

Enthymemes as Rhetorical Resources

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Abstract

In this paper we propose that Aristotelian enthymemes play a role in the resources available to dialogue participants. We take as our point of departure the idea that every individual has a set of linguistic resources that are formed and reformed through interaction with other individuals and context.

We regard enthymemes as dependent record types, functions which map contexts modelled as records, corresponding to the premises of the enthymeme, to a record type which models a proposition corresponding to the conclusion of the enthymeme. The advantage of using record types is that they give us semantic objects corresponding to enthymemes (as opposed to textual objects such as inference rules) and a straightforward way of generalizing, restricting and combining enthymemes thereby giving a theory of how agents can expand and reform their rhetorical resources on the basis of experience.

1 Introduction

Consider the interpretation of *rise* in (1):

- (1) Cherrilyn: Yeah I mean ⟨pause⟩ dog
 hairs rise anyway so
 Fiona: What do you mean, rise?
 Cherrilyn: The hair ⟨pause⟩ it rises up-
 stairs.

BNC file KBL, sentences 4201–4203

Cooper (fthc) discusses the exchange in (1), making the point that without Fiona’s clarification re-

quest and the consequent clarification by Cherrilyn, we would be unlikely to get at the appropriate meaning of *rise*. We agree with this, but would like to add that even though “upstairs” in the clarification ensures that the utterance of “rise” in question denotes a directional motion rather than an increase of an angle in relation to some landmark, in this case the body of a dog, we still do not fully understand the meaning of Cherrilyn’s initial utterance. If we consider a larger excerpt from the same dialogue as in (2), we get a better idea of what is really going on.

We argue that one aspect of understanding an exchange such as (2) is to understand the argumentation involved, which includes not only a knowledge of basic argument forms, but also an understanding of what notions are acceptable as bases for arguments in a particular context. We suggest a theory of *enthymemes*, inspired by Aristotle’s *Rhetoric* and previously discussed in Breitholtz and Villing (2008), Breitholtz (2010). We argue that, in a game-board or information state update approach to dialogue (Ginzburg, 1994; Cooper et al., 2000; Larsson, 2002; Ginzburg, fthc), rhetorical arguments point to a notion of *Enthymemes under Discussion* (EUD), similar to Questions under Discussion (QUD). A theory of enthymemes as rhetorical resources focuses on the interplay between argumentative structure and the *rhetorical resources* that an agent utilises when engaged in dialogue. Such an argumentative structure can be relevant over many turns in a dialogue and may be available in the background during the course of a whole dialogue. In this respect our proposal differs from theories of rhetorical relations as presented for example in SDRT

- (2) Cherrilyn: Most dogs aren't allowed up
 <pause> upstairs.
 He's allowed to go wherever
 he wants <pause> do what-
 ever 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 up-
 stairs.
 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

(Asher and Lascarides, 2003) where the focus is on pairwise relations between utterances such as contrast, elaboration and narration.

In this paper we first give an account of enthymemes and their role in argumentative structure (section 2). We then (section 3) give an account of how enthymemes figure in rhetorical resources employed in a dialogue. In section 4 we apply the theory we have developed to example (2). Finally (section 5), we draw some conclusions.

2 Dialogue and Argumentative Structure

Despite being central in rhetoric and argumentation analysis, enthymemes have been little studied within linguistics. However, enthymemes are frequently relevant for the type of data studied by linguists. For some examples of this, and a general discussion of enthymemes in dialogue, see Jackson and Jacobs (1980), Breitholtz and Villing (2008). The general definition of an enthymeme as it occurs in Aristotle's

Rhetoric is that it is a deductive argument that has the form of a syllogism, but is not logical since it is often based on what is accepted or likely rather than what is logically valid, and not all premises that are needed to form a logical argument are expressed. The argument patterns that enthymemes are derived from are referred to as *topoi* (sg. *topos*). For example, in (3)

