

How do you make an AI get the joke? Here's what I found on the web

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Abstract

Humour in interaction relies on general and domain-specific knowledge and can be formalised in terms of defeasible reasoning instances and types, i.e. enthymemes and *topoi*. This paper motivates the importance of defeasible reasoning for humour-enabled conversational AI and provides suggestions for incorporating it into spoken dialogue systems.

1 Introduction

The integration of world knowledge and linguistic knowledge is notoriously challenging in dialogue modelling. In order for a conversational AI to be able to interact with humans in any realistic context, the system requires not only knowledge of the lexicon and grammar, but also several assumptions about the world and how it is acceptable to reason in different contexts. One example where this is particularly relevant is in artificial agents that are supposed to be able to recognise humour and participate in humorous exchanges.

One of the current aims of AI research is to make conversational AIs more human like (which is generally thought to be a necessary step towards social robots for uses such as caring for the elderly). Tech companies who work on conversational AI therefore aim at expanding the repertoire of dialogic interactions that AIs can engage in from bare task-oriented dialogues to other, more playful, types of interactions that are supposed to bring some joy into the user experience. In this regard, it would benefit a conversational agent to have an understanding of the nature of humour and laughter in dialogue.

In this paper we show that humorous dialogue events can be analysed in terms of the *topoi*, defeasible principles of reasoning, that are involved in the production and interpretation of the interaction.

This analysis applies to scripted jokes as well as to spontaneous humorous interactions.

We claim that reasoning items and patterns can be found in wide range of text that can have thematic relation to the implemented scenario. For example, an interaction in a bakery is grounded in knowledge about baking and baked goods, such as common-sense knowledge like “fresh bread is better than stale bread”. Much of this information is available on the internet, and various resources can be used to access a source of such knowledge that matches the domain of an interaction.

2 Humour in Dialogue

2.1 Humour theories

In recent decades competing visions on humour have been developed, introducing such notions as ‘incongruity’, ‘incongruity resolution’, ‘semantic script’, ‘superiority’, ‘relief’, ‘pseudo-logic’ as key components of humour, among others. Ritchie (2004) emphasises the importance of explicating these so-called ‘theory-internal’ concepts in ‘theory-external’ terms which will arise from more general explanations relying on underlining cognitive processes, such as text comprehension (Ritchie, 2018). We agree with this principle in general, but in our case we explicate our theory of humour in terms of our wider theory on incremental reasoning in dialogue.

Notable linguistic theories of humour, such as the Semantic-Script Theory of Verbal Humour (SSTH, Raskin, 1985) and the General Theory of Verbal Humour (GTVH, Attardo and Raskin, 1991; Hempelmann and Attardo, 2011) are mainly about humour competence. They abstract away from the actual process of joke comprehension and do not include processing as a crucial condition for humour (Ritchie, 2018). Acknowledging Ritchie’s claim about a deficiency of actual explanations regarding

how jokes are processed as text, we view the dialogicity of joke processing as a crucial condition for getting a humorous effect that may result in amusement or laughter (or not!).

One important consequence of the dialogicity of jokes is the presence of the possibility that interlocutors might interpret the same piece of discourse in distinct ways. This is often taken advantage of in humour, and one way to account for this is using a theory of enthymematic arguments warranted by topoi (see section 4 and e.g. Breitholtz and Cooper, 2011).

2.2 Jokes and conversations

There is a large volume of published studies describing the role of jokes and laughter in interaction from the point of view of conversational analysis. These studies highlight the fact that humour can be found in a wide range of interactions, from political debates to medical examinations (Glenn and Holt, 2017), and provide insights about the organisation of humorous sequences. Notions such as the *laughable* (the thing which is being laughed about or the trigger for the laughter, Glenn, 2003), are further used in the course of development of formal model of dialogue (Ginzburg et al., 2015; Mazzocconi, 2019). The current work can be considered a step towards an implementable account that incorporates incongruity theories and the observations from conversational analysis and corpus studies into a theory of dialogue.

