Managing the Complexity of Dialogues in Context: A Data-Driven Discovery Method for Dialectical Reply Structures

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Accepted: 24 October 2020 / Published online: 19 January 2021

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Abstract

Current formal dialectical models postulate normative rules that enable discussants to conduct dialogical interactions without committing fallacies. Though the rules for conducting a dialogue are supposed to apply to interactions between actual arguers, they are without exception theoretically motivated. This creates a gap between model and reality, because dialogue participants typically leave important content-related elements implicit. Therefore, analysts cannot readily relate normative rules to actual debates in ways that will be empirically confirmable. This paper details a new, data-driven method for describing discussants' actual reply structures, wherein corpus studies serve to acknowledge the complexity of natural argumentation (itself understood as a function of context). Rather than refer exclusively to propositional content as an indicator of arguing pro/contra a given claim, the proposed approach to dialogue structure tracks the sequence of dialogical moves itself. This arguably improves the applicability of theoretical dialectical models to empirical data, and thus advances the study of dialogue systems.

Keywords Dialogue systems · Data driven reply-structure · Protocol for debate

1 Introduction

The guiding idea behind formal dialogue systems was to furnish models featuring *simple* rules for natural dialogues that do not contain fallacies. These rules were designed as sets of “precise but not necessarily realistic rules” (Hamblin 1970, p. 256; see also Walton 1989). Scholars typically view dialogue systems as providing clear, readily implementable directions as to the move(s) a participant may (not) perform at a given dialogue stage. Participants' behaviour (as modelled by these systems) is determined

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by *locution rules* and *turn-taking rules*. Locution rules specify the communicative intentions that a participant can perform in a particular dialogue, whereas turn-taking rules specify a dialogue's appropriate reply structure. A third type of rule is furnished by commitment rules, regulating the logical consistency of participants' statements throughout the dialogue. Insofar as the three kinds of rule do indeed avoid the production of fallacies, it will be the case that they have brought this result about jointly.

Dialogue systems have seen a broad range of applications in *philosophy* (related to investigating dialogical contexts for argumentation—e.g., Walton 2003; Krabbe and van Laar 2011), in *human-computer interaction* (aimed, amongst other things, at enabling students to manage dialogues with proper reasoning—e.g., Wells and Reed 2012; Black and Hunter 2012; Lawrence et al. 2012; Reed and Wells 2007), and in *artificial intelligence* (where agents can communicate, negotiate and make decisions within various types of dialogue—e.g., Parsons and Jennings 1996; Parsons et al. 2003; Schroeder et al. 1998). Such applications have, moreover, revealed important limitations to formal models in respect of how they deal with the richness of natural communication: a dialogue model can only provide a highly over-simplified picture of communication—one that is difficult to apply to real-life conversations.

Presumably because of these limitations, scholarly interest appears to have shifted over the past years from applications of dialogue systems to large-scale corpus studies of dialogue structure. Current research strongly focuses on the annotation of real-life dialogues (using, e.g., internet chat-room protocols or conversational transcripts). Given the complexity and context-dependency of real-life dialogue, however, the emphasis on *argumentation* in dialogue appears to have been lost. Many scholars today hold that argumentation in real-life conversations does not lend itself readily to formal description. Indeed, given the vagueness surrounding the performative realisation of argumentation in context, some scholars claim that it is impossible for an analyst to model existing languages for dialogue systems *by theoretical means*. Bowden et al. (2019), for instance, argue that one can only capture the peculiarities of social communication by appealing to a purely data-driven model instead.

The main purpose of this paper is to address the challenges accompanying attempts to provide a formal description of the peculiarities that arise in argumentative dialogue. This requires a representation of two processes: those, namely, of dialogue construction and of argument construction. Both processes can be captured by inference anchoring theory (IAT) (Reed and Budzynska 2011), which the present author applied to a corpus analysis of transcripts of the BBC Radio 4 program *The Moral Maze*—a UK radio broadcast in which participants discuss moral aspects of social and political phenomena. The focal challenges in representing the two processes broadly underline the context dependency of real-life dialogues. The initial data, obtained after content analysis alone, did not reveal any regularities that could be formally described. Even so, rather than merely accepting such a state of affairs as given, this circumstance was treated as furnishing a basis for further research.

In the present context, I aim to address these challenges by means of an additional corpus analysis, and by developing a new method for managing the complexity of natural conversations. The proposed method includes contextual parameters as part of the data to be analysed. Using my own analytical experience of the discourse in question and its context as a reference point, I set out rationales for participants'

performing or not performing certain particular sequences of moves in the dialogue. Such rationales are defined as constraints responsible for shaping the unfolding debate.

Finally, I set out to capture the more fluid and vague behaviour of participants in real-life dialogues using the formal language defined by Wells and Reed (2012) for the purpose of argumentative dialogue description, representing all regularities as a set of so-called “transition schemes”. The approach presented yields surprisingly good results, furnishing 28 transition schemes that describe how participants present, challenge and justify their standpoints during the debate. In a second step, I then describe those transition schemes as a set of rule-governed, data-driven reply structures. The rules themselves are more complex than the rules for standard dialogue systems, but are also more applicable to the task of describing natural conversations.

This research thus contributes to furthering such dialectical systems as have been proposed by Woods and Walton (1978), Walton and Krabbe (1995), Bench-Capon (1998) and Reed and Walton (2007), who aim to model new features of fallacy-free dialogues. The proposed reply structure includes not only a larger spectrum of locution rules that participants tend to follow in a debate, but also a specification of the argumentative structure enacted during an actual conversation. Moreover, the method for managing dialogical complexity in a specific context allows analysts to enrich existing studies of dialogue modelling by including new features obtained from natural conversations. This research thus confirms a common intuition to the effect that communicative context influences participants’ argumentative choices (Locher and Graham 2010). Admittedly, this corpus-based research was carried out on a rather small scale. A more comprehensive description of the rules governing real-life dialogues would additionally require not only a quantitative description of the corpus, but also a qualitative analysis, including definitions of the rationale justifying participants’ behaviour within the discourse. (I must leave this to future research.)

In Sect. 2, I describe the concepts and main building blocks of standard dialogue systems. Section 3 then presents the corpus-based studies of the BBC Radio 4 debate, while Sect. 4 illustrates the proposed method for managing the complexity of real-life conversations and presents the data-driven turn-taking rules. Section 5 discusses the research findings that emerge, while Sect. 6 ends by making some concluding points.

2 Dialogue Systems

Formal dialogue systems, also known as “dialogue games”, are understood to be formal descriptions of argumentative communication. They are employed as normative, “precise but not necessarily realistic” (Hamblin 1970) sets of rules for evaluating argumentative soundness in the context of different types of dialogue. The evaluation is usually accomplished by verifying whether participants of the dialogue are following those rules. In breaking them, a participant commits a fallacy. The paradigm of dialogue systems was first established by Hamblin who, in the context of his formal dialectics, introduced the concept of “dialogue moderation” (ibid.). This idea was extensively elaborated by such systems as, for instance, Mackenzie’s DC (1979), Woods and Walton’s CB (1978), Walton and Krabbe’s PPD and RPD (1995), Bench-Capon’s TDG (1998), and Reed and Walton’s ASD (2007), all of which outline distinct

argument types as deployed in different sorts of communication (as defined by Walton and Krabbe 1995, for example).

A dialogue game is defined as a set of rules capturing, amongst other things, the number of participants who can take part in the dialogue, the types of moves (locution) a participant can perform, the commitments they undertake during the dialogue, and so on. Here we will regard Prakken's (2006) general description for persuasive dialogues as an example of a standard dialogue system.

For the purposes of the current paper, two sets of rules pertaining to the moderation of participants' interactions must be elaborated. The first of these concerns locution rules, which describe communicative intentions which participants can enact in the dialogue. These have been modelled according to Searle's (1979) speech act theory as illocutionary force and propositional content. Prakken (2006), meanwhile, mentions the following as the most common locution rules for persuasion dialogues: *claim* φ for asserting some proposition φ ; *concede* φ for agreeing with the opponent about φ ; *why* φ for challenging φ ; φ *since* ψ for justification of φ given the premise ψ ; and *question* φ for asking whether the opponent accepts that φ holds.

The second set to be mentioned is turn-taking rules (protocol). Such rules specify the interaction occurring between participants. The most frequently encountered turn-taking rules in dialogue systems for Persuasion are given below.

