTR gameboard requires us to have a way of treating quantified noun phrases in TTR. The analysis chosen here follows Cooper (2013). There are other possible ways of representing quantification in TTR, see for example Ginzburg & Purver (2012). While we do not take a strong stand on this issue here, we do believe that there are interesting ways in which enthymemes and topoi are related to quantification.

(183)
$$\left[\begin{array}{ll}\text{pr:} & \left[\text{topoi}=[\,]:\text{list}(\mathit{Topos})\right] \\ \text{sh:} & \left[\begin{array}{ll}\text{eud}=[]:\text{list}(\mathit{Enthymeme}) & \\ \text{L-U:} & \left[\begin{array}{l}\text{e}:\mathit{Assertion} \\ \text{c}_{\text{actor}}:\text{actor(e,}C\text{)} \\ \text{c}_{\text{addressee}}:\text{addressee(e,}F\text{)} \\ \text{cnt}=\left[\text{e}:\text{allwd\_whtevr}(\text{dog}_{35})\right]:\mathit{RecType}\end{array}\right] \\ \text{beliefs}= & \left[\begin{array}{l}\text{prev:}\left[\begin{array}{l}\text{x}=\text{dog}_{35}:\mathit{Ind} \\ \text{c}_{\text{allowed\_whatever}}:\text{allwd\_whtevr(x)}\end{array}\right] \\ \text{restr}=\text{dog}:\mathit{Ppty} \\ \text{scope}=\text{not\_allwd\_up}:\mathit{Ppty} \\ \text{c}_{\text{most}}:\text{most(restr,scope)}\end{array}\right]:\mathit{RecType} \\ \text{topoi}=[]:\text{list}(\mathit{Topos})\end{array}\right]\end{array}\right]$$

Fiona's information state at this point in time is identical to (183).

Fiona's utterance *Too right! So they should! Shouldn't they?* ends with a tag question. Tag questions could be analysed as a kind of meta-questions regarding the opinion of the dialogue partner. However, in this conversation the function of the question does not seem to be eliciting information, since Cherrilyn has already communicated her view – at least implicitly – when she said that her dog is allowed to do whatever he wants and go whereever he likes (including upstairs). Instead, we suggest that the tag question is a way of showing solidarity between the conversational participants. This is a function described in the literature. For example Fairclough (1992) proposes that positive assertions followed by negative tag questions presuppose that high affinity with the proposition is being shared by the participants in the dialogue. Thus, there is no reason to treat this as a question eliciting information. In her utterance Fiona simply shows affinity and agreement with the proposition that dogs should be allowed upstairs.

Now, Cherrilyn could make infinitely many different utterances in response to Fiona's agreement, but she chooses *Yeah, I mean, dog hairs rise anyway.* There is obviously no way of telling precisely why and based on which assumptions Cherrilyn says this. However, if we consider this dialogue from a rhetorical perspective, we would say that Cherrilyn takes a stand for dogs being allowed to go upstairs, based on her claim about her own dog as well as *Yeah* in the utterance *Yeah, I mean, dog hairs rise anyway.* The continuation of this dialogue implies that Cherrilyn intended her utterance as support for her earlier claim. In (184) we see the enthymematic argument evoked by Cherrilyn's utterance. We refer to this enthymeme as ϵ_1.

(184) $$\epsilon_1 = \lambda r{:}\begin{bmatrix} \text{y}{:}\{Ind\} \\ \text{c}_{\text{doghairs}}{:}\text{doghairs(y)} \\ \text{c}_{\text{rise}}{:}\text{rise(y)} \end{bmatrix}. \begin{bmatrix} \text{x}{:}Ind \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{e-loc:Loc} \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{c}_{\text{be\_allowed}}{:}\text{be\_allowed(x, e-loc)} \end{bmatrix}$$

We assume that Cherrilyn's information state is updated with the enthymeme ϵ_1, which she now considers to be under discussion. If Cherrilyn expects the interaction to be successful, that is, if she expects Fiona to correctly interpret her utterance in relation to the previous discourse, Cherrilyn must assume that a topos or set of topoi underpinning the enthymeme is also accommodated by Fiona. Thus, Cherrilyn's gameboard will be updated with the relevant topos or set of topoi. However, in the case of ϵ_1 we cannot arrive at the underpinning topos simply by removing manifest fields, since

there are none. On the other hand, it seems unintuitive to expect anyone to have a general principle of reasoning as specific as ϵ_1. It seems like the topos in the sense of Ducrot, that is as one link between two utterances, (similar to Relevance Theory's implicit premise) in this case in fact relies on a number of more general topoi drawing on which an agent could arrive at the enthymeme.

