Incremental Reasoning in Dialogue (IncReD)

1 Purpose and aims

This project aims to investigate incremental human reasoning in dialogue by combining insights from a variety of fields involved in dialogue research (e.g. Artificial Intelligence, Formal Linguistics, Psycholinguistics, Philosophy). We will experimentally test how dialogue participants dynamically and incrementally update their common ground (shared context) and reason using this information, and develop a model to account for our findings. This project will integrate state of the art experimental techniques and formal models from syntactic, semantic and pragmatic domains into a model of dialogue. Specifically we will investigate:

1. How do people respond to why-questions at different points in a dialogue? What does this tell us about the reasoning people do in dialogue, and the resources they use to do it?
2. What happens in a dialogue (linguistically and interactionally) when there is a mismatch in the resources for reasoning between participants? What factors influence the arguments a person uses when conflicting resources are available?
3. How can this incremental human reasoning ability be formally modelled?

2 Survey of the field

Traditional theories of communication rely on a separation between speaker and hearer, with the speaker encoding and transmitting a message, and the hearer decoding it. However, these simplifications are inadequate when we consider dialogue (see e.g. (1), taken from the British National Corpus (BNC)). Units of meaning are co-created incrementally by multiple participants using incomplete utterances (e.g. line 7), with phenomena such as cross-person compound contributions (where one person continues another's utterance, as in lines 7 & 8), repairs (e.g. the clarification requests in lines 4 & 6), and disfluencies (e.g. the pause and restart in line 9) – seen as 'performance errors' in traditional linguistics – crucial in the co-construction of meaning. In this extract, a chemistry tutor (J) prompts a student (A) to answer the question posed in line 1, which A does in line 10, following a sequence in which J gets A to produce an unrelated word which begins with the same syllable as the answer, by continuing an incomplete utterance. To account for this example, content alone is inadequate – we also need to consider reasoning. J continuously provides information to allow A to incrementally construe the concept J is asking for.

(1)
1. **J:** Can you think of any catalysts?
2. **A:** Er is it potassium permanganate?
3. **J:** <unclear>
4. **A:** What
5. **J:** Pla <pause> a duck billed
6. **A:** Pardon?
7. **J:** A duck billed
8. **A:** Platypus.
9. **J:** And it's not platypus it's <pause> sounds like a type of pen.
10. **A:** Platinum.
11. **J:** Right, platinum. (BNC; file FMR 728-737)

Recently, a body of work in a variety of areas, including formal linguistics (Gregoromichelaki et al., 2009), Conversation Analysis (Hayashi, 2013), Dialogism (Linell, 2009), psycholinguistics (Pickering and Garrod, 2004, 2013), computational linguistics (Traum and Larsson, 2003; Schlangen and Skantze, 2009), and dialogue modelling (DeVault et al., 2009) has begun to converge on the specific problems raised by the incrementality inherent in dialogue and interaction, and it is therefore timely to investigate how the insights from these disparate research programmes can be integrated into a model of dialogue, which accounts for incremental updating of common ground both within and between dialogue participants, and how they reason over these. We briefly survey these approaches to dialogue and their relative strengths and weaknesses below.

2.1 Rhetorical reasoning in dialogue

Reasoning in dialogue often involves non-logical common-sense inferences. We will use the Aristotelian term *enthymeme* in connection with such inferences. An enthymeme is an argument which appeals to what is in the listener's mind. In his *Rhetoric* Aristotle refers to enthymemes as belonging to the part of discourse concerned with content and reasoning (*logos*).

Aristotle relates the enthymeme to logic by calling an enthymeme 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, and is therefore negotiable and cancellable. 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 come later on.

(2) 1. **A:** Oh! I'm invited to a wedding that night.
2. **A:** But the bride is pregnant,
3. **A:** so I might drop by in the wee hours. (Breitholtz, 2014a, p1)

Thus, A communicates that the bride being pregnant is a *reason* for her being able to come to the party after all. To be efficient, or even understandable, this argument requires some underpinning notion or rule which sanctions 2.2 above as a reason for 2.3.