- P1. After *claim* φ a participant can perform: (1) *why* φ ; (2) *claim* φ ; (3) *concede* φ .
- P2. After *why* φ a participant can perform: (1) φ *since* S or *claim* S ; (2) *retract* φ .
- P3. After φ *since* S a participant can perform: (1) *why* ψ , where $\psi \in S$; (2) *concede* ψ , where $\psi \in S$.
- P4. After *question* φ a participant can perform: (1) *claim* φ ; (2) *claim* $\neg\varphi$; (3) *retract* φ .

Alongside the turn-taking rules as defined by Prakken, some general rules governing the dialogue must be introduced. These describe the dynamics of the dialogue and can be articulated along such lines as "one participant may perform one locution in one turn". There is no consistency between different dialogue systems in respect of how those are specified. Sometimes, a set of turn-taking rules will start with one or two introductory rules specifying the general governance of the dialogue, whilst on the other hand Prakken, for example, in the context of his general account, already defines certain separate types of move, naming these "turn-taking functions" and "termination rules".

All the elements of the dialogue systems described by Prakken (2006), or their parts, are employed in a range of practical applications, starting with the theoretical description of human communication and ending with protocol descriptions for agents in the context of AI. In the first instance, though, a dialogue system should perhaps be regarded as just offering a guide to the sound construction of dialogues for human beings themselves. For example, the systems presented by Walton and Krabbe (1995), Yaskorska et al. (2013), Kacprzak and Yaskorska (2014) and Visser (2017), can be used by human beings to construct conversations without fallacies in such a way that they can also check the formal soundness of the rules they are following in the course of their reasoning.

3 The Structure of Real-Life Dialogues

The corpus-based studies of dialogue structure carried out by such linguists as Grosz (1986), Core and Allen (1997), Sutton et al. (1995) and Condon and Cech (1996) have proved informative about the linguistic structure of conversations, the application of speech acts in dialogue, and possibilities for the design of human-computer interactions. Yet none of the existing corpus studies relating to dialogue have focused on the phenomena associated with arguing within dialogue. By contrast, the ultimate aim of the research presented here is to present standardised rules for dialogue modelling in line with the paradigm outlined in the previous section, where proposing such a reply structure is in fact tantamount to positing a new domain of inquiry.

The aim is to capture two phenomena: on the one hand the dialogue itself, and on the other the argumentation introduced in the course of it. This theoretical gap has been observed in the context of a project involving argumentation mining. The main goal of that research was to construct a tool for the semi-automatic recognition of arguments in natural dialogues. Since standard methods had not proved effective for the task, Budzynska et al. (2014) introduced a new algorithm based on dialogue-structure recognition. For the purpose of carrying out their studies, they applied inference-anchoring theory (IAT) (see Budzynska and Reed 2011) to an analysis of transcripts from the BBC Radio 4 program *The Moral Maze*. The latter provides an analytical framework that enables the representation not only of dialogue and argument structure, but also interrelations between them. The theory in question is also supported by software in the form of the OVA+ analytical tool (Janier et al. 2014).

This resulted in corpus MM2012₀, consisting of a series of episodes in which participants discuss moral aspects of important social and political issues arising in Great Britain. Every episode includes four panellists, these being people familiar in public life and with a background in social activism. The program also includes discursive exchanges with witnesses, who describe situations relevant to the issue being discussed. During each program, the panellists are divided into two camps for discussion, typically broadly corresponding to political viewpoints of the left and right.

The combination of this research problem and these theoretical tools led to the studies presented in the next three subsections. In 3.1, I set out some of the principal elements of the theoretical framework for representing interconnections between dialogue and argument structure. In 3.2, I then give an account of corpus-based studies of radio debates involving the application of the framework. Finally, in 3.3, I provide a quantitative description of the first round of such corpus studies.

3.1 Corpus Analysis: Applying the IAT Framework

Applications of the IAT framework to the analysis of *Moral Maze* corpus have already been described in detail by Budzynska et al. (2014), Yaskorska (2014) and Janier and Yaskorska (2016). In the present work, a couple of key elements will be mentioned, using analyses of representative examples from the MM2012₀ corpus.

Example 1 (MM2012₀:33388)

Fig. 1 IAT representation of example 1

Claire Fox1: Isn't the problem that the only thing the banks have done is kind of consumer credit?

Claire Fox2: They should actually be taking more risk and giving more money out.

In Example 1 above, we see Claire Fox putting forward an argument in the course of the episode of *The Moral Maze* entitled “The Morality of Money”. In this programme, the participants are engaged in exploring ethical aspects of getting into debt, and at this point the discussion steers towards the issue of whether the possibilities for taking out loans created by banks amount to something morally good or not, and why it is that creditors are now themselves imposing limits on such borrowing, when everybody has apparently been “brainwashed” into purchasing more and more new things. Here, Claire Fox argues that banks should relax their limits on borrowing, as they are the ones responsible for having brought about a situation in which consumers find themselves saddled with ever-increasing debts in order to fund lifestyles they cannot afford.

In accordance with the rules of analysis of the IAT framework (Fig. 1), I have parsed Fox's utterance into two units (propositional reports of discourse events), construing these as dialogue moves. One unit represents one premise or conclusion pertaining to an argument. (See, for example, Toulmin (1958), together with the description of the relevant analytical issues in Reed and Rowe (2005)). Each propositional report is further analysed as to its propositional content (the left-hand side of the diagram), with the specifications of communicative intentions (illocutionary connections) with respect to *rhetorical questioning* and *asserting* represented in the central nodes. According to the assumptions of the IAT framework, a conversation is conducted via the application of so called “transition rules”, which are represented as a “default transition” in the diagram. The transition rules are equivalents of the protocol rules in dialogue systems. (This point, it is worth stressing, is one that is directly in line with the goal of this paper—namely, the discovery of such rules in real-life dialogue.) I am able, then, to analyse Claire Fox's first locution as rhetorical questioning: even though she poses a question, she is actually voicing a standpoint, which could be verbalised as “The fact that the banks have concentrated on providing consumer credit is a problem”. Also, she does not wait for somebody to answer her question, but continues on with what she has to say. In the next sentence she gives a reason why she thinks that there is a

problem, doing so via *asserting*. Thus we see that this participant's utterance has been analysed as a sequence of locutions: as *rhetorical questioning* followed by *asserting*.

Fox, it should be noted, does not employ any inference indicator, such as "because" or "since". Yet we can still recognise that she is seeking to justify the standpoint she introduced in her *rhetorical questioning*. Indeed, argumentation in dialogical contexts is mostly provided without indicators. Budzyska and Reed (2011), while introducing the IAT framework, explain whence inference emerges in such situations. In applying this framework to our present example, I am indicating a relationship of sorts between the propositional contents of Claire Fox's moves. Moreover, an intention on her part to justify her standpoint must also be recognised. According to the IAT framework, the intention of arguing is an implicit illocutionary connection anchored in the transitions themselves. The propositional content of such an intention amounts to the obtaining of a relation between a premise and a conclusion with respect to the argument being put forward. This, in turn, can be a relation of inference or conflict, depending on the participant's intention to argue, disagree, or agree. The dialogical argumentation executed by Fox is represented in Fig. 1, which presents the participant as not only engaging in a sequence of locutions (i.e. *rhetorical questioning* followed by *assertion*), but also implicitly arguing. The situation encountered in the data can be informally described as rule $P_{IAT}1$:

$P_{IAT}1$. After posing the rhetorical question φ , the same participant can argue by asserting ψ , where $\psi \rightarrow \varphi$.

The $P_{IAT}1$ rule can be compared to the P2 rule from Prakken's general description outlined in the previous section, the latter being the only identifiable rule given there that is responsible for determining how participants may argue. Here, I appeal to the same features as prove relevant in the context of the language employed to describe dialogue systems: i.e. I point out the propositional contents participants are introducing (φ , ψ and $\psi \rightarrow \varphi$), I specify the locutions participants may use in the dialogical interaction (i.e. *rhetorical questioning*, *arguing* and *asserting*), and I identify the participant performing each move at a particular stage in the conversation (where, in this case, the reply is performed by the same speaker). At the same time, a dissimilarity appears when I shift to rule-construction for real-life dialogues, as the latter involves three communicative intentions within a single sequence of locutions. This amounts to a different approach to that of classical dialogue systems, in which just two illocutionary intentions figure in any one sequence. It derives from the structure and assumptions of the IAT analytical framework. In the present investigations, dialogue rules will not be written as two illocutionary forces for two moves, because of the need to represent the relevant implicit illocutionary connections.