- (3) a. A person who had beaten his father,
 has also beaten his neighbour
 (*Rhetoric*, II.23.4)

the *topos* is that of “the more and the less”, which is basically a notion about scalarity, that in this case would correspond to the, slightly more specific, argument that if something is the case in a situation when it should be less expected, then it is probably the case in a situation where it should be more expected. However, in order to derive a premise that would actually make (3) true, we need several other - even more specific - inference rules. It is not clear how we should distinguish between these and the *topoi* at the top of the hierarchy of inference rules, and there are various interpretations of Aristotle's texts. A very useful discussion is given in Rapp (2010). We use the term ‘enthymeme’ rather than the more general ‘argument’ since the term has been widely employed in rhetoric building on Aristotle's original ideas and we wish to emphasize the importance of rhetorical notions in the kind of dialogue analysis we are interested in. Also we feel that Aristotle's views on rhetoric have a contribution to make to the semantic and pragmatic analysis of dialogue and that this has so far been underexploited in the semantic literature, in contrast, for example, to Aristotle's ideas relating to aspectual classes. However, our proposal is not meant as an exegesis of Aristotle's text but rather a modern theory inspired by Aristotle's ideas, and since enthymemes and *topoi* can be modelled by the same type of semantic objects, we will not attempt to make any precise distinction between the two, but refer to the more specified rules of inference as enthymemes and the more general ones as *topoi*.

We model enthymemes and *topoi* using TTR (type theory with records) (Cooper, 2005a; Cooper, 2005b; Cooper, fthc; Ginzburg, fthc) which exploits a large literature on record types from the

computer science literature (Tasistro, 1997; Betarte, 1998; Betarte and Tasistro, 1998; Coquand et al., 2004, among many other references). We will represent both enthymemes and topoi as functions from records to record types. These can be regarded as *dependent record types*, that is, objects which when provided with an object of a certain type will return a record type. A record is a set of fields which are in turn a pair of a label (or attribute) and a value. Thus a field in a record is like an attribute-value pair in a feature structure. Like feature structures, records are required to have only one field with a given label. Record *types* are like records except that where records have values in their fields, record types have types – the type to which the value should belong. A record, r , is of a given record type, T , just in case for every field in T , there is a corresponding field with the same label in r and the object in the corresponding field in r is of the type specified in the corresponding field in T . Note that r may in addition contain other fields with labels not occurring in T and will still be of type T . We will thus consider functions of the form in (4)

$$(4) \quad \lambda r: T_1(T_2[r])$$

where T_1 and $T_2[r]$ (given some value for r) are record types. Here we are using a more or less standard λ -notation for functions where $\lambda x: T(A)$ represents a function that for any object x of type T will return A . The exact nature of A will normally depend on which x the function was applied to and this fact is represented by the notation $A[x]$. In the definition of particular functions this notation is normally not necessary since ‘ x ’ will occur within the representation of A , as we will see in the examples immediately below. The intuitive idea is that when we observe a situation, represented as a record r of type T_1 , we can draw the conclusion that there is a situation of type $T_2[r]$. The function just returns a type but does not tell us what situation is of this type. The type T_1 thus corresponds to the premises of the enthymeme/topos and $T_2[r]$ to the conclusion. (5) is a simple example of an enthymeme from Aristotle (2007).

- (5) a. [he] is sick, for he has a fever
(*Rhetoric*, I.2.18)

$$b. \lambda r: \left[\begin{array}{l} x: Ind \\ c_{has_fever}: has_fever(x) \end{array} \right] \\ ([c_{sick}: sick(r.x)])$$

Here we are using record types that use types of situations constructed with predicates such as ‘has_fever’ and ‘sick’. If a is an individual then $has_fever(a)$ is the type of situation where a has fever. Similarly $sick(a)$ is the type of situation where a is sick. Note that what is used in (5b) are dependent versions of these types. That is, exactly which situation type you get in the field labelled c_{has_fever} in the type characterizing the domain of the function depends on the object which occurs in the x -field of r . The same is true for the field labelled c_{sick} in the body of the function. In the former the dependence is represented by ‘ x ’ referring to the x -field in the type to which r belongs. In the latter the dependence is external to the record type returned by the function and thus we have to be explicit in referring to the x -field of r using the standard notation $r.x$ to refer to the object in the x -field of r .

(5) is an example of what Aristotle (in Kennedy’s translation) calls an “irrefutable sign” since anybody who has a fever is indeed sick. In modern terms we would say that this corresponds to a non-defeasible inference. However, enthymemes can also be “refutable” which we might regard as corresponding to a defeasible inference. An example of this is given in (6).