This kind of underpinning principles of reasoning have been discussed at length in the literature on rhetoric and argumentation (e.g. Toulmin, 2003, a.o.). However, the idea of rules of thumb available to language users, which justify statements, suggestions or other types of utterances goes back to early classical times. The Sophists taught their students to argue based on *topoi* – principles that had proved successful in similar types of arguments in the past (Jarratt, 1998). In modern times, the concept of topoi was introduced in linguistics as a theory of linguistic meaning with parts of discourse being connected by topoi (Ducrot, 1988). On this view the set of topoi accessible to an individual do not constitute a monolithic logical system, but represents a set of resources at the disposal of a dialogue participant for producing and interpreting arguments.

In the philosophy of language the type of reasoning involved in enthymematic arguments has been discussed in terms of implicatures (Grice, 1975; Sperber and Wilson, 1995), which are reached via assumptions of rationality and relevance. The necessity of background knowledge or common ground is not denied, but its role in a theory of pragmatic inference is often not described in a precise way. In the literature on non-monotonic logic the principles warranting conclusions are called *default rules* that is rules that are true if there is nothing to contradict them.

One of the advantages of using topoi as the underpinning for arguments, rather than default rules, is that the set of topoi of one agent does not need to be consistent or lead to consistent conclusions even within one model or domain (Breitholtz, 2014b). This ability to follow various strains of reasoning - including inconsistent ones - seems to be a prerequisite for the complex type of interactive language understanding and problem solving that humans master so well.

Additionally, scholars in pragmatics and non-monotonic logic have for the most part failed to recognise the importance of interaction in reasoning. Breitholtz (2014b) suggests a micro-rhetorical perspective on language, where enthymematic inference is seen as essential in linguistic interaction,

offering a way to combine insights from conversation analysis and rhetoric with dialogue semantics formalised in Type Theory with Records (TTR; Cooper, 2005, 2012). TTR is a rich type theory that has the advantage of modelling both utterance events and utterance types. This is crucial for analysing meta-communicative aspects of interaction, and TTR has been successfully used for formal dialogue models (Ginzburg, 2012; Cooper, 2013).

Many of these scholars would agree that reasoning – like other aspects of dialogue – is incremental. However, incremental reasoning in dialogue has not yet been studied in theories of reasoning or modelled formally.

2.2 Mechanisms for coordination

Dynamic Syntax (DS; Kempson et al., 2001; Cann et al., 2005) is a grammar formalism that provides mechanisms - identical in comprehension and production - for building interpretations from sequences of words. As 'syntax' is merely the procedures for jointly constructing meanings on a word by word basis, DS can explain dialogue data considered ungrammatical in theories in which syntactic information and word order is key (e.g., the clarification/completion in lines 6 and 8 of (1); see e.g. Gregoromichelaki et al., 2011). However, although it emphasises the incremental coordination of meaning construction, and accounts for speaker-hearer interchangeability, it fails to explain the role of feedback, where grounding cues such as backchannels allow interlocutors to show whether they have demonstrated their understanding of an utterance with differing levels of confidence.

The grounding model (Clark, 1996) emphasises the role of feedback in dialogue, but fails to specify what is shared in terms of meaning or interpretation. Clearly both interpretation and grounding are required for an understanding of how dialogue participants maintain, extend and reason over mutually intelligible common ground. Ongoing research which combines the syntactic mechanisms of DS with the semantic representations of TTR (Purver et al., 2010; Hough and Purver, 2012) has been proposed to address the issues of grounding and incremental clarification (Eshghi et al., 2015), and offers promising avenues for further research, though the work is theoretical at this stage.