Within the dialogical process, and especially in debates, participants tend also to disagree and counter-argue. A representation of disagreement is shown in Example 2 below, and consists of a fragment from the episode already mentioned. At this point, Anne McElvoy is explaining the distorting effects of the housing benefit UK citizens are entitled to receive when they are unemployed, in receipt of a low income, or unable to pay their rent. Melanie Philips disagrees with the statement, claiming that the previous speaker has failed to understand the social mechanisms underpinning such assistance.

Fig. 2 IAT representation of example 2

Example 2 (MM2012₀:43290)

Anne McElvoy A distorting effect then on whether you're prepared to go into training, whether you will go back in to the labour market; on what terms you're prepared to take a job. Do you not accept any of that?

Melanie Phillips This again comes down to your misunderstanding of how housing benefit works.

In Example 2 above, Melanie Phillips is not only responding to Anne McElvoy's assertive questioning, but is also attacking her argument. She introduces some propositional content that stands in a relation of conflict with the previous speaker's statement. Such behaviour, though common in natural dialogues, does not seem to be captured in existing dialogue systems. Using the IAT diagram shown in Fig. 2, such a situation can be modelled as rule P_{IAT2} . Wells and Reed (2012) propose to model this relation of conflict exhibited by the propositional contents of locutions performed with an implicit intention of disagreeing by means of the „ $\vdash\circ$ ” symbol:

P_{IAT2} . After a participant poses rhetorical question φ , his/her opponent can disagree by asserting ψ , where $\varphi \vdash\circ \psi$.

Rules P_{IAT1} and P_{IAT2} are introduced as semi-formal intuitive descriptions of dialogue situations. Their role here is to delimit the idea of the reply structure for debates, based on a transition scheme that is taken to furnish the core building blocks for describing the dynamics of the dialogue: that is, a scheme formally describing the sequence of moves and the implicit intentions anchored in the transitions between those moves. These formulae allow one to capture the reply structure of a dialogue, and so also the structure of the arguments introduced during the dialogue.

3.2 The Annotation Scheme

As a first step in the pursuit of the corpus study, an annotation scheme was defined and applied to the transcripts. This consisted of tags defined in terms of the communicative intentions participants tended to have during the debate. Budzynska et al. (2013) defined a set of such tags in the MM2012₀ corpus during their pilot research. In line

with the IAT analytical framework, two types of tag are defined. The first consists of illocutionary connections anchored in propositional reports of discourse events, while the second consists of those describing implicit intentions. Both are represented in the description of the radio-debate structure as set of locution rules. Defining this set represents a functionalisation of the discourse that is one of the main steps needing to be undertaken where studies of argumentative discourse are concerned—something asserted already by van Eemeren and Grootendorst (2004) and further elaborated with reference to the domain of pragma-dialectics by Visser (2017).

In a radio debate, participants perform the following locutions: *asserting* (A), where a speaker introduces his or her own beliefs or opinions; *popular conceding* (PCon), where he/she introduces generally accepted beliefs and opinions; *pure questioning* (PQ), where he/she asks another participant to provide an opinion on a given topic; *assertive questioning* (AQ), where he/she asks another participant to provide an opinion on some topic and, at the same time, conveys his or her own opinion; *rhetorical questioning* (RQ), where he/she introduces his/her beliefs or opinions, but frames his/her utterance as a question (and where the difference between this intention and assertive questioning can be presented at the level of dialogue dynamics—namely, that after assertive questioning the speaker leaves room for his/her antagonist to respond, whereas after *rhetorical questioning* he/she continues his/her utterance); *pure challenging* (PCh), where he/she asks other participants for justification of their standpoint; *assertive challenging* (ACh), where he/she not only asks for justification but also conveys his/her own opinion on the topic; and, finally, *rhetorical challenging* (RCh), where he/she introduces his/her opinion, but frames his/her utterance as a challenge (and where the difference between this intention and *assertive challenging* is the same as in the case of *assertive* vs. *rhetorical questioning*).

Apart from discursive events that are reconstructible as dialogical locutions in the traditional fashion (i.e. in terms of illocutionary force and propositional content), two new types of move were identified in the MM20120 corpus: “no” and “yes”. In the case of the former, an utterance with negation is used when a speaker performs a dialogue move in which he or she negates a previous utterance. Such a locution can be observed in Example 3 below. John Lamiday, in his move, introduces a propositional content that can be summed up as “no”. This utterance might be compared to *rhetorical challenging*, as a form of negation after which a speaker continues his or her own move, but where the move “no”, unlike *rhetorical challenging*, contains no propositional content.

Example 3 (MM20120:1872)

Clifford Longley So this activity is, in fact, taking a very unfair advantage of people in a moment of great weakness.

John Lamiday Oh, I don’t think that’s true at all.

As regards the latter, an utterance with confirmation (“yes”) is used when a speaker, in his or her move, confirms the propositional content of a previous move, as in Example 4:

Example 4 (MM20120:1872)

Table 1 Distribution of illocutionary connections anchored in locutions in the MM2012₀ corpus

IF	A	Con	PCon	PQ	AQ	RQ	PCh	ACh	RCh	Total
Occurrences	1502	64	56	83	107	72	10	12	13	1919

Table 2 Distribution of illocutionary connections anchored in transitions in the MM2012₀ corpus

IF	ARG	DIS	AGR	NON	Total
Occurrences	412	145	47	172	776

Claire Fox In some ways you need that discipline, don't you, to be a saver, to think, I won't get into debt?

Nick Dearden In some ways I agree with you.

Implicit illocutionary connections relating to the argumentation process that participants tend to employ are specified using three tags: *arguing* (ARG), where a participant provides an argument, *disagreeing* (DIS), where he/she provides a counter-argument or simply disagrees with a previous statement by means of a “no” move, and *agreeing* (AGR), where he/she agrees with a statement using a “yes” move. Moreover, within this same corpus we also encounter *non-anchoring* (NON) transitions (i.e. ones that do not serve to anchor any of the above-mentioned illocutionary forces). These can be indicative of certain other intentions unrelated to the argumentation process, such as narration or change of turn.

3.3 Quantitative Description

The MM2012₀ corpus presents us with a large range of argumentative situations, and exhibits a wide variety of characteristics, making it highly relevant to the task of building a model of debates. The entire corpus contains 58,000 words, and has 297 questions or challenges, for about 1500 assertions. The transcripts also present us with *discourse regulators* (DReg) which occur, on average, every 15 units. This type of move is one that is only deployed by the chair of the debate, for the purpose of keeping order. It can be illustrated by such utterances as “Thank you for your speech, now let's hear your antagonist”. Since such moves figure not only in argumentative language, but also in conversational topics more generally, they are not taken into account in the present analysis. Tables 1 and 2 below show a distribution of communicative intentions (anchored in locutions and transitions, respectively) that may be considered representative for the MM2012₀ corpus.

Table 1 captures the majority of the assertions performed in the dialogue, yet the number of different intentions suffices for them to be representative as far as debates of this sort are concerned. For example, the 56 occurrences of *popular conceding* observable in the corpus are enough to identify this intention as typical for the discourse under examination. The number of occurrences of the *non-anchoring* tag in Table 2 is small in comparison to those of arguing, agreeing or disagreeing situations. This

shows that the BBC radio debate is a highly argumentative affair. What is more, the tiny amount of agreeing (just 6% in Table 2) shows that the dialogue pertains to matters that are highly controversial.

Having annotated the corpus with the set of tags selected, it is time to determine the structure of the dialogues, described as a set of transition schemes. In Table 3, we encounter the distribution of transitions anchoring implicit illocutionary connections. In the rows of the table, the sequence of moves indicates the illocutionary forces of two consecutive moves in the dialogue. In the columns marked ARG, DIS, AGR and NON, we see the proportion of implicit intentions found in the sequence. It can be observed that participants in the debate under investigation do not introduce their arguments exclusively by making assertions. Rather, when it comes to introducing arguments and counterarguments, they appeal to a whole spectrum of communicative intentions.

At the same time, Table 3 illustrates the principle problem posed by the complexity of real-life dialogues. There are six instances—such as the sequence A;“no”—where the implicit illocutionary force can be clearly specified. Nevertheless, most of the dialogue situations remain imprecise at this level of analysis. Hence, the latter cannot be said to allow for the kind of descriptions of turn-taking rules for radio debate that would instruct participants clearly as to how they can actually argue in the context of such debates. For example, when a participant replies with assertion to an assertive question, he/she may be implicitly performing all kinds of implicit moves. The source of the problem is clear: real-life dialogues are conducted in contexts that themselves influence participants’ behaviour. Even so, our thesis remains that, in spite of everything, real-life dialogues can be formally captured. With this in mind, in the next section I will undertake another analysis of a deeper kind, in which the complexity of real-life dialogues is visibly addressed.

