Human Computer Debate, a Computational Dialectics Approach

By

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ABSTRACT

This thesis documents work concerned with issues involved in adopting a computational dialectics approach to develop a human computer debating system that will engage students in competitive debate on controversial issues.

A fundamental element of the proposed debating system is the underlying dialogue model. There are many normative dialogue game systems that have been proposed in the area of informal logic and dialectics, and one of the main thrusts of the research to be reported here is concerned with an investigation of a suitable dialogue model required by an educational human computer debating system.

A second enquiry of the project is to develop a set of computational strategic heuristics to enable the computer to act as a participant in such an educational debate. The strategic knowledge is essential if the computer is to produce high quality dialogue contributions. There have been rich developments in the area of informal logic concerning the strategies used when people argue with each other, but how to use these strategies computationally is currently not known. A novelty of the research to be reported here is therefore concerned with the development and computational use of a set of debating strategic heuristics.

A well respected dialogue game DC has been selected and evaluated, in part via the construction of a system enabling two software agents to have a dialogue with each other using the DC model. In the light of this, a further system DE has been developed and its improvement over DC demonstrated. A set of strategic heuristics has been developed, and its appropriateness has been demonstrated by the analysis of agent-generated dialogues. A human computer debating prototype operationalising the DE dialogue model and the set of strategic heuristics has been built. A usability evaluation of the debating system gives further evidence for the suitability of the dialogue model DE and the proposed strategy.

By investigating prima facie reasonable dialectical models in use, the research contributes lessons concerning both means of broadening human computer dialogue and dialectical theory. A set of debating heuristics is essential for effective computational dialectics, and the work contributes towards development of such strategies for dialectical systems.
ACKNOWLEDGEMENTS

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CHAPTER ONE

INTRODUCTION

1.1 Background and Rationale

The recent development of computer based learning (CBL) systems and the emergence of the World Wide Web and the Internet have changed the study life of many people (Beck and Stern 1999; Cumming and McDougall 2000; Cunningham-Atkins et al. 2004; Grasso and Leng 2003). However, a common assumption underlying these computer based educational systems is that the computer does all the informing, the student being merely a passive receiver of the information. Such a type of teaching interaction may become unduly didactic and few systems communicate with students effectively (cf. Baker 2000; Moore 2000), for example compared with Socratic tutoring, a method of teaching based on asking students a series of carefully constructed questions that would lead students to recognise and fix gaps and inconsistencies in what they know of the domain (cf. Du Boulay and Luckin 2001). There is therefore a need for dialogue within interactive computer systems. Such dialogue capacity is seen as a fundamental part of a computer based learning system (Baker 2000; Moore 1993). The benefit of dialogue in computer based learning system seems clear. For example, Du Boulay et al. (1999) argue that it relieves the practical difficulties of facilitating one-to-one discussion in education. Elsewhere, Moore (1993; 2000) argues that it offers advantages in terms of progressing at the pace of the individual student and of allowing the student to interact without fear of ridicule from his tutor, and that students can study at their own convenience. Further, the importance of discussion between students and computer based learning systems has often been stressed by educational theorists (cf. Laurillard 1995).

There are many types of dialogue interactions in which people reason together, such as debate, persuasion, inquiry and information-seeking (Walton and Krabbe 1995). The question for Computer Based Learning research becomes which of the diverse dialogue types are effective in educational contexts. Answers to this question gained from empirical research have thus far been only partial (Ravenscroft and Pilkington 2000). However, the debating style of dialogue interaction is argued by Maudet and Moore (2001) to be important in critical thinking and developing debating and reasoning skills, and also suggested by Pilkington and Mallen’s (1996) educational discourse analysis to
be effective and to have rich educational benefit. A particular concern with this research therefore is to investigate issues surrounding a computer based system for educational debate.

There are at least two main areas of research dealing with dialogue: linguistic discourse analysis and dialectics. The former approach emphasises empirical research into natural language, its structure and processing and concerns actual conversational exchange. However there are well known difficulties with the computational implementation of such an intentional account of dialogue, in particular that of modelling beliefs. Beliefs are private and it may be very difficult to know what the person’s beliefs are in a dialogue, and difficult to infer them from dialogue alone, rendering this approach computationally intractable (cf. Mackenzie and Staines 1999: 21; Moore and Hobbs 1996; Girle 1992: 288).

The latter approach - dialectics - involves a logical account of interaction in terms of rules for particular kinds of responses and interaction, and utilises “Dialogue Game Theory” models developed within the field of Informal Logic to prescribe how dialogue should be regulated. Further, dialectics uses commitments rather than beliefs. Commitments are what a dialogue participant has said or accepted during the evolving dialogue. Commitments are public and thus it is easy to know what someone’s commitments are in a dialogue (Hamblin 1971; Mackenzie and Staines 1999: 21; Walton and Krabbe 1995; Maudet and Chaib-Draa 2002; Moore and Hobbs 1996).

There has been an increasing use of a computational dialectics approach in the area of human computer interaction (e.g. Moore 1993; Ravenscroft 1997), agent communication (e.g. Reed 1998; Jennings 2001; Maudet and Chaib-Draa 2002; McBurney and Parsons 2002), mediation of legal reasoning (e.g. Bench-Capon et al. 1998, 2000; Freeman and Farley 1996) and Artificial Intelligence in general (Walton 2000). Indeed, in some literature, computational dialectics is seen as a new sub-field of Artificial Intelligence (Gordon 1996).

There are, however, many open research issues within computational dialectics, and an investigation of what are believed to be amongst the most important of these forms the basis of this research project.
1.2 Research Problems and Related Work

The current project will address some of the research problems involved in adopting the computational dialectics as the basis for a human computer debating system. Previous research in this application area (Moore 1993, Maudet and Moore 2001; Reed and Norman 2003) has revealed several important issues that need further investigation.

Dialogue model. An important issue concerns the choice or development of a suitable dialectical model. A dialectical model can be defined as a set of rules to regulate participants as they make moves during the evolving dialogue. Adoption of an appropriate model is of fundamental importance, because it forms the dialogue model that the computer system will use to rule on the acceptability of user input and to delineate possible dialogue contributions that are allowed. The dialogue model is therefore the fundamental element underlying the proposed computer debate system. There are however many normative dialogue game systems that have been proposed in the area of informal logic and dialectics (cf. Maudet and Moore 2001; Reed and Norman 2003). It is necessary therefore to select or develop a suitable dialectical model given the requirements for an educational human-computer debate on controversial issues such as capital punishment. Next, the appropriateness of any proposed dialogue model needs to be established. The proposed experimental work required for this, aimed at iteratively building a computational realisation of the model and establishing whether the model can be readily used to generate good discourse, will form part of the unique contribution of this research. It is anticipated that this part of the work will contribute towards developments in human computer dialogue and also help to illuminate research issues in the field of dialectics itself.

Computational strategic heuristics. In dialectical systems, the dialogue regulations usually leave some room for choices as to permissible move types and substantive content (Moore 1993). It is crucial therefore that the computer has some means of selecting between the available possibilities. This choice must be based on some suitable strategy. There are rich developments in philosophy concerning the strategies used when people argue with each other, such as argument from analogy, argument from popularity and argument from consequence (Walton 1996b). However, how to use such strategies computationally is currently not known, but is essential if the computer is to produce high quality dialogue contributions. The research will therefore seek to develop a set of strategic heuristics usable by the debating system.
A crucial aspect of the strategic issue is dialectical relevance (Moore 1993). A problem for dialectical systems is that no rule actually controls the relevance of the dialogue moves (Maudet 2001). Without relevance rules to govern the dialogue however, it may lose focus, e.g. if the user inputs an irrelevant move, then a computer system without a relevance ruling will follow the student into an irrelevant dialogue. The computer therefore should be given some strategic means to handle irrelevant user inputs. Given the importance of relevance in dialectical system, existing literature concerning dialectical relevance (e.g. Walton 1999; Prakken 2001) will be critically reviewed and its effect within the computer debating system will be investigated.

To determine the appropriateness of the proposed strategies, further studies will be required, aimed at testing whether the strategy is appropriate.

1.3 Project Objectives

The overall aim is to research the theoretical and practical issues involved in developing a system capable of engaging its user in an educational debate on a controversial topic such as capital punishment. The following objectives will contribute to the achievement of this overall aim:

a) To conduct a critical review of relevant research literature concerning informal logic, dialectics, computational dialects and computer based learning.

b) In the light of the review in ‘a’, to select or develop a suitable dialectical model, and use it as the basis for development of prototype debating systems. Existing models have been developed within the philosophical field of “pure” dialectics; part of the novelty of the current research is the fact that the models are studied as computational dialogue models. These prototype debating systems will act as the test-bed for work involved in the remaining objectives.

c) To collect evidence, concerning the appropriateness of the dialectical model, and to amend the model as necessary.

d) To develop a set of strategic heuristics and conduct further studies to determine the appropriateness of the strategy.
1.4 Thesis Overview

Given these aims, the remainder of the thesis is organized as follows. Chapter two contains a critical review of literature concerning dialectics and a discussion of the requirements of the dialogue model for an educational debating system. Chapter three provides a comparative study of the most recent dialectical systems developed in the areas of informal logic and computational dialectics, against the specific requirements outlined in chapter two.

In the light of this assessment of the recent dialectical systems, chapter four argues for the adoption of Moore’s utilization of DC, and discusses means of evaluating DC. Chapter 5 outlines an inter-agent computer system that was built to facilitate an evaluation of the dialogue model argued for in chapter four. In the light of the evaluation results, a further system “DE” is proposed in chapter six. Chapter six also uses the inter-agent computer system to evaluate DE, and it is argued that DE does show improvements over DC in preventing fallacious argument and common dialogue errors. Chapter seven discusses a development and an informal usability evaluation of a human computer debate prototype which operationalises the proposed DE model.

In order to enable the computer to act as a dialogue participant, a set of strategic heuristics based on the literatures in the area of informal logic and computational dialectics has been developed and incorporated into the human computer prototype, and is discussed in chapter eight. Chapter eight also provides an exploration and discussion of the notion of dialectical relevance. Chapter nine contains an assessment of appropriateness of the proposed strategy by using both using both agent-based and user-based approaches. Chapter ten provides a summary of the research, reiterates its conclusion, and makes some suggestions for further research.
CHAPTER TWO

DIALECTICS AND DIALOGUE MODEL

REQUIREMENTS

2.1 Introduction

This chapter introduces the concept of Dialectics and Dialectical Systems, and argues for the adoption of a dialectical system as the underlying dialogue model for a computerised dialogue system. This chapter also contains a review of the literature concerning different types of dialogue, in the light of which the properties of a debate dialogue are identified. Finally, a set of requirements for an educational human computer debate dialogue model is proposed.

2.2 Dialectics

“Dialectics” can be seen as the branch of philosophy attempting to build dialogue models for “good dialogue”, and “Computational Dialectics” as the attempt to use such models within a computer system. The dialogue models that will be referred to here as “dialectical systems” (Hamblin 1971; Mackenzie 1979a), in fact have different nomenclature in the literature, such as “logical dialogue games”, “dialogue games” (Moore 1993; Moore and Hobbs 1996; Maudet and Moore 2001), “formal games of dialogue”, “dialectical games”, “normative dialogue model” (Walton 1984; 1998) and “commitment-based dialogue” (Reed and Norman 2003).

A dialectical system is seen as a rule governed structure for organised conversation where there is an exchange of arguments between two parties reasoning together on a turn-taking basis aimed at a collective goal (Walton 1998). The most important and fundamental component of dialectical system is the commitment store, which records what a dialogue participant has said or accepted during the evolving dialogue (Hamblin 1971). A dialectical system also contains a set of available move types, a set of dialogue rules and a set of commitment rules. Dialogue rules prevent illegal events during the evolving dialogue, and commitment rules specify the effect of different move types on the participants’ commitment stores. Some dialectical systems also contain winning and

Dialectical systems, as so characterised, have a number of attractions from the point of view of their utilisation within a computer dialogue system. Walton (1998) argues that the use of dialectical systems can show people how to prevent fallacious arguments and common errors. Moore and Hobbs (1996) argue that using dialectical systems, if the system is valid, can yield “fair and reasonable” dialogue. Further, Maudet and Moore (2001) argue that by constraining dialogue to a specific set of moves, each defined in terms of its effect on the commitment stores, a computer dialogue system based on dialectical systems is able to bypass the need for complex pragmatic parsing, while still providing opportunity for educationally useful interaction. In addition, dialectical systems seek to model commitment rather than belief. The separation of commitment from belief has the advantage that one can allow for machines to argue without having to concede that they have beliefs (Moore and Hobbs 1996).

Further support for the adoption of dialectical systems as the basis for computerised dialogue system can be found in the context of computer based learning. For example, Maudet and Moore (1993) use Mackenzie’s (1979a) DC to enable educationally valuable “devil’s advocate” discussions. Bench-Capon et al. (1998; 2000) investigate the use of dialectical systems in a legal educational context, and develop “TDG”, a dialogue game for this purpose. Pilkington and Ravenscroft (2000) develop a dialogue game framework to enable the computer to act as a “facilitating tutor” and the student the “explainer”. The evaluation of their computerised system demonstrates its effectiveness in stimulating improvements in students’ understanding of the physics of motion (Ravenscroft and Matheson 2001; 2002).

There are, then, a number of arguments for the adoption of dialectical systems as the basis for a computerised dialogue system. There are, however, many dialectical systems in the area of dialectics and computational dialectics. To seek a suitable model for a computerised debating system, it is necessary to know the properties of a debating style dialogue and its distinguishing features from other types of dialogue. A review of the literature concerning the dialogue typology is therefore given next.

### 2.3 Dialogue Typology

This section contains a review of two key dialogue typologies, that of Walton and Krabbe
(1995), and Baker (2000). This section also proposes an integrated dialogue typology which is arguably broad enough to house both those of Walton and Krabbe (1995), and Baker (2000).

2.3.1 Walton and Krabbe’s Dialogue Typology

In the area of argumentation theory, Walton and Krabbe (1995) distinguish six basic types of dialogue: persuasion, negotiation, inquiry, deliberation, information seeking and eristic, see table 2.1 (taken from Walton 2000: 336). This dialogue typology is based on three factors (indicated by the headings in table 2.1): (i) the initial situation, (ii) the private aims of the participating agent, (iii) the joint aims to which all participants implicitly subscribe.

Table 2.1 Walton and Krabbe’s dialogue typology

<table>
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<tr>
<th>Type of dialogue</th>
<th>Initial situation</th>
<th>Participant’s goal</th>
<th>Goal of dialogue</th>
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<tbody>
<tr>
<td>Persuasion</td>
<td>Conflict of opinion</td>
<td>Persuade other party</td>
<td>Resolve or clarify issue</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Needs to have proof</td>
<td>Find and verify evidence</td>
<td>Prove (disprove)</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Conflict of interest</td>
<td>Get what you most want</td>
<td>Reasonable settlement that both can live with</td>
</tr>
<tr>
<td>Information-seeking</td>
<td>Need information</td>
<td>Acquire or give information</td>
<td>Exchange information</td>
</tr>
<tr>
<td>Deliberation</td>
<td>Dilemma or practical choice</td>
<td>Co-ordinate goals and actions</td>
<td>Decide best available course of action</td>
</tr>
<tr>
<td>Eristic</td>
<td>Personal conflict</td>
<td>Verbally hit out at opponent</td>
<td>Reveal deeper basis of conflict</td>
</tr>
</tbody>
</table>

Reed (1998) examines Walton and Krabbe's dialogue model and suggests that ‘eristic’ dialogue is unlikely to play a significant role in current computer science research on the ground that its aim is to “serve primarily as substitute for [physical] fighting”. He also suggests that persuasion, inquiry and information-seeking dialogues handle belief, while negotiation dialogue raises a contract and deliberation dialogue forms a plan. He further notes that information-seeking dialogue is asymmetric.

Krabbe (2000) also discusses this dialogue typology. He argues that only persuasive, negotiation and eristic dialogue are argumentative, whereas deliberation, inquiry and information seeking are seen as non-argumentative, although reasoning is believed to occur in all of them.
This, then, is Walton and Krabbe’s dialogue typology. Baker’s (2000) dialogue typology is reviewed next.

2.3.2 Baker’s Dialogue Typology

Baker’s problem solving model claims that there are eight basic forms of interaction in co-operative problem solving activity in learning situations, see figure 2.1 (taken from Baker 2000: 131).

![Baker's dialogue model](image)

Figure 2.1 Baker’s dialogue model

Baker’s model is based on three dimensions (indicated by the arrows in figure 2.1): [1] degree of (dis)agreement, [2] degree of (a)symmetry, [3] degree of (non)alignment. Baker’s notion of “agreement” can be seen as similar to the factor of “initial situation” in Walton and Krabbe’s (1995) dialogue typology. Baker’s explanation of the degree of (a)symmetry is “either each participant has an alternative proposal, or else one participant simply contests another’s proposal (Baker 2000: 131). The notion of “alignment” in Baker’s model indicates that the desired end goals are the same for both players, while non-alignment means they do not have identical end goals.
2.3.3 Integrated Dialogue Typology

This section provides an attempt to resolve Walton and Krabbe’s and Baker’s dialogue typologies by proposing an integrated dialogue typology.

