

Understanding Laughter

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1 Introduction

Laughter is pervasive in human conversation (more than 30k tokens in the dialogue part of the British National Corpus (BNC) (approx. 1 of every 14 turns ($n = 430k$))). Most laughter is not triggered by humorous stimuli¹ and close to half of all laughter events are reactions to one's own speech (e.g., [20]). In this paper, we demonstrate that laughter needs to be integrated with lexically and phrasally produced import—arguing against the common assumption (see e.g., [10]) that laughter has no propositional content. Following this we develop a semantic-pragmatic analysis: we show how relatively general meanings, aligned with contextually-driven reasoning lead to a variety of disparate inferences.

2 Why assign content to laughter acts?

(1a–c) illustrates that laughter can occur as a stand alone utterance. In (1a,b) it conveys² that the question does not need addressing (a common use of laughter in political interviews [21], exemplified in (1b)), whereas in (1c) it conveys that the descriptive content of the assertion is false. (1d–e) illustrate cases of laughter with a quite different force: (1d) exemplifies laughter not intended to weaken the speaker's assertion; (1e) from a doctor's interaction with a patient, involves an initial laughter exchange concerning the patient's unpleasant condition, but ends with the doctor's sympathetic laughter, which in no way undermines his statement concerning her situation. (1f) exemplifies intra-utterance laughter, where the laughter has the effect of scare-quoting ([19]) the sub-utterance it precedes. (1g) illustrates that a laughter act can give rise to an intended meaning clarification request ([8]), hence having a content on a par with linguistic speech, whereas (1h) illustrates a non-linguistic trigger for laughter:

- (1) a. Isaac: H, How long have you been here? Tracy: We were talking about you. Isaac: That's hilarious. Wh... What... Were you walking around behind us or what? Yale: (laughs) (No response provided \leadsto this question doesn't warrant answering) <https://www.youtube.com/watch?v=FBn28iNcpBA>

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¹[In a report about a football match:] *The Chelsea man adopts that 'mirthless laugh at the dreadful awfulness and unfairness of it all' that his manager [Jose Mourinho] enjoys so much.* [The Guardian, November 29, 2015]

²For the moment, we use this in a way non-committal between semantic denotation and implicature to mean 'allows one to conclude'. We will return to this crucial issue below.

- b. David Gregory; interviewing Chuck Schumer:
 DG: (1) Is Sarah Palin the future of the Republican party?
 CS: (2) **.hh hh=W(h)well(h)heh heh heh .hhuh** (From [21])³
- c. Frank: She was actually erm phonin the doctor to see if she could come in and see him that morning about her gastroenteritis. Emily: Oh. Frank: She'll love me for telling you that. (laughs) (↔ Frank doesn't think his wife will love him for telling Emily ... (From [12])
- d. 'Dave is someone who stands up for what he believes in, the sort of guy, now I think about it, you would want as your prime minister, if you had your choice.' He laughs, but he's not joking. (The Guardian, 30 Oct, 2015)
- e. Anon 1: you know you're not going to be (laughing):[able to move it any] Anon 2: (laughs) Anon 1: and it's going to stay that way. Anon 2: (laughing):[No, Anna, you're alright.] Anon 1: (laughs) Anon 2: (laughing)::[You're alright.] (BNC, 89-92, G4D)
- f. A : well I I'm interested 'in it in a (. laughs) ((comfortably)) re:laxed way, you know, I mean I . I do keep, I have kept up with it (London Lund Corpus)
- g. Bonnie: (laughs) Cassie: Why are you laughing?
- h. (At a doctor's surgery): Anon1: No wonder you're getting a buzzing in your ears there's a big lump of concrete in there. Anon 2: Is there? Anon 1: Let's have another look at this. Oh my. (laughs) (BNC)

3 Laughter as an event anaphor

Classifying laughter is not straightforward, neither in terms of form⁴ nor function, and *a fortiori* with respect to the mapping between the two, which remains still very much an open question.⁵ There is no consensual functional taxonomy—existing functional taxonomies of laughter focus on what laughter does as an emotion rather than via propositional content.⁶ [25] investigate the sounds of human laughter in a very large corpus of naturally occurring conversational speech in Japanese and propose that the two largest classes by far are either polite or genuinely mirthful categories. They achieve better than 70% accuracy in automatic classification using machine learning.