4 A Method for Managing the Complexity of Real-Life Conversation

As regards transition-scheme specifications, our radio-debate-related working corpus consists of two types of case. The first sort, named “simple cases”, clearly points to an implicit illocutionary connection anchored in the transition between locutions: e.g., within the A;“no” sequence, an intention of DIS is anchored. Such instances can be reported via a formal description of a turn-taking case identified in the corpus. Meanwhile, another type of sequence, named “complex cases”, may anchor different implicit illocutionary forces in different dialogue situations: e.g., a transition between AQ;A may anchor ARG, DIS, or AGR, depending on the context. If our description is to achieve a measure of clarity, some additional contextual analysis is therefore called for, and I shall present this in three stages: in 4.1, the language of transition-scheme specifications and method for managing the complexity of real-life conversations will be introduced; in 4.2, an example of corpus management following the proposed procedures will be demonstrated; and finally, in 4.3, the rules governing radio debates will be listed.

Table 3 Statistics for typical interactions in the MM2012₀ corpus

Replies to	#	Sequence	#	ARG	DIS	AGR	NON
A	611	A;A	513 (100%)	318 (62%)	88 (17%)	29 (6%)	78 (15%)
		A;PCon	14 (100%)	12 (86%)	2 (14%)	–	–
		A;PQ	19 (100%)	1 (5%)	1 (5%)	–	17 (90%)
		A;AQ	24 (100%)	10 (42%)	9 (37%)	–	5 (21%)
		A;RQ	25 (100%)	8 (32%)	3 (12%)	–	14 (56%)
		A;“no”	2 (100%)	–	2 (100%)	–	–
PCon	12	A;“yes”	2 (100%)	–	–	2 (100%)	–
		PCon;A	12 (100%)	9 (76%)	1 (8%)	1 (8%)	1 (8%)
	29	PQ;A	22 (100%)	3 (14%)	3 (14%)	–	16 (72%)
		PQ;PQ	3 (100%)	–	–	–	3 (100%)
		PQ;AQ	3 (100%)	–	–	–	3 (100%)
		PQ;“yes”	1 (100%)	–	–	1 (100%)	–
AQ	62	AQ;A	49 (100%)	14 (29%)	14 (29%)	11 (22%)	10 (20%)
		AQ;AQ	9 (100%)	4 (44%)	5 (56%)	–	–
		AQ;“no”	2 (100%)	–	2 (100%)	–	–
		AQ;“yes”	2 (100%)	–	–	2 (100%)	–
	12	RQ;AQ	6 (100%)	4 (67%)	–	–	2 (33%)
		RQ;RQ	6 (100%)	4 (67%)	–	–	2 (33%)
ACh	6	ACh;A	5 (100%)	2 (40%)	–	–	3 (60%)
		ACh;“yes”	1 (100%)	–	–	1 (100%)	–
Total	776		776	412	145	47	172

4.1 Formal Language and the Defining of Rationales

For the purpose of giving a formal description of the structure of the debate, I employ the concepts and formal language introduced by Wells and Reed (2012). The transition scheme is a formal description of a type of sequence that indicates the implicit illocutionary connection and the structure of argument anchored within it. Its basic building blocks are the pair of locutions L_x^b and L_y^w , where L is a locution that a participant can perform, x and $y \in \mathbb{N}$ indicate a sequence of moves, and b and w indicate speakers performing a move. The illocutionary connection anchored in the locution, along with any propositional content (see the left-hand and central nodes in the IAT diagrams in Figs. 1 and 1), is formalised in accordance with speech-act theory (Searle 1979: namely, $YA_k(\phi)$, where YA is a variable for tags from the annotation scheme, $k \in \mathbb{N}$ is an ordinal number assigned to the illocutionary connection, and ϕ is some propositional content. A locution in which a participant does not furnish any propositional content, in that they execute a move that can be summarised as “yes” or “no”, is represented as $L_{\text{“yes”}}^b$ or $L_{\text{“no”}}^b$. A transition between two moves is represented as $TA_z(L_x^b; L_y^b)$, where TA is a transition-scheme application. An illocutionary connection anchored in a transition is represented as $TA(L_x^b, L_y^w) \downarrow A_m(\psi)$.

A simple transition, involving asserting followed by “no”, can be represented as transition scheme TS1 in quotation 1. The first row of the scheme represents features of the first move in the sequence: first locution anchors *asserting* communicative intention. The second row shows the second move within it: this move can be represented as a simple denial “no”. Indicators b and w , which were assigned to the first and second locutions are used in the third line to show that the sequence was performed by different speakers. The third and fourth rows represent the way in which the second speaker’s disagreement will contribute to determining the structure of the argumentation. According to the IAT analytical framework, when a speaker performs “no” as a response to some propositional content ϕ he implicitly introduces $\neg\phi$, what is shown in the fourth row. At the same time, he performs *disagreeing* intention, propositional content of which is an obvious relation of conflict between ϕ and $\neg\phi$. This is captured in last line of the transition scheme.

$$\begin{aligned}
 & \text{TS1} L_x^b \downarrow A_k(\phi) \\
 & L_{\text{“no”}}^w \\
 & b \neq w, \\
 & TA(L_x^b; L_{\text{“no”}}^w) \downarrow A_m(\neg\phi) \\
 & TA(L_x^b; L_{\text{“no”}}^w) \downarrow DIS_m(\phi \vdash \neg\phi)
 \end{aligned} \tag{1}$$

Transition 1 captures the instance in MM2012₀ given in Example 5 below, whose IAT representation is then presented in Fig. 3. This is a fragment from the programme “Problem families”, where the participants are disagreeing as to whether poverty is a choice or not.

Example 5 (MM2012₀:1007)

Fig. 3 IAT representation of Example 5

CL They have absolutely very little choice except to take the terms that are being offered to them

JL And that is totally untrue.

Complex cases can be described as transition schemes along similar lines to TS1 above. Nevertheless, we need to add to this certain parameters that influence the way speakers make use of a particular sequence for arguing, disagreeing and agreeing. Surprisingly, it appears that only two such contextual parameters suffice for a precise reply structure specification. The first concerns how the dialogue is governed: in radio-debate discourse a speaker may, in the course of a single utterance, introduce several pro- and con- arguments using different communicative intentions. Hence, a description of a radio debate as a context for arguing must not only take account of turns involving different speakers, as is specified in standard dialogue systems, but should also capture situations where a participant responds to his or her own locution. This gives two types of transition: a transition with the same respondent (S), where two consecutive locutions are produced by the same speaker, and a transition with a different respondent (D), where consecutive locutions issue from different speakers. The other contextual parameter, meanwhile, pertains to the use of reported speech: participants in the debate tend to invoke some previous statement of their opponents in order to attack it or demonstrate the inconsistency of the latter's claims.

Furthermore, two situations can be specified on the basis of this second parameter, as well: the participant can use reported speech in his or her move (R), or can use his or her own statements (N). Combined together, these two parameters then specify four types of transition: same-respondent transition with reported speech (SR), same-respondent transition without reported speech (SN), different-respondent transition with reported speech (DR), and different-respondent transition without reported speech (DN). Within these four types of transition, a participant can implicitly argue, disagree, agree, or perform a move with no implicit argumentation-related intention. Such a classification gives 16 possible instances, indicated as values in the template shown in Table 4.

Each value from the above table was justified by defining a rationale for a respondent's performance of a move in the dialogue. Such a rationale was defined as a

Table 4 Template for capturing frequency of occurrence, where S means that both locutions were performed by the same speaker, D means that locutions were performed by different speakers, R means that the content of one locution is expressed as reported speech, and N means that there was no reported speech found in the propositional content of the locutions; grey cells indicate cases that cannot occur in debate

$L_x;L_y$	S		D	
R	Arguing (ST1)	SR_{ARG}	Arguing (DT1)	DR_{ARG}
	Disagreeing (ST2)	SR_{DIS}	Disagreeing (DT2)	DR_{DIS}
	Agreeing (ST3)	SR_{AGR}	Agreeing (DT3)	DR_{AGR}
	Non-anchoring (ST4; ST5)	SR_{NON}	Non-anchoring (DT5)	DR_{NON}
N	Arguing (ST1)	SN_{ARG}	Arguing (E1)	DN_{ARG}
	Disagreeing (E2)	SN_{DIS}	Disagreeing (DT2)	DN_{DIS}
	Agreeing (E3)	SN_{AGR}	Agreeing (DT1)	DN_{AGR}
	Non-anchoring (ST4; ST5)	SN_{NON}	Non-anchoring (DT5)	DN_{NON}

response to the question “Why would a respondent *w* respond to his/her own or his/her opponent’s move?” That question receives an answer in each case from the author of the present article—who, as an analyst, is operating from a standpoint of familiarity with the discourse. The reasons for participants to take a turn were chosen from the set of implicit intentions relating to argumentation: namely, ARG, DIS, AGR and NON. Each rationale is mentioned next to the value it justifies in the template.