2.3 Information state models

The approaches outlined in section 2.2 have an impoverished notion of context, in contrast to information state models (e.g. KoS: Ginzburg, 2012; Traum and Larsson, 2003), which show how coordination of the dialogue gameboard (DGB) progresses with successive utterances. The DGB provides a structured characterisation of the information available to dialogue participants and divides it into public (what is taken to be in common ground) and private, offering a principled way in which asymmetries in shared knowledge can be represented. A major contribution of this work has been in demonstrating that the same mechanisms, e.g. repair, can apply at all levels of linguistic interaction. For example the clarification question "what?" can query the sound or linguistic content of the prior utterance (to clarify a mishearing or identify a referent), or meta-linguistic information, such as the reasons for the utterance ("what do you mean?" cf. Purver and Ginzburg, 2004).

Breitholtz (2011) shows that some clarification requests are used to elicit enthymematic arguments. For example, C's clarification request in (3), elicits information that functions as a premise in the enthymematic argument "Let's meet in the drama studio, because I have an audition (and that's where I'll be)". If C can match this argument with topoi stored in her cognitive resources, she will make sense of what U is trying to communicate.

(3) 1. **U:** Will you meet me in the drama studio?
2. **C:** The drama studio?
3. **U:** Yes, I've got an audition. (Ginzburg, 2012, p149)

This link between questions and enthymemes is also apparent in the case of why-questions (Jackson and Jacobs, 1980) which can be used to elicit a reason for the speaker saying something.

KoS has formed the basis for a number of computational models discussed in section 2.5 below. However, this work to date has used non-incremental grammars which are not optimally capable of

capturing the full range of dialogue phenomena, or how people access this information in a timely way to reason with it.

2.4 The psychology of dialogue

Despite clear and well-established evidence from psychological experiments (Altmann and Kamide, 1999) and Conversation Analysis (Goodwin, 1979; Lerner, 1991) that people easily interpret and produce incomplete utterances, most psycholinguistic explorations of dialogue are motivated by linguistic theories that take the sentence as the basic unit of meaning (Frazier and Clifton, 2005) and/or psychological theories that emphasise the importance of individual processing (Pickering and Garrod, 2004, 2013). This means that no current psycholinguistic theory of dialogue attempts to offer a mechanistic account of fundamental dialogical phenomena such as grounding or repair, or to characterise their linguistic manifestations as non-sentential utterances and disfluencies. This focus means that experiments on dialogue are typically constrained in an interactional sense, by e.g., using a confederate who uses scripted rather than free dialogue and narrowing down the range of responses available to participants (Branigan et al., 2000). This is motivated by the need to maintain the level of experimental control, but means that it is unclear whether the results scale up to more naturalistic dialogue. Where corpus linguistics has been used to corroborate experimental results in natural dialogue, conflicting results emerge (e.g. in the ongoing debate on syntactic priming; Jaeger and Snider, 2013; Healey et al., 2014). These highlight the concern that corpus studies do not have the fine-grained control over the contexts and potentially confounding variables which is key for psychological experiments.

2.5 Computational models of dialogue

In computational models (Traum and Larsson, 2003; Schlangen and Skantze, 2009; DeVault et al., 2009) the focus is understandably on what can be practically implemented. This means they may not capture a complete picture of human-human dialogue, and can involve abstractions which are not necessarily psychologically plausible. For example, Poesio and Rieser (2010) take computation of the semantics and dialogue act or intention recognition to be essential to successful communication, but psycholinguistic evidence into 'good-enough' processing (Ferreira and Patson, 2007) suggests that many aspects of language comprehension may not be (or need to be) fully specified when building up interpretations. Conversely, computational modelling has highlighted the necessity of domain and genre specificity in models of dialogue, with implications for the conflicting results of psycholinguistic experiments, as discussed above. Although domain general interactional mechanisms (e.g. repair) are available, much of what we say is interpretable only within a specific domain and this serves to constrain the search space as to what will constitute an appropriate next contribution. This also constrains the resources – such as topoi – that will be available in any given conversational situation.