An example of explicit joke telling in dialogue is shown in the following excerpt from the British National Corpus (BNC):¹

(A) *Phillip (46), Jane (40), Christopher (9), David (6) – at home having breakfast [BNC KCH]*

- D 3797 Knock, knock.
 J 3798 Who's there?
 D 3799 The Avon lady, your bell's broken!
 P 3800 The Avo- Avon lady?
 D 3801 Mm mm.
 P 3802 What does she do?
 (...)
 D 3820 She fixes bells.
 P 3821 <laughing>: No
 D 3822 Well what [does she do?]
 J 3823 [Guess] can't you?

C 3824 <talking from other room> She rings the bell, she rings.

(...)

J 3829 She's somebody who comes to the door and tries to sell you some make-up and perfume and toys and things.

In this extract, 6-year old David reproduces the knock-knock joke (in line 3799) without understanding its meaning. In the terminology of humour theories (Raskin, 1985; Hempelmann and Attardo, 2011) we can say that he does not understand what is *incongruous* about the Avon lady knocking, which is what (allegedly!) makes the joke funny. Later, Christopher (3824) explains what the Avon lady does, which should help David to get the joke, and Jane (3829) also adds more information which might help David to understand.² In order to understand this joke at least two things are required: a) knowledge of the general structure of knock-knock jokes and b) cultural knowledge of the Avon lady being a door to door salesperson (for Avon make-up products) who, according to the longstanding advertising campaign, rings the bell (leading to the advertising slogan “Ding Dong, Avon Calling” becoming a well-known phrase.³ This joke breaks the pattern of knock-knock jokes, as “knock-knock” doesn't generally bear any sense apart from being a set-up for an upcoming pun from the joke-teller. Cultural knowledge is important too but here it acts to emphasise the humour (Ritchie, 2018). Note that not all the authors shared this cultural knowledge, so they, like David, did not initially get the joke. Although they understood the breaking of the “knock-knock” frame, they did not fully appreciate why the joke used an Avon lady rather than, say, a postman.

This ability to get the joke at different levels is also characteristic of jokes – which rely on interlocutors having different (and possibly multiple) interpretive resources available (see section 4). For example, the classic chicken joke: “Why did the chicken cross the road? To get to the other side” works at the level of subverting the absurdist notion of a chicken crossing the road for exactly the same reason a person would (which even small children can grasp), but has an added level of interpretation available if you know that where you go when you're dead can be referred to as “the other side”,

²Note that understanding a joke and finding it funny are not the same thing. We do not go into this distinction here.

³See e.g. <https://www.youtube.com/watch?v=66IWgU9AAis> from 1956.

¹Overlapping material is shown in square brackets.

and have the additional knowledge that a (possibly suicidal) chicken crossing a road is likely to be hit by a car and killed.⁴

The mismatch between sources of background knowledge are also exploited in general humorous dialogue (without the specific frame of a joke):

(B) *Glenn (72), Ann (70), Mike (42), Becky (41), Lucy (35), Dan (32) [Family whatsapp group; discussing plans for Lucy's son Kyle's first birthday]*

- L 1 Mike is resigned to the fact that Kyle has stolen his birthday forever
- L 2 Also fun fact - we worked out that when Kyle turns 18 Mike will turn 60! Something tells me that's a joint birthday party waiting to happen
- A 3 One I'll miss
- L 4 That's cheery mum!
- L 5 Also you might not
- D 6 I am busy that week actually so I will miss it with Mum (...)
- L 7 What the 18th?
- D 8 yeah. If it was a triple birthday I would move things around, but just a double? not worth it (...)
- G 9 I'll be at the birthday party so long as one of my children is prepared to wheel me there

In the whatsapp group chat shown in (B), the humour is generated by contrasting the family specific knowledge (that Ann believes she will die soon) with common knowledge about appropriate reasons for missing a party (that one might miss an event such as a party, if one has a prior engagement). Both of these *topoi* (see section 4) can be offered as reasons behind Ann's contribution in line 3, and for Dan's contribution in line 6 to be interpreted as humorous, both must be accessible.