A respondent may reply to his/her own locution when he/she:

- ST1: Introduces a pro-argument for a statement (TA anchors *arguing*);
- ST2: Introduces a con-argument to someone else’s statement after invoking the latter’s words (TA anchors *disagreeing*);
- ST3: Agrees with someone after invoking their words (TA anchors *agreeing*);
- ST4: Narrates a story (TA is *non-anchoring*);
- ST5: Changes the topic (TA is *non-anchoring*).

A respondent may reply to the locution of his/her opponent when he/she:

- DT1: Introduces a pro-argument for the statement introduced in the previous move through reported speech (TA anchors *arguing*);
- DT2: Introduces a con-argument to the statement introduced in the previous move (TA anchors *disagreeing*);
- DT3: Agrees with the previous speaker (TA anchors *agreeing*);
- DT4: Answers a question (TA is *non-anchoring*);
- DT5: Changes the topic or responds to the question (TA is *non-anchoring*).

Above and beyond these two sets of possibilities, situations also arise that are, nevertheless, quite untypical for the discourse: participants might (but do not tend to) justify each other’s statements during the debate, and might (but do not normally) agree or disagree with their own opinions. These correspond to the cases shown as grey cells in Table 4, and listed below.

Cases not typical for radio debates:

- DE1: *arguing* anchored in a dialogical transition between locutions performed by different speakers where there is no reported speech: participants in radio debates do not as a rule aim to justify their opponents' standpoints;
- DE2: *disagreeing* anchored in a monological transition without reported speech in L_x : participants do not as a rule disagree with themselves;
- DE3: *agreeing* anchored in a monological transition without reported speech in L_x : participants do not as a rule explicitly agree with themselves.

A transition scheme can be specified when only one implicit illocutionary force has been used within a transition type. In such a situation we may speak about there being "a unique value". For example, a value—say, DR_{ARG} —can be regarded as unique only when there is at least one case in the data picked out by DR_{ARG} , and no cases captured by the values DR_{DIS} , DR_{AGR} or DR_{NON} . In this case, we may wish to describe arguing in the context of a different-speaker sequence with reported speech being used. For the sake of arriving at a precise transition-scheme description, it will then be necessary to distribute occurrences of complex cases according to the template presented. For example, we can find ourselves furnishing a transition scheme for a sequence which, at the IAT level of analysis, can anchor ARG and DIS, because it turns out that participants are behaving differently in different contexts: e.g., that they argue without using reported speech when responding to their own moves, but disagree using reported speech when replying to opponents' moves.

In a situation where, after data distribution, the data itself remains unclear (as when values show up from the set of those corresponding to dialogue errors), the occurrences represented by that data can be re-analysed. It turned out that such re-analysis can also then reveal errors in the first round of corpus analysis, such as those listed below:

- AE1: Wrongly annotated illocutionary connections anchored in locutions—i.e. mistakenly assigned illocutionary forces from the set (A, PCon, PQ, AQ, RQ, PCh, Ach, RCh);
- AE2: Wrongly annotated illocutionary connections anchored in transitions—i.e. mistakenly assigned illocutionary forces from the set (ARG, AGR, DIS, NON);
- AE3: Unrecognised reported speech.

Re-analysed cases were mostly represented by non-unique values and dialogue error values. Also, all instances of *non-anchoring* were re-analysed due to the high percentage of unrecognised ARG, DIS and AGR illocutionary connections, which may indicate the presence of analytical error AE2. In the wake of applying the proposed procedure for managing dialogue complexity to the MM2012₀ corpus, 28 transition schemes were specified.

4.2 An Example of the Application of the Method

A sequence consisting of asserting followed by assertive questioning (A;AQ) will serve here as a representative example of complexity in real-life conversation. According to the data from Table 3, over the course of 24 appearances of this sequence, the transition between the two anchored ARG in 10 occurrences and DIS in 9 occurrences, and was NON-anchoring in 5 occurrences. The participants' use of different implicit intentions

Table 5 Initial list of occurrences of the A;AQ sequence in the MM2012₀ corpus

A;AQ				
	S	18	D	6
R	Arguing (ST1)	0	Arguing (DT1)	0
	Disagreeing (ST2)	3	Disagreeing (DT2)	0
	Agreeing (ST3)	0	Agreeing (DT3)	0
	Non-anchoring (ST4; ST5)	0	Non-anchoring (DT5)	0
N	Arguing (ST1)	10	Arguing (E1)	0
	Disagreeing (E2)	2	Disagreeing (DT2)	4
	Agreeing (E3)	0	Agreeing (DT1)	0
	Non-anchoring (ST4; ST5)	3	Non-anchoring (DT5)	2

within the sequence does not allow this case to be classified as simple. Therefore, I propose to analyse the context responsible for determining their behaviour. Additional annotation of all 24 cases of the A;AQ sequence with selected contextual parameters resulted in their being distributed within the template as shown in Table 5 below.

In the initial distribution of A;AQ sequence occurrences, the value SR_{DIS} is already unique. I can say with confidence that when a speaker responds to their own assertion and uses reported speech (i.e. SR), he/she is implicitly disagreeing. Also, there are no instances of different-speaker transition with reported speech. This allows us to exclude this transition-type from the reply-rule specification for the sequence being investigated. Nevertheless, in the case of the transition-type where participants did not use reported speech, there are two rather more unclear situations. In the case of a transition performed by the same speaker, three values were identified: SN_{ARG} , SN_{DIS} and SN_{NON} . Arguing in same-speaker turn is justified by rationale ST1, which says that participants can justify a statement put forward by themselves in a previous move. However, within the same type of transition disagreeing is not allowed, due to constraint DE2. Therefore, it is necessary to review the analysis of those two occurrences—as also with non-anchoring cases. In the case of different-speaker transition types, the data also must be reviewed. In this transition-type, two values can be identified: SN_{DIS} and SN_{NON} . According to rationale DT2, a participant in a radio debate may disagree with the statement their opponent has put forward.

Due to constraints on space, I will confine myself here to examining two samples subjected to data revision, with the aim of giving readers an idea of how the corpus revision was conducted. An example of disagreement within a same-speaker transition—illustrating cases representing the value SN_{DIS} —is given below:

Example 6 (MM2012₀:365)

Melanie Phillips You say that people who are powerless cannot be prejudiced.
 Melanie Phillips So when black people say, for example, Jews control the banks, that's not prejudice?

In the case of Example 6 above, which is a fragment of an episode in which participants seek to address the issue of inclusivity in Great Britain, reported speech can

Table 6 Revised list of occurrences of the A;AQ sequence in the MM2012₀ corpus

A;AQ	S	18	D	5
R	Arguing (ST1)	0	Arguing (DT1)	0
	Disagreeing (ST2)	7	Disagreeing (DT2)	0
	Agreeing (ST3)	0	Agreeing (DT3)	0
	Non-anchoring (ST4; ST5)	0	Non-anchoring (DT5)	0
N	Arguing (ST1)	11	Arguing (E1)	0
	Disagreeing (E2)	0	Disagreeing (DT2)	5
	Agreeing (E3)	0	Agreeing (DT1)	0
	Non-anchoring (ST4; ST5)	0	Non-anchoring (DT5)	0

be identified in both locutions. In the first of these, Phillips recalls her opponent's statement, and in the second, the hypothetical standpoint of a group of people. This discloses annotation error AE3. As a result, the occurrence is classifiable as instantiating the value SR_{DIS} , which aims to indicate locutions with reported speech. Another case to be mentioned here is represented in Example 7 below:

Example 7 (MM2012₀:2129)

Owen Jones I mean we spend about 20 billion as a nation on housing benefit.

Anne McElvoy I was just trying to find out whether you thought that in itself this is undesirable.