2.6 Summary

In summary, there is much interesting and ongoing research about various aspects of dialogue, as outlined above. However, the role of reasoning and implications for the organisation of common ground, including how relevant resources can be accessed and used incrementally in interaction has been hitherto underexplored. Due to significant recent advances in the application of linguistic theories to dialogue and new experimental techniques for dialogue (see section 3.1.1), we believe it is now possible to combine the insights from these fields into a model of incremental reasoning in dialogue.

3 Project description

This project aims to use experimental techniques from psychology and sociolinguistics to investigate how people reason in dialogue incrementally and model our findings using DS and TTR in an information state dialogue model. These theories and methods are independently motivated and their synthesis will allow us to formally demonstrate the interconnectedness of syntax, semantics and pragmatics in accounting for the role of interaction in reasoning in dialogue.

3.1 Method

We will use three highly inter-related methods to conduct this research: experiments, corpus studies and formal modelling. We will first conduct experiments into the responses people give to why-questions. The results of this will provide the initial data to be formally modelled and suggest targeted analyses for the corpus studies, to test the generalisability of our findings. Results from the corpus studies will therefore also be used to refine the dialogue model. The predictions of the model will then feed into the hypotheses and design of later experiments, which will provide evidence for preferring one dialogue model over another, and suggest ways in which our model can be improved.

3.1.1 Experiments

We propose to conduct a series of experiments to investigate the enthymemes people use in a dialogue, and to see what factors influence which argument people choose when more than one topos is available. Experiments will be conducted using the Dialogue Experimental Toolkit (DiET), a text chat interface, which has been successfully used to conduct experiments on dialogue phenomena, including clarification requests and compound contributions (Healey et al., 2003; Howes et al., 2012). The close experimental control means we can vary the information each participant is exposed to, without them being aware of this. The chat tool methodology is not restrictive in terms of language, and we will run experiments in Swedish and English, offering cross-linguistic validity to our results.

Previous experiments (see section 5) show that the *balloon task*, a moral dilemma in which participants have to decide who to throw out of a hot-air balloon that will crash into the mountains and kill all three if one is not sacrificed, leads to reasoning using enthymematic arguments. The choice, between a pregnant school teacher, her husband the pilot, and a research scientist who believes he is on the brink of a cure for cancer requires participants to construct chains of reasoning about who they think is most or least valuable. This is ideal for our purposes as there is no objectively right answer and different dialogues produce different chains of reasoning, resulting in different decisions (see (4) for examples from different dialogues concerning whether or not to throw out the scientist).

(4)
1. **P:** the doctor is as you say possibly going to change and save thousands of lives
2. **N:** It all comes down to how likely Nick really is to coming up with the cure
3. **S:** On very first thoughts, you'd think that the Dr should definitely stay. but he must have a team of scientists working on the project.
4. **P:** we dont know if the doctor is even a nice person. he could potentially be a terrible person who is just really clever

The first experiment will investigate how people understand their own reasoning processes, in the context of a dialogue, by asking them directly. We will introduce 'spoof' clarification questions into the dialogue that appear to come from the other participant, analogously to Healey et al. (2003), but directly addressing reasoning by using why-questions (e.g. 'what do you mean?', 'why?'). Responses to the spoof questions will be analysed for the underlying topoi. A variant of this experiment that has been programmed and piloted in a Masters course shows that such spoof questions do elicit enthymematic reasoning in their responses, as shown in 5, where the turn appearing to come from Participant 2 is actually a 'spoof' turn automatically generated by the server.

(5) **Participant 1:** do you think Susie is fat?
Participant 2: what do you mean?
Participant 1: because i think the fattest should jump, because he weighs more

We hypothesise that how people respond to the why-questions will be influenced by both the current turn, and the enthymematic arguments they have shared previously in the dialogue, with later turns leading to more explicit descriptions of topoi, as participants incrementally refine and recognise their own arguments through the process of dialogue.