3 Computational humour

A considerable amount of literature has been published on computational humour, highlighting the importance of understanding humour for dialogue systems (e.g., Raskin and Attardo, 1994; Hempelmann, 2008; Binsted et al., 1995).

⁴See e.g. <https://www.esquire.com/uk/life/news/a12346/the-upsetting-true-meaning-of-that-why-did-the-chicken-cross-the-road-joke/>

A number of authors have investigated *humour generation*, mainly using template-based approaches inspired by humour theories. Examples of generated humorous texts are puns (Ritchie, 2005), lightbulb jokes (Raskin and Attardo, 1994), humorous names (Ozbal and Strapparava, 2012) and acronyms (Stock and Strapparava, 2005).

Much of the current literature on *humour recognition* pays particular attention to either detecting salient linguistic features, such as stylistic features (Mihalcea and Strapparava, 2005), handcrafted humour-specific features (Zhang and Liu, 2014) and N-gram patterns (Taylor and Mazlack, 2004), or latent semantic structures, (Taylor, 2009; Yang et al., 2015). Yang et al. (2015), in addition, focus on humour anchors, i.e. words or phrases that enable humour in a sentence.

So far, however, there has been little discussion about detecting humour in an interactive setting. For example, recent studies were mostly concerned with scripted dialogues, such as TV series like 'Friends' and 'The Big Bang Theory'. Purandare and Litman (2006) used both prosodic and linguistic features and Bertero and Fung (2016) used a text-based deep learning approach. Both of these studies marked utterances followed by laughs as humorous, and the rest as non-humorous. The main weakness of this approach is that in real dialogues laughter is not necessarily associated with humorous content: it is not always triggered by humour and can express a wide range of emotions, such as amusement, aggression, social anxiety, fear, joy and self-directed comment (Poyatos, 1993; Provine, 2004) and may also be used to convey propositional content (Ginzburg et al., 2015). In addition to this, not all events that are perceived as humorous provoke laughter. Even though laughter in conversations can be predicted with a fairly high accuracy (Maraev et al., 2019), it is still not indicative of whether the preceding content was humorous as opposed to, for example, the laughter having been used to soften a bold opinion expressed by one of the interlocutors.

Computational humour in the era of big data and deep learning can rely on joke explanations that dialogue participants can contribute among other knowledge resources that are present in online data. Previously published studies (e.g., Yang et al., 2015) were concerned with lexical incongruities that could be detected using distributional semantic models trained on large amount of texts.

Hereby we propose another approach, based on mining defeasible reasoning patterns from data. We propose relying on the notions of *enthymemes* and *topoi*, which have already been used to theoretically explain how humour works in dialogue (Breitholtz and Maraev, 2019).

4 Enthymematic reasoning

Argumentation and reasoning in dialogue is predominantly *enthymematic* (Breitholtz and Cooper, 2011; Breitholtz, 2014b; Breitholtz et al., 2017). An enthymeme is an argument which appeals to what is in the listener’s mind, i.e. an interlocutor must draw on background knowledge or contextual information to correctly interpret the argument. Aristotle referred to that which enthymematic arguments are based on as the *topoi* of the arguments. For Aristotle, a topos was a “place” or “field”, where a public speaker or a participant in a dialectic debate could find ideas on which to build their argument.

More recently, Ducrot (1980) and Anscombe (1995) have suggested that every link between a statement and another statement, or between a statement and (for example) an exhortation in discourse is a topos, and that topoi are thus essential to any theory of semantics beyond the sentence, as well as important for contextual interpretation of lexical meaning.

Importantly, reasoning *in interaction* is predominantly defeasible. That is, it is not logical in a technical sense⁵ but based on principles and assumptions that are available to language users engaged in interaction.

Following the work of Breitholtz and Maraev (2019) we adopt the notions of *enthymemes* and *topoi* as instances and types of defeasible argumentation items in order to capture the mismatches that lead to humorous incongruity. Moreover, these concepts can be useful to capture many other dialogical phenomena that rely on non-explicit knowledge, such as presuppositions and implicatures.