We will offer a proposal that offers a basic account for, a fairly wide range of cases, as exemplified in (1), without claiming to be exhaustive. We propose to analyse laughter as a kind of eventive/situational anaphor, which can involve at least two distinct meanings:

1. A phylo- and onto-genetically prior meaning that conveys **enjoyment** of a situation and which can be related to the earliest laughter by children ([24]).

³https://www.youtube.com/watch?v=Zq_o8T8q0q0

⁴[26] show huge variance within and across subjects. The number of phones used per laughter ranges from 2 to 59, with a mean (and median) of 32 (std : 14.4).

⁵[3, 17] have found using both explicit ratings and online methods that voiced laughter elicited much more positive evaluation than did unvoiced laughter among subjects.

⁶For instance, [18] identifies eight social functions of laughter, including the expression of affiliation, aggression, social anxiety, fear, joy, comicality, amusement and as a self-directed comment.

2. A meaning we dub **incongruity** laughter—recognition that a situation or an event is in some ways incongruous. Indeed one might view this as a common feature of various theories of humour, ranging from Hobbs’s superiority based account [13] to recent theories by Raskin, Attardo, Hurley, Dennett and Adam (e.g., [2, 14]). We assume that the variety of inferences associated with laughter arise from the combination of these meanings with contextually driven reasoning, which has a significant pragmatic component.

Proposing that laughter is ambiguous is defensible for a variety of reasons. First, the existence of distinct production and control mechanisms [22]. Second, there is copious evidence for misunderstanding the force of laughter; some cases can be analyzed in terms of referential uncertainty as to the laughable event, others seem better analyzed as misidentification of the intended use (which in some cases, might not be under the conscious control of the laugher).

- (2) a. How could he explain a 7,000-mile drift at sea with stick figures? His impatience simmered. . . . The native couple smiled and kindly shook their heads. ‘Even though we did not understand each other, I began to talk and talk,’ Alvarenga told me. ‘The more I talked, the more we all roared with laughter. I am not sure why they were laughing. I was laughing at being saved.’(The Guardian, 9 Nov, 2015)
- b. Yoga Teacher: [Explains how to place a folded blanket above the groin and under the stomach and then bend forward folding the stomach over the blanket.] Student: [laughs] Teacher: Was that funny? (attested example)

At the same time, we propose, somewhat tentatively, that at least on some occasions incongruity laughter involves enjoyment as well. It seems clear, nonetheless, that not all laughter is associated with enjoyment, as with instances of embarrassment and/or nervous laughter, exemplified in (3), which one might wish to argue should be assimilable to incongruity; to the extent, one decides not to make such an assimilation, we nonetheless have an example of an enjoyment-less type of laughter:

- (3) INT And then the demands at home are from your husband on one side and your children on the other. And basically the only time that I hear that you have for yourself is once a month on a Thursday night when you go to church. PAT Right. [Hhhh uh huh] INT [That doesn’t] sound like very much. PAT It’s not much. [hhhh heh hhh] INT [O k a y]. Tell me about depression. Has that been an issue for you . . . (Example from [11])

4 Formal Framework

In the rest of the paper, we show how the analysis of laughter as an eventive anaphor can be formalized within the dialogue framework KoS [8, 9]. KoS is formulated using the type theoretic formalism TTR [6] and has recently been extended to underpin defeasible reasoning [5].