We cannot tell whether contextual clues or intonation enables Fiona to accommodate an enthymematic relation between the utterance *Yeah, dog hairs rise anyway* and the previously established and agreed upon notion that dogs should be allowed upstairs. However, Fiona might be able to accommodate an enthymeme but still not make sense of it due to lack of an appropriate topos to underpin the enthymeme. So, let us assume that Fiona interprets Cherrilyn's utterances as expressing an enthymematic argument. Then an enthymeme is pushed onto eud on Fiona's gameboard. She tries to accommodate a topos which would make sense of ϵ_1. Failing to do so, Fiona makes a clarification request which indicates that none of the meanings of *rise* which she is aware of helps her reach a relevant interpretation of the utterance. Fiona's clarification request is an explicit signal that she has not been able to accommodate the topos or set of topoi underpinning the enthymeme.

In her clarification, Cherrilyn does not only elaborate what meaning of *rise* she had in mind, she also adds a sequence to explain the reasoning behing her utterance *dog hairs rise anyway.* The sequence *friends said it was, oh God I wouldn't allow mine upstairs because of all the pause dog hairs* actually points out the topos which Cherrilyn rejects in saying *dog hairs rise anyway.*

So, let us look more closely at the underpinning topoi and the reasoning that would be necessary for arriving at ϵ_1 drawing on these topoi.

The topoi of dog hairs

One topos that everybody seems to agree on here is one saying basically that if a dog with hairs is at a certain place at a certain time, there will be hairs of that dog at that place at a later point in time. We call this topos $\tau_{hairy\_dogs\_shed}$, as represented in (185).

(185) $$\tau_{hairy\_dogs\_shed} = \lambda r{:} \begin{bmatrix} \text{x}{:}Ind \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{y}{:}\{Ind\} \\ \text{c}_{\text{hairs}}{:}\text{hairs(y)} \\ \text{c}_{\text{of}}{:}\text{of(y,x)} \\ \text{e-loc}{:}Loc \\ \text{e-time}{:}Time \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \end{bmatrix}. \begin{bmatrix} \text{z}{:}\{Ind\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,}r\text{.x)} \\ \text{e-time}_1{:}Time \\ \text{c}_{<}{:}r\text{.t<t} \\ \text{c}_{\text{be}_1}{:}\text{be(z,}r\text{.e-loc,e-time)} \end{bmatrix}$$

We may generalise the topos in (185) by removing the field labelled with y in the domain type and all the fields which depend on the y-field, c_{hairs} and c_{of}. There is nothing in the return type that depends on these fields, and therefore a generalisation is possible. The topos we obtain after the generalisation says that if there is a dog upstairs at some point in time there will be hairs there at a later point in time (no matter if the dog is hairy or not). We call this topos τ_{dogs_shed}.

(186) $$\tau_{dogs\_shed} = \lambda r{:} \begin{bmatrix} \text{x}{:}Ind \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{y}{:}\{Ind\} \\ \text{e-loc}{:}Loc \\ \text{e-time}{:}Time \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \end{bmatrix}. \begin{bmatrix} \text{z}{:}\{Ind\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,}r\text{.x)} \\ \text{e-time}_1{:}Time \\ \text{c}_{<}{:}r\text{.t<t} \\ \text{c}_{\text{be}_1}{:}\text{be(z,}r\text{.e-loc,e-time)} \end{bmatrix}$$

This topos could be specified, or restricted, by adding fields to the domain type. We then obtain a topos specifying that τ_{dogs_shed} applies to situations where the location is upstairs, that is if a dog is upstairs at some point in time, there will be doghairs upstairs at a later point in time. Since

upstairs is a subtype of *location*, (187), which we refer to as $\tau_{dogs\_up\_shed\_up}$, is a subtype of (186).