In (C) we find an example of a reply to a question requiring enrichment with implicit assumptions in order to be seen as a relevant answer to the question.

(C) Peter: Would you drive a SAAB?

Mary: I wouldn’t drive any Swedish car.

(from Wilson and Sperber, 2004)

The implied answer to the question in (C) is that Mary would not drive a SAAB. This conclusion is based on the fact that a SAAB is a Swedish car. In Aristotelian dialectic and rhetoric, (C) would be warranted by a topos, which is formulated as a function in (1) – that if something is true for a particular *genus*, then it is also true of a *species* (subtype) of that genus – and a premise, in this case that a SAAB is a “species” of the “genus” car. If Peter in (C) is not aware of either the topos or the premise, the answer given by Mary will seem to him to bear no relevance to the question.

$$P(g) \rightarrow P(s), \text{ where } s \sqsubseteq g \quad (1)$$

Following Ducrot (1988), we refer to all rules or principles used to underpin reasoning as topoi. Instances of topoi are *enthymemes*, such as the one in (C), which are ubiquitous in our interactions. They can be accompanied with textual clues, for example in conventional implicatures (e.g., “J Jonah Jameson is always demanding pictures of Spider-man because he is a baby boomer, and therefore doesn’t know how to use the internet to find them.”⁶). Importantly, topoi are *defeasible*, for instance, one of the interlocutors can deny the topos “the more the merrier” in a certain dialogue situation (e.g. one might respond by invoking the proverb “too many cooks spoil the broth” which represents a contradictory topos).

Most researchers in humour theory employ the notion of *incongruity*, following Raskin (1985), as a clash between two scripts that are opposite in a certain sense (such as *animal vs. human* or *alive vs. dead*). Our interpretation of incongruity takes this basic definition and attempts to give more precise definitions of these clashes or mismatches, based on the accommodation of topoi and enthymemes by dialogue participants. In example (A) the joke triggers clarifications because the topos of an Avon lady being a person who typically rings a bell is not shared between the participants and needs to be accommodated in order to understand the humour.

Interestingly, the attempt to explain the joke (A) by David through guesswork (“She fixes bells”),

⁵In a logical argument the conclusion holds given the premises. For example, given the premises *Socrates is a man* and *all men are mortal*, the conclusion *Socrates is mortal* is a necessary consequence. In most arguments in natural discourse this is not the case.

⁶<https://www.reddit.com/r/shittymoviedetails/comments/dhq6on/j-jonah-jameson-is-always-demanding-pictures-of/>

was met with laughter that is, in turn, caused by the incongruity between David’s contribution and knowledge of what an Avon lady actually does.

4.1 Bagels

(D) presents another example of a humorous effect created by enthymematic reasoning underpinned by topoi.

- (D) (*in a Soviet bakery*)
- 1 A Are the bagels fresh?
 - 2 B No.
 - 3 A What about the muffins?
 - 4 B Better get the bagels.

The context of the joke is that A is a customer in a bakery, and this short dialogue is underpinned by two topoi – one saying that if some food is not fresh, you should not buy it, and one saying that if you have to choose between two food items, and one is fresher than the other, you should choose the fresher one:

$$\frac{\text{not_fresh}(x)}{\text{not_buy}(x)} \quad (2)$$

$$\frac{\text{fresher_than}(x, y)}{\text{buy}(x)} \quad (3)$$

Let us think of the updates of the dialogue above: After the first utterance the inquirer/customer, A, has communicated that they are considering buying some bagels, and that the freshness of the bagels will have impact on their willingness to buy them. When B has replied “no”, we know that the bagels are not fresh, and indeed, A starts inquiring about the freshness of other types of bread. We can assume that a topos along the lines of ‘don’t buy non_fresh food’ is accommodated in the dialogue. If B had not agreed with this, they would have said something like ‘they are not fresh, but they are actually best when they are a few days old’, or similar. The second exchange evokes the topoi that if one food item is fresher than another, you should buy the fresher one. Both of these topoi seem acceptable, and most people would agree with them. However, in this case, two topoi are accommodated which, when instantiated in this particular context, lead to inconsistent conclusions. That is, one of the topoi says that A should buy the bagels and one that they should not, and this is of course, a type of incongruity. So the fact that a topos is accommodated which clashes with a previously accommodated topos, regarding the same question

under discussion, seems to create the humorous effect in this case.

