Are Widows Always Wicked?
Learning concepts through enthymematic reasoning

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Abstract. This paper suggests that enthymematic reasoning may play
a role in the acquisition of new concepts by a language learner. To illus-
trate this we analyse an example of natural dialogue using Type Theory
with Records. Our approach allows us to represent misunderstanding and
misinterpretation of meaning, since it is based on the conceptualisation
of entities in individuals rather than on a God's eye view of meaning.
Thus our account fits well with an approach to word meaning where
speakers are constantly adjusting meanings on the basis of experience.
An enthymematic perspective on the learning of concepts relates previ-
ous work done on enthymematic reasoning cast in TTR to work where
enthymemes are used to explain lexical disambiguation.

Keywords: Enthymeme, topos, Type Theory with Records, learning,
lexicon, human reasoning

1   Introduction

Consider the example in (1) of an interaction between a mother and a child:

(1)

Mother:	When Snow White was still a baby her mother died. After some time her father, the king, remarried. His new wife was beautiful but vain and wicked.
Child:	Yes mum – a widow!

To anyone familiar with the conventional meaning of the word *widow*, it seems
obvious that the child has got it wrong. However, how did she get it wrong? And
can the mechanisms of how she got it wrong explain how most of us eventually
get it right?

In this paper we suggest how reasoning using *enthymemes* – rhetorical ar-
guments – can be a means not only of lexical disambiguation (as suggested by
Pustejovsky (1998)), but also a means of acquiring new concepts. We will intro-
duce enthymematic reasoning in dialogue as it is presented in Breitholtz (2014a),

Breitholtz (2014b), Breitholtz and Cooper (2011). We will then analyse the example in (1) in terms of the inferences that may be drawn using enthymematic reasoning based on *topoi* in the resources of the dialogue participants. For our account we will use Type Theory with Records (TTR) Cooper (2013), Cooper (2005), Ginzburg (2012).

2 Enthymematic Reasoning

2.1 What Is an Enthymeme?

An *enthymeme* is a rhetorical argument which appeals to what is in the listener's mind. In his *Rhetoric* Aristotle refers to enthymemes as belonging to the *logos*-part of discourse, that is, to the part concerned with content and reasoning. Aristotle also relates the enthymeme to logic by calling it a "rhetorical syllogism". However, in the case of a syllogism, the inference presented as the conclusion is non-negotiable, while an enthymeme owes a lot to context and background knowledge. It is therefore often negotiable and defeasible.

Jackson and Jacobs (1980), Breitholtz (2014a), Breitholtz and Cooper (2011) show that enthymematic reasoning occurs frequently in spontaneous dialogue and other types of highly interactive language genres, not only in rhetoric In 2, *A* presents an argument that she cannot make it to a party because she is going to a wedding, but since the bride is pregnant she might be able to drop by later in the evening.

(2) *A*: Oh! I'm invited to a wedding that night. But the bride is pregnant so I might drop by in the wee hours. (**?**)p1]Breitholtz2014b

Thus, *A* implies that the bride being pregnant might be a reason for the wedding not continuing very late – an assumption itself underpinned by a chain of inference. We refer to all of these underpinnings as the *topoi* of the enthymeme.

Ducrot (1988) and Anscombre (1995) propose a theory of meaning in context where the notion of topos is central. 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 (enthymematic) argument. Important points of the theory they propose are that topoi are assumed or taken for granted in a community, and that one topos can be employed in various contexts as underpinning for different types of arguments, but also the converse – that different topoi can be employed in one context.

Anscombre suggests that 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 even be applicable in the same contexts. Following Ducrot and Anscombre, we argue that topoi,

contrary to logical rules, do not constitute a monolithic system. Instead the system of topoi in the resources of one individual consists of principles which may be combined in different ways – like logical rules – but which may be inconsistent if combined in a specific situation.

2.2   Enthymemes and the Lexicon

The work on enthymemes and topoi by Breitholtz, Ducrot and Anscombre is mainly concerned with the relation between utterances in dialogue and discourse. However, Pustejovsky (1998) suggests that enthymemes are also important for lexical interpretation. He discusses the example *Steven King began a new novel* (**?**)p 238]Pustejovsky1998 and argues that the world knowledge regarding who Steven King is (a writer) and what writers do (write novels) serves as hidden premises in an enthymematic argument with the conclusion that Steven King has begun *writing* a new novel. In the terms of Ducrot and Breitholtz, this example is underpinned by a *topos* saying that "writers write", or "if someone is a writer, they write". However, there are also other possible topoi in our resources that could be drawn on in this context, for example the topos "people read novels". Interestingly, our bias towards interpreting *began* in this case as *began writing* rather than *began reading* is not directly linked to the number of occurrences of events where writers write novels compared to the number of occurrences of events where writers read novels – arguably, writers on average read more novels than they write. Instead the preference for the first interpretation has to do with the salience of the topos.