$$(187)\quad \tau_{dogs\_up\_shed\_up} = \lambda r{:}\begin{bmatrix} \text{x}{:}Ind \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{y}{:}\{Ind\} \\ \text{e-loc}{:}Loc \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{e-time}{:}Time \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \end{bmatrix}. \begin{bmatrix} \text{z}{:}\{Ind\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,}r\text{.x)} \\ \text{e-time}_1{:}Time \\ \text{c}_{<}{:}r\text{.t<t} \\ \text{c}_{\text{be}_1}{:}\text{be(z,}r\text{.e-loc,e-time)} \end{bmatrix}$$

Cherrilyn and Fiona would also, presumably, have access to a topos stating that doghairs upstairs are undesirable. We refer to this topos as $\tau_{hairs\_up\_undes}$.

$$(188)\quad \tau_{hairs\_up\_undes} = \lambda r{:}\begin{bmatrix} \text{x}{:}Ind \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{e-loc}{:}Loc \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{z}{:}\{Ind\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,x)} \\ \text{e-time}_1{:}Time \\ \text{c}_{\text{be}_1}{:}\text{be(z,e-loc,e-time}_1\text{)} \end{bmatrix}. \begin{bmatrix} \text{c}_{\text{undesirable}}{:}\text{undesirable}(r) \end{bmatrix}$$

Now, in order to arrive at a topos saying that dogs upstairs are undesirable, $\tau_{dogs\_up\_undes}$, we need to combine the topoi $\tau_{dogs\_up\_hairs\_up}$ and $\tau_{hairs\_up\_undes}$. We do this through *composition* like we did in 73. To obtain a fixed-point type for $\tau_{dogs\_up\_hairs\_up}$ we need to merge the domain type and the result type adjusting the references to r in the dependencies, as in (189). We will refer to this type as $\mathcal{F}(\tau_{dogs\_up\_hairs\_up})$, and we could say it

represents a situation where there is a dog upstairs at some point in time and dog hairs upstairs at a later point in time.

$$(189)\quad \mathcal{F}(\tau_{dogs\_up\_hairs\_up}) = \begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{e-loc}{:}\mathit{Loc} \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{e-time}{:}\mathit{Time} \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \\ \text{z}{:}\{\mathit{Ind}\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,x)} \\ \text{e-time}_1{:}\mathit{Time} \\ \text{c}_{<}{:}\text{t}{<}\text{t} \\ \text{c}_{\text{be}_1}{:}\text{be(z,e-loc,e-time}_1\text{)} \end{bmatrix}$$

Since $\mathcal{F}(\tau_{dogs\_up\_hairs\_up})$ is a subtype of the domain type of $\tau_{hairs\_up\_undes}$, they may be composed. The composition of the topoi $\tau_{dogs\_up\_hairs\_up}$ and $\tau_{hairs\_up\_undes}$, $\tau_{dogs\_up\_hairs\_up} \circ \tau_{hairs\_up\_undes}$ is (190).

$$(190)\quad \text{a. } \lambda r : \mathcal{F}(\tau_{dogs\_up\_hairs\_up}).\left[\text{c}_{\text{undesirable}}{:}\text{undesirable}(r)\right] =$$

$$\lambda r{:}\begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{e-loc}{:}\mathit{Loc} \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{e-time}{:}\mathit{Time} \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \\ \text{z}{:}\{\mathit{Ind}\} \\ \text{c}_{\text{hairs}_1}{:}\text{hairs(z)} \\ \text{c}_{\text{of}_1}{:}\text{of(z,x)} \\ \text{e-time}_1{:}\mathit{Time} \\ \text{c}_{<}{:}\text{t}{<}\text{t} \\ \text{c}_{\text{be}_1}{:}\text{be(z,e-loc,e-time}_1\text{)} \end{bmatrix}.$$
$$\left[\text{c}_{\text{undesirable}}{:}\text{undesirable}(r)\right]$$

Through generalisation, we finally arrive at a topos stating that if a dog is upstairs, that is an undesirable situation:

$$(191)\quad \tau_{dogs\_up\_undes} = \lambda r{:}\begin{bmatrix} \text{x}{:}\mathit{Ind} \\ \text{c}_{\text{dog}}{:}\text{dog(x)} \\ \text{e-loc}{:}\mathit{Loc} \\ \text{c}_{\text{upstairs}}{:}\text{upstairs(e-loc)} \\ \text{e-time}{:}\mathit{Time} \\ \text{c}_{\text{be}}{:}\text{be(x,e-loc,e-time)} \end{bmatrix}. \\ (\left[\text{c}_{\text{undesirable}}{:}\text{undesirable}(r)\right])$$