Walton and Krabbe’s model focuses on the philosophical study of dialogue, whereas Baker’s model is based on cooperative problem solving activity in learning situations. It might be argued that some of the existing educational dialogues, as identified by other researchers, are outside Walton and Krabbe’s dialogue typology. For example, Ravenscroft and Matheson’s (2002) asymmetric dialogues, and Pilkington and Mallen’s (1996) inquiry dialogue with asymmetric roles. Further, in agent communication research, McBurney and Parsons (2001) identify two kinds of dialogue: discovery and command dialogue, both of which are outside Walton and Krabbe’s (1995) dialogue typology. It might be thought that Baker’s model is more general and can subsume Walton and Krabbe’s. However, some of Walton and Krabbe’s dialogue types (e.g. deliberation and inquiry dialogues) can not be distinguished by Baker’s model. To

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<th>(a) symmetry</th>
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<td>conflict</td>
<td>collaborative</td>
<td>symmetric</td>
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<td>collaborative</td>
<td>asymmetric</td>
<td>Auction</td>
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<tr>
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<td>non-collaborative</td>
<td>symmetric</td>
<td>Debate (Maudet and Moore 2001)</td>
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<td>Complex critical discussion (Van Eemeren 1996)</td>
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<td>Symmetric persuasion (Walton and Krabbe 1995)</td>
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<td>Asymmetric persuasion (Walton and Krabbe 1995)</td>
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</tr>
<tr>
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<td>collaborative</td>
<td>symmetric</td>
<td>Deliberation, inquiry (Walton and Krabbe 1995)</td>
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<td>ignorance</td>
<td>collaborative</td>
<td>symmetric</td>
<td>Discovery (McBurney and Parsons 2001)</td>
</tr>
<tr>
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<td>collaborative</td>
<td>asymmetric</td>
<td>Facilitating dialogue (Ravenscroft and Pilkington 2000)</td>
</tr>
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<td>non-collaborative</td>
<td>symmetric</td>
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<tr>
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<td>ignorance</td>
<td>non-collaborative</td>
<td>asymmetric</td>
<td>Information-seeking (Walton and Krabbe 1995)</td>
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</table>
resolve all this, an integrated dialogue typology is proposed as shown in table 2.2.

The integrated dialogue typology is formed based on three factors: (i) initial situation, (ii) (a)symmetric, (iii) (non) collaborative. The notion of “initial situation” is similar to that of Walton and Krabbe. The notion of “symmetry” is taken to suggest that each participant makes more or less equal contributions to the dialogue and follows the same dialogue rules, while “asymmetric” suggests that participants play different roles in dialogue and follow different dialogue rules (cf. Maudet and Moore 2001). The notion of “collaborative” indicates that the desired end goals are the same for both players, while non-collaborative means they do not have identical end goals (cf. Maudet and Moore 2001).

Eight types of dialogue are presented in the proposed dialogue typology (see table 2.2). They are briefly discussed in turn below.

1) Co-argumentation dialogue and one-sided co-argumentation dialogue

Co-argumentation dialogues start from a position of conflict, but both participants’ aims are identical, with symmetric roles. A common example of such dialogue is the negotiation dialogue (cf. Parsons and Jennings 1996; Reed 1998). The difference between one-sided co-argumentative dialogue and co-argumentative dialogue is that the participants of the former adopt asymmetric roles and follow different rules of dialogue (e.g. locution rules, dialogue rules or commitment rules).

2) Argumentation and one-sided argumentation dialogue

Argumentation dialogue starts from conflicts, but both sides attempt to persuade the other to accept their thesis, e.g. Maudet and Moore’s (2001) debating dialogue, Van Eemeren et al.’s (1996) complex critical discussion, and Walton and Krabbe’s (1995) permissive persuasion dialogue (PPD). One-sided argumentative dialogue has different roles for both participants, such that one side builds its position, the other side attacks or contests it, e.g. Walton and Krabbe’s (1995) rigorous persuasion dialogue (RPD).

3) Co-construction dialogue and one-sided co-construction dialogue

Co-construction dialogue starts from an open problem or question, and two participants contribute more or less equally to solve the problem e.g. McBurney and Parsons’s (2001)
discovery dialogue, Walton and Krabbe’s (1995) deliberation and inquiry dialogue. The participants of one-sided co-construction dialogue have different roles, one side provides the solution, the other side may criticise or point out mistakes, but both parties have an identical overall goal to solve the problem e.g. Ravenscroft and Pilkington’s (2000) facilitating dialogue.

4) Information exchange and information seeking dialogue

Such dialogues do not start from conflict. In an information-exchange dialogue, both participants lack information, and they have the same roles in seeking and providing information following the same rules of dialogue, this kind of dialogue is therefore symmetric in nature (cf. Hamblin’s (1971) information-oriented dialogue). In an information seeking dialogue, the participants have different dialogue roles and obligations, one side lacks information, and the other side provides information, this kind of dialogue is therefore asymmetric in nature (cf. Walton and Krabbe’s (1995) information seeking dialogue).

2.4 Dialogue Model Requirements

The broad dialogue typology developed in the previous section enables the debating system of the current project to be refined, in that it will concern an argumentation type of dialogue (in table 2.2) only, and other types of dialogues are out of the scope of this project. This kind of dialogue has distinctive features from others. First, both participants will start from conflicting views and they both have their own thesis, e.g. one holds the thesis P and the other holds the view ¬P. Secondly, they try to convert each other to their own view. Additionally, this kind of dialogue is symmetric in nature which means both sides will follow the same dialogue regulations.

To enable such a debate with a computerised system on a controversial issue such as capital punishment, the student will need to appreciate the need to defend his point of view against attacks by giving convincing reasons. The symmetrical nature of such a debate also enables the student to build his own position and to attack the opponent’s view. This may encourage the student to think critically during the debate more generally. In addition, by using a formal dialectical system to regulate such a debate, the students can learn the rules of debate, and improve their debating skills. A further educational advantage of using a formal dialectical system is that the student can learn the logical structure of the argument,
and improve his reasoning skills. In addition, by revealing the issues under discussion, the student is given an opportunity to learn the domain knowledge, and to perceive issues from different angles. Similar arguments for the advantage of such an educational debate are also made in (Pilkington and Mallen 1996, Moore 1993; Moore 2000; Moore and Hobbs 1996; Maudet and Moore 2001; Ravenscroft and Pilkington 2000; Harcher 1999; Quinn 1997).

The educational benefit of such a debate per se is therefore clear. It is now necessary to specify the requirements of the dialogue model which will be used to regulate such a debate within a computerised dialogue system. Following Moore (1993), which in turn derives from Walton (1989), it can be argued that the following set of criteria is required for a suitable underlying model for a human-computer debate:

1) The model needs to be “persuasion” style and symmetric in nature

A central requirement of the current project is that it focuses on educational human computer debate. In this scenario, there are two parties to the debate, one party is the computer, and the other is an individual student. They start from conflicting views on a controversial issue, e.g. one party holds the view that “capital punishment is acceptable”, the other party holds that “capital punishment is not acceptable”, and each party seeks to persuade the other party to give up his own and accept his opponent’s thesis. In the case of a computer and individual student, the computer will establish the student’s response to the question (e.g.) “are you in favour of capital punishment?”, and will adopt, for the purpose of the debate, the opposite view, and attempt to convert the student to its viewpoint. As the debating dialogue is symmetric in nature, both parties can build their own positions and challenge or attack the opponent’s position, each has their own goal to achieve, but only one party at most can be successful. The overall dialogue goal can be seen therefore as to resolve conflicts between participants. In sum, the dialogue model should be “persuasion style” (Walton 1998; Walton and Krabbe 1995) with equality of rules for both participants (Moore 1993: 206).

2) The set of move types provided by the model should be adequate for expression

In dialectical systems, there are locution rules which delineate the available move types. This criterion concerns whether participants are able to say anything they want to say in the debate using the set of available move types (Moore 1993: 206). As the application
area of the current project is education, it appears to be important to allow students to ask questions and the computer to question the students’ understandings in an interactive educational environment.

3) The model should leave enough room for strategic formation

Loui (1998) argues that a good dialogue model should leave some room for strategic formation. This requirement therefore concerns whether the dialogue model leaves much freedom for the dialogue participants to perform their debating strategies such as distance strategy (cf. Walton 1998), build and demolish strategy (cf. Moore 1993), thus avoiding ineffective discussions.

4) The model should be able to prevent fallacious argument

This issue concerns how philosophically sound the dialogue model is, that is how far it can prevent fallacious argument (Walton 1998). This criterion is important because one of the main potential utilities of the debating system is to develop students’ debating skills and teach students how to avoid common errors and fallacies in arguments. Intuitively, the computer should not produce any fallacious argument in the first instance. Moreover, if the student argues in a fallacious manner, the computer should be able to recognise the fallacious argument and promote a guideline message for correction. As a result, whether the selected or developed dialogue model can block certain kinds of fallacies, such as question-begging (Mackenzie 1979a), and straw man fallacy (Walton 1996a) is therefore crucial for the success of this project.

5) The model should impose only a light cognitive load on the user

This concerns the usability of the dialogue model, for example, ease of learning to use, users’ awareness of a move’s impact on the commitment store and users’ perceived satisfaction and comfort with the system. A suitable dialogue model is expected to be easy for the user to manipulate with only a minimal extra cognitive load.

6) The model should be computationally tractable

The point here is that the dialogue model should be, of course, computationally tractable, given that one party of the conversation is intended to be the computer.
2.5 Summary

The concepts of dialectics and dialectical systems have been introduced. Use of a dialectical system, it has been argued, is promising for a computerised dialogue system. In the light of the literature review of two key philosophical and educational dialogue typologies and the proposed integrated dialogue typology, the properties of a debating style dialogue have been identified and argued to have potential educational advantages. Given the properties of a specific debating dialogue, a set of criteria for an educational human computer debate dialogue model have been proposed. The formulation of these criteria facilitates an assessment of the various dialogue models that have been proposed in the area of informal logic and computational dialectics. This will be considered in the next chapter.
CHAPTER THREE

A COMPARATIVE STUDY OF RECENT
DIALECTICAL SYSTEMS

3.1 Introduction

There have been a number of dialectical systems proposed by dialogical theorists, such as Hamblin (1971) and Mackenzie (1979a), Lorenzen and Lorenz (1978) (cited in Walton (1984)), Barth and Krabbe (1982), Hintikka (1979) and Walton (1984). Moore (1993) argues that, considering the requirements of a debate, the Lorenz approach is asymmetric and overly deterministic, the Bath and Krabbe approach hard for the student to master and not directly applicable to debate and the Hintikka approach heavily biased toward the questioner. He also argues that there are conceptual difficulties with the dark side commitment set on which some of Walton’s games are based. On this argument, Hamblin and Mackenzie style dialogue seem the most appropriate for the specific requirements of a debate-centred dialogue system. Since then, there has been much different use and development of Hamblin and Mackenzie style dialectical systems (termed by Reed and Norman (2003:12) as a commitment-based approach) in computer science and philosophy, e.g. Prakken (2000), Bench-Capon (1998), Ravenscroft and Pilkington (2000), Walton and Krabbe (1995), Moore (1993) and Lodder and Herezog (1995). To select a suitable model for an educational human computer debating system, it is necessary to critically review these recent models against the criteria argued for in chapter two. The remainder of this chapter will therefore assess each in turn.

3.2 Prakken

Prakken (2001: 193) indicates that his dialogue game is inspired by an earlier framework of this kind presented by Loui (1998). He refers to his dialogue game as “persuasion with dispute”, a sub-type of persuasion dialogue (cf. Walton 1998). There is a conflicting view between the two participants, the proponent aims at making the opponent concede the proponent’s claim and the opponent instead aims at making the proponent withdraw his claim. Prakken argues that the underlying logic of his framework is defeasible rather than deductive, and that this allows one to attack one’s opponent’s argument with a
counterargument.

3.2.1 The Dialogue Framework

Prakken’s framework contains a set of available move types, commitment rules, dialogue rules and termination rules, which are outlined as follows (cf. Prakken 2000: 231-232).

Available move types

1) Claim: statement P.
2) Challenge: why (P)?
3) Retract: withdraw P.
4) Concede: accept P.
5) Argue: with the form “P, so Q”, where P is a set of premises.

Commitment rules

1) “Claim P” or “concede P” will result in P being included in speaker’s store.
2) “Retract P” will remove P from the speaker’s store.
3) “Argue (Q, so P)” will result in Q and P being included in the speaker’s store.
4) In all other cases (e.g. challenge) the commitments remain unchanged.

Dialogue rules

1) “Claim P” can be answered only by “Challenge P” and “Concede P”.
2) “Challenge P” can be responded to with “Argue (Q, so P)” or “Retract P”.
3) “Argue (P, so Q)” can be followed by “Challenge P,” (P₁ ∈ P), “Argue (P’, so ¬Q), “Concede P₁ (P₁ ∈ P) or “Concede (P implies Q)”.
4) No move is available to respond to “Concede P” or “Retract P”.
5) Each move must leave the move maker’s commitments classically consistent.
6) A proposition may be conceded only if the move maker is not committed to it.

7) A proposition \( P \) may not be conceded if the move maker’s commitments justify \( \neg P \).

8) Only explicit commitments can be retracted.

9) Statements under challenge can not be used as premises.

10) No counterargument can be made on a conceded argument.

**Termination rules**

The player running out of legal moves is the loser.

### 3.2.2 Assessment

Given this explanation of Prakken’s game, it is now possible to assess it against the criteria argued for in section 2.4 above.

1) *Persuasion and symmetric*

The dialogue framework is designed for a competitive dispute between two participants. Both parties have the same obligation and opportunities in the evolving dispute. Prakken’s framework therefore satisfies this criterion.

2) *Expressive adequacy*

The second criterion concerns whether the set of move types is adequate for the participants to conduct the debate. There are five move types in Prakken’s framework, which enable the participants to advance their standpoint, to cast doubt on, attack or accept the opponent’s standpoints and to withdraw their commitment. One intuitive difficulty is the absence of a question move type, which may prevent students from asking the tutor some questions and tutors from questioning the student’s understandings; this may therefore be undesirable from an educational point of view and not helpful in debate generally. Prakken’s framework is on balance therefore not acceptable in respect of this criterion.
3) Strategic formation

In Prakken’s dialogue regulations, a claim can be answered only by a challenge or concession and an argument can be answered only with a counter argument, a challenge, or concession. It is not clear in this framework, how a distance strategy (cf. Walton 1998), for example, can be formed since the model does not leave enough room for this. Further, Prakken’s model requires that each move must leave the move maker’s commitment store classically consistent, and a side effect of this is that the system lacks an important strategy in the debate, that is to ask the other party to resolve inconsistencies. Prakken himself points out that one of the limitations of his system is lacking “lines of questioning in cross examination of witness” and “revealing an inconsistency in the witness testimony” (2000:237). From this point of view, Prakken’s framework does not meet this criterion.

4) Philosophical soundness

The set of commitment rules follows a one-way commitment agenda, which means that one will commit only to what one has explicitly stated and accepted (Walton 1998). Thus, the commitment functions are “private write and public access” (McBurney and Parsons 2002).

The set of dialogue rules is clearly designed to prevent illegal events during the evolving dispute. However, several dialogue rules may arguably be problematic. Firstly, the dialogue rule (4) defines that a retraction is not allowed to be attacked. Walton (1998: 46), however, argues that a retraction cannot be passed unchallenged if the statement being retracted is a modus ponens consequence of the remainder of one’s commitments. Therefore, dialogue rule (4) may turn out to be unduly restrictive.

Further, the dialogue rule (5) indicates that each move must leave the move-maker’s commitments classically consistent. Other systems, by contrast, such as Hamblin (1971), Mackenzie (1979a) and Walton and Krabbe (1995), allow the dialogue participant to be inconsistent in that the opponent can pose a resolution demand if he wishes to do so. In an educational dialogue system, the dialogue participants are expected to withdraw or change their point views during the evolving dialogue, and inconsistencies might be inevitable (e.g. the user might originally utter P, but later on change his mind and utter \( \neg P \)). Therefore, dialogue rule (5) may put unnecessary restrictions on the dialogue participants from this point of view.
Given all these, it might therefore be difficult to say that the framework meets this specific criterion.

5) Usability and computational tractability

Intuitively, the system’s available set of move types, its clear commitment rules, simple dialogue rules and termination rules may ease the learning difficulty from the user’s point of view (although this is an empirical issue of course). However, Prakken (2001: 194) indicates that to make a legal counterargument, one is required to assess the strength of the argument (cf. Prakken and Sartor 1996). The strength of arguments, in a controversial domain such as capital punishment, is itself debatable and this may involve complex meta-dialogue to resolve. Further, the requirement for classical consistency intuitively will make it hard for the user to learn to use the model.

Prakken concedes that much work needs to be done to investigate the technical property of implementation of the system (2000: 238). It is unknown from his papers (cf. Prakken 2000, 2001) whether the framework is computationally tractable.

3.2.3 Summary

In sum, Prakken’s protocol is attractive in its simplicity and the underlying logic is defeasible. But the absence of question and resolution demand move types may be undesirable from an educational point of view. The requirement for remaining classical consistent might leave difficulties for a human user to manipulate the dialogue model. The strength of argument is itself debatable, and this may involve complex meta-dialogue to resolve. As a result, Prakken’s framework seems to be unsuitable for an educational human computer debate.