For the second experiment we will use the character-by-character variant of the DiET chat tool to introduce why-questions both mid-turn (e.g. between a determiner and a noun) and at the end of a

turn (as Healey et al., 2011, do for reprise fragments), thus systematically varying how much of the turn has been produced before the server generated spoof why-question. This experiment will give us an insight into how accessible topoi are at different stages in the production of a turn.

Further experiments will seek to influence the choices made by participants by making different topoi more or less accessible in the dialogue. The task specific corpus analysis will provide a database of balloon task topoi, and we will add these as turns to the ongoing dialogue, providing possible arguments that the interlocutors had not themselves considered. In one experiment we will manipulate whether these enthymematic turns appear to come from the participants' conversational partner or from an external source (participants are known to do more work to accommodate information when it appears to come from their interlocutor (Healey et al., 2011; Howes et al., 2015)). In another, we will manipulate whether both participants are exposed to the same or different arguments, to investigate how mismatches at this level are managed. For these experiments we will also examine the dialogue partners' choice of who to sacrifice, and whether the additional arguments affected their ability to come to an agreement. Specific details of these experiments will be determined by the results of the corpus studies and the predictions made by our emergent formal model.

Based on previous experience with the chat tool (Howes, 2012; Howes et al., 2011, 2012, 2015), data from experiments in each year of the project is expected to take 1-2 months to collect (including recruiting subjects) and up to 4 months to analyse (in parallel with the other strands of research). The experiments will be designed and carried out by Howes and Breitholtz.

3.1.2 Corpus studies

We will collect data from a number of different sources, primarily the spoken portion of the British National Corpus (BNC) which contains over 10 million words, spoken Map Task dialogues in Swedish (Gross and Forsberg, 2015) and English (Anderson et al., 1991), and text-based dialogues from the Balloon Task Corpus (Howes et al., 2011). We will qualitatively analyse a small number of dialogues, both for linguistic features (e.g. repair; Colman and Healey, 2011) and the range of enthymematic reasoning employed. The specific annotation tasks will depend on the results from the first experiments, but the initial analysis will involve why-questions and their antecedents and responses. For a portion of the BNC (11,469 contributions from 53 dialogues) we will be able to cross-reference these analyses with existing annotations on non-sentential utterances (Fernández and Ginzburg, 2002), clarification requests (Purver et al., 2003) and compound contributions (Howes et al., 2011).

In the task specific dialogues, we will first extend preliminary work into identifying and categorising enthymematic arguments in balloon task dialogues (Breitholtz and Howes, 2015; Breitholtz et al., 2015) to produce a database of topoi used which can then be used in the second set of experiments. we will then look for examples where the dialogues result in alignment between interlocutors, as well as those which don't and analyse how this is managed linguistically. The results will give us insights into how enthymemes and topoi are employed, and how they are updated dynamically during a conversation. The analysis of online text chat about a moral dilemma will demonstrate how transferable the findings are to a different dialogue environment. Further corpus analyses will be informed by the formal models and experimental results.

The corpus work will be carried out by Howes and Breitholtz, both of whom have experience working with large dialogue corpora. Howes has collaborations with Matthew Purver (Queen Mary University of London) who will be available to offer advice on corpus studies, and provide access to an existing web-based annotation tool (Purver, 2001).

3.1.3 Formal modelling

Breitholtz (2014a,b) and Breitholtz and Cooper (2011) model enthymematic arguments and the underpinning topoi in the dialogue participants' resources as functions which return types (dependent types). As an example, the enthymeme in (2) would be represented as a function from a situation where someone is going to a wedding where the bride is pregnant to a type of situation where that

same person is still able to attend a different function on the same night. When a conversational participant makes an utterance like "the bride is pregnant – I might drop by in the wee hours", she counts on other dialogue participants having access to a set of topoi that combined are able to validate the argument. However, sometimes our individual takes on the conversation do not match. In (6) for example, J's utterance suggests that she has formed a hypothesis about the kind of argument P is making based on P's utterance and the topoi in J's resources which are associated with the type of situation described in that utterance.