In the next section we will look at the components of a spoken dialogue system that we believe are required to comprehend (and generate) humour.

5 Desiderata

5.1 Enthymeme mining and clustering

In order for a conversational AI to be able to understand humour (whether in joke form or just in general humorous interactions), we therefore believe that they need the same resources as required to understand human reasoning in dialogue; that is a library of topoi (Breitholtz and Cooper, 2011; Breitholtz, 2014b). In order to acquire such a resource, we propose to mine enthymemes from a variety of sources.

As mentioned in Section 2, in everyday interactions, people often reason in form of enthymemes:

- (E) Dave: ...you’re gonna be home from football until four, you gonna have your dinner, want a bath.
 Lee: Yeah, but I might not go to school tomorrow.
 Dave: Why?
 Lee: Cos of my cough.
 Dave: How can you play football and not go to school then?
 Lee: Cos I was going out in the fresh air, I’m alright when I’m out in the fresh air.
 Dave: So why aren’t you going to school then?
 Lee: I’m in the class room all day dad. [BNC KBE 10554-10561]

In (E) one enthymeme is constituted by Lee’s assertion that he might not go to school and the reply to David’s “why?”-question, introduced by “cos” (because). Why-questions are known to invoke enthymemes in dialogue, offered as reasons (Schlöder et al., 2016), and we can exploit this fact to look for enthymemes in spoken dialogue corpora such as the BNC. In Schlöder et al. (2016), they report that the spoken dialogue portion of the BNC contains 2256 why-questions, and using the same search tool (SCoRE Purver, 2001) shows 4972 utterances in the same corpus start with ‘because’ or ‘cos’.

In text-based resources, such as Wikipedia, or online reviews (which have previously been used

for reconstructing enthymemes by Rajendran et al., 2016) and Reddit, we can rely on different structures and keywords to search for potential enthymematic arguments (for example, “therefore”, “since”, “once”, “so”).

We plan to take the following steps in the process of mining enthymemes:

1. dependency parsing and pattern-based extraction of enthymeme candidates based on their surface structure
2. annotation, whether or not the extracted structure is an enthymeme and annotation of the premise(s) and the consequence(s) of it.
3. enthymeme classification (for example, keywords like “since” can just relate to a time frame)
4. enthymeme parsing, that will lead to a semantic representation of an enthymeme

We hypothesise that a great amount of data that is needed for interpreting jokes can be extracted from ontologies, especially ones that aim at collecting data for improving general knowledge of computers, such as ConceptNet (Speer et al., 2017). The importance of ontologies was emphasised by the proponents of Ontological Semantic Theory of Humour (OSTH, Raskin, 2017). However, we do not consider them a last resort, as Raskin does, but rather a core component of understanding humour and other dialogical reasoning, such as explaining the mismatches between the arguments presented in (E).⁷

Importantly, many common enthymemes in everyday use (such as “if one is ill one should not go to school” employed by Lee in (E)) are generally considered to be common knowledge and do not need to be spelled out when they are invoked in dialogue (even though they are often culturally specific). However, even these topoi must be learned by children, and a search in the CHILDES corpus⁸ (MacWhinney, 2000), shows a distinct peak of ‘why?’-questions in children at around age 3, and

⁷We acknowledge, as pointed out to us by an anonymous reviewer, that ontologies have been criticised for being ad hoc and not providing consistent levels of information across domains, however, the same may be expected of human language learners who have more developed and consistent ontologies (in terms of the salient topoi available to them) in particular domains, which only become generalised through experience.