3.3 Bench-Capon

Bench-Capon’s “TDG” dialogue game (Bench-Capon 1998; Bench-Capon et al. 2000) is based on Toulmin’s argumentation schema. The game can be used to mediate discussions between human participants and seeks to ensure that the argument resulting from the dialogue has an appropriate structure.
3.3.1 Specification of TDG

Bench-Capon makes use of the notion of a claim stack in addition to the commitment store. The stack is used to record the claims made during the course of the game. When a claim is made, it is pushed onto the claim stack, and when it is resolved it is popped from the stack. The game is outlined as follows (cf. Bench-Capon et al. 2000: 244-248). [O stands for opponent, P stands for the proponent, Ref stands for the referee, C, D and S are propositional variables]

- **claim (C)**
  
  Description: P asserts that C  
  Preconditions: P has control of the dialogue  
  Post-conditions: O has control of the dialogue  
  C is pushed onto the claim stack  
  P is committed to C  
  Completion Conditions: C is popped from the claim stack

- **why (C)**
  
  Description: O seeks data supporting C  
  Preconditions: O has control of the dialogue  
  C is top of claim stack  
  Post-conditions: P has control of the dialogue  
  Completion Conditions: C is not top of claim stack

- **OK (C)**
  
  Description: O accepts C  
  Preconditions: O has control of the dialogue  
  C is top of claim stack  
  Post-conditions: C is popped from the claim stack  
  O is committed to C  
  O is not committed to “not C”  
  If not C is on claim stack, it is removed  
  Referee has control of the dialogue  
  Completion Conditions: None.

- **So (C)**
  
  Description: O requests the warrant for C
Preconditions: O has control of the dialogue
O is not committed to if D then C, for any D for which he is not committed to -D.
C is top of claim stack
Post-conditions: P has control of the dialogue
Completion Conditions: C is not top of the claim stack

- **Presupposing (C)**
  Description: O requests the presupposition of C
  Preconditions: O has control of the dialogue
  If D then C is top of claim stack
  Post-conditions: P has control of the dialogue
  Completion Conditions: If D then C is popped from the claim stack

- **On Account Of (C)**
  Description: O requests the backing for the warrant of C
  Precondition: O has control of the dialogue
  If D then C is top of claim stack
  P has issued a supply warrant (C)
  Post-conditions: P has control of the dialogue
  Completion Conditions: If D then C is popped from the claim stack.

- **Supply Data (C)**
  Description: P asserts that D and that D supports C
  Preconditions: P has control of the dialogue
  O has issued a Why (C)
  C is top of the claim stack
  Post-conditions: P is committed to D
  D is pushed on the claim stack
  O has control of the dialogue
  Completion Conditions: D is popped from the claim stack

- **Supply Warrant (C)**
  Description: P asserts that if D then C
  Preconditions: P has control of the dialogue
  O has issued a So (C)
C is top of the claim stack

Post-conditions: P is committed to If D then C
If D then C is pushed on to the claim stack
O has control of the dialogue

Completion Conditions: If D then C is popped from the claim stack

- **Supply Presupposition (C)**

  Description: P asserts that S
  Preconditions: P has control of the dialogue
  O has issued a presupposing (C)
  If D then C is top of the claim stack
  Post-conditions: P is committed to S
  P is committed to If not S then not C
  S is pushed on to the claim stack
  O has control of the dialogue
  Completion Conditions: S is popped from the claim stack

- **Supply backing (C)**

  Description: P says that B is the authority for his argument for C
  Preconditions: P has control of the dialogue
  O has issued an on account of (C)
  P has issued a supply warrant (C)
  If D then C is top of the claim stack
  Post-conditions: R has control of the dialogue
  O is committed to If D then C
  If D then C is popped from the claim stack
  Completion Conditions: None

- **Withdraw (C)**

  Description: P withdraws his commitment to C
  Preconditions: P has control of the dialogue
  C is top of the claim stack
  Post-conditions: C is popped from the claim stack
  P is not committed to C
  R has control of the dialogue
Completion Conditions: None

- **Switch Focus (C)**
  
  Description: O wishes to consider a claim not currently top of the claim stack
  
  Preconditions: C is not top of claim stack
  
  C is on the claim stack
  
  O has control of the dialogue
  
  O is not committed to C
  
  Post-conditions: C is moved to top of claim stack
  
  O has control of the dialogue
  
  Completion Conditions: None

- **Current Claim (C)**
  
  Description: The referee passes control to the opponent of the current claim.
  
  Preconditions: C is top of the claim stack
  
  Ref has control of the dialogue
  
  Player A is committed to C
  
  Post-conditions: Player B has control of the dialogue
  
  Completion Conditions: None

- **End**
  
  Description: The referee terminates the dialogue
  
  Preconditions: Ref has control of the dialogue
  
  The claim stack is empty
  
  Post-conditions: The dialogue terminates
  
  Completion Conditions: None

- **Rebut? (C)**
  
  Description: Player is invited to rebut an implicit commitment
  
  Preconditions: Referee has control of the dialogue
  
  C is top of claim stack
  
  Player is not committed to C
  
  Player is committed to if D then C for some D
  
  Player is committed to D
Post-conditions: Player has control of the dialogue
Player is opponent, other player is proponent

Completion Conditions: C is not top of claim stack

- **Rebuttal (C)**

  Description: Player provides a rebuttal, D, of C

  Preconditions: Player has control of the dialogue
Player is not committed to C
Other player is committed to C

  Post-conditions: D is pushed on to the claim stack
Player is committed to -C
Player is committed to D
C is pushed on to claim stack
Player is committed to if D then -C
If D then -C is pushed onto claim stack
Player is proponent, other player is opponent
Opponent has control of the dialogue

  Completion Conditions: -C is no longer on the claim stack

### 3.3.2 Assessment

1) **Persuasion and symmetric**

DTG is symmetric in that both participants follow the same regulation during the course of dialogue. Bench-Capon (1998) indicates that the participants of TDG game are not intending to “win”, but rather to reach a position where there is a supported claim on which they agree. The game might therefore be explanation-based rather than persuasion style.

2) **Expressive adequacy**

DTG specifies 16 move types. This seems advantageous as far as the criterion of expressive adequacy is concerned. However, there is no “question” move type available, and this will prevent the tutor from questioning the understanding of the students and the student from asking some questions; this may be undesirable in an educational context and in a debate in general.
3) Strategic formation

The set of move types provided by TDG are arguably too tightly bound to Toulmin’s structure. The unavailability of question and resolution demand move types makes debate strategies, such as using a line of questions (e.g. distance strategy (cf. Walton 1998)), or Socratic tutoring (cf. Du Boulay and Luckin (2001)) to lead students to recognise inconsistencies in what they know of the domain, impossible to be formed in TDG dialogue. However, the educational advantage of this kind of dialogue strategy has been stressed by Ravenscroft and Pilkington (2000) and Du Boulay and Luckin (2001). TDG is therefore undesirable from this point of view.

4) Philosophical soundness

Bench-Capon (1998: 19) argues that his game allows for the modelling of arguments in a fashion more realistic than the other, logic bound, dialogue games found in the literature. The game is developed based on Toulmin’s (1958) schema. Bench-Capon (1998) indicates that Toulmin’s schema is particularly suitable for legal domain. However, Loui (1998) argues that the distinction between the data and backing of Toulmin’s model is not clear.

Further, TDG says nothing about how to prevent fallacious arguments. Indeed, Bench-Capon (1998: 8) points out that TDG is not intended to enforce logically correct behaviour.

This might not suit the specific requirements of preventing fallacious argument and common errors in a human computer debate.

5) Usability and computational tractability

Each of the 16 move types of the game TDG affects the commitment store and claim stack differently. This might cause difficulties for the user as they to learn to manipulate the dialogue model. The existence of a prototype utilising TDG (cf. Bench-Capon 1998) shows the computational tractability of dialogue framework.

3.3.3 Summary

TDG appears to be a computationally tractable dialogue model. However, its explanation-based nature, absence of a question move type and potential user learning
difficulties make it unsuitable for the specific educational human computer debating system of this project.

3.4 Ravenscroft and Pilkington

Ravenscroft and Pilkington’s (2000) CoLLeGE dialogue game incorporates Levin and Moore (1977), Mackenzie (1979a), and Walton (1984)’s dialogue game theory (Ravenscroft 1997; Ravenscroft and Pilkington 2000). The game envisages the computer as a “facilitating tutor” and the student as the “explainer”. The tutor raises some questions, students answer each question, the tutor solves any contradictions within the student’s commitments and helps the students to reach the correct answer, rather than directly tell them the answer. A prototype has been developed, and Ravenscroft and Matheson claim that the evaluation results demonstrate its effectiveness in stimulating improvements in students’ understanding of the physics of motion (2001; 2002).

3.4.1 The CoLLeGE Game

Ravenscroft and Pilkington (2000) point out that the framework governs the way that the student and the facilitator perform their role in the game. It covers the types of move available to each participant and commitment rules along with issues of initiative and turn taking. The framework can be outlined as follows (cf. Ravenscroft and Pilkington 2000).

Move types

The learner and the system are allocated different move types. There are three move types available for the learner:

1) Assertion: has the form “I assert P”, or “Yes” for acceptance.
2) Withdraw: has the form “I withdraw P” or “No” in response to a question.
3) Don’t know: has the form “I don’t know whether P”.

There are seven move types available for the system:

1) Construct: for example “What causes box to have property speed?”.
2) Question: has the form “Is it the case that P?”.
3) Question-counterfactual: for example, “the person’s push greater than friction causes the box to increase speed, what causes the box to decrease speed?”.

4) Challenge: has the form “Why P?”

5) Persuade: has the form “Isn’t it the case that P?”.

6) Resolve: has the form “Resolve (P and Q)”.

7) Assume: has the form “Let us assume that P”.

**Commitment rules**

Only the learner has a commitment store, which is called the student’s “explanation model”. The system’s moves will not affect the student’s commitment store, with the exception of “Assume”. The commitment rules are as follows:

1) Assertion P will add P to the commitment store.

2) Withdraw P results in P being removed from the store.

3) Assume P will add P to the commitment store.

4) “Don’t know” will not have any effect on the commitment store.

**Initiative and turn taking**

The system provided with two “initiative qualifiers”: Pass and Continue. The learner may use Continue to make further assertions and withdrawals in the same turn, and the learner may also pass the initiative to the system. Once the system has the initiative, it usually retains it until the learner overrides the system’s control using Continue.

**Beginning and ending the game**

The game begins with an explanatory task, and the game is over when the learner has provided a consistent, complete and general explanatory model or the system runs out of tactics.
3.4.2 Assessment

1) Persuasion and symmetric

The game provides three move types for the learner, and seven for the system. The game is therefore asymmetric. The students are restricted to answering the particular questions raised by the system, there is no facility for students to ask the tutor particular questions or to challenge the system’s position. This therefore does not meet the requirement of engaging students in a competitive debate with the computer adopting the symmetric roles.

2) Expressive adequacy

The availability of initiative qualifiers seems advantageous as far as the criterion of expressive adequacy is concerned, since the learner is allowed to make multiple locutions in one turn. However, there are only three move types allocated to the student. There is no move available for students to ask questions, or even challenge the tutor’s positions. It is arguably the case that the student might not be able to say everything they want to say given the small set of move types allocated to the learner.

3) Strategic formation

There are several lower level tactics implemented to manage the discourse such as Challenge-construct, Probe-question, Persuade, Resolve, Acquire construct, Assume (Ravenscroft and Pilkington 2000). The system’s strategy is to ask the learner particular questions in the domain, and whenever conflict occurs, the computer will ask the learner to resolve conflicts. This seems attractive from an educational point of view. However, the game set up leaves the learner less room to perform strategy since the learner is allowed to answer questions or make assertions only.

4) Philosophical soundness

The set of available move types and their effect on the learner’s commitment store is clearly set. Ravenscroft and Pilkington (2000) do not mention how to prevent illegal events during the evolving dialogue. They accept as a weakness that the game is over if the system runs out of tactics, and leave it for further work.
5) Usability and computational tractability

The CoLLeGe prototype has been developed, the system is therefore computationally tractable. The system interface implements an interaction language using a menu and template scheme. Ravenscroft and Pilkington (2000: 281) point out that although the system can be used by researchers and students, future refinements on HCI and usability are still necessary.

3.4.3 Summary

Given the discussion above, the strategy and computational tractability of the game is attractive, but its asymmetric nature makes it unsuitable for a symmetric educational human computer debate.

3.5 Walton and Krabbe

Walton and Krabbe (1995) introduce two types of dialogue game, one is a permissive type of persuasion dialogue (PPD), and the other is a rigorous type of persuasion dialogue (RPD). PPD is a Hamblin style of game and RPD is a Lorenzen-type game. It was argued earlier that the Lorenzen style of game is unlikely to be appropriate for a human-centred debate on the ground that it is overly deterministic and asymmetric (cf. Moore 1993). The particular interest here therefore is to look at the PPD dialogue model.

3.5.1 PPD Building Blocks

There are four building blocks in PPD: locution rules, commitment rules, structural rules, and win and loss rules. They are outlined as follows (cf. Walton and Krabbe 1995:149-152).

Locution rules

There are nine permitted locutions. Multiple locutions are allowed in one move.

1) Assertion: \( a \) (P)
2) Concessions: \( c \) (P)
3) Elementary arguments: \( \Delta \) so P
4) Request for concessions \( \text{con} \) (P)?
Commitment rules

Each participant is assigned three sets of commitments--dark side commitments, assertions and concessions. The set of concessions that are not in the set of assertions are “mere” concessions. The commitment rules are:

1) An assertion a (P) will result in P being included in the speaker’s assertion and concession set.

2) A concession c (P) will add P to the speaker’s concession set.

3) A retraction nc (P) will result in P being not included in the speaker’s assertion set and concession set.

4) A retraction na (P) removes P from the speaker’s assertion set only.

5) An elementary argument will add all elements of the argument into the speaker’s assertion and concession set.

Structure rules

1) Two parties move alternatively.

2) Resolve (P, Q) must be followed by no commitment P or no commitment Q.

3) Question con (P)? can be answered only by a concession c(P), or no commitment P.

4) If the previous move includes extractor serious (P)?, the speaker can answer only with a concession c (P), or no commitment P, but the speaker must utter a concession c (P) if P is in the speaker’s dark-side commitment set.

5) Each element of an elementary argument must be either conceded or challenged.

6) A challenge of P must be followed by an elementary argument, nc (P) or na (P).

7) Retracting a strong commitment na (P) can be used only if P is an assertion of the
speaker.

8) Retracting a commitment nc (P) can be used if either the preceding move contains con (P)?, or serious(P)?, or P is a concession of the speaker.

9) A concession c (P) is allowed only if P is not a concession of the speaker and either P is an assertion of the other party, or the preceding move contains con (P)? or serious (P)?.

10) A request con (P)? may be used only if one of the speaker’s assertions P is not among the concessions of the listener.

11) The question “serious (P)?” may be used only if the preceding move contains nc (P) or challenge (P).

12) An elementary argument “Δ so P” may be used only if P is not among the concessions of the listener and some earlier move contains challenge (P).

13) Challenge (P) can be used only if P is an unchallenged assertion of the listener and not a concession of the speaker.

14) Each unchallenged assertion of the listener is a concession of the speaker.

15) For each basic argument of the speaker and for each Q that is an element of the argument, if Q is retracted by the speaker, then all the elements of the argument that are premises for Q must be retracted, moreover if Q is a premise for P, then P must be retracted.

16) A retracted initial thesis can not be reinstated.

**Win-and-Loss Rules**

There is an initial thesis, and if the proponent has retracted the thesis, then the opponent wins the game, if the opponent has committed to the thesis, the proponent wins the game.

**3.5.2 Assessment**

1) *Persuasion and symmetric*

The game PPD is permissive persuasion dialogue. It is symmetric, in that the two parties share the same locution, structure, commitment and winning rules. From this aspect, this
framework meets the specific requirements of a human computer debate.

2) Expressive adequacy

The permitted locutions include statements, elementary argument, questions and retractions. Statements are subdivided into assertions and concessions. An elementary argument is a set of premises drawing a conclusion using the key word “so” (e.g. P, so Q). Questions include four subtypes: Request for concession is yes/no questions, Challenge has the form “Why P?”, Confront is a request for resolving inconsistencies, and Extractor has the form “are you serious about P?”. Retractions include retracting assertion and concession and retracting assertions only. Each move may include some or all the locutions described above, in other words, each move may have multiple locutions. Allowing multiple moves in one turn seems advantageous as far as the criterion of expressive adequacy concerned. However, it might be argued that the response to a question might be restrictive in that only “Yes” and “No” options are allowed. Other systems, by contrast, e.g. Mackenzie’s (1979a) DC, allow three options: “Yes”, “No” and “no commitment” in response to a question.

3) Strategic formation

It might initially appear that allowing multiple locutions in one turn will facilitate strategic formation. However, Walton and Krabbe argue that if a party makes an assertion, the other party, in the very next move, should either challenge or concede the new assertion as defined in the structure rule (5). A potential drawback with this legislation is that it may leave little room for strategic formation since one might wish to make a plan aiming to rebut the new assertion.

4) Philosophical soundness

The 16 structure rules are designed to prevent illegal events during the evolving dialogue. However, Walton and Krabbe (1995:178) point out that there is no facility to ban the fallacy of question begging, in that additional rules are needed concerning the kinds of arguments that can be used in response to challenges.