4.1 Dialogue Gameboards and enthymemes

On the approach developed in KoS, there is actually no single context—instead of a single context, analysis is formulated at a level of information states, one per conversational participant. The dialogue gameboard (DGB) represents the publicized information in a given information state. Its structure is given in (4)—the *spkr, addr* fields allow one to track turn ownership, *Facts* represents conversationally shared assumptions, *VisInf* represents the dialogue participant’s (view of) the visual situation and attended entities, *Pending* and *Moves* represent respectively

moves that are in the process of being grounded or have been grounded, *QUD* tracks the questions currently under discussion.

$$(4) \quad \text{DGBType} =_{def} \left[\begin{array}{l} \text{spkr: Ind} \\ \text{addr: Ind} \\ \text{utt-time : Time} \\ \text{c-utt : addressing(spkr,addr,utt-time)} \\ \text{Facts : Set(Proposition)} \\ \\ \text{VisInf : } \left[\begin{array}{l} \text{VisSit : RecType} \\ \text{InAttention : Ind} \\ \text{c1 : member(InAttention,VisSit)} \end{array} \right] \\ \text{Pending : list(locutionary Proposition)} \\ \text{Moves : list(locutionary Proposition)} \\ \text{QUD : poset(Infostruc)} \end{array} \right]$$

In recent work,[5, 4] proposed that the dialogue gameboard also tracks **topoi** and **enthymemes** that conversational participants exploit during an interaction (e.g., in reasoning about rhetorical relations.). Enthymemes are defeasible arguments accounted for in rhetorical theory, but also found in conversational data [15]. Topoi represent general inferential patterns which may be used to underpin the enthymemes (e.g., *given two routes choose the shortest one*). Following [4] we formalise topoi and enthymemes as *dependent types*, more specifically functions from records to record types. The topoi just mentioned regarding routes would be represented in TTR as the function in (5), which intuitively should be interpreted as a rule of thumb saying that if we have a situation of the type where we have two routes to choose from and one of these is shorter than the other, we may predict a situation where we choose the shortest route.

$$(5) \quad \lambda r: \left[\begin{array}{l} \text{x:Ind} \\ \text{y:Ind} \\ \text{c}_{\text{route}}:\text{route}(x) \\ \text{c}_{\text{route}_1}:\text{route}(y) \\ \text{c}_{\text{shorter_than}}:\text{shorter_than}(x, y) \end{array} \right] . [\text{c}_{\text{choose}}:\text{choose}(r.x)]$$

The actual arguments conveyed in dialogue or other discourse which are drawing on topoi are referred to as *enthymemes*. They are applications of topoi in particular cases, e.g., *given that the route via Walnut street is shorter than the route via Alma, choose Walnut street*. Formally, an enthymeme belonging to a topos is a specification of the topos in the sense that the domain type of the enthymeme is a subtype of the domain type of the topos, and for anything, *e*, in its domain the result of applying the enthymeme to *e* is a subtype of the result of applying the topos to *e*. A specification of our topos concerning routes in (5) is shown in (6). It says that in a situation where we have a choice between Walnut Street and Alma and Walnut Street is shorter, we should choose Walnut Street. The domain type of this enthymeme is clearly a subtype of the domain type of the topos since the labels ‘x’ and ‘y’ are associated with particular entities, namely Walnut Street and Alma, not just with a type *Ind* as in the topos.

$$(6) \quad \lambda r: \left[\begin{array}{l} \text{x=Walnut Street:Ind} \\ \text{y=Alma:Ind} \\ \text{c}_{\text{route}}:\text{route}(x) \\ \text{c}_{\text{route}_1}:\text{route}(y) \\ \text{c}_{\text{shorter_than}}:\text{shorter_than}(x, y) \end{array} \right] . [\text{c}_{\text{choose}}:\text{choose}(r.x)]$$

The analysis of enthymemes and topoi as dependent types in various degrees of specification exploits the possibilities of subtyping in TTR ([4, 6]) and enables us to formally represent how we employ topoi in different enthymemes through operations like restriction, generalisation and composition.