The topos in (191) seems to be recognized by Cherrilyn and Fiona, in the sense that they are both aware that this is a generally accepted way of reasoning. Also, it serves as underpinning for a second enthymeme in this dialogue – an enthymeme evoked by Cherrilyn's report of her friends' comment *I wouldn't allow mine upstairs because of all the dog hairs!*, which would also be underpinned by a topos like τ_{undes_disal} in (192).

$$(192)\quad \tau_{undes\_disal} = \lambda r{:}\begin{bmatrix} \text{s} & :\mathit{Rec} \\ \text{c}_{\text{undesirable}} & :\text{undesirable(s)} \end{bmatrix} \\ (\text{disallow}(r.\text{s}))$$

Cherrilyn's friend, in order to reason as she does, has not only to accept the topos $\tau_{dogs\_up\_hairs\_up}$, but also a topos that says the opposite – if there are no dogs upstairs, there will be no dog hairs upstairs. In other words, Cherrilyn's friend interprets the implication between dogs up and hairs up as a biconditional. This type of reasoning may be logically faulty, but it has been shown that this is the way most people interpret implication (Stenning & van Lambalgen, 2008). This may be because in many real life situations this is a useful rule. For example, if we do a job we get paid, and if we do not do the job we do not get paid.

However, when Cherrilyn points out that her friend's reasoning – and that of all other dogs-upstairs-disallowers – is not valid, it could be argued that she in fact forces the conversation, or the conversation participants, to accommodate a more logically accurate way of reasoning, or a higher degree of exactness of reasoning.

So, by pointing to the fact that hairs rise, corresponding to the topos $\tau_{hairs\_down\_hairs\_up}$ in (193), Cherrilyn has demonstrated that it is not possible to avoid hairs upstairs by keeping dogs downstairs. Also, we would need a topos saying that if two possible actions lead to the same result, you should choose the action which is preferable in some respect, for example because it takes less effort or because it gives some additional desirable result.

(193) a. if there are doghairs downstairs at some point in time there will be doghairs upstairs at a later point in time

b. λr: $\begin{bmatrix} \text{x}:Ind \\ \text{c}_{\text{dog}}:\text{dog(x)} \\ \text{y}:\{Ind\} \\ \text{c}_{\text{hairs}_1}:\text{hairs(y)} \\ \text{c}_{\text{of}_1}:\text{of(y,x)} \\ \text{e-loc}:Loc \\ \text{c}_{\text{downstairs}}:\text{downstairs(e-loc)} \\ \text{e-time}:Time \\ \text{c}_{\text{be}}:\text{be(y,e-loc,e-time)} \end{bmatrix}$.

$$\begin{bmatrix} \text{z}:\{Ind\} \\ \text{c}_{\text{hairs}_1}:\text{hairs(z)} \\ \text{c}_{\text{of}_1}:\text{of(z,}r\text{.x)} \\ \text{e-loc}_1:Loc \\ \text{c}_{\text{upstairs}}:\text{upstairs(e-loc)} \\ \text{e-time}_1:Time \\ \text{c}_{<}:r\text{.e-time}<\text{e-time}_1 \\ \text{c}_{\text{be}_1}:\text{be(z,e-loc}_1\text{,e-time}_1\text{)} \end{bmatrix}$$

So there is a question of balancing the undesirable consequences of dogs upstairs with the desirable consequences. Cherrilyn's point is that it does not matter which of these takes precedence, since both options – allow dog upstairs or not allow dog upstairs – result in the same situation: hairs upstairs.

However, Fiona questions the topos that dogs should not be allowed upstairs from another angle: She claims that dog hairs are not a serious problem, which renders the discussion of whether hairs get upstairs or not unnecessary. The topos which she is challenging is $\tau_{hairs\_up\_undes}$.