5) Usability

The commitment functions intuitively seem too complicated. In PPD, each participant is
assigned three commitment stores—the dark side commitment store, the set of assertions and the set of concessions (light side), the set of concessions that are not in the set of assertions are mere concessions. There is, however, some duplication between the set of concessions and the set of assertions. Further, it has been argued that the dark side commitment will raise the cognitive load to the user (Moore 1993; Maudet and Moore 2001).

The retraction of commitment, “nc (P)” will remove P from both the assertion set and the concession set, and the retraction of strong commitment, “na (P)” will remove P only from the speaker’s assertion set. It is not clear, in the specified structure rule 7 and 8, when to use nc (P) and when to use na (P). This may cause conceptual difficulties in practice.

The extractor “serious (p)?” can be used only if the preceding move contains ‘no commitment p’ or ‘why p?’, and if p is in the hearer’s dark side commitment store, the hearer should utter concession (p). But it is not clear how the questioner can know whether P is in hearer’s commitment store, since the dark side commitment is not explicitly known to both participants (cf. Walton and Krabbe 1995:125). This again is likely to cause difficulty in practice.

In addition to these potential difficulties with the commitment rules, intuitively, the set of structure rules looks too complex for people to use.

6) Computational tractability

The complex commitment functions and structure rules of PPD game might make it difficult for computational implementation. Whether it is computationally tractable is an open empirical issue.

3.5.3 Summary

PPD is persuasion type of dialogue. Both players are regulated by the same rules, it is therefore symmetric. PPD provides no facilitates to ban the fallacy of question begging. Its structure rules and commitment functions look intuitively complex, and this may make the system difficult for people to use in practice. In addition, the dark-side commitment may raise the cognitive load to the user. All these difficulties suggest that PPD may not be a perfect match for the specific requirements of educational human computer debate.
3.6 Moore

The formal argumentation system DC was developed by Mackenzie (1979a) to study the fallacy of question begging, and later on adopted and slightly amended by Moore (1993) as the underlying model for a potential intelligent tutorial system. The DC system is set up with two participants in dialogue with each other. Each party is assigned a commitment store, which records participants’ commitments at each stage of the dialogue. Commitments can be added or deleted from commitment stores during the evolving dialogue. Participants’ moves are regulated by a set of rules, which prohibits illegal events. The amended DC system can be outlined as follows (cf. Moore and Hobbs 1996).

3.6.1 The Amended DC System

Available move types

The DC model makes the following move types available to both participants in the dialogue:

1) Statements. P, Q, etc. and the truth-functional compounds of statements: ‘Not P’, ‘If P then Q’, ‘P and Q’ and ‘P or Q’.

2) Questions. The question of the statement P is ‘Is it the case that P?’.

3) Challenges. The challenge of the statement P is ‘Why is it supposed that P?’ (or briefly ‘Why P?’).

4) Withdrawals. The withdrawal of the statement P is ‘No commitment P’.

5) Resolution demands. The resolution demand of the statement P is ‘resolve whether P’.

The move type “Statements” refers to atomic statements, conditionals and the conjunction of these atomic statements. A statement can be used to advance a standpoint, answer a challenge or answer a question. “Questions” are restricted to bipolar (yes-no) questions. “Challenges” are designed to elicit grounding evidence. “Withdrawals” have the effect of removing a statement from the commitment store of the move maker if it is there; it can be used when a participant does not want to commit to a statement in his store any more, or gives a non-committal response to a question or a challenge. Finally,
“Resolution demands” are requests to resolve inconsistencies in the event of one’s partner being committed to inconsistencies.

Commitment rules

The commitment rules are as follows:

1) Initial commitment, CR0: The initial commitment of each participant is null.

2) Withdrawals, CRw: After the withdrawal of P, the statement P is not included in the speaker’s store.

3) Statements, CRS: A statement P results in P being added to each store.

4) Defense, CRys: After a statement P, if the precedent event was ‘Why Q?’, P and ‘If P then Q’ are included in each store.

5) Challenges, CRY: A challenge of P results in P being added to the store of the hearer, and P being removed from, and ‘Why-P?’ being added to, the store of the maker of the move.

The rule CR0 indicates that commitment stores are empty at the beginning of the game. CRw implies that a withdrawal of P will delete P from his store if it is there. Rule CRS and CRys make it clear that the commitment policy follows “silence means assent” conventions (Mackenzie 1979a; 1979b) and that a statement will go to both stores; if the participant in question does not agree, they can either challenge or withdraw to delete it from their store. The rule CRys specifies that when a statement P is uttered in answer to a challenge ‘Why Q?’, the conditional (‘If P then Q’) will be simultaneously added to both stores as well. Mackenzie (1979a) argues this arrangement avoids the need, present in an earlier system H (Hamblin 1970), for the double locution P and ‘If P then Q’ to answer a challenge ‘Why Q?’, and achieves the same effect more neatly.

The rule CRY carries out three operations when a challenge move occurs. One is to include the statement challenged (say P) in the hearer’s store. Mackenzie (1984) defends this on the grounds that if the hearer disagrees with P, he can remove it explicitly. The second operation is that P is removed from the challenger’s store. Mackenzie (1979a) points out that it avoids the need, present in H, for the double locution ‘No commitment P’ and ‘Why P?’. The third operation is that the challenge (say ‘Why Q?’) is included in the challenger’s store, and then the statement Q is regarded as being “under challenge” by
the challenger.

**Dialogue rules**

Participants in a dialogue using the DC model are required to adopt the following rules:

1) **RFORM:** Participants may utter individual permitted locutions in turn.

2) **RREPSTAT:** Mutual commitment may not be uttered.

3) **REQUEST:** “Question P?” may be answered only by P, “Not P” or “No commitment P”.

4) **RCHALL:** “Why P?” must be responded to by a withdrawal of P, a statement not under challenge by the challenger, or a resolution demand of any of the commitments of the hearer, which immediately imply P.

5) **RESOLVE:** Resolution demands may be made only if the hearer is committed to an immediately inconsistent conjunction of statements, or withdraws or challenges an immediate consequence of his commitments.

6) **RESOLUTION:** A resolution demand must be followed by withdrawal of one of the offending conjuncts, or affirmation of the disputed consequence.

The rule **RFORM** tends to engender short dialogue turns; a participant’s one turn contribution must be either a statement, or a withdrawal, question, challenge, or resolution demand of a statement. **RREPSTAT** will prevent participants from asserting a previously agreed statement, and is based on an alleged rule in actual discussion, e.g. “Yes, dear, I know” (Mackenzie 1979b: 710). **REQUEST** restricts the answer to question P to only yes, no or no commitment. It does not allow qualified answers, e.g. “I think P, but…..”, but the no commitment option avoids the fallacy of many questions and ad ignorantiam if the respondent has no evidence in favour of either P or not P (Walton 1984:115).

**RCHALL** indicates that there are three options available in response to a challenge. The first option can be used if the respondent has no evidence to support the challenged statement. This option has the advantage of enabling participants to avoid loaded challenges, as discussed in (Moore 1993:151). The second option is to give a grounding statement, on the condition that the grounding statement should not be under challenge by the challenger, otherwise, the respondent is seen as begging the question. This option,
together with the commitment rule CR\textsubscript{Y} is indicated by Mackenzie (1979a: 120) as the essential part of DC’s treatment of question begging. The third option can be used if the challenger has already committed to the reasons (say Q, If Q then P) to the challenged statement (say P). In practice, this resolution demand can be expressed, as “you already know why”.

\texttt{RRESOLVE} and \texttt{RRESOLUTION} respectively provide the precondition and post-condition of a resolution demand. There are two types of resolution demands in DC. The first can be used to point out inconsistencies in the opponent’s commitment store (e.g. resolve \{P, Q, Q\Rightarrow\neg P\} and resolve \{P, \neg P\}), requiring the opponent to withdraw one of the inconsistent statements. The second type of resolution demand can be issued when one’s partner is challenging or withdrawing a statement (say P), and reasons for P (say Q, If Q then P) are in his commitment store at the same time; under such circumstances, the respondent must either (i) withdraw Q, or (ii) withdraw If Q then P, or (iii) admit P.

\textbf{3.6.2 Assessment}

\textit{1) Persuasion and symmetric}

The game DC is symmetric in that the two dialogue participants are bound by the same regulations (move types, commitment rules and dialogue rules) as they make moves in the dialogue.

Moore (1993), in utilising of DC, assigns the two players the opposite views of the issue under debate, and both try to convert each other’s views. This suggests that the game DC can be used to regulate a persuasion style dialogue.

DC therefore suits the “persuasion and symmetric” criterion.

\textit{2) Expressive adequacy}

DC provides five move types: statement, question, challenge, resolve and withdrawal. The statement and challenge move types enable the participants to advance standpoints and challenge the partner’s position. The provision of a question move type enables the participants to ask questions. The resolve move type can be used whenever an inconsistency occurs in the debate, and the participants can use the withdrawal move type to remove any propositions to which they no longer adhere. Further, Moore’s
experimental study of the utility of DC reveals that “the participants are generally able to say all they want to say within a debate” (1993: 210) and “the restricted range of move types allowed by DC imposed little impoverishment in comparison with unconstrained dialogue” (1993:226). Therefore, the set of move types seems practically useful and may be sufficient to carry out useful debate.

It might be argued that the dialogue rule R\textsc{form} tends to engender short dialogue turns in that participants cannot make an argument within a turn. This seems disadvantageous as far as the criterion of expressive adequacy is concerned, however this may lead to more interactive dialogue.

3) Strategic formation

DC’s rule regulation is rather slender (Moore 1993: 246). After a question or a resolution demand, the relevance of move choices is strictly regulated. After a challenge (why P), one can respond with no commitment P, a resolution demand (in some circumstances) or a ground for P. However, the rules say little about the content of the ground P. Further, there are no restrictions on the move types or move contents after a withdrawal or a statement. DC therefore leaves much room to the discretion of the participants of the dialogue model. This is seen as the strength of the dialogue model in that enough room is left for participants’ strategic play.

4) Philosophical soundness

DC’s history can be traced from Hamblin’s (1971) system “H”. Mackenzie’s game DC is developed based on “H” with the purpose of studying the fallacy of question begging.

The commitment policy is “silence means assent” (Mackenzie 1979b). For any statement made by one party, it will go to both commitment stores. Mackenzie argues that if you do not agree, you can either withdraw or challenge it and thus delete it from your store.

There have been however, criticisms of certain DC rules. Woods and Walton (1982) and Walton (1984) argue that DC erroneously bans certain sequences of question begging. Elsewhere, Maudet and Moore (2001) argue that the rule R\textsc{repstat} may prevent one from answering questions in a preferred way in that a mutual commitment cannot be legally used as an answer to a question.

DC may therefore have certain difficulties on the “philosophical soundness” criterion.
5) Usability

Walton (1984) argues that the set of DC rules is practically useful. Further, Moore’s (1993: 204) experimental work reveals that the user can generally accept the set of move types, and Moore argues that certain difficulties (e.g. the use of “resolution demand”) could be overcome by suitable computational aid. Moore also suggests that rule breaks (made by the user) were infrequent, and argues that many of those that did occur could have been avoided by computational support. This on the one hand suggests that the user can largely adopt DC without undue difficulties, and on the other hand suggests the need for further usability study in a computational environment.

6) Computational tractability

An interface has been developed (cf. Pilkington et al. 1992) that allows two players to engage in a DC dialogue supported by a computer-based game board and referee. The successful implementation of this interface effectively furnishes an affirmative answer to the question of DC’s computational tractability (cf. Moore 1993).

3.6.3 Summary

As discussed above, its persuasion style, symmetric nature, simplicity, usability and computational tractability make a strong case for DC as a suitable framework for human computer debate, but the failure to block certain fallacies and common errors may weaken the case for DC.

3.7 Lodder and Herezog

“Dialaw” (Lodder and Herezog 1995; Leene et al. 1994; Lodder 1999) is a two-person game for modelling legal reasoning. The framework has been implemented in Prolog, and this shows that the system can accept input and upgrade the commitment stores.

3.7.1 Dialaw Framework

Move types

Dialaw allows five move types:
1) Claim: player claims a sentence S, or claims a sentence ¬S (deny), or claims refusal of a sentence.

2) Question: player questions the sentence S.

3) Accept: player accepts sentence S.

4) Withdrawal: player withdraws a sentence S.

5) Arbitrator: player calls in the arbitrator to decide a sentence S.

**Commitment rules**

The commitment rules are as follows:

1) A claim (P) or accept (P) results in P being added to the speaker’s commitment store.

2) A withdrawal (P) will remove P from the speaker’s commitment store.

3) If a dialogue ends because a sentence is accepted, all open claims of that dialogue opponent are withdrawn from his store, and all open claims of the dialogue proponent are added to the opponent’s store. Here, a claim is said to be open, if the dialogue about this claim has not ended yet.

4) If a dialogue ends because a sentence is withdrawn, all open claims of that dialogue proponent are withdrawn from his store, and all open claims of the dialogue opponent are added to the opponent’s store.

**Dialogue rules**

The dialogue rules are as follows:

1) A claim (S) can be made only if the speaker has not claimed S before and S is not in either store.

2) A negation (¬S) can be made only to react to S.

3) Accept (S) can be made only if S is not in the speaker’s store and S is in the opponent’s store. A negation ¬S can not be accepted if S in the speaker’s store.

4) A withdrawal (P) can be made only if P is in speaker’s store.
5) A player can call the arbitrator if only one party commits to the sentence.

6) Claim (P) can be responded to with question (P), or refuse (P), or claim (¬P), or accept (P or an earlier claim), or claim (Q) where Q can influence the balance of P.

7) Any move type is allowed after a question except a question.

8) After a player accepts or withdraws a sentence, the next move is either a new argument for, or a new reaction to, the same sentence that the accepted/withdrawn sentence was an argument for or a reaction to.

8) After a call for arbitrator, the arbitrator can either let the player accept or withdraw a sentence.

Termination rules

A dialogue about the thesis S ends if either S is in both commitment stores or S is not in either commitment store.

3.7.2 Assessment

1) Persuasion and symmetric

The two participants start from conflict about a sentence (thesis), one is the proponent, and the other is the opponent. The proponent aims to commit the thesis to the opponent’s store and the opponent’s aims to remove the thesis from the proponent’s store. Further, the game is symmetric in that the two parties share the same move types, commitment rules, dialogue rules and termination rules. The game therefore satisfies this criterion.

2) Expressive adequacy

There are five move types: claim, question, accept, withdrawal and arbitrator. The move type “question” here is the challenge of a sentence, and questions like “Is it the case that P?” are absent. This might be undesirable from an educational point of view since this may prevent the tutor from questioning the students’ understanding, and also prevent students from asking the tutor questions.
3) **Strategic formation**

The absence of a question (e.g. Is it the case that P?) and a resolution demand move type makes debate strategies, such as using a line of questions (e.g. distance strategy (cf. Walton 1998)) or asking the other party to resolve inconsistencies, unlikely to be formed.

Further, the dialogue rule (8) indicates that after a withdrawal or acceptance of P, the next move should be a new argument for or a new reaction to the sentence being supported by P. This may leave less room for participants’ strategic play. Other dialectical systems, by contrast, e.g. Mackenzie’s (1979a) DC, impose no restriction on the move types and move contents after a withdrawal or a statement.

The dialogue model is arguably undesirable from this point of view.

4) **Philosophical soundness**

Dialogue rule (1) specifies that a claim (S) can be made only if the speaker has not claimed S before and S is not in either store. Lodder and Herezog (1995) argue that this arrangement is to disallow repetition. However, this may prevent participants from using an earlier statement as an answer to a challenge.

Dialogue rule (3) prevents one from accepting ¬S if S is in his store. Lodder and Herezog (1995) argue that this arrangement is to require a participant to keep consistency of his commitment. However, Wood et al. (2000: 310) argue that rational agents are required to revise their beliefs. In an educational dialogue system, the dialogue participants are expected to withdraw or change their point views during the evolving dialogue, and inconsistencies might be inevitable (e.g. the user might originally utter P, but later on change his mind and utter ¬P). Therefore, dialogue rule (3) may put unnecessary restrictions on the dialogue participants from this point of view.

Further, the game specification says nothing about how to block fallacies, such as begging the question (Mackenzie 1979a) or circular argument (Woods and Walton 1978; 1982).

5) **Usability and computational tractability**

The commitment rules (3) and (4) appear very complex, and thus may be difficult for the user to learn to use.
The implemented prototype of Dialaw reported in (Lodder and Herezog 1995) shows the computational tractability of the game. However, it is not clear from their papers whether the usability of the prototype was evaluated.

3.7.3 Summary

Dialaw’s symmetric nature and its computational tractability strengthen its case to be a model of legal reasoning. However, the absence of question move type and certain philosophical difficulties with the set of rules would weaken its case to be a suitable model for the required educational human computer debate system.

3.8 Summary

This chapter has assessed some of the developments of dialectical systems in the area of dialectics and computational dialectics. This critical review of the literature enables a suitable dialectical model to be selected, and to be used as the basis for further study. This will be discussed in the next chapter.
CHAPTER FOUR

A PROPOSAL

4.1 Introduction

This chapter argues for the adoption of Moore’s utilisation of DC, and discusses means of using it as the basis to develop a suitable model for human computer debate. First, the adoption of the Moore’s utilisation of DC system is argued for. Next, some objections to the DC system are posed and discussed. Finally, a suitable means of evaluating the DC system is proposed.