(6) **P:** Metal was actually the reason I started doing Hip Hop ...

P: ...because I hated Metal.

J: Oh, I thought you were going to say something completely different!

This 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 (as described in e.g. Eshghi et al., 2015) – by incrementally constraining the search space. Our approach exploits the fact that our individual takes on dialogues usually match i.e. we have access to the same topoi which are necessary to interpret and evaluate arguments made or alluded to in dialogue, but we can probe this reasoning at the points where there is a mismatch.

Subtyping in TTR is important for our account of how we employ topoi in different enthymemes through operations like restriction, generalisation and composition. An Information State Update model cast in TTR in the style of Ginzburg (2012) allows for a precise representation of interactions involving enthymematic inferences underpinned by topoi, and it also makes it possible to predict the kind of enthymemes which will be interpreted and produced by an agent with access to specific topoi.

The formal model will be continuously developed thoughout the project, by all three researchers. Cooper is an expert in the semantics of natural language, from both a theoretical and computational perspective, specifically TTR. Breitholtz is an expert in enthymematic reasoning, formalised in TTR. Howes has worked on applying DS+TTR to dialogue phenomena.

3.2 Timetable

The projected timetable for these three work packages is illustrated in the Gantt chart below (figure 1). Key deliverables are conference and journal papers; see section 3.2.1.

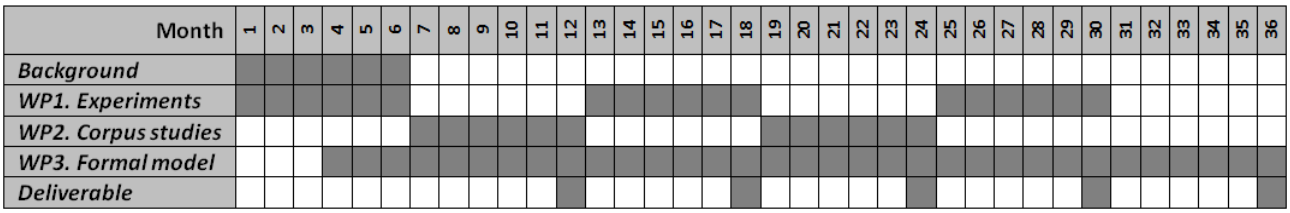

Figure 1: Projected timetable of project

3.2.1 Dissemination of the research results

Scientific results (including novel methods and empirical findings) will be communicated to the community through international peer reviewed conferences and journals. The primary targets are open access journal papers in the most prestigious journals in the areas relevant to IncReD (e.g. *Dialogue and Discourse*, *Cognitive Science*, *Computational Linguistics*, *Linguistics and Philosophy*). We also plan to submit papers to the most prestigious conferences in the area (e.g., Conference of the ACL, EACL, SemDial, SigDial, Cognitive Science Conference). We will also have a publicly accessible website and blog to report on progress in the project.

4 Significance

The proposed research project will address foundational questions in dialogue research. One of the main issues in understanding and modelling dialogue is in determining what constrains both

how we interpret the conversations we are part of, and how we decide on an appropriate next turn. This problem concerns how we can constrain the search space sufficiently that it is tractable, without making it so constrained that it is completely determined.

This approach is timely, building on very recent advances (cited above) in experimental and corpus techniques as well as syntactic, semantic and pragmatic modelling, and offers a formal way to represent aspects of world knowledge, including the sorts of reasoning people actually use in everyday conversation. Our approach of validating and refining our formal model with experimental and corpus evidence at all stages of the project offers the opportunity to empirically test our predictions, and has potential implications for a variety of areas of study, in addition to those outlined in the background research, including language learning and the organisation of the lexicon. Using the same representations for information at all levels means that we will have an efficient and scalable model to cover a wide range of dialogue phenomena, offering insights into not just how people say what they do, but why, thus contributing new insights to work on questions and clarification. This homogeneity of representation also means that the model will be implementable.