- (6) a. it is a sign of fever that somebody
breathes rapidly
(*Rhetoric*, I.2.18)

$$b. \lambda r: \left[\begin{array}{l} x: Ind \\ c_{breathe_rapidly}: breathe_rapidly(x) \end{array} \right] \\ ([c_{has_fever}: has_fever(r.x)])$$

This means that if you observe somebody breathing rapidly, it might be the case that you draw the conclusion that they have fever. However, if you do this you might be wrong. Aristotle thus recognizes the importance of defeasible inference in human reasoning.

An advantage of modelling enthymemes as functions is that the functions are semantic objects which

can be manipulated in the theory of resources which we sketch below. An alternative is to consider enthymemes to be rules of inference in a logical representation, that is, textual objects. But that would mean that we have to include such textual objects in our semantic domain. It might also mean that we have to deal with the exact nature of a defeasible logic. However, Aristotle seems to us to be suggesting that the rhetorical use of enthymemes is not linked to a single logic, in contrast to syllogisms. Rather they represent rhetorical strategies which people use in order to convince others of certain propositions. Our functions represent an association of two types rather than a logical rule of inference and thus they do not commit us to rationality or consistency, which seems to us appropriate for the kind of reasoning that humans engage in. This is not to say that rationality and consistency are not desirable constraints. But we would like to be able to model agents who do not live up to such constraints. The fact that our functions associate one type with another also makes them similar in an important respect to the model of associative reasoning in Shastri (1999), where inference corresponds to a transient propagation of rhythmic activity over cell-clusters that represent relational knowledge such as frames and schemas.

An advantage of using record types to model enthymemes is that this gives us straightforward ways to manipulate them, creating new enthymemes from old ones. This will become important in the theory of resources we describe below. For example, we may wish to specify (6b) so that it applies to only one individual Socrates. This we can do by employing TTR's manifest fields (Coquand et al., 2004) as in (7).

$$(7) \quad \lambda r: \left[\begin{array}{l} x=\text{socrates:Ind} \\ c_{\text{breathe_rapidly}}:\text{breathe_rapidly}(x) \end{array} \right] \\ \quad \quad \quad ([c_{\text{has_fever}}:\text{has_fever}(r.x)])$$

The manifest field $[x=\text{socrates:Ind}]$ requires the object in the x-field not only to be of type *Ind* but in addition to be identical with the particular object 'socrates' of that type. In our discussion of resources below we will characterize other operations which can be performed on enthymemes.

In dialogue it is not unusual that we not only want

to convince others that certain propositions are true, but we also want to persuade them to act in certain ways. To be able to include this type of enthymeme in our resources we need to introduce an "action enthymeme", in which the conclusion is an exhortation to act in a certain way. (8) is an Aristotelian example of this kind of enthymeme.

- (8) a. As a mortal, do not cherish immortal anger

(*Rhetoric*, II.21.6)

$$b. \quad \lambda r: \left[\begin{array}{l} x:\text{Ind} \\ c_{\text{mortal}}:\text{mortal}(x) \end{array} \right] \\ (! \text{ do_not_cherish_immortal_anger}(r.x))$$

The notation ' $! \text{ do_not_cherish_immortal_anger}(r.x)$ ' in (8) is an informal notation representing an imperative. We do not commit ourselves to any particular analysis of imperatives in this paper.

3 Rhetorical Resources in Dialogue

We propose to add rhetorical resources in the form of collections of enthymemes to the kind of resources discussed in Larsson (2007), Cooper and Ranta (2008), Larsson and Cooper (2009), Cooper and Larsson (2009), Cooper (fthc). 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. Resources will include traditional "linguistic components" such as grammar, lexicon and semantics. An important part of the theory we are developing is that these resources are dynamic in that they 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). Our need to coordinate language with our interlocutors is, we believe, paramount in driving language acquisition. However, it persists into the mature language as well. In particular the ability to coordinate meaning in dialogue and handle innovative utterances is always important for dialogic interaction. 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 partners 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.

If enthymemes are to be included as rhetorical resources, then it becomes important for us to be able to relate enthymemes to each other and have well-defined operations for creating new enthymemes on the basis of old. We propose three operations on enthymemes that can be used for this:

- generalization
- restriction (or specification)
- composition

These are variants of common operations on functions which are employed in formal systems. *Generalization* has to do with making a function more generally applicable. For example, if a function applies to dogs which have hairs, then we can generalize that function to one that applies to dogs in general. *Restriction* is the opposite, that is, making a function less generally applicable. For example, if we have a function which applies to dogs in general we can restrict it to be a function which applies only to dogs which are upstairs. *Composition* has to do with combining two functions into one, that is, if we have a function from A to B and another function from B to C , then we can compose the two functions into a single function from A to C . For example, if we have a function which maps from situations where there is a dog upstairs to a type of situation where there are dog hairs upstairs and another function which maps from a situation where there are dog hairs upstairs to a type of situation where this is undesirable we can compose this to a function which maps from situations where there is a dog upstairs to a type of situation where this is undesirable.¹

¹This example is not exactly an example of standard function composition as should become clear below.