4.2 The Adoption of DC

The previous chapter contained a comparative study of the most recent developments of dialogue models (Prakken 2000, Bench-Capon 1998, Walton and Krabbe 1995, Ravenscroft and Pilkington 2000, Moore 1993, Lodder and Herczog 1995) in the area of informal logic and computational dialectics. The study suggests that Bench-Capon’s system is explanation based rather than debate oriented. Prakken’s and Lodder and Herczog’s systems lack a question move type, and this may prevent students from asking the tutor questions and tutors from questioning the student’s understandings, and this in turn is undesirable from an educational point of view (cf. Veerman 2002). Ravenscroft and Pilkington’s system is asymmetrical and the dark side commitment of Walton and Krabbe’s PPD would be likely to raise the cognitive load to the user. This is not, of course, to deny the general worth of these systems, but rather to suggest that they may not be a perfect match for the specific requirements of educational human computer debate.

However, Moore’s (1993) utilisation of DC arguably meets most of the requirements (in that the “persuasion and symmetric”, “expressive adequacy”, “strategic formation”, “computational tractable” and “usability” criteria are all met, although it might have certain difficulties on the “philosophical soundness” criterion and it needs further usability study in a computational environment). Further advantages of adopting DC as the underlying dialogue model are discussed by Moore and Hobbs (1996): the design of the rules suggests computational tractability, and its symmetric nature enables either the tutor or the students to build their own positions. Further, Walton (1984) also suggests
that the set of DC rules is practically useful. For the reasons discussed above, the dialogue game DC is chosen as the base system for further study.

4.3 Some Objections to DC

There might be however a number of objections that could be raised to the system DC. First, it seems that certain move types, such as “accept” or “concession” (as appear in Prakken 2000, Walton and Krabbe 1995, Bench-Capon 1998), which one might intuitively expect to see in a debate, appear to be absent in DC. However, it might be replied that concessions or acceptances can be made in the game DC by asserting the accepted or conceded propositions (cf. Mackenzie and Staines 1999).

A second objection to the system DC might be that because it makes available only bi-polar questions, this prevents users from asking questions such as “how…”, “where…”, “when…” or “who…”. A possible response to this objection would be to treat all such questions as bids of a different game type, namely information-seeking dialogue (cf. Moore 1993). The current project considers pure debate, a type of argumentation dialogue discussed in section 2.3.3 above. The work of moving beyond such a debate is left for further work and discussed in chapter ten.

A third objection might be that the DC model operates at too high a level. One of the attractions of DC, from both computational and user perspectives, is the relative simplicity of its rule set. It may be held, however, to be too simple to adequately regulate debate. For example, there is no guidance within the rules as to the content of the ground to answer a challenge, or to the semantic possibilities after a statement or a no commitment move. This, on the other hand, reflects Loui’s (1998) argument that a good dialogue model should leave enough room for participants’ strategic formation. The rules per se, then, do not necessarily lead to good dialogue, but may well give the framework which, when allied with strategic discretion, will cause such dialogue to result. A similar reliance on strategy also provides the response to a possible concern that students will learn little if anything by playing DC (cf. Moore 1993). What such strategic wisdom consists of, and how it might be made available to a machine, is one of the major issues of the current project (chapter 8).

It might also be argued that there is no way of stopping a dialogue participant adopting a tactic of continuously replying with a “no commitment” (cf. Walton 1998). On the other
hand, someone adopting this kind of tactic is at least prevented from winning a debate. In general, cooperative dialogue participants, who take seriously the aim of winning the debate, need to be assumed. How realistic this assumption would be in practice is an empirical question, beyond the scope of this thesis.

A final objection might be that there is no formal victory move in the system DC. Following Moore (1993), the computer would claim victory if the user has explicitly committed to the computer’s thesis and the computer would concede defeat if it has explicitly committed to the user’s thesis.

4.4 The Proposed Study of DC

Regarding the “philosophical soundness” criterion of a human computer debate dialogue model, there might be certain difficulties in the system DC’s ability to prevent fallacious argument and common errors. For example, Woods and Walton (1982) and Walton (1984) argue that DC erroneously bans certain sequences of moves as question begging, and Maudet and Moore (2001) argue that the rule $R_{\text{REPSTAT}}$ may prevent one from answering questions in a preferred way. It is not clear whether there are more problems related to the set of rules, and the issue of whether DC can prevent all fallacious argument remains open. This issue is important because one of the main potential utilities of the debating system is to develop students’ critical thinking and debating skills, and to teach students how to avoid fallacious argument and common errors in a contentious debate. Given this, the dialogue model should be able to pick out fallacious argument and common errors when they occur during the course of debate. A systematic study of the set of DC rules is therefore necessary, to establish the extent to which it might fulfil one of the requirements of educational human computer debate, which is that the model can prevent fallacious argument and common dialogue errors.

There are, it might be suggested, two possible approaches to study the properties of a dialogue model such as DE. One involves a formal analysis of the model’s rules in an attempt to “prove” the validity of the model. The other is a more inductive approach and involves studying the results of use of the model in practice. Most work in dialectics adopts the latter, and this will be the approach used in the current research. In particular, Maudet and Moore (2001) argue that a computational environment may be used as a test-bed to study proposed dialogue models. Traum and Larsson (2003: 328) also suggest that computational dialogue systems can provide a test-bed for theories of dialogue.
Further, conversational simulation is also stressed by Amgoud and Maudet (2000) to be an important means to get empirical results about dialogue structure and its behaviours. A suitable means of such a study, it can be argued, is to allow two computer systems to run with a proposed model in dialogue with each other and study the result, since there is no human involvement and it is therefore easy to control the experimental variables. Given this, it would seem prudent to build two computational agents that can debate with each other via DC, and analyse the dialogue transcripts. The results could be further used to amend the DC system as necessary. The amended system could then be studied using similar conversational simulation, to establish whether it does show improvement over DC in preventing fallacious argument and common errors.

4.5 Summary

This chapter has argued for the adoption of Moore’s (1993) utilisation of DC in the light of the literature reviewed in the previous chapter. Some objections to DC have been posed and responded to. A proposed means of study of DC has been made, namely the construction of a 2-agent system and use of this system to facilitate the evaluation of DC. This proposal necessitates the construction of a suitable 2-agent system in which the agents conduct dialogue with each other using DC as the dialogue model. This will be considered in the next chapter.
CHAPTER FIVE

EMPIRICAL EVALUATION OF DC

5.1 Introduction

The previous chapter proposed a computer-based study of the set of DC rules in order to establish whether the model can prevent fallacious argument and common dialogue errors. This chapter will follow this agenda and conduct an empirical evaluation of the game DC. Firstly, two computational agents able to debate with each other via the DC model are constructed and their knowledge representation is discussed. Next, the dialogue transcripts generated by these agents as they use a DC-based dialogue model are analysed. Finally, problems concerning DC rules are categorized in the light of the analysis.

5.2 DC Computational Agents

![Figure 5.1 Agents system architecture]

Figure 5.1 Agents system architecture
A computational test-bed which enables two software agents (referred to henceforth as Simon and Chris) to conduct debate with each other via DC, has been built using the Java programming language. The system enables the two agents to conduct a debate with it on the controversial issue of capital punishment. Both agents can adopt either a proponent or an opponent role. That is, if one agent chooses to support the view of “capital punishment is acceptable”, the other agent will adopt the opposite view “capital punishment is not acceptable”, and visa versa. The two agents then engage in debate on the topic of capital punishment, given these initial positions on the issue. The system architecture is shown in figure 5.1.

There are six main components of the system. The interface unit (see figure 5.2, which depicts two agents (Chris and Simon) debating capital punishment (CP)) provides a number of facilities. The dialogue history will record the debate. The commitment-stores show both agents’ commitment store contents. In order to control the process of the debate, a “New game” menu item is designed to start the debate, a “Pause” button is available to temporarily stop a debate, and a “Continue” button will carry on the dialogue if necessary. A “Save as” menu item is designed to save the dialogue history and both commitment stores as a separate file for subsequent analysis.

![DC Conversational Agents](image)

**Figure 5.2** DC agents interface
The second main component of the system is the dialogue unit. This can be regarded as the despatch centre of the agent interaction. This unit provides functions to update the dialogue history and manage the turn taking of the agents and referee. This unit will schedule the corresponding agent to make a move and then pass the agent’s move to the referee for judgement. If the move is legal, the commitment manager will be called to update the commitment stores. Otherwise, the referee will post a warning message and request the corresponding agent to redo its move. Thus, the role of the referee is to force the participants to follow the DC dialogue rules. In addition, the referee is also in charge of winning or losing; the original DC regime makes no stipulation re winning and losing, but following Moore (1993), one agent will lose the debate when its thesis is removed from its store and the opponent’s thesis is added to (and not subsequently withdrawn from) its store.

The scheduling unit comprises a scheduler for each agent. They are responsible for generating moves in the light of the knowledge base of that agent and the prevailing state of both commitment stores. Both schedulers share the same set of strategists. There are question, challenge, resolution, assertion and withdrawal strategists, which are designed to deal with different dialogue situations. (i) The question strategist deals with incoming questions and will generate three choices: “Yes”, “No” and “I am not sure about it” according to rule RQUEST. (ii) The challenge strategist deals with incoming challenges and will produce a set of moves, which consists of a resolution demand if the challenged statement is a consequence of partner’s store, withdrawal of the statement being challenged, and asserting of any propositional statement in its own knowledge base, according to the rule RCHALL; (iii) The resolution strategist handles resolution requests, and it will produce a set of moves, which consists of withdrawal of any of the conflicting conjuncts and affirmation of the disputed consequence, according to the rule RRESOLUTION. (iv) The assertion and withdrawal strategists are designed to handle the situation of a statement or a withdrawal, they will produce a set of moves which consists of asserting or asking questions about any statement in its own knowledge base, requesting a resolution demand according to the rule RRESOLVE, withdrawal of any statement in its own commitment store, and challenge of any statement in partner’s store. In the current system, these strategists produce a pool of move-choices. The scheduler then selects one (on a random basis) and passes it to the dialogue unit to make a contribution. Using random argument is intended to result in the dialogue transcripts generated by the agents covering different aspects of the proposed model. The argument is that this may reveal certain failures of the dialogue rules that might be overlooked by manual use of the rules.
The commitment unit is responsible for maintaining the agents’ commitment stores. It includes a commitment manager and two commitment stores, one for each agent. The commitment manager updates both agents’ commitment stores according to DC commitment rules. After each agent’s move, both commitment stores repaint the system interface; any statement under challenge is marked with a “??” as shown in figure 5.2.

The knowledge base unit consists of a knowledge base manager and the knowledge bases of the two agents. When the game starts, the dialogue manager will invoke the knowledge base manager to initialise both agents’ knowledge bases. One agent will be set up to support the view that “capital punishment (CP) is acceptable”, the other to support “capital punishment is not acceptable”. The agent knowledge bases contain a set of propositions and consequence relationships between these propositions. The domain knowledge is formalised from Moore’s (1993) experimental study of DC with human participants. An example of the system domain knowledge can be seen in appendix D2.

### 5.3 Knowledge Representation

![Diagram](image)

**Figure 5.3** System knowledge base architecture

Several ways of representing knowledge for use in argumentation systems can be found in the literature, e.g. Ravenscroft and Pilkington’s (2000) rhetorical structure theory (RST) and Bench-Capon’s (1998) and Freeman and Farley’s (1996) revised versions of Toulmin’s (1958) argument formalism. Moore (1993) argues that the knowledge base should be able to provide statements that can be used to answer questions, support other statements, and provide a statement that can be used to rebut other statements. To provide such a service for the debating system, a modified version of Toulmin’s schema is
adopted, as illustrated in figure 5.3.

Essentially, the modal qualifier and the backing have been omitted from Toulmin’s original schema. A horizontal line in figure 5.3 shows a rebuttal relationship, a vertical line shows a supportive relationship. Chaining of argument is allowed by this representation, in that some data can be claims of other arguments (cf. Bench-Capon 1998). Any statement might have an associated rebuttal which is currently defined as the negation of the statement (cf. Freeman and Farley 1996). In addition, each claim or data might have more than one data support. The knowledge base distinguishes hard evidence from opinion; the former is represented by blue coloured text in figure 5.3; the distinction is important in certain aspects of the system’s dialogue strategy, which will be discussed in chapter eight. An example of such knowledge representation can be seen in appendix D2.

5.4 Analysis of DC Dialogue Transcripts

The system outlined above has been used to generate four dialogues. This section will discuss some of issues arising from the analysis of these agent-generated dialogues. Extracts from four dialogue transcripts: DC1, DC2, DC3, DC4 will be discussed (full transcripts are in appendix A). The analysis is carried out in two ways: one is to detect whether even if both agents follow the DC rules (as evidenced by the DC referee not objecting to their moves), fallacious argument is still generated, the other is to analyse whether the referee’s judgements are appropriate. These analyses show that in total the agents made 258 (25+73+52+108 from each of DC1-DC4) DC legal moves, and 19 (2+3+5+9) of them are found to be fallacious. The DC referee made 35 (5+10+8+12) judgements of illegal moves being made. Although all these judgements represent a correct application of the DC rule set, 24 (4+6+5+9) of them are analysed to be inappropriate in that DC wrongly bans certain sequences of moves as fallacious argument or dialogue errors. These figures therefore suggest weaknesses in the DC rule set. In particular, these issues fall into the following categories.

5.4.1 Straw Man Fallacy

The straw man fallacy involves a misrepresentation of someone’s commitments in order to refute that person’s argument (Walton 1996a). It is found from the transcripts that
certain instances of resolution demand for an alleged inconsistency might involve an intuitively erroneous representation of the opponent’s positions, e.g. the following extract from DC2 (S for Simon, C for Chris, R for referee; blue italicised type annotations are added by the author and indicate the move type and rules being used by each move).

001: C>Is it the case that CP is acceptable? ……………………………………………..Move type: question
002: S>Yes, I think CP is acceptable. …………………………..Move type: statement; rule: CRS, RQUEST
003: C>I think CP is not acceptable. ………………………………………………..Move type: statement; rule: CRS
004: S>Please resolve CP is acceptable and CP is not acceptable in your store. ……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………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The transcript shows that it is illegal both for Chris to give an affirmative answer to the question in turn 017, 019 and 023, and a negative answer in turn 021, the reason given by the referee is that the statement is in both stores. The only choice for Chris is therefore to withdraw the statement “CP is acceptable”. Intuitively, this seems to give too much power to the questioner and should not be allowed in a fair dialogue. This issue revealed here is in line with Maudet and Moore’s (2001) argument that the rule RREPSTAT may prevent participants from answering questions in their preferred way.

Further, certain moves, which use a mutual commitment to answer a challenge might have been wrongly banned by the DC referee as a repetition. The following dialogue fragment is taken from DC4 as an example.

120: S>Why is it that 60% British people support CP? ………………..……….…… Move type: challenge; rule: CRY
121: C>Because murderers should not receive capital punishment.……Move type: statement; rule: RCHALL
122: R> This statement is in both stores, you can not state it any more, please try again! ….Rule: RREPSTAT

The dialogue fragment shows that Chris uses an agreed statement “murderers should not receive capital punishment” to answer a challenge in turn 121, but the referee raises the flag saying that the statement is in both stores. It looks intuitively unreasonable to prevent one using a previously agreed statement to answer a challenge.

5.4.3 Question Begging

Mackenzie describes question begging as “when one participant asks the other to grant him the premise which contains the substance of what is under dispute” (1979a:117). It is shown in the dialogue transcripts that certain sequences of moves are arguably wrongly banned by DC as begging the question. The following dialogue fragment is taken from DC4 as an example:

094: S>Why is it that innocent people get killed? ………………..……….…… Move type: challenge; rule: CRY
095: C>Because murderers should not receive capital punishment. ……………………………………………………………………..Move type: statement; rule: CRYS, RCHALL
096: S>I don't think there are mistakes during judicial process implies innocent people get killed.
…………………………………………………………………Move type: withdrawal; rule: CRW
…………………………………………………………………

102: S>Why is it that scientific techniques will guarantee the success of justice?
In the above dialogue fragment, Simon challenges the statement “innocent people get killed” in turn 094, which makes the statement under challenge with respect to Simon and means that Chris can not use it to answer a challenge any more, and this causes the DC referee to judge that Chris is begging the question in turn 103. However, Chris has successfully defended the statement “innocent people get killed” in turn 095 and Simon accepts this (or at least raises no objection to it). Therefore the statement should not be under dispute and Chris is therefore not begging the question in turn 103. This evidence is actually in line with Woods and Walton’s (1982) argument that DC erroneously bans certain sequences of moves as question begging.

Mackenzie (1985; 1990; 1994) later amended DC, via the substitution in clause (iii) of RCHALL of the requirement that the ground statement be "acceptable", in place of the requirement that it be "not under challenge". A statement, S, is acceptable to participant A at a stage n, just in case that either (i) S is a modus ponens consequence of A’s store or (ii) S is not under challenge by A (Mackenzie 1990: 575). Fulfilling either or both of the conditions can be judged as making S acceptable. He argues that the amended rule would cause only genuine question-begging sequences to be banned (1985: 335). It is true that this amendment will remove the problem illustrated in the above dialogue fragment. In this case, the statement “innocent people get killed” is under challenge with respect to Simon, so the second condition for “acceptable” is not met. However, Simon de facto commits to it after turn 095, which means that the first condition of “acceptable” is met. Consequently, the statement “innocent people get killed” is acceptable to Simon and Chris will therefore not be begging the question in turn 103.