3   Learning concepts using enthymemes

We will now return to the example dialogue in (1). We will consider the types representing the individuals mentioned in the data, the enthymematic arguments present and the topoi that underpin the arguments or are obtained as a result of generalising an enthymeme. We would like to think of reasoning in terms of dialogue game boards representing dialogue participants' respective take on the dialogue at any point in time. We should therefore think of the enthymematic arguments, topoi and types representing individuals as features of such a gameboard. Following many other gameboard-based approaches to dialogue, for example the ones found in Ginzburg (2012) and Cooper (2013) we use the formalism Type Theory with Records. TTR is a rich type theory that has the advantage of modelling both utterance events and utterance types, which is crucial for analysing meta-communicative aspects of interaction. Subtyping in TTR is also important for our account of how we employ topoi in different enthymemes through operations like restriction and generalisation. The mother's utterance in (1) says explicitly that Snow White's stepmother is vain and wicked. Thus we may assume that the type of Snow White's step mother that is common ground in the dialogue this far is the one in (3)[1].

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[1] This could also be a subtype of 3 including other constraints like "woman". However, we leave aside such considerations here for clarity

(3)

$$\begin{bmatrix} \text{x=Snow White's stepmother:}Ind \\ c_{\text{vain}}\text{:vain(x)} \\ c_{\text{wicked}}\text{:wicked(x)} \end{bmatrix}$$

The child's utterance together with that of the mother, makes up a co-constructed enthymeme saying that *Snow White's stepmother is vain and wicked, therefore, she is a widow.* We represent topoi and enthymemes as dependent types, functions from records to record types, as seen in (4). Intuitively, such a function represents the idea that if you have a situation of one type – say, the type where someone is vain and wicked – then you can predict the type of situation where that person is a widow.

(4)

$$\lambda r\text{:}\begin{bmatrix} \text{x=Snow White's stepmother:}Ind \\ c_{\text{vain}}\text{:vain(x)} \\ c_{\text{wicked}}\text{:wicked(x)} \end{bmatrix} . \begin{bmatrix} c_{\text{widow}}\text{:widow}(r.\text{x}) \end{bmatrix}$$

For the child to make this argument, we must assume that she has access to a topos that underpins the enthymeme. To obtain a possible topos we generalise the enthymeme in (4) by removing the value of the manifest field (x=Snow White's stepmother:Ind)in the domain type. We now have a dependent type representing a topos saying that "if someone is vain and wicked, they are a widow".

(5) $$\lambda r\text{:}\begin{bmatrix} \text{x:}Ind \\ c_{\text{vain}}\text{:vain(x)} \\ c_{\text{wicked}}\text{:wicked(x)} \end{bmatrix} . \begin{bmatrix} c_{\text{widow}}\text{:widow}(r.\text{x}) \end{bmatrix}$$

Now, we may ask, how was this topos established? It seems reasonable to say that if the child believes that someone being vain and wicked is a reason for concluding that that person is a widow, the child perceives *vain and wicked* as essential components of the meaning of the word *widow*. But how was this idea established? No one is likely to have told the child that *widow* means *vain and wicked*, or that widows are vain and wicked. We argue that the child has learnt this from reasoning.

Consider for example this excerpt from another fairy tale – *Cinderella*:

(6)   "After a few years Cinderella's father took a new wife, a widow with two daughters of her own"

From this passage, we learn that Cinderella's stepmother is a widow. As the story evolves, we get multiple proof that she is also vain and wicked. From the story of *Cinderella* a topos regarding widows may be tentatively construed, namely the one in (7):

(7)

$$\lambda r\text{:}\begin{bmatrix} \text{x:}Ind \\ c_{\text{widow}}\text{:widow(x)} \end{bmatrix} . \begin{bmatrix} c_{\text{vain}}\text{:vain}(r.\text{x}) \\ c_{\text{wicked}}\text{:wicked}(r.\text{x}) \end{bmatrix}$$

This topos says that if we have a situation of the type where someone is a widow, we also have a type of situation where that person is vain and wicked.