Topoi and enthymemes get added into the dialogue gameboard in a number of different ways. [4] discusses some of these cases. One case is where it is not clear which rhetorical relation is being introduced between two propositions in the dialogue. If the subject matter of the latest move is associated with a topos in the agent’s resources, the topos will be added to the gameboard and an enthymeme under discussion (EUD) will also be integrated through accommodation. The other typical case is where the enthymematic structure is clear. In this case the latest move – possibly combined with beliefs already integrated in the discourse model – causes an enthymeme under discussion to be added to the gameboard. This enthymeme may then be matched to the resources of the agent. If there is a topos that validates the EUD, this topos is added to the gameboard. If there is no relevant topos the agent might still accommodate a topos based on the content of the EUD. For example, if agent *A* says “let’s take Walnut Street, it’s shorter” and agent *B* comes from a cultural and social context where efficiency and time is not important, he may not have access to a topos saying that “shorter routes are preferable”. However, he may tentatively accommodate a topos which is a generalisation of the EUD. Mismatches between topoi and EUD on the gameboard of a dialogue participant may give rise to clarification requests (e.g., (1g)).

The relevance of enthymemes in dialogue and the topoi that underpin them becomes particularly apparent in cases when our individual takes on an ongoing interaction do not match. Consider an agent involved in dialogue who suggests to another dialogue participant that they choose to go somewhere via a particular street because it is longer (rather than shorter). Dialogue participant *A* may have a topos in mind about long walks being beneficial to one’s health or the like, but this topos might not be available to dialogue participant *B*, who will then not understand the intention of *A*’s utterance and possibly make a clarification request. It is also possible that some topos is indeed accommodated on the DGB of a dialogue participant in the process of interpreting an utterance, but that this topos does not agree with the topos and enthymeme intended by the speaker.

In (7), we have an example of such a situation. In this interview with Swedish rap artist Petter, the journalist’s utterance suggests that she has formed a hypothesis about the kind of argument Petter is making based on his utterance and the topos in the journalist’s resources which she associates with the type of situation described in that utterance.

- (7) a. Petter: Metal was actually the reason I started doing Hip Hop ...[pause]
 Petter:...Because I hated metal.
 Journalist: Oh, I thought you were going to say something completely different!

(7) provides evidence that we start reasoning before an argument is fully spelled out and the way we process rhetorical structure is analogous to the way we process sentential and non-sentential utterances [7].

4.2 Interfacing with the grammar

We use HPSG_{TTR} [8], a variant of the grammatical formalism Head-driven Phrase Structure Grammar ([23]). In HPSG_{TTR} speech events are identified with records and grammatical types (‘signs’) are identified with record types.

We exemplify this with a lexical entry for a greeting word such as ‘hi’, as in (8), whose context—specified via the field ‘dgb-params’—is supposed to be the initial state of a conversation:

$$(8) \left[\begin{array}{l} \text{phon : hi} \\ \text{cat.head = interj : syncat} \\ \text{dgb-params : } \left[\begin{array}{l} \text{spkr : IND} \\ \text{addr : IND} \\ \text{utt-time : TIME} \\ \text{Moves = } \langle \rangle \text{: list(LocProp)} \\ \text{qud = } \{ \} \text{: set(Question)} \end{array} \right] \\ \text{cont = Greet(spkr,ind,utt-time) : IllocProp} \end{array} \right]$$

More generally, the context, represented within the field *dgb-params*, plays a crucial role via QUD, VisSit or Pending, providing the main predicate and/or the conversational move type. Thus, as we have seen above the antecedents of laughter come from varied sources. In this, they resemble nominal pronouns in dialogue. (9a) is an example of anaphora from an ungrounded utterance, whereas (9b) is an example of anaphora from a disfluent utterance:

- (9) a. A: Did John phone? B: Is he someone with a booming bass voice?
 b. Peter was, well he was fired.

This motivates the notion of an *active* move, as the source of an antecedent for a pronoun. What is an active move? Clearly this is an intricate notion, but drawing on a dialogue oriented conceptualization of the right frontier constraint (e.g., [1])—the “right frontier” is constituted by elements of QUD, answers to such (TOPICAL facts), and utterances under grounding/correction:

- (10) For a given DGB *dgb0*, an ActiveMove is an element of *dgb0.Moves* or *dgb0.Pending* such that either (a) *qud-update-contribution(m^{content})* is in *dgb0.QUD* or (b) *m^{content}* is TOPICAL or (c) *m* is in *dgb0.Pending*.