However, Mackenzie’s new amendment (which is not implemented in the current system) seems to fail to ban certain sequences of what intuitively appear to be question-begging moves, e.g. the following dialogue example (which is not generated by the current system):

002: S>I think CP is acceptable. ..................................................Move type: statement; rule: CRS
003: C>Is it the case that CP is not a good deterrent?. ..................................................Move type: question
004: S>No, I think CP is a good deterrent..................................................Move type: statement; rule: CRS, RQUEST
005: C> I think innocent people may get killed ..................................................Move type: statement; rule: CRS
006: S> I think CP is a good deterrent implies CP is acceptable. ................Move type: statement; rule: CRS
Why do you think CP is a good deterrent? ………………………..Move type: challenge; rule: CRY
Because CP is acceptable ……………………………………Move type: statement; rule: CRS, RCHALL

In the above dialogue fragment, it is apparent to see that Simon is begging the question in turn 008 since he is using the proposition “CP is acceptable” which he is trying to prove in turn 004 and 006. However, according to Mackenzie’s new amendment, Chris does not commit to the challenge of “CP is acceptable” and therefore the second condition of “acceptable” is met, and Simon is therefore not begging the question in turn 008.

The result seems to be that DC, even with Mackenzie’s new amendment, sometimes still fails to deal with genuine question begging. The issue of banning question begging therefore remains open, as is evidenced by Mackenzie’s (1994) claim that neither Walton (1991) nor his own theories of fallacies address the problem adequately.

5.4.4 Inappropriate Challenge

There are instances in the transcripts of a participant challenging a statement, which has not been advanced by the opponent. For example, the following dialogue fragment is taken from DC2.

I think murderers should not receive capital punishment. ………………..Move type: statement; rule: CRS
I think political or racial bias will not cause prejudice. ………………..Move type: statement; rule: CRS
Please resolve CP is acceptable and CP is not acceptable in your store. …………………………………………………Move type: resolution demand; rule: RRESOLVE
I don't think CP is not acceptable. ………………………………..Move type: withdrawal; rule: CRW
Why is it that murderers should not receive capital punishment? …………………………………………………………..Move type: challenge; rule: CRY

In the above case, Chris claims that “murderers should not receive capital punishment” in turn 047, it is therefore strange that Chris challenges a statement made by himself in turn 051. Indeed, on some occasions, participants are even challenging their own thesis, e.g. (DC1: 033; DC3: 066). Self-attacking might be seen as a poor strategic play rather than unfair protocol, but it reflects the issue that there is no pre-condition specified for a challenge in DC, which may cause one party to challenge a statement not advanced by the other party. This may be reasonable if restricted to information-oriented dialogue, because participants can ask for information only if they do not know it. But in a contentious debate, one perhaps ought to attack only the standpoints advanced by the other party (Van Eermeren et al. 1996).
5.5 Summary

Two computational agents have been constructed as a test-bed to generate dialogue transcripts, and this has facilitated the evaluation of the dialectical system DC. Several issues concerning DC’s ability to prevent fallacious argument and common errors are brought to light by the agent-generated dialogues. First, the commitment rules of CRs and CRys may cause some unnecessary conflict and one may get into conflict purely because of statements made by the other party. Second, the rule REPSTAT may prevent one from answering a question in the preferred way and from answering a challenge using an agreed statement. Third, DC sometimes fails to deal with genuine question begging and erroneously bans certain intuitively valid sequences of moves as question begging. Finally, the absence of a pre-condition for a challenge may lead to participants attacking a statement, which is not advanced by the other party. In the light of these results, a further system, DE, will be designed. This will be discussed in the next chapter.
CHAPTER SIX

SYSTEM DE

6.1 Introduction

The previous chapter studied the system DC and revealed several issues concerning DC’s ability to prevent fallacious argument and common errors. This chapter will involve the construction and evaluation of a further system, referred to henceforth as “DE”, designed with a view to overcoming the weaknesses with DC identified in chapter five. Firstly, system DE is proposed in the light of the results revealed in the previous chapter. Then, a conversational simulation and analysis of DE, similar to that for DC as discussed in chapter 5, are conducted. The analysis suggests that DE does show improvement over DC in preventing fallacious argument and common dialogue errors.

6.2 System DE

System DE has the same set of move types as DC, since no problem has been found concerning the set of move types as such. However, the commitment rules and dialogue rules are modified as discussed below.

6.2.1 Commitment Rules

Each party owns a commitment store, and each commitment store contains two lists of statements: the “assertion list” contains the statements the participants have stated and the “concession list” contains the statements the participants have implicitly accepted (i.e. statements uttered by the partner and against which they have raised no objection). The DE commitment rules are therefore as follows:

Initial commitment, CR0: The initial commitment of each participant is null.

Withdrawals, CRw: After the withdrawal of P, the statement P is not included in the speaker’s store.

Statements, CRs: After a statement P, unless the preceding event was a challenge, P is included in the speaker’s assertion list and hearer’s concession
list, and ‘Not P’ will be removed from the speaker’s concession list if it is there.

**Defence, CRYS:** After a statement P, if the preceding event was ‘Why Q?’, ‘P’ and ‘If P then Q’ are included in the speaker’s assertion list and the hearer’s concession list. ‘Not P’ and ‘Not (If P then Q)’ are removed from the speaker’s concession list if they are there.

**Challenges, CRy:** A challenge of P results in P being removed from the store of the move maker if it is there.

In a DC commitment store, the commitments are put together into one list. However, intuitively these commitments may be appropriately divided into two different types: asserted statement and implicitly accepted statement. An assertion shows a participant’s standpoint in the dialogue, a statement that the participant is obliged to defend if the other party requests him to do so, whereas a concession is a statement that the participant is committed to in a weak sense, which carries no burden of proof (Walton and Krabbe 1995). Therefore the commitment store in DE is separated into two lists: assertions and concessions. The assertion list contains statements one has asserted, the concession list contains statements made by the other party which one has only implicitly accepted.

The rules CRo and CRw remain unchanged and need no comment. The clause “asserting a statement will remove the negation from the speaker’s concession set” is added to the commitment rules CRs and CRYS. This addition is intended to solve the problem, discussed earlier in section 5.4.1, of the unnecessary conflict caused purely by statements made by the other party. It might be argued that this arrangement might be too generous to the dialogue participant since it may help the speaker to maintain consistency of his store. However, it is worth noting that the added clause specifies that asserting a statement will not remove the negation from the speaker’s assertion set, but rather from the speaker’s concession set. For example, if the speaker has uttered ¬P at earlier stage of dialogue, and now the speaker utters P, then the negation ¬P will not be removed from the speaker’s store since it is in the speaker’s assertion set rather than in the speaker’s concession set. The speaker is still in an inconsistent situation. This arrangement is therefore not too generous.

The clause of DC’s CRy “After the challenge of P, P is added to the hearer’s store” is dropped on the grounds that one should be able to challenge only propositions to which one’s dialogue partner is explicitly committed. The clause in the original CRy “the
challenge ‘Why P?’ is included in the speaker’s commitment” is dropped, because DE uses a different approach (see section 6.2.2 for details), rather than commitment to challenge, to tackle the issue of question begging.

6.2.2 Dialogues Rules

The rules that differ from DC are as follows:

**RREPSTAT:** Mutual commitment may not be uttered unless to answer a question or a challenge.

**RCHALL:** ‘Why P?’ must be responded to by (i) a withdrawal of P, or (ii) a statement acceptable to the challenger or (iii) a resolution demand of any of the commitments of the challenger, which immediately imply P.

**RLEGALCHALL:** ‘Why P?’ may not be used unless P is on the assertion list of the hearer.

**RFORM, RQUEST, RRESOLVE and RRESOLUTION** remain unchanged from DC and need no comment. In order to address the issues of DC’s unnecessary restriction on repeat statements, the rule **RREPSTAT** is modified to ban repeated voluntary statements only (‘voluntary’ in the sense that the statement is not used to answer a question or a challenge). The rule now therefore allows one to answer a question in the preferred way or answer a challenge using an agreed statement.

To address the issue of the absence in DC of a pre-condition for a challenge, one extra dialogue rule is added, namely **RLEGALCHALL** -“‘Why P?’ may not be used unless P is on the hearer’s assertion list”. One is allowed to attack only standpoints advanced by the other party (Van Eemeren 1996), otherwise ‘Why P?’ is academic (Woods and Walton 1982: 590).

To address the issue that DC still fails to ban certain sequences of question begging, the dialogue rule **RCHALL** is modified so that a statement in response to a challenge must be “acceptable”, in place of the requirement that it be "not under challenge". It should be noted, however, that this concept of “acceptable” is different from Mackenzie’s (1990, 1994) notion. Mackenzie sets two conditions for a statement S to be acceptable to participant A at a stage n: just in case that either (i) S is a modus ponens consequence of
A’s store, or (ii) S is not under challenge by A (1990: 575). Mackenzie’s first condition seems reasonable, because if A has de facto committed to S then S should be acceptable to A. However, the second condition is problematic because the fact that A is not committed to ‘Why S?’ does not necessarily imply that S is acceptable to A, as evidenced by the agent-generated dialogue analysed in section 5.3.3 of chapter five.

In the game DE, a statement S is proposed to be acceptable to participant A at a stage n, just in case that S is, at a stage n, (i) a commitment of A or (ii) a de facto commitment of A or (iii) a new commitment of A’s store. If a proposition fulfils one or more of those conditions, it can be judged as acceptable to A. The first condition—“S is a commitment” is intuitive, and the second condition “a de facto commitment” is the same as Mackenzie’s first condition. The third condition considers that a new commitment with respect to A’s store is acceptable. A new commitment means a statement which has never been to A’s store (in effect the proposition has never been uttered by either player) prior to dialogue stage n. The following example may help to understand how DE deals with the fallacy of question begging.

<table>
<thead>
<tr>
<th>Turn</th>
<th>Participants</th>
<th>Move</th>
<th>Simon’s store</th>
<th>Chris’s store</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Simon</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>02</td>
<td>Chris</td>
<td>Why P?</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Simon</td>
<td>R</td>
<td>P, R, R⇒P</td>
<td>R, R⇒P</td>
</tr>
<tr>
<td>05</td>
<td>Simon</td>
<td>P</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the above dialogue, the commitment stores are updated according to DE commitment rules. Simon asserts P in turn 01 and P goes to both stores, Chris challenges P in turn 02 and this removes P from his store. Simon answers the challenge in turn 03 and R, R⇒P go to both stores. Again, Chris challenges R in turn 04 and this removes R from his store.

It is clear from the above dialogue that Simon is begging the question in turn 05 but not in turn 03. In turn 03, the statement R issued by Simon has never been to Chris’s store before turn 03, and it is therefore a new commitment with respect to Chris and the third condition of “acceptable” is therefore met. Simon is therefore not begging the question according to the notion of “acceptable”.

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However, it can be seen that only the statement “R→P” is in Chris’s store before Chris utters the statement P in turn 05. P is therefore not a commitment, nor a de facto commitment, nor a new commitment of Chris’s store (since P has been to Chris’s store after turn 01); none of the three conditions of acceptable is met and the statement P is therefore not acceptable to Chris. Simon will therefore be judged as begging the question in turn 05, by the application of the notion of “acceptable”.

6.3 DE Computational Agents

To investigate whether system DE does in practice show any improvement over DC in preventing fallacious argument and common errors, a similar agent-based study to that carried out on DC, has been carried out on the system DE. Two computational agents that can debate with each other via the game DE have been built. To ensure that only the independent variable (DC or DE) affects the generated dialogue transcripts, the system architecture, dialogue unit, knowledge base unit and scheduling unit all remain unchanged from the DC system, only the commitment functions and dialogue rules are replaced by the DE regime.
The commitment manager updates both agents’ commitment stores according to DE commitment rules. Each commitment store is designed to have two lists of statements, those that have been stated and those that have been implicitly accepted, and they are shown in one list on the interface. In order to distinguish them from each other, any statement that is only implicitly accepted is marked with a ‘*’, as shown in figure 6.1.

The only difference between DE and DC referees is that DE referee is responsible for forcing participants to follow the DE rules rather than the DC rules.

6.4 Analysis of DE Dialogue Transcripts

Three dialogue transcripts DE1, DE2 and DE3 have been generated and analysed (full transcripts are in appendix B). In total, the agents made 146 (51+40+55) DE legal moves, 10 (2+3+5) DE illegal moves and the DE referee made 13 (3+4+6) contributions. In order to analyse the generated dialogue, firstly, the fallacy of question begging, the straw man fallacy, inappropriate challenge and statement repetition are examined, to establish whether DE successfully deals with these issues (that were argued in chapter five to be the weaknesses of DC). Other fallacies such as complex question, appeals to emotions and irrelevant conclusions (cf. Walton 1984; Woods et al. 2000) are then briefly discussed.

6.4.1 Question Begging

First, it is necessary to look at whether DE fails to ban sequences of question begging. There are 11 DE legal moves (DE1: 040, 049, 053; DE2: 010, 030, 039; DE3: 016, 018, 020, 046, 050), which are using a statement to answer a challenge. Among them, 7 instances (DE1: 040, 049, 053; DE2: 010, 030; DE3: 016, 020) of statements used are new commitments with respect to both commitment stores, they are not under dispute and therefore the speaker is not begging the question. On 3 occasions (DE2: 039, DE3: 018, 050) statements used are agreed (mutually committed) statements and hence the speaker again cannot be accused of begging the question. The remaining instance (DE3: 046) might initially seem to represent an instance of question begging, and therefore needs some discussion:

017: C>Why is it that scientific techniques will guarantee the success of justice?
018: S>Because murderers should receive capital punishment.  

.................................................................Move type: statement; rule: CRYS, RCHALL

.................................
045: C>Why is it that 60% British people do not support CP? ..........Move Type: challenge; rule: CRY
046: S>Because scientific techniques will guarantee the success of justice.  

.................................................................Move type: statement; rule: CRYS, RCHALL
047: C>Why is it that repeat crime rate is extremely low? ..............Move Type: challenge; rule: CRY

In the above fragment, Simon is answering a challenge in turn 046 with the statement “scientific techniques will guarantee the success of justice” which Chris has de facto committed to after turn 018 and is therefore not under dispute. Simon is therefore not begging the question in turn 046. According to the discussions above, then, no fallacy of question begging has been found from the DE legal moves.

A second issue is to see whether DE wrongly bans certain intuitively reasonable sequences of moves as question begging. There are three occasions (DE1: 047; DE2: 008; DE3: 050) that are judged by the DE referee as question begging. These dialogue fragments are reproduced below.

Case 1 (DE1)

003: C>I think CP is not acceptable. ...........................................Move type: statement; rule: CRS

.............................................
024: S>I don't think CP is not acceptable. ......................................Move type: withdrawal; rule: CRW

.............................................
046: S>Why is it that scientific techniques will not guarantee the success of justice?  

.................................................................Move Type: challenge; rule: CRY
047: C>Because CP is not acceptable. ..............................................Move type: statement
048: R>You are begging the question 'CP is not acceptable' which is under dispute, please try again!  

.................................................................Rule: RCHALL

Case 2 (DE2)

002: S>Yes, I think CP is acceptable. .................................Move type: statement; rule: CRS
003: C>I think CP is not acceptable. .................................Move type: statement; rule: CRS

.................................
007: C>Why is it that CP is a good deterrent? .............................Move Type: challenge; rule: CRY
008: S>Because CP is acceptable. ..............................................Move type: statement
009: R>You are begging the question 'CP is acceptable' which is under dispute, please try again!  

.................................................................Rule: RCHALL
Case 3 (DE3)

016: S>Because it is not wrong to take human life. ........................................Move type: statement; rule: CRS, RCHALL

037: C>I don't think it is not wrong to take human life. ................................Move type: withdrawal; rule: CRw

047: C>Why is it that repeat crime rate is extremely low? ........................Move Type: challenge; rule: CRy

048: S>Because it is not wrong to take human life. ........................................Move type: statement

049: R>You are begging the question ‘it is not wrong to take human life’ which is under dispute, please try again! ........................................Move type: challenge; rule: RCHALL

Case 1 (turn 047) and case 2 (turn 008) show respectively that the participant is using his thesis “CP is not acceptable”, “CP is acceptable” as a premise in turn 047, 008; since these are intuitively under dispute at that stage, the participant is begging the question and the referee’s intervention is therefore reasonable. Case 3 shows that Simon is using the statement “it is not wrong to take human life” as a premise in turn 048, a statement contested by Chris in turn 037, and hence is begging the question. Given the above analysis, the DE referee’s judgements on question begging seem correct.

6.4.2 Straw Man Fallacy

The focus here is to examine whether the resolution demands in the transcripts involve misrepresentation of the opponent’s positions. There are three resolution demands used (DE1: 023, 054; DE2: 045), their situations are similar and therefore just one example is cited here (from DE1).