Now, from dependent types like topoi and enthymemes, we may derive *fixed point types*. A fixed point type in this context would be a type describing the situation from a more holistic perspective, so instead of perceiving that we have access to a topos saying that if someone is a widow, they are vain and wicked, we perceive a scenario where this topos would be accuarate as one type of situation. For example, if we have a topos saying that in the summer, people spend time at the beach, we may from this topos construe a type of situation In which the topos would be realised, namely a type of situation where it is summer and people spend time at the beach. In formal terms this means that if τ_2 is the topos in (7), 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 (8). For a thorough discussion of fixed point types in TTR, see Cooper (fthc).

(8)
$$\begin{bmatrix} \text{x:}Ind \\ \text{c}_{\text{widow}}\text{:widow(x)} \\ \text{c}_{\text{wicked}}\text{:wicked(x)} \\ \text{c}_{\text{vain}}\text{:vain(x)} \end{bmatrix}$$

We perceive the reasoning with enthymemes and topoi to be partly associative, and related to the kind of associations that arise in neural activity where association of two patterns of neural activation during perception eventually lead to the fact that an external stimulation of one pattern will engender the second pattern even in the absence of a stimulus. This means that for a child to perceive a number of qualities co-ocurring in one individual in a situation, the child would find it reasonable to construe various types of dependencies between these qualities. Thus, when encountering a type of situation where someone (Snow White's stepmother) is vain and wicked, the child draws on a topos construed from the type of situation in (8), saying that if someone is vain and wicked, they are a widow.

Other topoi that would be possible to derive from (8) would be ones saying that vain widows are wicked and that widows are wicked and vain. In fact, from all topoi we may derive any topos that has the same fixed point type. The more constraints we add to the situation type encountered by the child in *Cinderella*, such as "in_fairytale" and "stepmother", the more acceptable some of the dependent types construed from the situation type will seem.

However, it is not the case that the topoi we have access to are symmetrical in the sense that the dependency is equally strong in both directions. For example, it seems like a useful rule of thumb that someone who is called Lisa identifies as a woman, while the inference rule that if someone identifies as a woman, then that person is called Lisa, would be a pretty useless rule. In order to acchieve a dynamic theory of language learning and reasoning, we would thus need to include a probabilistic component. Exactly how this would be set up we

leave aside for the time being, but it seems intuitively clear that the child, as it encounters the word *widow* in other situations, will revise the dependencies of the relevant topoi in her resources, and *vain* and *wicked* would gradually move from the centre of the meaning of *widow* to the periphery to become at most a connotation.

4   Conclusion

We have seen an example that illustrates how we use reasoning to establish the meaning of words as well as to disambiguate word meaning. Our approach allows us to represent misunderstanding and misinterpretation of meaning, since it is based on the conceptualisation of entities in individuals rather than on a God's eye view of meaning. Thus our account fits well with an approach to word meaning where speakers are constantly adjusting meanings on the basis of experience, which can be found in work by for example Cooper (2012), Kempson *et al.* (2012), Ludlow (2014) and Pustejovsky (1998).

One of the advantages of using topoi as the underpinning for the kind of non-monotonic reasoning we find in enthymemes, rather than default rules, is that the set of topoi of one agent does not constitute a monolithic logical system. Thus they do not need to be consistent or lead to consistent conclusions even within one model or domain (Breitholtz, 2014a). This ability to follow various strains of reasoning also inconsistent ones seems to be a prerequisite for the complex type of interactive language understanding and problem solving that humans master so well. However, in order to fully take advantage of the possibility to model this ability, we need to be able to account for the reasoning of agents with access to a wider range of topoi than those we have considered here. A natural progression of the account presented here would be to extend the model presented in Breitholtz (2014a) to include a probablilistic component. This would enable us to make predictions regarding the enthymematic inferences of an agent with access to several topoi applicable in a particular situation. It would also allow for modelling the learning of new topoi through interaction with other agents. Interesting work has been done by Cooper *et al.* (2014) on probabilistic semantics in TTR, and Clark and Lappin (2010) convincingly show how language learning is related to probability theory. Both of these approaches fit well with the approach that we suggest, and they thus offer a way to introduce a probabilistic component into the account of learning presented here.

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