In the discussion below we show how these notions interact in an interesting way with the notion of record type. For example, generalization can be achieved by removing a field from a record type and restriction by adding a field. Notice that these operations on enthymemes need not be logically justified. For example, just because something holds for dogs with hairs does not mean that it will hold for dogs in general. It is an important point about rhetorical manipulations that, even though they can be made formally precise, they are not in general based on valid logical inference.²

We start with an enthymeme about dog hairs which is relevant to the domain of the dialogue in (2). This is given in (9). Intuitively this function

- (9) a. “If a dog with hairs is at a particular location at a certain time, then there will be a subsequent time at which hairs from that dog will be at that location.”
i.e. “Dogs with hairs shed”

$$\text{b. } \lambda r: \left[\begin{array}{l} x:Ind \\ c_{dog}:dog(x) \\ y:\{Ind\} \\ c_{hairs}:hairs(y) \\ c_{of}:of(y,x) \\ e-loc:Loc \\ e-time:Time \\ c_{be}:be(x,e-loc,e-time) \end{array} \right] \left(\left[\begin{array}{l} z:\{Ind\} \\ c_{hairs_1}:hairs(z) \\ c_{of_1}:of(z,r.x) \\ e-time_1:Time \\ c_{<}:r.t < t \\ c_{be_1}:be(z,r.e-loc,e-time) \end{array} \right] \right)$$

maps from a situation in which there is a dog and a set of hairs (the notation $\{Ind\}$ represents the type of sets of individuals) which are “of” the dog and the dog is present at a given location and time to a type of situations where there is a set of hairs of the dog at a later time at the same location.

²The fact that something can be made formally precise does not, of course, entail that it is morally desirable. As linguists, we are trying to build a theory of behavioural phenomena rather than prescribe proper behaviour.

Generalization. Notice that the type that (9b) returns (the “conclusion”) does not depend on the field labelled with ‘y’ in the domain type (the “premises”). Thus we can consider generalizing this enthymeme by removing the ‘y’-field from the domain type. We cannot simply do this, however, since there are other fields in the domain type which depend on the ‘y’-field, namely those labelled c_{hairs} and c_{of} . If we are to remove the ‘y’-field then we must also remove these two fields if we are to obtain a well-typed function. There is nothing in the returned type that depends on these fields either. Therefore, (10) is a generalization of (9). This says

$$(10) \quad \lambda r: \left[\begin{array}{l} x:Ind \\ c_{\text{dog}}:\text{dog}(x) \\ e\text{-loc}:Loc \\ e\text{-time}:Time \\ c_{\text{be}}:\text{be}(x,e\text{-loc},e\text{-time}) \end{array} \right] \left(\left[\begin{array}{l} z:\{Ind\} \\ c_{\text{hairs}_1}:\text{hairs}(z) \\ c_{\text{of}_1}:\text{of}(z,r.x) \\ e\text{-time}_1:Time \\ c_{<}:r.t < t \\ c_{\text{be}_1}:\text{be}(z,r.e\text{-loc},e\text{-time}) \end{array} \right] \right)$$

that if a dog is at a certain place at a certain time there will be dog hairs at that place at a later time. Note that this generalization is not by any means the result of a logical operation, that is, (10) does not in any way follow from the previous enthymeme.

Restriction. Restriction (or specification) can involve adding a field to the domain type. In (11) we add the information that the location is upstairs. Thus (11) says that if a dog is upstairs there will be dog hairs upstairs.