Case 4 (DE1):

002: S>Yes, I think CP is acceptable. ..................................................Move type statement; rule: CRS

003: C>I think CP is not acceptable. ..................................................Move type: statement; rule: CRS

023: C> Please resolve CP is acceptable and CP is not acceptable in your store. ........................................Move type: resolution demand; rule: RESOLVE

The commitment policy in DE remains “silence means assent” as it was in DC (Mackenzie 1979a; 1979b). For any statement made by one party, it will go to both commitment stores; if the hearer does not agree, he can withdraw, challenge or deny it and thus delete it from his store. In case 4, Simon states that “CP is acceptable” in turn 002, and it goes to Simon’s assertion list and Chris’s concession list, Chris does not agree with it and states “CP is not acceptable” in turn 003. According to DE’s CRs, “CP is
acceptable” will be removed from Chris’s concession list and the statement “CP is not acceptable” goes to Chris’s assertion list and Simon’s concession list. Now, Simon is simultaneously committed to “CP is acceptable” and “CP is not acceptable”, however, Simon keeps silent without issuing a withdrawal, challenge or denial of the statement “CP is not acceptable”, therefore the resolution demand is issued by Chris in turn 023. The case of misrepresentation of opponent’s position therefore still exists in DE. To avoid this, it can be suggested that a resolution demand can be made only on one’s assertions rather than concessions. The rule RRESOLVE therefore requires further consideration.

6.4.3 Inappropriate Challenge

To examine whether the DE referee correctly prevents one from challenging the standpoints not actually advanced by the partner, it is necessary to look at whether there are inappropriate challenge in the dialogue transcripts. There are 11 legal challenges (DE1: 039, 046, 052; DE2: 007, 029, 038; DE3: 015, 017, 019, 045, 047) found in the dialogue transcripts, and in each case the statement being challenged is advanced by the other party, suggesting that none of them is inappropriate. There are four occasions (DE2: 042; DE3: 024, 061, 063) that are judged by DE referee as illegal challenges and it is found in each case that the challenged statement is not made by the opponent, therefore it is argued that the referee’s judgements are appropriate.

6.4.4 Issue of Repetition

Here, the appropriateness of the DE repetition regulation is examined; it concerns repeated statements. There are three occasions on which repeated voluntary statements are banned by the referee (DE1: 012; DE2: 012; DE3: 028). Under these situations, the banned statement is a mutual commitment and therefore unnecessarily uttered again, so the referee’s judgements are argued to be necessary and valid.

6.4.5 Other Issues

Other fallacies possibly occurring in dialectical systems such as “complex question” and “appeals to emotions” are not found from the dialogue transcripts. According to Woods et al. (2000: 61), the complex question fallacy occurs whenever a question is asked that contains a hidden, illicit, or unsupported assumption, e.g. the question “Have you stopped beating your spouse?”, no matter which way the non-spouse-beater answers, he or she
stands convicted of having at some time or other engaged in spouse-beating (Walton 1984: 27). In the current experimental setting, the propositions in the knowledge bases are carefully constructed to avoid two or more propositions rolled into one, and conjuncts of statements are not implemented in the current system. These arrangements may have already excluded the possibility of complex questions. The fallacy of emotions may include the abusive version of ad hominem and the boosterism version of ad populum and involves emotions going too far and hence interfering with the ultimate purpose of argument (Woods et al. 2000: 43). In the current system, the domain knowledge is carefully formalized to exclude strong emotional content, and this results in no fallacy of emotions being found in the agent-generated dialogue transcripts.

It might appear at first sight that the DE system permits the fallacy of irrelevant conclusions. According to Walton (1984), this fallacy involves giving evidence that does not provide the conclusion it was supposed to prove. Consider the following dialogue fragment from DE3.

017: C>Why is it that scientific techniques will guarantee the success of justice?  

…………………………………………………………………………………………Move Type: challenge; rule: CRy

018: S>Because murderers should receive capital punishment.  

…………………………………………………………………………………………Move type: statement; rule: CRys, Rchall

019: C>Why is it that CP is acceptable?  

…………………………………………………………………………………………Move Type: challenge; rule: CRy

In this dialogue fragment, the ground Simon is using in turn 018 is intuitively not relevant to the conclusion being argued for, yet the dialogue is legal according to DE. Furthermore, according to the DE (and indeed DC) commitment rule CRys, after turn 18, “murderers should receive capital punishment” and “murderers should receive capital punishment implies scientific techniques will guarantee the success of justice” will go to both stores and hence commit both participants to the apparent irrelevance. However, Chris can challenge the conditional (though the challenge of a conditional is not implemented in the current system) if he doubts the relevance of the argument and this suggests that the DE system does provide a means of participants avoiding being disadvantaged by irrelevant conclusions.

6.5 Discussion

The analysis discussed in the previous section suggests that the system DE is dealing with fallacious arguments and common errors well. In particular, DE appears advantageous,
compared with DC, in preventing the fallacy of question begging, inappropriate challenges and the straw man fallacy, and in handling of the issue of repetition.

There are, however, several concerns with system implementation and data analysis that ought to be discussed. Firstly, the DE system allows atomic statement, P, Q, etc. and the truth-functional compounds of statements: “Not P”, “If P then Q”, “P and Q” and “P or Q”. However, the conjunction of statements (e.g. “P and Q”) and disjunction of statements (e.g. “P or Q”) have not been implemented in the current DE system. Further, the challenge of a conditional (e.g. Why “P implies Q”?) has not currently been implemented either. These are left for further work.

Secondly, it appears, in the system DC, that there are at least four kinds of resolution demands that are allowed to be made: (1) resolve \{P, Q, Q\implies\neg P\}, (2) resolve \{P, \neg P\}, (3) resolve \{Q, Q\implies P, why P\} and (4) resolve \{Q, Q\implies P, withdrawal P\}. According to Walton (1996b, 2002), most everyday argumentations are defeasible such that an expression like \{P, Q, Q\implies\neg P\} (type 1) is not seen as inconsistent. The type (1) resolution demand should therefore be abandoned, on this argument. However, Walton elsewhere (1998: 45) argues that an obvious inconsistency (for example, if one of his commitments is clearly the negation of another (type 2)) cannot be passed unchallenged. He also points out that a withdrawal or a challenge of a modus ponens consequence of one’s commitments (type 3 and type 4) should not be freely allowed in a persuasion style dialogue. The type (2), (3) and (4) resolution demands should therefore be retained. Given the above discussions, the current DE system has adopted only the type (2), (3) and (4) as inconsistency.

Thirdly, the study adopts an inductive approach in that the conclusion is drawn based on the analysis of a limited number of agent-generated dialogues, and it might be argued that the agents system may generate another fallacy on some future occasion. However, this study is intended not as a statistical enquiry, but rather as an investigation into details of the system’s ability in preventing fallacies. Further, 169 utterances are generated (DE1: 56; DE2: 47; DE3: 66). Each category of fallacies is considered in depth by using these agent-generated arguments, and as a result this study does, it is held, provide sufficient data for the purpose of this analysis.

Finally, this study concerns dialectical systems in relation to fallacies. It might be argued that fallacies might be hidden within propositions (e.g. emotional content or complex statement that have been implemented in the system knowledge base), and that these are impossible for dialectical systems to detect since there is no rule (e.g. in the system DE) to
prevent a participant from asserting an emotional statement or from asking a complex question. However, the knowledge base of the current system has been carefully constructed to avoid emotional content and complex statements (see section 6.4.5 above). As a result, the analysis in this study is restricted to potential fallacies relating to the rules of the dialectical system per se. It is also restricted to what Walton (e.g. Walton 1984) refers to as “informal fallacies”, which will be taken here to mean deficiencies of argument in a dialectical context (cf. Walton 1980).

### 6.6 Summary

This chapter has discussed a new system DE, development of which was motivated by results concerning DC, discussed in chapter five. This chapter also discussed the evaluation of DE, and the result shows improvements over DC in preventing fallacious arguments and common errors. In particular, DE appears advantageous over DC in preventing the fallacy of question begging, inappropriate challenges and the straw man fallacy, and in handling of the issue of repetition. The analysis also suggested an amendment of the DE dialogue rule R\textsc{resolve}. Finally, issues related to the system implementation and data analysis have been discussed.

However, a further crucial issue concerning the dialogue model DE is whether potential users can successfully manipulate it. This issue cannot be settled on an a priori basis. Empirical data is needed with regard to how far users become familiar with the system through exposure to it, ease of learning, awareness of a move’s impact on the commitment stores and perceived satisfaction and comfort with the system (Moore 1993). A usability evaluation of the amended system is therefore necessary, to establish whether it fulfils the usability requirements of a dialogue model for educational human computer debate.

To enable the usability evaluation, a crucial element is the existence of an actual implementation of the system in some form (Dix et al. 1998). This may range from a simulation of the system’s interactive capabilities, without its underlying functionality, through a basic functional prototype to a fully implemented system (Dix et al. 1998). Therefore, there are at least two possible ways a usability study can be carried out. One is to enable dialogue between a subject and an experimenter, simulating the eventual system (the so-called “Wizard of Oz” approach (Hobbs and Moore 1998)). The alternative is a (human) subject operating on a functioning computer-based prototype (cf. Hall 2001).
The former approach has potential difficulties to keep and manipulate both participants’ commitment stores and may suffer from the drawback that it may in practice not be feasible to have the system working in the way the Wizard of Oz test suggested (Hobbs and Moore 1998). The latter approach is therefore seen as the more appropriate. This necessitates the construction of a human-computer debate prototype via the proposed dialogue model DE. This will be considered in the next chapter.
CHAPTER SEVEN

A HUMAN COMPUTER DEBATE PROTOTYPE

7.1 Introduction

The previous chapter developed a dialectical system “DE” which, it was argued, can help prevent fallacious arguments and common errors. This chapter considers using the DE model as the basis for a human computer debate prototype. First, the debate prototype and its development process are briefly introduced. Next, the architecture and main components of the system are considered. Finally, means of handling user input and system output are discussed.

7.2 The DE Debate Prototype

A fully functional human-computer debating prototype, operationalising the dialogue model DE, has been incrementally built using the Java programming language. The system enables the user to conduct a debate with it on the controversial issue of capital punishment. The computer can adopt either a proponent or an opponent role. That is, if the user chooses to support the view of “capital punishment is acceptable”, the computer will adopt the opposite view “capital punishment is not acceptable”, and visa versa. The system then engages the user in debate on the topic of capital punishment, given these initial positions on the issue.

During the process of arriving at this prototype, four independent HCI experts from Leeds Metropolitan University helped to evaluate and thus improve the initial prototypes (indicated in the remaining sections of this chapter). A particular issue, arising from the evaluations concerning the dialogue model DE, needs to be discussed here. One evaluator was not happy that certain resolution demands made by the system concerned a genuine inconsistency. A specific example can be seen in the snapshot of the evaluator using the system in figure 7.1 (cf. appendix E1).

In the dialogue fragment shown in figure 7.1, it is true that the evaluator is not in an inconsistent situation. The resolution demand made by the system involves a misrepresentation of the evaluator’s positions in that “CP is not acceptable” is made by
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Figure 7.1 An example dialogue

the system rather than the user. This is in line with the problem of the DE dialogue rule RRESOLVE revealed in the previous chapter’s agent-based study (section 6.4.2). To avoid this, it can be suggested that a resolution demand (i.e. resolve (P, ¬P), resolve (Q, Q\text{\text\textGT}P, why P) and resolve (Q, Q\text{\text\textGT}P, withdrawal P)) be made only on one’s expressed commitment rather than implicit commitment. The DE dialogue rule RRESOLVE in turn can be modified as “Resolution demands may be made only if the hearer is committed to an immediately inconsistent conjunction of expressed statements, or withdraws or challenges an immediate consequence of his expressed commitments”. The third clause of the dialogue rule RCHALL (see page 61 above) is modified accordingly. The amended rules have been adopted in the current debating system.

7.3 System Architecture and Main Components

The system architecture of the human computer debating system is shown in figure 7.2.

There are five main units of the system: the interface unit, the dialogue unit, the
Figure 7.2 Human computer debating system architecture

Figure 7.3 Human computer debating system user interface
commitment unit, the scheduling unit and the knowledge base unit. The *interface unit* provides the system’s user interface (see figure 7.3). It provides a dialogue history, which records the debate, and commitment-stores to show both the user’s and the computer’s commitment store contents. Input facilities require the user to select the move type and move content from a menu. The interface manager enables the user to save the debate history and to change the background colour of the interface, and provides help facilities.

The *dialogue unit* can be regarded as the despatch centre of the dialogue interactions. This unit consists of an input manager, a dialogue manager, a referee, and an output manager. The input manager provides dynamic support for the user’s input, in that it makes available to the user only those move types permissible under the DE rules given the prevailing state of the dialogue. It then delivers the user input to the dialogue manager. The dialogue manager controls the turn taking of the interaction and is in charge of the input manager, output manager, referee, the commitment unit and the scheduling unit. Each move is passed to the DE referee for judgement. If the move is legal, the commitment manager is called to update the commitment stores, the output manager is called to update the dialogue history and the scheduling unit is called to make a move on behalf of the computer. In the event of an illegal move, the referee posts a message and requests the user to make another move.

The *scheduling unit* is responsible for generating the computer’s dialogue moves. The *commitment unit* is responsible for updating the user’s and the computer’s commitment stores. The *knowledge base unit* consists of a knowledge base manager and a dedicated system knowledge base. They are essentially a reuse of the DE inter-agent system discussed in chapter six.

### 7.4 Input Facilities

There are three possible interaction styles that can in principle be used to handle user’s input: command line, natural language and menu. Command line interfaces can be flexible and powerful, but they bring difficulty in use and learning the set commands. Perhaps the most attractive means of communicating with computers, at least at first glance, is by natural language. However, the ambiguity of natural language and the precise instructions required by the computer make it unlikely that a general natural language interface will be available in the foreseeable future. Further, the use of natural
language in a restricted domain also requires the user to learn which phrases the computer understands and the user may become frustrated if too much is expected (Dix et al. 1998). However, a menu driven interface is visible and less demanding of the user since it relies on user’s recognition rather than recall. In the specific case of human-computer debate, Moore (1993) argues that a menu driven interface may suffice to yield interesting debate. In addition, there are several precedents for the use of this approach in a computational dialogue game (e.g. Hartley and Hintze 1990; Bench-Capon 1998). Although it may be argued that the prescribed menu may not offer the line of argument the user would like to pursue (Moore 1993), this may in practice be alleviated by enlarging the computer’s knowledge base and hence providing more available options from which the user may select. In the light of the above arguments, a menu-based approach is adopted in the current system.

Under this menu based approach, the user needs to make a double selection, choosing from the available move types and then from the list of prescribed propositions. Moore (1993) suggests that the legally available move type can be identified before the user makes a move, hence largely preventing the user from breaking the rules and thus avoiding the fragmented debate that might be the result of frequent rule breaks. Further, this arrangement may increase the learnability of the game since users are not required to remember the dialogue rules. This approach is therefore adopted by the current prototype. Given this, the details of the dynamic provision by the DE system of legal available moves or move types are specified as follows:

1. After a question made by the computer, there are three move choices available for the user at the interface: ‘Yes’, ‘No’ and ‘I am not sure about it’.

2. After the computer makes a resolution demand for an inconsistency like (P, ¬P), there are two move choices available enabling withdrawal of either of the conflicting statements.

3. After a resolution demand for an inconsistency like (P, P\(\rightarrow\)Q, why Q?) or (P, P\(\rightarrow\)Q, withdrawal Q) made by the computer after the user has challenged or withdrawn Q, there are three move choices available, withdrawal of either of the conflicting statements or affirmation of the disputed consequence Q.

4. After a challenge of P made by the computer, the ‘Because..’ move type and a move “I don’t know why P” are available; and additionally a resolution demand move type is available when the computer has committed an inconsistency by issuing the challenge.
(5) After a withdrawal or a statement made by the computer, the statement, question, challenge and withdrawal move types are always available. A resolution demand move type will be available if and when the computer has committed an inconsistency.

Once the user has selected a move type, they need to select some propositional content. The system provides a number of means for doing this, depending on the nature of the move type. The details are as follows: (1) the move contents for resolution demand and challenge move types can be selected from the computer’s commitment store; (2) the move contents for a withdrawal can be selected from the user’s commitment store; (3) the move contents for assertion and question move types can be selected from the list of propositions (with the aid of the “implies” checkbox shown in figure 7.3, the user may construct a conditional, e.g. P → Q). The location of propositions on the screen is highlighted with a green-coloured border (as suggested by one of the HCI experts). In addition, the blinking message bar at the bottom of the user interface provides dynamic instructions to support user input (again, as suggested by one of the HCI experts).

These, then, are the input facilities for the debating system. Further implemented examples can be seen in appendix F. The current system does not allow the user to select a conjunction of statements (e.g. P ∧ Q), a disjunction of statements (e.g. P ∨ Q), or to challenge a conditional. These are left for further work.

7.5 System Output

The output facility of the system concerns the generation of argumentation text in English. The ingredients of the argumentation text are a set of move types and a set of propositions. Essentially, the output manager of the system will receive a “move” object from the system scheduler and then generate the argumentation text. A “move” object is designed to have three attributes: turn, move type and move content. The turn taker could be the user or the computer or the referee. The move type might be an “assertion”, a “question”, a “challenge”, a “no commitment” or a “resolution demand”. The move content could be a proposition, a conditional, or a conflict set which might contain a set of propositions or conditionals. A conditional is expressed as the connection of two propositions with the “implies” or “a prima facie reason for” link. A conflict set is expressed as each element (proposition and/or conditional) of the set with the word “and” link. When the output manager receives a move object, it first checks the move type of that move object. The remaining processing algorithms for each move type are as follows.
**Assertion (P)**

If the current move type is an assertion, it might be (i) an answer to a question, (ii) a response to a challenge or (iii) a voluntary statement. The output manager therefore needs to check the dialogue history and establish the previous move type.