Our analysis of this example elucidates how enthymematic arguments are underpinned by topoi, which must be recognisable in order for the communication to be successful. To obtain a topos that would serve as a linking premise between the premise and the conclusion in the enthymeme $\epsilon_{hairs\_rise\_dogs\_up}$ require many manipulations on topoi, fails to relevantly connect the enthymeme to the topoi to which she has access. Cherrilyn clarifies not only by elaborating on the appropriate interpretation of *rise*, she also points to an enthymeme partly based on competing topoi.

This dialogue is thus an excellent example of the fact that we may reason using topoi that we do not agree with, or which are inconsistent.

5.6 Summary

In this chapter we have looked at various examples of reasoning in natural dialogue which could be accounted for in terms of enthymemes and topoi. First, we considered an example where the rhetorical structure is necessary for making a relevant interpretation. We suggested in chapter 2 that the accommodation of rhetorical structure could depend on relevant topoi in an agent's cognitive resources. In section 5.1 we described this in more detail, and showed that the ability to accommodate an enthymeme drawing on topos has to do with being able to identify the enthymeme as an instantiation of the topos, which means that the domain type of the enthymeme is a subtype of the topos. In section 5.2 we saw an example of how misunderstandings could occur if one dialogue partner accommodates a different topos than the one intended by the speaker. We saw that the room to accommodate alternative topoi is due to the fact that both of the intended topoi, specified to *metal*, are restrictions of the enthymeme that is explicit in the dialogue. Thus, any of them would fit with the dialogue evidence. In section 5.3 We discussed the concept of topoi as rhetorical resources and related it to other work on linguistic resources. We pointed out that such resources are necessary to explain language learning and change. In section 5.4 we considered two examples of non-monotonic reasoning and suggested how they could be accounted for in our theory. A theory using topoi rather than default rules can explain the Tweety example, where the rules are more or less specified, and thus more or less compelling. Moreover, a theory using topoi rather than a monolithic logical system does not have a problem explaining inconsistencies as that in the Nixon Diamond. Finally, we returned to our example about dog hairs from chapter 1. Taking the enthymemes conveyed in the dialogue as our point of departure we analysed some of the reasoning going on. Our analysis shows that the enthymeme prompting a clarification request needed several manipulations of topoi before a topos could be reached that would be specific enough to underpin the enthymeme. This indicates that it is vital in communication to consider the accessibility of the intended topoi in relation to the enthymemes conveyed.

Chapter 6

Conclusions and future work

6.1 Conclusions

In this thesis we have investigated the mechanisms of enthymemes in dialogue. We were interested in how enthymemes relate to different types of inferences, how they contribute to cohesion and also how they interact with the patterns of reasoning that underpin them – topoi. In explicitly rhetorical discourse such as political speeches, enthymemes are often conspicuous. Enthymematic arguments in dialogue, on the other hand, seem to be less recognisable. When interpreting pieces of dialogue like *Let's walk along Walnut Street – it's shorter* we might not even reflect on the rhetorical structure, since the enthymeme conveyed is based on common-place and uncontroversial topoi such as efficiency, correlation between short and fast, etc. In the literature on pragmatic inferences it is often suggested that the rules for making such inferences are general and independent of context. We found that, while we may draw on general principles to make the interpretation that more than the truth-conditional content is being implicated or presupposed, we cannot rely on general principles like Gricean maxims or relevance assumptions to make appropriate interpretations of precisely *what* is presupposed or implicated.

No linguistic or language philosophical theory denies that world knowledge is necessary to actually make pragmatic inferences. However, the organisation of this knowledge and the mechanisms for including it in dialogue models is not well covered in pragmatics. The anti-inferentialist theory of meaning in context does pay more attention to the role of world knowledge than theories like Gricean pragmatics and Relevance Theory. However, Recanati (2004) mainly acknowledges the role of world knowledge in the context

of primary pragmatic processes such as disambiguation and enrichment, not as underpinning for inferences like implicatures. Recanati talks about world knowledge organised as schemas and frames. These can be seen as groups or clusters of connected things, people and events, usually related to a particular activity such as restaurant visit. While we do not want to rule out the use of frames and schemas for modelling dialogue, we suggest that modelling part of world knowledge as topoi could be advantageous. Many topoi would be included in several schemas, and, intuitively, it seems possible that it might sometimes be hard for an agent to identify a particular situation as belonging to a schema or frame, whereas it could be easier to recognise an enthymematic argument as belonging to a topos. With a set of topoi rather than a set of domain-specific schemas, the agent is free to draw on any topos in any domain, specify it, generalise it and combine it with other topoi. It seems to us that this approach would be interesting if we want to model creative agents who can adjust to new situations.