Composition. In order to talk about composition of two enthymemes we first need to talk about fixed-point types for enthymemes. If ε_1 is the enthymeme in (11), then a fixed-point type for ε_1 is a type T such that $a : T$ implies $a : \varepsilon_1(a)$. Such a type can be obtained by merging the domain type and the result type, adjusting the references to r in the dependencies, as in (12).

$$(11) \quad \lambda r: \left[\begin{array}{l} x:Ind \\ c_{\text{dog}}:\text{dog}(x) \\ e\text{-loc}:Loc \\ c_{\text{upstairs}}:\text{upstairs}(e\text{-loc}) \\ e\text{-time}:Time \\ c_{\text{be}}:\text{be}(x,e\text{-loc},e\text{-time}) \end{array} \right] \left(\left[\begin{array}{l} z:\{Ind\} \\ c_{\text{hairs}_1}:\text{hairs}(z) \\ c_{\text{of}_1}:\text{of}(z,r.x) \\ e\text{-time}_1:Time \\ c_{<}:r.e\text{-time} < e\text{-time}_1 \\ c_{\text{be}_1}:\text{be}(z,r.e\text{-loc},e\text{-time}_1) \end{array} \right] \right)$$

$$(12) \quad \left[\begin{array}{l} x:Ind \\ c_{\text{dog}}:\text{dog}(x) \\ e\text{-loc}:Loc \\ c_{\text{upstairs}}:\text{upstairs}(e\text{-loc}) \\ e\text{-time}:Time \\ c_{\text{be}}:\text{be}(x,e\text{-loc},e\text{-time}) \\ z:\{Ind\} \\ c_{\text{hairs}_1}:\text{hairs}(z) \\ c_{\text{of}_1}:\text{of}(z,x) \\ e\text{-time}_1:Time \\ c_{<}:t < t \\ c_{\text{be}_1}:\text{be}(z,e\text{-loc},e\text{-time}_1) \end{array} \right]$$

We will refer to this type as $\mathcal{F}(\varepsilon_1)$.

Now consider the enthymeme in (13): “dog hairs upstairs is an undesirable situation”.

$$(13) \quad \lambda r: \left[\begin{array}{l} x:Ind \\ c_{\text{dog}}:\text{dog}(x) \\ e\text{-loc}:Loc \\ c_{\text{upstairs}}:\text{upstairs}(e\text{-loc}) \\ z:\{Ind\} \\ c_{\text{hairs}_1}:\text{hairs}(z) \\ c_{\text{of}_1}:\text{of}(z,x) \\ e\text{-time}_1:Time \\ c_{\text{be}_1}:\text{be}(z,e\text{-loc},e\text{-time}_1) \end{array} \right] ([c_{\text{undesirable}}:\text{undesirable}(r)])$$

Call (13) ε_2 . Note that $\mathcal{F}(\varepsilon_1)$ is a subtype of the domain type of ε_2 . This is a condition which must be fulfilled in order to be able to compose ε_1 with ε_2 . The composition of ε_1 and ε_2 , $\varepsilon_1 \circ \varepsilon_2$, is (14).

$$(14) \quad \lambda r : \mathcal{F}(\varepsilon_1)([c_{\text{undesirable}}:\text{undesirable}(r)])$$

From this, by generalization, we can obtain a useful enthymeme: “Dogs upstairs is an undesirable situation” given in (15).

$$(15) \quad \lambda r: \left[\begin{array}{l} x:Ind \\ c_{dog}:dog(x) \\ e-loc:Loc \\ c_{upstairs}:upstairs(e-loc) \\ e-time:Time \\ c_{be}:be(x,e-loc,e-time) \end{array} \right] \\ ([c_{undesirable}:undesirable(r)])$$

4 The Dog Hairs Dialogue

Let us now revisit the excerpt in (2) and look at what happens in terms of enthymemes and the operations on enthymemes described in section 3. We are not of course claiming that we can determine the exact resources that any particular dialogue participant would have at their disposal when taking part in this dialogue. Rather we set ourselves the task of describing what enthymemes could be used by an agent in order to take part in this dialogue. 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 enthymemes which could achieve the same result. What is important is to show that our theory enables us to formulate at least one of these in order to get the desired dialogue behaviour.

The dialogue in (2) is essentially about whether dogs should be allowed everywhere in the house, more specifically - upstairs. Cherrilyn claims that most dogs are not allowed upstairs, alluding to the enthymeme in (15)- “dogs upstairs is an undesirable situation”. She then continues by saying that *her* dog is allowed to go wherever he wants, thus challenging (15). However, she still seems to accept the enthymeme in (13) “dog hairs upstairs are undesirable”. Cherrilyn supports the decision to allow her dog upstairs with the assertion that “dog hairs rise” or, after Fiona’s clarification request that they “rise upstairs”. This seems to be referring to an enthymeme something like (16).