This is a fragment of an episode in which participants are discussing the morality of maintaining a welfare state that involves giving citizens credits and a standard of living they themselves cannot afford. In it, annotation error AE1 is committed. Here, Anne McElvoy's move in the sequence—the second—is not a question, but an assertion. This is put forward with the goal of encouraging Owen Jones to provide the kind of answer Anne is expecting, while the utterance in question also serves as a description of her expectations—though not as an utterance having any of the illocutionary connections proper to a question. On that basis, this case was lifted from the analysis of the A;AQ sequence.

The review of the data left 23 cases of the A;AQ sequence as material for consideration. Their distribution is presented in Table 6. The data, clearly distributed, yields three unique values: $SR_{DIS} = 7$, $SN_{ARG} = 11$, and $DN_{DIS} = 5$. On the basis of these, the transition schemes T9, TS10 and TS11 can then be defined.¹

Now as regards the TS9 transition scheme given below, the first two lines suffice to indicate the sequence the scheme pertains to. The first line of this says that the first locution of the sequence anchors reported speech, while the second shows that a speaker responded with an instance of *assertive questioning* towards the first locution. The third then goes on to specify the reported speech in more detail: namely, anchoring

¹ The numbering of transition schemes employed here remains in line with the original and complete set as presented in the "Appendix".

Fig. 4 IAT representation of the Disagreeing illocutionary connection from Example 6

an instance of *asserting* on the part of the person cited. Meanwhile, the fourth states that both locutions were performed by the same person. Finally, the last line specifies an implicit illocutionary intention of *DIS* anchored in the transition between the two locutions. The relation of conflict obtains between the propositional content of the reported speech and the statement conveyed during *assertive questioning*. The structure of such a dialogue move is shown in Fig. 4 below.

$$\begin{aligned}
 \text{TS9} & L_x^b \downarrow A_k (L_z^p) \\
 & L_y^w \downarrow A Q_l (\psi) \\
 & L_z^p \downarrow A (\phi) \\
 & b = w; \\
 & T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \phi)
 \end{aligned} \tag{2}$$

Transition scheme TS10, given below, describes a same-speaker transition type without reported speech. Here, in the first line, we encounter a locution consisting of a simple *asserting* of a propositional content ϕ . The second line represents assertive questioning of a propositional content ψ , while the third informs us that both locutions are performed by the same speaker. The two last lines represent implicit communicative intentions of *agreeing*, which are being anchored by the transition between those two locutions. In this case, some flexibility is called for in respect of which, out of ϕ and ψ , is the premise and which the conclusion.

$$\begin{aligned}
 \text{TS10} & L_x^b \downarrow A_k (\phi) \\
 & L_y^w \downarrow A Q_l (\psi) \\
 & b = w; \\
 & T(L_x^b; L_y^w) \downarrow ARG_m (\phi \vdash \psi) \\
 & \text{or } ARG_m (\psi \vdash \phi)
 \end{aligned} \tag{3}$$

Transition scheme TS11 illustrates the context of a different-speaker transition performed as an A;AQ sequence. The first line of the scheme represents the first locution of the sequence, the second line the second locution. The third tells us that this time, the two locutions were performed by different speakers. The disagreement identified in such a context, along with its propositional content, are indicated in the final line of the description.

$$\begin{aligned}
 & \mathbf{TS11} L_x^b \downarrow A_k(\phi) \\
 & L_y^w \downarrow A Q_l(\psi) \\
 & b \neq w; \\
 & T(L_x^b; L_y^b) \downarrow DIS_m(\psi \vdash \phi)
 \end{aligned} \tag{4}$$

This proposed procedure for carrying out corpus re-analysis was applied to the entire MM20120 corpus. In most cases, a new distribution of instances yielded unique values, which were then captured in the form of 28 transition schemes.² When it comes to defining the reply structure for the debate in the manner outlined in the following section, this set of transition schemes will play a core role.

4.3 The Reply Structure for Radio Debates

Protocol rules are constructed for three types of implicit communicative intentions: *arguing*, *agreeing* and *disagreeing*. When it comes to non-anchoring transitions (i.e. all other types of communicative intention, taken together as a set), the following four intentions are picked out: introducing the second statement of a same-speaker transition, introducing the second question of a same-speaker transition, asking a question in a different-speaker transition, and answering a question in a different-speaker transition.

Given the contextual parameters considered above, we are dealing here with both same-speaker and different-speaker forms of interaction. Given this fact, two separate sets of rules must be specified: one for each of these. Therefore, to capture the dynamics of real-life debate, the possibility of performing two moves in a row must also be introduced. In the debates of *The Moral Maze*, participants would sometimes introduce more than two moves in a sequence. Nevertheless, our first version of the data-driven model remains a simplified one, as the role of the chair is not included here. In addition, in our current version of the description, one turn for a participant will be limited to two same-speaker sequences. This will exclude the possibility of long monologues. It is also worth noting that in the case of the sequence $L_m^b; L_{m+1}^w$, where $b \neq w$, w should have priority as regards continuing his or her move while following same-speaker transition rules. With these considerations in mind, rules GT1 and GT2 can be stipulated as serving to define the general governance of a dialogue. They allow a participant to introduce simple arguments—i.e. one statement and one premise for purposes of justification or attack:

GT1: After a sequence $L_m^b; L_{m+1}^w$, where $b \neq w$, the performer of the second move can perform move L_{m+2}^w or give a turn to his opponent;

GT2: In the sequence of moves $L_1; L_2; \dots; L_n$, and where $n \in \mathbb{N}$, where $L_m^b; L_{m+1}^w$ (where $1 \leq m \leq n$, and $b = w$) was performed by one speaker, move L_{m+2}^w must be performed by another speaker.

Rules for applying same-speaker transitions:

² Of these, four still included more than one possible anchored illocutionary force, where such cases already then call for a third—linguistic—level of analysis. Even so, 24 of the transition schemes did specify a clear dialogical context for argumentation, and could be described as turn-taking rules for debate.

STR1: After *asserting* φ , where φ does not contain reported speech, a participant performs:

- STR1.1: *arguing*, via *asserting* ψ , where $\psi \rightarrow \varphi$;
- STR1.2: introducing a second statement, via *asserting* ψ ;
- STR1.3: *agreeing*, via *popular conceding* ψ , where $(\psi \rightarrow \varphi)$;
- STR1.4: *arguing*, via *assertive questioning* ψ , where $\psi \rightarrow \varphi$ or $\varphi \rightarrow \psi$;
- STR1.5: *arguing*, via *rhetorical questioning* ψ , where $\psi \rightarrow \varphi$;
- STR1.6: introducing a second statement, via *rhetorical questioning* ψ ;
- STR1.7: *disagreeing*, via *asserting* L_p , where L_p contains ψ (the reported speech of p), and where $\psi \vdash \circ \varphi$.

STR2: After *popular conceding* φ , where φ does not contain reported speech, a participant performs:

- STR2.1: *arguing*, via *asserting* ψ , where $\varphi \rightarrow \psi$ or $\psi \rightarrow \varphi$.

STR3: After *pure questioning* φ , where φ does not contain reported speech, a participant performs:

- STR3.1: introducing another question, via *pure questioning* ψ ;
- STR3.2: introducing another question, via *assertive questioning* ψ .

STR4: After *assertive questioning* φ , where φ does not contain reported speech, a participant performs:

- STR4.1: *arguing*, via *asserting* ψ , where $\varphi \rightarrow \psi$;
- STR4.2: *arguing*, via *assertive questioning* ψ , where $\varphi \rightarrow \psi$ or $\psi \rightarrow \varphi$.

STR5: After *rhetorical questioning* φ , where φ does not contain reported speech, a participant performs:

- STR5.1: *arguing*, via *asserting* ψ , where $\varphi \rightarrow \psi$;
- STR5.2: introducing another statement via *asserting* ψ ;
- STR5.3: *arguing*, via *assertive questioning* ψ , where $\varphi \rightarrow \psi$;
- STR5.4: *arguing*, via *rhetorical questioning* ψ , where $\varphi \rightarrow \psi$;
- STR5.5: introducing another statement, via *rhetorical questioning* ψ .

STR6: After *assertive challenging* φ , where φ does not contain reported speech, a participant performs:

- STR6.1: *arguing*, via *asserting* ψ , where ψ contains reported speech.

STR7: After *asserting* L_p , where L_p contains φ (reported speech of p), a participant performs:

- STR7.1: *disagreeing*, via *assertive questioning* ψ , where $\psi \vdash \circ \varphi$.

STR8: After *assertive challenging* L_p , where L_p contains φ (reported speech of p) a participants performs:

- STR8.1: *arguing*, via *asserting* ψ , where $\varphi \rightarrow \psi$.