In the context of pragmatic inferences we also connected the phenomenon of accommodation to enthymemes. We described two different cases of accommodation which both contribute to cohesion and sense-making. First, we have the case where the enthymematic structure is explicit. One such example is the piece of discourse used by Grice to illustrate the concept of conventional implicature: *He is an Englishman. He is, therefore, brave.* Here we are explicitly told that the reason for the referent of *he* being brave is his being an Englishman. Thus we may accommodate a topos linking Englishmen and courage, without which the discourse would not make sense. When we have an explicit enthymeme or when the rhetorical structure of a discourse is apparent enough for other reasons, we may not only accommodate topoi we already acknowledge, but also accommodate new topoi. We claim that this kind of accommodation may contribute to learning, in that an agent accommodates new topoi which he may tentatively add to his cognitive resources. The second type of accommodation we suggest is accommodation of enthymemes based on topoi. The type of situation we are interested in here is where an agent is able to infer an enthymematic structure between two utterances based on topoi that are easily associated with the discourse. This kind of accommodation contributes to cohesion in dialogue since it helps create a relation between two discourse units.

The idea of inferring rhetorical relations based on world knowledge is rejected by Asher and Lascarides since many rhetorical relations in dialogue and other discourse cannot be based on default rules. We suggest that this problem is avoided in a theory using topoi as resources for non-monotonic reasoning. As opposed to default rules, topoi do not have to be hierarchical.

This means that a topos which does not correspond to what is usually the case may be used to underpin an argument even if none of the exceptions hold. Moreover, since a system of topoi is not a monolithic logical system, it may include inconsistent topoi and topoi leading to inconsistent conclusions.

We have presented a suggestion for how to model a short enthymematic dialogue like the Walnut Street example in (98). The formalisation process has lead to many insights, not least on the nature of enthymemes and topoi and the relation between them.

The view of topoi represented by Ducrot and that represented by Aristotle differ in many ways. For Ducrot the topos is the necessary link between two utterances, not unlike an implicated premise in Relevance Theory. That is, for Ducrot a topos may be highly specified and instantiated. The topos in Aristotelian rhetoric on the other hand, is an abstract idea upon which many different types of arguments may be founded. We argue that language users are helped by topoi which are as recognisable as possible in relation to the discourse, while still being general enough to already be part of the agent's resources. Thus topoi tend not to be *instantiated*, viz. they apply to more than one individual of a certain type. However, it is possible that instantiated principles of reasoning becomes part of our cognitive resources, if they concern individuals and events that are central enough to us. This all comes down to that the essential difference between enthymemes and topoi is that enthymemes are conveyed in the discourse while topoi are either part of our cognitive resources or possible to derive from our cognitive resources.

In our formalisation we treat enthymeme and topos as the same type of formal object. This means that we have a way of moving seamlessly between them, which is necessary to explain how we expand our resources by first tentatively, then permanently, integrating enthymematic inferences from discourse. Such mechanism would also explain how we can obtain new topoi by combining, generalising and restricting topoi which are already established in our resources.

We pointed out a connection between enthymemes and informationally redundant utterances (IRUs), which have been shown to contribute to limiting the cognitive load of dialogue participants. We argue that IRUs and their antecedents evoke enthymemes drawing on situation relevant topoi. The fact that suggestions, proposals or claims are presented with a supporting premise minimises the cognitive load, since the addressee has to make fewer inferences. However, he would still not be overloaded with all the evident premises of strictly logical reasoning.

Finally, our account of enthymemes in dialogue shows that a micro-rhetorical perspective may serve to combine different strands of linguistic

research which each contribute with important perspectives on how language works. Like Conversation Analysis, a rhetorical perspective acknowledges the point of view of the individual agent, and pays attention to perlocutionary effect. On the other hand, a micro-rhetorical take on linguistic interaction that includes enthymemes and topoi allows us to talk about many of the things that goes on in dialogue in formal terms. Thus we may also relate our account to formal pragmatics and semantics.