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

$$b. \lambda r: \left[\begin{array}{l} x:Ind \\ c_{dog}:dog(x) \\ y:\{Ind\} \\ c_{hairs_1}:hairs(y) \\ c_{of_1}:of(y,x) \\ e-loc:Loc \\ c_{downstairs}:downstairs(e-loc) \\ e-time:Time \\ c_{be}:be(y,e-loc,e-time) \end{array} \right] \\ \left(\left[\begin{array}{l} z:\{Ind\} \\ c_{hairs_1}:hairs(z) \\ c_{of_1}:of(z,r.x) \\ e-loc_1:Loc \\ c_{upstairs}:upstairs(e-loc) \\ e-time_1:Time \\ c_{<}:r.e-time < e-time_1 \\ c_{be_1}:be(z,e-loc_1,e-time_1) \end{array} \right] \right)$$

We also need new enthymemes linking what should be allowed to what is desirable or undesirable.

$$(17) \quad a. \lambda r: \left[\begin{array}{l} s:Rec \\ c_{desirable}:desirable(s) \\ (!allow(r.s)) \end{array} \right] \\ b. \lambda r: \left[\begin{array}{l} s:Rec \\ c_{undesirable}:undesirable(s) \\ (!disallow(r.s)) \end{array} \right]$$

We would like to compose (15) with (17b). For technical reasons having to do with the predication of the complete record r rather than a field in r we cannot form a fixed point type from (15) but need to work with the variant (18).

$$(18) \quad \lambda r: s: \left[\begin{array}{l} x:Ind \\ c_{dog}:dog(x) \\ e-loc:Loc \\ c_{upstairs}:upstairs(e-loc) \\ e-time:Time \\ c_{be}:be(x,e-loc,e-time) \end{array} \right] \\ ([c_{undesirable}:undesirable(r.s)])$$

From (18) and (17b) we can obtain (19) by composition and generalization.

$$(19) \quad \lambda r: \left[s: \begin{array}{l} x:Ind \\ c_{dog}:dog(x) \\ e-loc:Loc \\ c_{upstairs}:upstairs(e-loc) \\ e-time:Time \\ c_{be}:be(x,e-loc,e-time) \\ (!disallow(r.s)) \end{array} \right]$$

The enthymeme (19) is central to the discussion in (2). There is also in the background a similar enthymeme with the conclusion that dogs should be allowed upstairs on the basis of this being a desirable situation. Perhaps if you allow dogs upstairs you do not need to discipline your dog to make it stay downstairs, or you like your dog and want to maximise the time you spend with it.

Given that “dog hairs rise”, i.e. (16), there will be dog hairs upstairs whether you allow your dog upstairs or not. To interpret Cherrilyn’s utterance about dog hairs we need to assume that if two different actions lead to the same, undesirable situation, and you have to choose between the two, you should, if possible, choose one that also has some desirable consequence. 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 enthymeme 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. Here she is challenging the enthymeme (13).

5 Conclusion

It has been suggested by Breitholtz and Villing (2008) and Breitholtz (2010) that Aristotelian enthymemes contribute to coherence and help the processing of spoken dialogue. In this paper we have suggested how enthymemes can be used to represent the rhetorical resources that an agent needs to draw common sense inferences and assign rhetorical relations between utterances. The idea that rhetorical resources include associations between types that are established and reinforced over time in an

agent’s resources seems to resemble the work of Shastri (1999) and colleagues on neural computation of reflexive reasoning and relational information processing. This suggests to us that future work might explore the idea that enthymematic rhetorical resources could be neurally plausible.

The idea of rhetorical resources also ties in with work on other types of linguistic resources which have been represented in TTR. The fact that we can represent resources for syntax as well as semantics and rhetorical resources in one framework is theoretically appealing as well as an advantage in the context of dialogue modelling. It also means that if we can find a neurological representation for our types we will have found neurological representations in all of these domains.