Rules for applying different-speaker transitions:

DTR1: After a speaker b has engaged in *asserting* φ , where φ is not reported speech, a speaker w performs:

- DTR1.1: *disagreeing* via performing a “no” move;
- DTR1.2: *agreeing* via performing a “yes” move;
- DTR1.3: *arguing*, via *popular conceding* ψ , where $\psi \rightarrow \varphi$;
- DTR1.4: *disagreeing*, via *assertive questioning* ψ , where $\psi \vdash \varphi$;
- DTR1.5: *disagreeing*, via *rhetorical questioning* ψ , where $\psi \vdash \varphi$.

DTR2: After a speaker b has engaged in *assertive questioning* φ , a speaker w performs:

- DTR2.1: *disagreeing* via performing a “no” move;
- DTR2.2: *agreeing* via performing a “yes” move;
- DTR2.3: *agreeing* via *asserting* φ ;
- DTR2.4: *disagreeing* via *asserting* ψ , where $\psi \vdash \varphi$;
- DTR2.5: a non-anchoring move.

DTR3: After a speaker b has engaged in *popular conceding* φ , where φ is not reported speech, a participant w performs:

DTR3.1: a non-anchoring move, e.g. changing the topic via *asserting* ψ .

DTR4: After a speaker b has engaged in *pure questioning* φ , where φ does not contain a reported speech, a participant w performs:

DTR4.1: answer the question via *asserting* ψ .

DRT5: After a speaker b has engaged in *rhetorical questioning* φ , where φ is not *reported speech*, participant w performs:

DTR5.1: *disagreeing* via *asserting* ψ , where $\psi \vdash \varphi$.

The definition for each rule is based on a transition scheme indicating the fact of its appearance in the corpus. Certain sequences, whose being allowed seems to be obvious to the point of triviality, are not included in the proposed set. At this juncture, moreover, it is worth restating that the goal of the present research is to generate rules that will track real-life debate as closely as possible. Such an approach must therefore leave the door open for possible expansions of the reply structure, in the event that further analysis of the corpus brings to light new sequences capturing how participants argue.

5 Discussion

In the wake of the foregoing research, certain observations emerge that seem relevant when seeking to discuss possible future directions of investigation. The constraints on contextual analysis of the discourse that were adopted here—such as the rationales chosen, and errors highlighted, at a preliminary stage of the description process—could, of course, be expanded or altered for the purpose of analysing different sorts of discourse. In the present scenario, conditions were chosen that would allow for the recognition, via the application of particular descriptive models, of variants of

the argumentative process present in the naturally occurring text. For example, the assumption that a participant performs L_y in some different-speaker interaction in order to introduce a pro-argument for the statement introduced by his or her antagonist could have been picked up on. However, this cannot count as a rationale where radio debate is concerned, since in this type of dialogue participants do not justify each other's beliefs. Equally, one could have opted to assume that a participant can keep on performing turns within a same-speaker interaction in order to block the possibility of his or her antagonist getting a chance to speak. Yet this parameter is definitely not applicable to the analysis of debates conducted on the BBC Radio 4 channel.

The research results set out here also point to differences between the reply structure of persuasion dialogues of the sort modelled by standard dialogue systems and ones occurring in a natural context. The first such difference emerges already at the level of the specification of locution rules. It is simply not possible to fit the whole spectrum of communicative intentions manifested in the debate into standard languages for dialogue systems. What is surely interesting in this respect is that an expanded list of tags, defined in the wake of the pilot studies, proved sufficiently exhaustive to identify all of the intentions participants were seen to execute across multiple episodes of the programme *The Moral Maze*.

These findings certainly do not exhaust the real-life sources upon which one might draw when seeking to bring argumentative processes to light for theoretical purposes. Such intentions as *assertive questioning*, *rhetorical questioning* and *assertive challenging* represent new operations with respect to our commitment store, of the sort that may well prompt further research into what is involved in fallacy-free arguing. For example, when a participant asks a question and conveys his or her own belief, as in the case of an instance of *assertive questioning*, this affects not only his or her opponent's commitment store, but also his or her own one, with consequences for the future that stem from the commitments in question. The same situation holds, as well, for *assertive challenging*, and even more so for *popular conceding*, which would seem to install the propositional content involved in everyone's commitment base. (A participant who wishes to remove the statement in question from his or her base must furnish a sufficient counter-argument.) These and other examples point to the possibility of a dialogue system in which the context for argumentation is more highly elaborated in respect of commitment rules—a set of rules of the kind that the present author has been obliged to pass over in the context of this study. Such an investigation should also include a reliable analysis of new communicative intentions in terms of pragmatic goals, and of the functions of antecedently raised questions, as well as a preliminary survey of expected answers, too. Such work would offer a basis for further elaboration of our current technical definitions of the intentions involved, but this time on the basis of observation.

As was noted earlier, corpus studies can also serve to identify novelties in dialogue structures as contexts for arguing. The first peculiarity in this regard is that, in a persuasive dialogue such as a radio debate, participants do not have to be triggered to argue in ways defined in standard systems using the move “Why φ ”. The debate dynamics are constructed in such a way that there are many same-speaker turns in which participants justify their statements right after posing them, without any invitations. More than challenging, participants in radio debate use disagreement. They attack

standpoints without asking for justifications. The use of reported speech seems like an obvious feature, but actually has yet to be adequately captured. Participants make use of their antagonists' words in their own process of argumentation, and including this factor in the descriptive model proves helpful when it comes to explaining such anomalies as "self-disagreement", where a participant responds to his or her own move by disagreeing.

Finally, some sort of brief mention needs to be made of the set of turn-taking rules presented here. The set in question is an open one. New rules for the type of dialogue encountered in *The Moral Maze* can certainly be added, as and when they are uncovered in the transcripts. The present author believes that the turn-taking rules proposed here may offer a starting point for defining a data-driven dialogue system, while the method according to which those rules have been defined could, equally, be applied to other discourses in order to descriptively capture their structure as well. Without wishing to sound over-optimistic, data-driven models thus promise to impart a second breath of life to projects involving the application of dialogue systems.

6 Conclusions

The aim of this paper has been to present two things: firstly, a method for managing the complexity of dialogues in natural context, and secondly, a data-driven reply structure for radio debates—where the latter is meant to serve as a illustrative of the application of that method to the discourse actually met with in episodes of the BBC Radio 4 broadcast series *The Moral Maze*. As such, the approach is one that seeks to capture the real-life dialogical context of such debates, specifically as far as argumentation is concerned. The proposed reply structure promises, through its attempt at a formal specification of what actual communication involves, to help close the theoretical gap between communication modelling and communicative reality. Indeed, it now seems reasonable to assert that the project of producing a data-driven model has produced some unexpectedly positive results in respect of confirming the possibility of giving a formal description of the conversational context. The vague and poorly organised data with which we found ourselves confronted in Table 3 illustrated the influence that context exerts on the argumentative routes pursued by participants in the course of the debate. Our proposed method for managing the complexity of such dialogue as it relates to changes in context has, I hope, demonstrated that the inclusion of just two parameters of analysis suffices to significantly clarify the data, permitting the argumentation process involved to be not merely posited (as something we are content to assume), but actually formally captured.