4.3 Monitoring and Appraisal

Metacommunicative interaction is handled in KoS by assuming that in the aftermath of an utterance *u* it is initially represented in the DGB by means of a *locutionary proposition* individuated by *u* and a grammatical type T_u associated with *u*. If T_u fully classifies *u*, *u* gets grounded, otherwise clarification interaction ensues regulated by a question inferable from *u* and T_u . If this interaction is successful, this leads to a new, more detailed (or corrected) representation of either *u* or T_u . [9] develop their account in KoS of disfluencies, or phenomena of Own Communication Management (OCMs), by extending the account just mentioned of the coherence and realization of clarification requests: as the utterance unfolds incrementally there potentially arise questions about what has happened so far (e.g. *what did the speaker mean with sub-utterance u1?*) or what is still to come (e.g. *what word does the speaker mean to utter after sub-utterance u2?*). These can be accommodated into the context if either uncertainty about the correctness of a sub-utterance arises or the speaker has planning or realizational problems.

Thus, the monitoring and update/clarification cycle is modified to happen at the end of each word utterance event, and in case of the need for repair, a repair question gets accommodated into QUD.

This ubiquitous self-monitoring ties in with commonly accepted assumptions in cognitive psychology work on emotion (see [16]). Although there exist a variety of approaches to modelling emotions, there is a basic consensus that emotions are caused by *appraising* events in relation to concerns. In terms of a time course of appraisal, there exists an initial automatic appraisal that does not require conscious processing, and a secondary appraisal that often includes conscious reflection on the meaning of the emotion and that can lead to new intentions. One could hypothesize that *enjoyment* laughter is associated with a first appraisal, while *incongruity* laughter is associated with a secondary appraisal.

5 Enjoyment laughter

In this section we also offer a sketchy explication of enjoyment laughter. (11) associates an enjoyment laugh with the laugher’s judgement of an eventuality l as enjoyable; more specifically l with respect to being classified by the type L (an *austinian proposition*) as enjoyable; with respect to form we underspecify this, appealing to a type `laughterphontype` compatible with the apparent large range of possible realizations. We make no special assumptions about the construal of enjoyment beyond those assumed by various cognitive theories of emotion on this score [16]. On most such theories this involves appraisal of the active situation in a positive way (the nature of the appraisal varies with the theory).

$$(11) \quad \left[\begin{array}{l} \text{phon} : \text{laughterphontype} \\ \\ \text{dgb-params} : \left[\begin{array}{l} \text{spkr} : \text{Ind} \\ \text{addr} : \text{Ind} \\ \text{t} : \text{TIME} \\ \text{c1} : \text{addressing}(\text{spkr}, \text{addr}, \text{t}) \\ \text{p} = \left[\begin{array}{l} \text{sit} = l \\ \text{sit-type} = L \end{array} \right] : \text{Prop} \\ \text{c2} : \text{ActiveSit}(l) \end{array} \right] \\ \\ \text{content} = \text{Enjoy}(\text{spkr}, \text{p}) : \text{RecType} \end{array} \right]$$

The notion of active situation in dialogue pertains to the accessible situational antecedents of a laughter act, which involve a generalisation of Asher’s characterisation of eventive antecedents via the right frontier constraint for text (e.g., [1]). As we have seen above, they can be exophoric (1h), whereas when their antecedent is an utterance, they can be the ongoing utterance (1f), the most recent (1a–c), or a situation described by a sequence of moves, including the most recent move (*the punchline*):

$$(12) \quad \text{Given } l : \text{Rec} \text{ and } d : \text{DGBType}, \text{Active}(l, d) \text{ if (i) } = (l, d. \text{VisSit}) \\ \text{or (ii) } = (l, d. \text{MaxPending}) \\ \text{or (iii) } = (l, d. \text{MaxQUD.sit})$$

Given this meaning and the topos *If I’m enjoying that I/you said that p , then I agree that p* , we can obtain as a consequence that enjoyment laughter can be used as a positive feedback signal, as in (1d) and the doctor’s final laugh in (1e).