6.2 Future work

The hypothesis that enthymematic arguments based on relevant topoi may contribute to lower the cognitive load of dialogue participants could be applied to dialogue systems operating in safety critical environments, for example in vehicles. The conclusions in this thesis indicates that information presented as enthymemes would be helpful not only when the system adds new information, such as motivating a driving instruction with previously unknown facts about the traffic situation, but also in situations where the contribution serves a rhetorical rather than an informational purpose. The system's pointing to a topos relevant to the situation may make it easier for the driver to decide whether or not to accept the instruction.

A way of pursuing our hypotheses about enthymemes and cognitive load would be to set up an experiment where drivers are given instructions either in the form of enthymematic arguments underpinned by a relevant topoi, in the form of instructions without a supporting premise, and as enthymematic arguments that do not have obvious connections to relevant topoi, while their cognitive load is measured continuously. An experiment like this would not only test our hypothesis regarding the connection between cognitive load and rhetorical structure, but would potentially give us some information about which topoi are considered relevant in particular situations and which are not.

When we model a dialogue based on already existing data, we know which enthymemes are conveyed in the discourse and we may formulate topoi which would result in the observed dialogue behaviour. However, if we were to model artificial agents capable of interpreting, producing and reacting to new dialogue contributions, other issues arise. One such issue is how an agent chooses between available topoi. A way of doing this would be to develop our model and introduce a probabilistic component. An interesting possibility would be to combine the micro-rhetorical approach presented here with the probabilistic type theory introduced in Cooper et al. (2014).

Appendix A

Update Rules

- *Update private games*: If an agent has a project on her gameboard, and no games, search resources for relevant game and push it onto private games".

- *Update private topoi & beliefs*: If an agent has a game on the gameboard in which she is supposed to make the next move, but no item on the agenda, search resources for relevant topoi and other relevant information and push them onto private topoi and private beliefs.

- *Update agenda* : If the agenda is empty and a player has a game on *private:games* in which he is to make the next move, and there is sufficient information on the gameboard to formulate an utterance, then push an utterance of the same type as is specified in *games* onto the gameboard.

- *Make move* If there is a move type on an agent's agenda, the agent can realise that move by uttering the string specified on the agenda.

- *Update L-U*: When an utterance has been made by self, the move is popped off the agenda and pushed onto L-U. The game on private games is popped off and pushed onto *shared:games*.

- *Update L-U*: When an utterance has been made by other, the move is pushed onto L-U and the current game is pushed onto *shared:games* and adjusted to the stage of the conversation.

- *Update qud*: If there is a suggestion- request- or question move on *L-U*, a corresponding question may be pushed onto *qud*.

- *Update agenda*/: If there is a game on shared games where agent a is to make the next move, and there is relevant information on private topoi and beliefs, a move of the type indicated in the game may be pushed onto the agenda of a's gameboard.

- *Downdate qud/update shared beliefs*: If there is a question on qud and a move on L-U which resolves the question on *qud*, the question is popped off *qud*, and *shared beliefs* is updated accordingly.

- *Downdate games*: If there is a game anywhere on the gameboard that has reached its final stage, the game is popped off the gameboard.

- *Downdate project*: If there is a shared belief on the gamebord that the project has been carried out, the project may be downdated.

- *Update beliefs*: If there is a statement on *L-U*, for example a motivation, explanation or justification, a corresponding shared belief is integrated.

- *Downdate private beliefs*: If there is a belief on *private beliefs* which is also represented on *shared beliefs* , the belief on *private beliefs* is popped off.

Appendix B

TTR-update rules

- Update of Private games (102)
- Game specific update rules
- Update agenda$_{sg}$ (108)
- Update latest utterance$_{sug.}$ (123)
- Update private topoi and beliefs (118)
- Specify content of agenda (120)
- Update qud (125)
- Update L-U′ (126)
- Update shared games (127)
- Update agenda′$_{sugg}$ (129)
- Update latest utterance$_{mot}$ (131)
- Update shared beliefs (132)
- Update eud (135)
- Update shared topoi (136),(137)
- Accommodate topos′ (139)
- Accommodate eud (140)
- Learn topos(142)

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Enthymemes in Dialogue

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