⁸Using ChildFreq (Bååth, 2010)

there is evidence that children’s why-questions promote explanations (Bova and Arcidiacono, 2013). Why-questions have also been analysed as eliciting premises of enthymemes by Schlöder et al. (2016) where a good answer to a why-question is one that in combination with the utterance that inspired the question, constitutes an acceptable enthymeme. Thus, we hypothesise that we may be able to mine enthymemes based on common knowledge from a corpus of child-directed speech, such as CHILDES, using methods as described above.

Following this, extracted enthymemes can be clustered in order to induce more general rules, or relate to one of the already described topoi, such as the Aristotelian topos of “the more and the less”. The gist of this topos is that a small thing is contained in a large thing—for example, if you can build a castle you can build a cottage, or if you can run a marathon then you can run a half marathon.

5.2 Dialogue management and incongruity

The next steps towards creating a humour enabled AI involves implementation of dialogue management along the lines of Maraev et al. (2018a) which employs an information-state update approach (Larsson and Traum, 2000; Larsson, 2002) and Kos dialogue framework (Ginzburg et al., 2015).

Following Breitholtz (2014a) we extend dialogue state representation by introducing two new fields: privately available salient *rhet_resources*, and (thought to be) public *eud* and *topoi* for enthymemes and topoi under discussion.

$$\left[\begin{array}{l} \text{rhet_resources} : [\text{topoi} : [\textit{Topos}]] \\ \text{dgb} \quad \quad \quad : \left[\begin{array}{l} \text{eud} : [\textit{Enthymeme}] \\ \text{topoi} : [\textit{Topoi}] \end{array} \right] \end{array} \right] \quad (4)$$

For this component we will also need to give a more precise definition of incongruity, that will constitute a list of possible clashes between topoi and enthymemes following the definitions within Type Theory with Records formalism (TTR, Cooper, 2005) presented in e.g. Ginzburg et al. (2015); Breitholtz and Maraev (2019).

5.3 Mechanisms for selecting the most salient topoi

As in example (E) there can be several supporting topoi, e.g. “if one is sick, one shouldn’t get outside” and “if one is sick it is good to get fresh air”, whereby one is more salient in a certain situation.

Jokes can play on this property of human reasoning, as listeners are usually not aware of all the potential ambiguities of or supporting topoi for an utterance, so a joke-teller can guide a listener down a certain path and then reveal a less salient topos in the joke’s punchline. Consider, for example, the double entendre of the following office notice (cited by [Ritchie, 2018](#), from Parson’s joke collection):

(F) THE TYPISTS’ REPRODUCTION EQUIPMENT IS NOT TO BE INTERFERED WITH WITHOUT THE PRIOR PERMISSION OF THE MANAGER.

The “improper” topoi become more salient once one notices the alternative interpretation. As noted by [Ritchie \(2018\)](#), full humorous appreciation requires both interpretations to be perceived.

In our work we are planning to make use of Bayesian networks, following [Maguire \(2019\)](#), who interpreted topoi as networks rather than functions which will allow probabilistic judgements regarding the salience of a topos.

6 Conclusions

The purpose of this paper was to outline the requirements for a dialogue system that will have the appropriate resources to understand humour, and to suggest why we believe this is useful. We are aiming not only at understanding humour in a classical joke structure with set-up and punchline, but also in a more general sense of conversational incongruity, such as the one in (B), where Dan’s contribution deliberately highlights another (non-intended) topos available to the discourse participants.

This account will enable dialogue systems to react with smiles and/or laughter, which is important for natural and engaged human-computer interaction ([El Haddad et al., 2016](#)). Importantly, this is not only focused on a content of a single dialogue act ([Smith et al., 2011](#); [Devillers et al., 2018](#)) but instead on the overall dialogue situation. This contributes to the appropriateness of dialogue systems’ reactions.

This work is also an important step towards understanding the meaning of a user’s laughter, with a necessary intermediate step of identifying the laughable ([Maraev et al., 2018b](#)) and relating it to one or several topoi available in the current dialogue state, therefore understanding what was *incongruous* about the system or user contribution.

Importantly, we believe that not only will this work make the notion of incongruity more precise in a way that benefits conversational AI, but it will also add to our understanding of general human-human reasoning in dialogue.

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