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Appendix

$$\begin{aligned}
 &\mathbf{TS1} L_x^b \downarrow A_k (\phi) \\
 &\quad L_{no'}^w, \\
 &\quad b \neq w; \\
 &\quad T A(L_x^b; L_{no'}^w) \downarrow A_m (\neg \phi) \\
 &\quad T A(L_x^b; L_{no'}^w) \downarrow DIS_m (\phi \vdash \neg \phi)
 \end{aligned} \tag{5}$$

$$\begin{aligned}
 &\mathbf{TS2} L_x^b \downarrow A Q_k (\phi) \\
 &\quad L_{no'}^w, \\
 &\quad b \neq w; \\
 &\quad T(L_x^b; L_{no'}^w) \downarrow A_m (\neg \phi) \\
 &\quad T(L_x^b; L_{no'}^w) \downarrow DIS_m (\phi \vdash \neg \phi)
 \end{aligned} \tag{6}$$

$$\begin{aligned}
 &\mathbf{TS3} L_x^b \downarrow A_k (\phi) \\
 &\quad L_{yes'}^w, \\
 &\quad b \neq w; \\
 &\quad T(L_x^b; L_{yes'}^w) \downarrow AGR_m (\phi)
 \end{aligned} \tag{7}$$

$$\begin{aligned}
 &\mathbf{TS4} L_x^b \downarrow A Q_k (\phi) \\
 &\quad L_{yes'}^w, \\
 &\quad b \neq w; \\
 &\quad T(L_x^b; L_{no'}^w) \downarrow AGR_m (\phi)
 \end{aligned} \tag{8}$$

$$\begin{aligned}
 &\mathbf{TS5} L_x^b \downarrow A_k (\phi) \\
 &\quad L_y^w \downarrow PCon_l (\psi) \\
 &\quad b = w; \\
 &\quad T(L_x^b; L_y^w) \downarrow ARG_m (\psi \vdash \phi)
 \end{aligned} \tag{9}$$

$$\begin{aligned}
 &\mathbf{TS6} L_x^b \downarrow A_k (\phi) \\
 &\quad L_y^w \downarrow PCon_l (\psi) \\
 &\quad b \neq w; \\
 &\quad T(L_x; L_y) \downarrow AGR_m (\psi \vdash \phi)
 \end{aligned} \tag{10}$$

$$\begin{aligned}
 &\mathbf{TS7} L_x^b \downarrow A_k (\phi) \\
 &\quad L_y^w \downarrow PQ_l (\psi) \\
 &\quad b \neq w; \\
 &\quad T(L_x; L_y) \text{ is non-anchoring}
 \end{aligned} \tag{11}$$

$$\begin{aligned}
& \mathbf{TS8} L_x^b \downarrow A_k (L_z^p) \\
& L_y^w \downarrow A Q_l (\psi) \\
& L_z^p \downarrow A (\varphi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \phi)
\end{aligned} \tag{12}$$

$$\begin{aligned}
& \mathbf{TS9} L_x^b \downarrow A_k (\varphi) \\
& L_y^w \downarrow A Q_l (L_z^p) \\
& L_z^p \downarrow A (\psi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \phi)
\end{aligned} \tag{13}$$

$$\begin{aligned}
& \mathbf{TS10} L_x^b \downarrow A_k (\phi) \\
& L_y^w \downarrow A Q_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow ARG_m (\phi \vdash \psi) \\
& \text{or } ARG_m (\psi \vdash \phi)
\end{aligned} \tag{14}$$

$$\begin{aligned}
& \mathbf{TS11} L_x^b \downarrow A_k (\phi) \\
& L_y^w \downarrow A Q_l (\psi) \\
& b \neq w; \\
& T(L_x^b; L_y^b) \downarrow DIS_m (\psi \vdash \phi)
\end{aligned} \tag{15}$$

$$\begin{aligned}
& \mathbf{TS12} L_x^b \downarrow A_k (\phi) \\
& L_y^w \downarrow R Q_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^b) \downarrow ARG_m (\phi \vdash \psi) \\
& \text{or } T(L_x^b; L_y^b) \downarrow ARG_m (\psi \vdash \phi) \\
& \text{or } T(L_x^b; L_y^b) \text{ is non-anchoring}
\end{aligned} \tag{16}$$

$$\begin{aligned}
& \mathbf{TS13} L_x^b \downarrow A_k (\phi) \\
& L_y^w \downarrow R Q_l (\psi) \\
& b \neq w; \\
& T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \phi)
\end{aligned} \tag{17}$$

$$\begin{aligned}
& \mathbf{TS14} L_x^b \downarrow P Con_k (\phi) \\
& L_y^w \downarrow A_l (\psi) \\
& b = w; \\
& T(L_x^b; L_{y'}^w) \downarrow ARG_m (\phi \vdash \psi) \text{ or}
\end{aligned}$$

$$T(L_x^b; L_y^w) \downarrow ARG_m (\psi \vdash \phi) \quad (18)$$

$$\begin{aligned} \mathbf{TS15} & L_x^b \downarrow PCOn_k (\phi) \\ & L_y^w \downarrow A_l (\psi) \\ & b \neq w; \\ & T(L_x^b; L_y^w) \text{ is non anchoring} \end{aligned} \quad (19)$$

$$\begin{aligned} \mathbf{TS16} & L_x^b \downarrow PQ_k (\phi) \\ & L_y^w \downarrow A_l (\psi) \\ & b \neq w; \\ & T(L_x^b; L_y^w) \text{ is non-anchoring} \end{aligned} \quad (20)$$

$$\begin{aligned} \mathbf{TS17} & L_x^b \downarrow PQ_k (\phi) \\ & L_y^w \downarrow PQ_l (\psi) \\ & b = w; \\ & T(L_x^b; L_y^w) \text{ is non-anchoring} \end{aligned} \quad (21)$$

$$\begin{aligned} \mathbf{TS18} & L_x^b \downarrow PQ_k (\phi) \\ & L_y^w \downarrow AQ_l (\psi) \\ & b = w; \\ & T(L_x^b; L_y^w) \text{ is non-anchoring} \end{aligned} \quad (22)$$

$$\begin{aligned} \mathbf{TS19} & L_x^b \downarrow AQ_k (\phi) \\ & L_y^w \downarrow A_l (\psi) \\ & b = w; \\ & T(L_x^b; L_y^b) \downarrow ARG_m (\phi \vdash \psi) \end{aligned} \quad (23)$$

$$\begin{aligned} \mathbf{TS20} & L_x^b \downarrow AQ_l (L_z^p) \\ & L_y^w \downarrow A_k (\psi) \\ & L_z^p \downarrow A (\varphi) \\ & b \neq w; \\ & T(L_x^b; L_y^b) \downarrow ARG_m (\varphi \vdash \psi) \text{ or} \\ & T(L_x^b; L_y^b) \downarrow AGR_m (\phi) \end{aligned} \quad (24)$$

$$\begin{aligned} \mathbf{TS21} & L_x^b \downarrow AQ_k (\phi) \\ & L_y^w \downarrow A_l (\psi) \\ & b \neq w; \\ & T(L_x^b; L_y^w) \downarrow AGR_m (\phi) \text{ or} \\ & T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \circ \phi) \text{ or} \\ & T(L_x^b; L_y^w) \text{ is non-anchoring} \end{aligned} \quad (25)$$

$$\begin{aligned}
& \mathbf{TS22} L_x^b \downarrow A Q_k (\phi) \\
& L_y^w \downarrow A Q_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow ARG_m (\phi \vdash \psi) \text{ or} \\
& T(L_x^b; L_y^w) \downarrow ARG_m (\psi \vdash \phi)
\end{aligned} \tag{26}$$

$$\begin{aligned}
& \mathbf{TS23} L_x^b \downarrow R Q_k (\phi) \\
& L_y^b \downarrow A_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^b) \downarrow ARG_m (\phi \vdash \psi) \text{ or} \\
& T(L_x^b; L_y^b) \text{ is non-anchoring}
\end{aligned} \tag{27}$$

$$\begin{aligned}
& \mathbf{TS24} L_x^b \downarrow R Q_k (\phi) \\
& L_y^w \downarrow A_l (\psi) \\
& b \neq w; \\
& T(L_x^b; L_y^w) \downarrow DIS_m (\psi \vdash \phi)
\end{aligned} \tag{28}$$

$$\begin{aligned}
& \mathbf{TS25} L_x^b \downarrow R Q_k (\phi) \\
& L_y^w \downarrow A Q_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow ARG_m (\phi \vdash \psi)
\end{aligned} \tag{29}$$

$$\begin{aligned}
& \mathbf{TS26} L_x^b \downarrow R Q_k (\phi) \\
& L_y^w \downarrow R Q_l (\psi) \\
& b = w; \\
& T(L_x^b; L_y^w) \downarrow ARG_m (\phi \vdash \psi) \text{ or} \\
& T(L_x^b; L_y^w) \text{ is non-anchoring}
\end{aligned} \tag{30}$$

$$\begin{aligned}
& \mathbf{TS27} L_x^b \downarrow A Ch_k (\phi) \\
& L_y^b \downarrow A_l (\psi) \\
& L_x \text{ or } L_y \text{ contains reported speech;} \\
& T(L_x^b; L_y^b) \downarrow ARG_m (\phi \vdash \psi)
\end{aligned} \tag{31}$$

$$\begin{aligned}
& \mathbf{TS28} L_x^b \downarrow A Ch_k (\phi) \\
& L_y^w \downarrow A_l (\psi) \\
& b \neq w; \\
& L_x \text{ or } L_y \text{ contains reported speech;} \\
& T(L_x^b; L_y^b) \downarrow ARG_m (\phi \vdash \psi)
\end{aligned} \tag{32}$$

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