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References

- Aristotle. 2007. *On Rhetoric: a Theory of Civic Discourse*. Oxford University Press, second edition. Translated with Introduction, Notes, and Appendices by George A. Kennedy.
- Nicholas Asher and Alex Lascarides. 2003. *Logics of Conversation*. Cambridge University Press.
- Gustavo Betarte and Alvaro Tasistro. 1998. Extension of Martin-Löf’s type theory with record types and subtyping. In Giovanni Sambin and Jan Smith, editors, *Twenty-Five Years of Constructive Type Theory*, number 36 in Oxford Logic Guides. Oxford University Press, Oxford.
- Gustavo Betarte. 1998. *Dependent Record Types and Algebraic Structures in Type Theory*. Ph.D. thesis, Department of Computing Science, University of Gothenburg and Chalmers University of Technology.
- Ellen Breitholtz and Jessica Villing. 2008. Can aristotelian enthymemes decrease the cognitive load of a dialogue system user? In *Proceedings of LonDial 2008, the 12th SEMDIAL workshop*, June.
- Ellen Breitholtz. 2010. Clarification requests as enthymeme elicitors. In *Aspects of Semantics and Pragmatics of Dialogue. SemDial 2010, 14th Workshop on the Semantics and Pragmatics of Dialogue* .
- Robin Cooper and Staffan Larsson. 2009. Compositional and ontological semantics in learning from

- corrective feedback and explicit definition. In Jens Edlund, Joakim Gustafson, Anna Hjalmarsson, and Gabriel Skantze, editors, *Proceedings of DiaHolmia: 2009 Workshop on the Semantics and Pragmatics of Dialogue*, pages 59–66. Department of Speech, Music and Hearing, KTH.
- Robin Cooper and Aarne Ranta. 2008. Natural Languages as Collections of Resources. In Robin Cooper and Ruth Kempson, editors, *Language in Flux: Dialogue Coordination, Language Variation, Change and Evolution*, volume 1 of *Communication, Mind and Language*, pages 109–120. College Publications, London.
- Robin Cooper, Elisabet Engdahl, Staffan Larsson, and Stina Ericsson. 2000. Accommodating questions and the nature of QUD. In Poesio and Traum, editors, *Proceedings of GötaLog*, pages 57–62.
- Robin Cooper. 2005a. Austinian truth, attitudes and type theory. *Research on Language and Computation*, 3:333–362.
- Robin Cooper. 2005b. Records and record types in semantic theory. *Journal of Logic and Computation*, 15(2):99–112.
- Robin Cooper. fthc. Type theory and semantics in flux. In Ruth Kempson, Nicholas Asher, and Tim Fernando, editors, *Handbook of the Philosophy of Science*, volume 14: Philosophy of Linguistics. Elsevier BV. General editors: Dov M. Gabbay, Paul Thagard and John Woods.
- Thierry Coquand, Randy Pollack, and Makoto Takeyama. 2004. A logical framework with dependently typed records. *Fundamenta Informaticae*, XX:1–22.
- Jonathan Ginzburg. 1994. An update semantics for dialogue. In Harry Bunt, editor, *Proceedings of the 1st International Workshop on Computational Semantics*, Tilburg University. ITK Tilburg.
- Jonathan Ginzburg. fthc. *The Interactive Stance: Meaning for Conversation*. Oxford University Press, Oxford.
- Sally Jackson and Scott Jacobs. 1980. Structure of conversational argument: Pragmatic bases for the enthymeme. *Quarterly Journal of Speech*, 66:251–265.
- Staffan Larsson and Robin Cooper. 2009. Towards a formal view of corrective feedback. In Afra Alishahi, Thierry Poibeau, and Aline Villavicencio, editors, *Proceedings of the Workshop on Cognitive Aspects of Computational Language Acquisition*, pages 1–9. EACL.
- Staffan Larsson. 2002. *Issue-based Dialogue Management*. Ph.D. thesis, University of Gothenburg.
- Staffan Larsson. 2007. A general framework for semantic plasticity and negotiation. In Harry Bunt and E. C. G. Thijsse, editors, *Proceedings of the 7th International Workshop on Computational Semantics (IWCS-7)*, pages 101–117.
- Christof Rapp. 2010. Aristotle’s rhetoric. In Edward N. Zalta, editor, *The Stanford Encyclopedia of Philosophy (Spring 2010 Edition)*.
- Lokendra Shastri. 1999. Advances in shruti - a neurally motivated model of relational knowledge representation and rapid inference using temporal synchrony. *Applied Intelligence*, 11:79–108.
- Alvaro Tasistro. 1997. *Substitution, record types and subtyping in type theory, with applications to the theory of programming*. Ph.D. thesis, Department of Computing Science, University of Gothenburg and Chalmers University of Technology.