This has clear implications for artificial agents and interactive robots, specifically those intended to have human-like behaviours, e.g. companion robots for the elderly. One of the reasons it is currently so difficult to produce human-like dialogue models is that we do not fully understand the ways in which we use all of the resources available to us in communication. This project is intended to contribute to bridging this gap. The work in this project also has important implications for understanding reasoning in practical dialogic situations, including in areas such as understanding tacit knowledge in medicine (Thornton, 2006), and therapy dialogues, where a mismatch of underlying topoi between a psychiatrist and patient can have potentially catastrophic consequences (Thompson et al., 2015).

5 Preliminary results

Preliminary experiments using the DiET chat tool into incremental clarification (Healey et al., 2011) and compound contributions (Howes et al., 2012) show that participants use a variety of factors in responding to incomplete utterances and interruptive clarifications including the point at which the interruption occurs, the predictability of the upcoming material and common ground – in the case of incremental clarifications, it also matters whether the question appears to come from their interlocutor or an outside source. Work in Eshghi et al. (2015) on DS+TTR offers us a theoretical perspective from which to model these differences, but remains agnostic about what people are reasoning over in these cases, which is a key dialogic resource, as explicated in Breitholtz (2014a,b).

This means that current formulations of both mechanistic models and information state models of dialogue are currently insufficient to fully explain the incremental updating and accessing of common ground in interactive dialogue. These experiments, combined with insights from corpus studies (Howes et al., 2011; Purver et al., 2009) and recent work on DS+TTR (Howes, 2012; Eshghi et al., 2015) suggest that the co-construction of meanings and interpretations in dialogue depends on factors, including enthymematic reasoning, that are usually considered to be unformalisable. However, as Breitholtz (2014a,b) shows, enthymemes and topoi can be formally modelled using TTR (Cooper, 2005, 2012), and the non-monoticity of the system allows people to reason using inconsistent topoi, which, as seen in the balloon task dialogue examples (4) is typical of human reasoning. Preliminary work into identifying and categorising enthymematic arguments in balloon task dialogues (Breitholtz and Howes, 2015; Breitholtz et al., 2015) indicates the feasibility of using existing balloon task dialogues to create a taxonomy of arguments to feed into later experiments, as detailed in section 3.1.

These preliminary results suggest that experimental, corpus and formal techniques can be effectively synthesised. This project aims to do this, by developing a testable and psychologically plausible formal model of dialogue, based on an information state model. This model will be a first attempt to formally synthesise the convergent results discussed above, accounting for reasoning over dynamic but asymmetric common ground in dialogue.

6 Local environment and international collaboration

The project will be located within The Centre for Linguistic Theory and Studies in Probability (CLASP; led by Shalom Lappin; supported by the Swedish Research Council: E0003901) in our department at the University of Gothenburg. One of the centre's focus areas is dialogue and interaction.

We have links with internationally renowned researchers on several ongoing international projects who we will discuss our research and exchange ideas with. None of these directly address incremental reasoning in dialogue, but do involve work on areas linked to our proposal. Three such projects are:

DUEL: Disfluencies, Exclamations and Laughter in Dialogue, Jonathan Ginzburg, Universit Paris Diderot (Paris 7) and David Schlangen, Bielefeld University (Agence Nationale de la Research: ANR-13-FRAL-0001 and Deutsche Forschungsgemeinschaft: SCHL 845/5-1).
`http://www.dsg-bielefeld.de/DUEL/`

Babble: Domain-general methods for learning natural spoken dialogue systems Oliver Lemon and Arash Eshghi, Heriot-Watt University (EPSRC: EP/M01553X/1).
`https://sites.google.com/site/hwinteractionlab/babble`

Asymmetry in Conversation: Raquel Fernández Rovira, University of Amsterdam (NWO: 276-89-008).
`http://www.nwo.nl/en/research-and-results/research-projects/i/32/13232.html`

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