6 Incongruous laughter

We can describe the meaning of incongruous laughter, to a first approximation, as in (13): the laugh marks a proposition whose situational component l is *active* as *incongruous*, relative to the currently maximal enthymeme under discussion:

$$(13) \quad \left[\begin{array}{l} \text{phon} : \text{laughterphontype} \\ \\ \text{dgb-params} : \left[\begin{array}{l} \text{spkr} : \text{Ind} \\ \text{addr} : \text{Ind} \\ \text{t} : \text{TIME} \\ \text{c1} : \text{addressing}(\text{spkr}, \text{addr}, \text{t}) \\ \text{MaxEud} = \text{e} : (\text{Rec})\text{RecType} \\ \text{p} = \left[\begin{array}{l} \text{sit} = \text{l} \\ \text{sit-type} = \text{L} \end{array} \right] : \text{prop} \\ \text{c2} : \text{ActiveSit}(\text{l}) \end{array} \right] \\ \\ \text{content} = \text{Incongr}(\text{p}, \text{e}, \tau) : \text{RecType} \end{array} \right]$$

We explicate *incongruity* in terms of a clash between the enthymeme triggered by the laughable and a topos which the enthymeme is supposed to instantiate. That is, the laughable l satisfies the domain type of the enthymeme, but there is a clash between the range of the enthymeme and that of the topos that the enthymeme is supposed to instantiate. Specifically, in (14), p is a proposition comprised of l , the laughable event, and L a type that classifies l , E is the triggered enthymeme, and τ is the clashing topos— E 's domain is a subtype of τ , but its range ($\text{P}(\text{unch})\text{L}(\text{ine})$) is incompatible with τ 's range:

$$(14) \quad \text{Incongruous}(p, E, \tau) \text{ iff } p = \left[\begin{array}{l} \text{sit} = \text{l} \\ \text{sit-type} = \text{L} \end{array} \right] : \text{TrueProp}, \tau = \lambda r : T_1 . T_2 : (\text{Rec} \rightarrow \text{RecType}), \\ E = \lambda r : L . PL : (\text{Rec} \rightarrow \text{RecType}) \quad L \sqsubseteq T_1 \text{ and } PL \perp T_2$$

Assertion cancellation Consider again the example in (1b)—Frank tells Emily that his wife has gastroenteritis, then he says that his wife will love him for telling Emily this. One simple view of the function of laughter here is as (mock) self-repair. Frank relies on the enthymeme ‘If I’m saying she will love me because I mentioned her gastroenteritis, then I don’t mean it.’ This clashes with the sincerity topos ‘If A says p , then A means p ’.

Laughter as scare quoting Here we have an interaction between laughter and disfluency. Here the laughable is A’s upcoming utterance u classified by a sign T_u . u is maximally Pending, assuming an incremental view of processing, as motivated by the treatment of disfluencies in [9]. The laughter can mark it as incongruous. In what way incongruous? We assume this often relies on a clash with the topos ‘If Utter(A, u_1), u_1 represents A’s choice to refer to u_1 ’s referent.’

Question deflection How does laughing enable questions to be deflected? A poses q ; for B not to address q , B has to accommodate the issue ?Wish(B, q) [*whether B wishes to discuss q*] into QUD and provide an utterance about this issue (see[8], Chapter 8, section 8.3.1). A possible active situation accessible to B is the maximally pending utterance—A’s query. Hence,

B’s laughter can convey that this utterance is incongruous. In what way? We assume this relies on the violation of the topos ‘If Ask(A,B,q), then q is a good/serious question’.

7 Conclusions and Future Work

Laughter is a frequent phenomenon in conversations with a wide range of meanings—it can both reinforce and cancel an assertion, deflect a question, or be used as scare quoting. We propose that laughter is an event anaphor that can convey at least two distinct meanings: the **enjoyment** of an event and the recognition of an **incongruous** event. We formalize these two meanings in the KoS framework, which captures the high degree of context dependency of laughter. The treatment explains how laughter can be the source for clarification requests due to ambiguity and difficulty in resolving the laughable. We are currently working on a more detailed classification of laughter based on the enjoyment/incongruity distinction, and linking form with function. We plan to address cross-linguistic differences, to experimentally test the enjoyment/incongruity distinction and its relation to the appraisal mechanism.

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