If the previous move type is a question, the output manager checks whether the current move content is the same as that of the incoming question. If they are the same, then this implies that the current move maker has given a positive response and the current move is expressed as "Yes, I think P.". Otherwise, the current move maker has given a negative response and the current move is expressed as "No, I think ‘¬ P’.".

If the previous move type is a challenge, then the statement is seen as a ground in the game DE and the current move is expressed as "Because P.".

If the previous move type is neither a question nor a challenge, then the current move is bound to be a voluntary statement. The output manager then checks whether the current move content is a piece of hard evidence, if it is, then checks whether the previous move is an asserted statement, if it is, then asks the system knowledge base manager to check whether the current statement directly contradicts the previous statement, if it does, then the current move is expressed as "But P.". The remaining voluntary statements are expressed as "I think P.".

**No commitment (P)**

If the current move type is a “no commitment”, the previous move type might be (i) a question (ii) a challenge or (iii) others. These situations need to be dealt with differently. The output manager therefore checks the dialogue history and establishes the previous move type.

If the previous move type is (i) a question, the current move is expressed as "I am not sure about it." (cf. Mackenzie 1989).

If the previous move type is (ii) a challenge, the current move is expressed as "I don't know why P. ".

If the previous move type is (iii), this means the current move is a voluntary “no commitment”. On this occasion, the current move is expressed as "I don’t think that P." (as suggested by one of the HCI experts).
Resolution demand (R)

Here, ‘R’ stands for a set of conflicting propositions or conditionals. A resolution demand following a challenge (Why P?) or a withdrawal can be seen a suggestion that the dialogue partner has committed to the reasons for P. The current move is therefore expressed as "You already know (or commit to the reasons for) this, please resolve R in your positions." (this was also suggested by one of the HCI experts). The remaining type of resolution demand is simply expressed as "Please resolve R in your positions.".

Challenge (P) or Question (P)

Following Mackenzie (1979b), a challenge (Why P?) is expressed as "Why is it the case that P?", and a question (P) is expressed as "Is it the case that P?".

7.6 Summary

This chapter has documented the design and construction of a human computer debating system using the dialogue model DE. In particular, it has considered the architecture of the system, and means of handling user input and system output.

However, a particular concern with DE, especially from a computational perspective, is that it leaves much to the discretion of the user of the model. In the human computer debate setting, it is crucial therefore that the computer is given some means of selecting between available possibilities. This choice must be based on some suitable strategy. Appropriate strategic knowledge is, then, essential if the computer is to produce high quality dialogue contributions. This is actually the second major issue of the research, the development of suitable strategies to enable a computer as a debating participant to produce high quality dialogue contributions (cf. section 1.2 above). This will be given in the next chapter.
CHAPTER EIGHT

COMPUTATIONAL STRATEGIC HEURISTICS

8.1 Introduction

The previous chapters developed a dialogue model “DE”, which, it was argued, is a suitable model for human computer debate. However, a particular concern with DE, especially from a computational perspective, is that it leaves much to the discretion of the user of the model. In the DE regulations, after a question or a resolution demand, the selection of move choices is strictly regulated. After a challenge (why P), one can respond with no commitment P, a resolution demand (in some circumstances) or a ground for P. However, there is no guidance within the rules as to the content of the ground. Further, after a withdrawal or a statement, there are no restrictions on the move types or move contents. All DE does is to legitimise a set of move types given the prevailing circumstances, and occasionally give some indication of the semantic possibilities. In a human computer debate setting, it is crucial therefore that the computer is given some means of selecting between available possibilities, e.g. to maintain focus after a statement or a withdrawal, so that the produced moves are appropriate at the pragmatic level. Appropriate strategic knowledge is, then, essential if the computer is to produce high quality dialogue contributions. Given this, this chapter will seek to develop a set of strategic heuristics usable by a computer as a dialogue participant.

Philosophical investigation of dialogue, e.g. Walton (1996) and Krabbe (1999), has revealed rich sets of strategies that are used when people argue with each other. Similarly, in the area of computational dialectics, there are investigations of strategies for human computer interaction (e.g. Moore 1993), and agent communications (e.g. Amgoud and Maudet 2002). In addition, there has been work on the notion of dialectical relevance (e.g. Walton 1999; Prakken 2000; Maudet 2001). Each of these investigations has a different focus, e.g. Walton (1996) focuses on schemas for the generation of arguments; Krabbe’s (1999) dialogue profile may serve as an instrument for exploring various strategic possibilities according to a “dialogue tree”; Moore (1993) and Amgoud and Maudet (2002) focus on decision making during the process of argument; dialectical relevance research concerns whether a move is relevant. All are potentially useful toward a set of debating heuristics for a human computer debate. Indeed, the proposal for strategy made
in this chapter takes a hybrid approach drawing on each of these investigations.

The remainder of this chapter is organised as follows: firstly, the profile that might be adopted by an educational human computer debating system is defined; next a set of computational strategic heuristics is proposed and incorporated into the human computer debating system developed in the previous chapter; finally, the relationships of this proposal to other investigations are discussed.

### 8.2 System Profile

It can be argued that some of the strategic decisions that need to be made during dialogue are highly dependent on the truth seeking nature of the system (cf. Moore 1993), e.g. after a question, a challenge or a resolution demand, in that a truth seeking system would always speak the truth while a non-truth seeking system may speak falsehood for the sake of argument (cf. Maudet and Moore’s (2001) “devil’s advocate” discussion and Grasso et al.’s (2000) “partially cooperative” agent). In addition, Amgoud and Maudet (2002) argue that the profile of an agent may influence its choice between the available possibilities. It is therefore necessary to consider the profile that might be adopted by a human computer debating system.

Amgoud and Parsons (2001) make some proposals for a broad class of agent profiles: agreeable (accept whenever possible), disagreeable (accept only when no reason not to), open-minded (challenge only when necessary), argumentative (challenge whenever possible) and elephant child (question whenever possible). In addition, Amgoud and Maudet (2002) propose strategies for a prudent agent that is one which is more reluctant to expose his argument than a non-prudent agent. In a similar vein, Grasso et al.’s (2000) Daphne is defined as a “partially cooperative” agent, which is allowed to tell lies about her own beliefs only.

The main potential utility of the current debating system is to develop students’ debating and reasoning skills. In the context of an educational human computer debate, the computer is intended to be not only a debate competitor but also an intelligent tutor. From an educational point of view, whilst intuitively one may wish the system to speak the truth, on the other hand, it could be argued that some sort of deception may be inherent in the definition of dialectical argumentation (cf. Grasso et al. 2000) and in the playing of devil’s advocate, yet both of these may be educationally valuable. A balance between
trust and deception might therefore be required. It can be argued that the computer should be honest with respect to the publicly inspectable stores, since the system should be seen to be trustworthy (cf. Grasso et al. 2000). How, though, should the computer treat its knowledge base? The computer is required to have the ability to argue either as a proponent or an opponent of the topic under discussion, and this implies that the computer’s knowledge base can support both the opponent view and proponent view (see figure 8.1 for an example of the system knowledge base in the domain of capital punishment). As a result, the computer may constantly face inconsistent knowledge while making decisions. In this situation, it is suggested that the computer be allowed to insist on its own view for the sake of argument, even though it may have more reasons in favour of the user’s view. Given the above discussions, the system is currently configured as what can be described as a “partially honest” agent. Against this profile of the debating system, a set of debating heuristics can now be proposed.

Figure 8.1 An example of the system’s knowledge base

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1 A horizontal line shows a rebuttal relationship, a vertical line shows a supportive relationship and a blue coloured data is a piece of hard evidence as opposed to an opinion.
8.3 A Set of Proposed Strategic Heuristics

There are five dialogue situations that the computer might face, defined by the previous move type made by the user: a challenge, a question, a resolution demand, a statement or a withdrawal. Each therefore needs to be considered in the dialogue model DE. Following Moore (1993), these decisions are captured at three levels.

1) Retain or change the current focus.
2) Build own view or demolish the user’s view.
3) Select method to fulfil the objective set at level 1 and 2.

Moore argues that (1) and (2) refer to strategies which apply only when the computer is facing a statement or withdrawal (i.e. the computer has the initiative), while (3) refers to tactics used to reach the aims fixed at level 1, 2, and applies in every game situation. These levels of decisions are discussed in turn below.

The level (1) decision concerns whether to retain the current focus or to change it. The decision, that is, involves whether to continue the attempt to substantiate or undermine a particular proposition. Moore (1993) argues that continuing to execute a plan of questions or addressing the previous move will guarantee the current focus is retained but that it is possible not to directly address the user’s latest utterance yet still retain focus (e.g. using Walton’s (1998) distance strategy). Moore further suggests that there is a presumption in favour of addressing the previous move, but that this presumption is broken when the line of questioning is deemed a blind alley, or if a successful removal of the user’s support has been made, or if, on regaining the initiative after a period without it, a resolution demand can legally be made.

The decision at level (2) considers whether to adapt a build or a demolish strategy. A build strategy involves positively building support for the computer’s own thesis; while a demolish strategy seeks to remove the user’s support for his thesis. This decision is needed only at the beginning of games and when the level 1 decision involves a shift in focus. A demolish strategy could possibly be part of a broader build strategy, e.g. a goal directed plan of questions building the computer’s own view might involve removing some unwanted responses from the user. A building attempt might also be part of a broader demolish strategy, e.g. the computer is using a line of questions to build the case for P in order to attack the user’s view ¬P. Moore found no evidence to suggest a priority between the build and demolish strategy, and argues that the decisions at level (1) and (2)
heavily depend on the results of level (3) heuristics, in that, for example, a demolish strategy would be adopted if no build methods are available.

The third level of decisions applies to each of the dialogue situations. The level 3 heuristics for each dialogue situation are given in turn below. (To illustrate the proposed strategic heuristics in action, example dialogues (generated by the current version of the debating system which incorporates the proposed strategy (see section 8.4 below)) are provided).

1) A question raised by the user

Questions asked may involve questioning an individual statement, e.g. “Is it the case that P?” or a conditional, e.g. “Is it the case that Q implies P?” In these situations, the computer is allowed by the DE rules to answer “Yes”, “No” or “no commitment”. Moore (1993) suggests that the decision must be based on the truth seeking nature of the game. In the current proposal, the system is required to be a partially honest agent, which may tell lies only for the sake of argument. In addition, Moore suggests one should give an answer in such a way as to avoid unwelcome commitment. Given this, heuristics for the computer, when facing a question, can be proposed as follows.

(1) If neither P nor ¬P can be found in knowledge base (KB), then the computer speaks the truth with a “no commitment”.

(2) If only one of them (P and ¬P) can be found in KB,
   a. If the computer has previously uttered “no commitment” to the found statement, then it utters “no commitment” to remain consistent.
   b. Else the computer speaks the truth and utters the found statement.

(3) If both (P, ¬P) are found in the computer’s KB, and assuming that ¬P supports the computer’s view and P supports the user’s view.
   a. If the computer has an acceptable support for ¬P, then utter ¬P.
   b. If the computer has no acceptable support for ¬P, and the computer has committed to the reasons for P, then the computer should utter P.
   c. If the computer has no acceptable support for ¬P, and the computer has not committed to the reasons for P, the computer should say “no commitment”.

Heuristic (1) suggests that the computer should be honest if it does not know the answer. To make this decision, the computer needs to consider its own knowledge base only. Heuristic (2a) suggests that the computer should avoid an unwelcome commitment which
has previously been withdrawn from its store, in that the computer is honest with respect to its publicly inspectable store. Heuristic (2b) suggests the computer should utter the only found answer truthfully. To make this decision, the computer needs to consider its knowledge base and its own commitment store.

Heuristic (3) will be used when the computer is facing inconsistent knowledge in that both answers are found in its KB. Under this situation, it was argued in section 8.2 that the computer may “tell lies” for the sake of argument. Heuristic (3a) suggests the computer should insist on its view  for the sake of argument if it has an acceptable support for . Heuristic (3b) suggests the computer should accept the user’s view if the computer has no acceptable reason for  and the user has provided prima facie reasons for . Heuristic (3c) suggests the computer should utter “no commitment” if the computer has no acceptable reason for  and the user has not provided a prima facie reason for . The “no commitment” option in heuristic (3c) arguably prevents the computer from committing the fallacy of ignorance (cf. Walton 1998) which consists of accepting a proposition to be true simply on the basis that it has not been proved false, or that it is false because it has not been proved true (Copi and Cohen 1994).

To illustrate the proposed strategic heuristics in action and to demonstrate that they do facilitate dialogue, an example dialogue is given below. The heuristic being invoked is indicated in parenthesis at the end of the appropriate line. In all examples in this chapter, CP stands for capital punishment, C stands for the computer and S stands for the student using the system (in the current transcripts S’s contributions are provided by the thesis author, C’s by the debate prototype using the system’s knowledge base in figure 8.1).

01: C> Is it the case that CP is acceptable?
02: S> No, I think CP is not acceptable.
03: C> I think CP is acceptable.
04: S> Is it the case that innocent people may get killed?
05: C> No, I think it is unlikely innocent people get killed. .........................................................(3a)
06: S> Why do you think it is unlikely innocent people get killed?
07: C> Because scientific techniques such as fingerprinting will increase the success of justice.
08: S> Why do you think scientific techniques such as fingerprinting will increase the success of justice?
09: C> I don’t know why scientific techniques such as fingerprinting will increase the success of justice.
10: S> Is it the case that innocent people may get killed?
11: C> I am not sure about it. .................................................................(3c)
12: S> Is it the case that there are mistakes during the judicial process?
13: C> Yes, I think there are mistakes during the judicial process. ...........................................(2b)
14: S> Is it the case that there are mistakes during the judicial process is a prima facie reason for innocent
people may get killed?
15: C> Yes, I think there are mistakes during the judicial process is a prima facie reason for innocent people may get killed. ...........................................................................................................(2b)
16: S> Is it the case that innocent people may get killed?
17: C> Yes, I think innocent people may get killed. .................................................................................................(3b)
18: S> Is it the case that scientific techniques such as fingerprinting will increase the success of justice?
19: C> I am not sure about it. ...........................................................................................................................................(2a)
20: S> Is it the case that it is wrong to take a human life?
21: C> I am not sure about it. ...........................................................................................................................................(1)

The game is set up in turn 01-03. The user adopts the view of “CP is not acceptable” and the computer automatically adopts the opposite view of “CP is acceptable”. In turn 05, the computer faces a question and finds both answers for that question {“innocent people may get killed”, “it is unlikely innocent people get killed”} in its KB. The computer is also aware that the proposition “innocent people may get killed” is a support of the user’s thesis and the computer has an acceptable support “scientific techniques such as fingerprinting will increase the success of justice” for the proposition “it is unlikely innocent people get killed”. The computer therefore fires the heuristic (3a) and insists on its view “it is unlikely innocent people get killed”.

In turn 11, the computer faces the same question as in turn 05. The computer now has no acceptable support for the proposition “it is unlikely innocent people get killed” since the proposition “scientific techniques such as fingerprinting will increase the success of justice” is neither a commitment nor a de facto commitment nor a new commitment of the user’s store due to the computer’s withdrawal in turn 09. However, the computer has not committed to the reasons for the user’s view “innocent people may get killed”, the heuristic (3c) is therefore fired and the computer pretends to have no idea about it, for the sake of argument.

In turn 13 and 15, the computer faces questions from the user. In both situations, only one of the answers can be found in the computer’s KB and in neither case has the computer previously issued a “no commitment”, the computer therefore fires the heuristic (2b) and speaks the truth, leaving the computer committed to the reasons for the user’s view “innocent people may get killed”.

In turn 17, the computer faces the same question as in turn 05 and in turn 11. The computer now has no acceptable support for the proposition “it is unlikely innocent people get killed”, and has committed to the reasons for the user’s view “innocent people may get killed”. The computer therefore fires the heuristic (3b) and accepts the user’s
view “innocent people may get killed”.

In turn 19, the computer is facing a question of the proposition “scientific techniques such as fingerprinting will increase the success of justice”. The computer finds only one answer can be found in its KB and the answer has been withdrawn by the computer itself in turn 09, the computer therefore fires the heuristic (2a) to avoid the unwelcome commitment.

In turn 21, neither answer to the user’s question of the proposition “it is wrong to take a human life” can be found in the computer’s KB, the computer therefore fires the heuristic (1) and honestly admits having no idea about it.

It is worth noting that there are three different non-committal responses to a question. In some instances, the computer really does have no idea (e.g. in turn 21); in some instances, the computer does have idea but the idea has already been removed in the early stage of the dialogue (e.g. in turn 19); and in others it is only pretending to have no idea (i.e. in turn 11). The first two instances need no further explanation. The third instance occurs under the following conditions: (i) both answers are found in its KB, (ii) the answer supporting its own view (say ¬P) cannot stand due to events in the early stage of dialogue, (iii) the answer supporting user’s view (say P) is excluded since the user has not given the computer reasons to accept it at the stage of dialogue. Fulfilling all the three conditions, the computer will pretend to have no idea.

2) A challenge made by the user

There are three DE legal options available in response to a challenge: a resolution demand, a ground, or a withdrawal. The first option concerns an inconsistency when the user is challenging a modus ponens consequence of his own commitments. From an educational point of view, it can be argued that the computer should point out this inconsistency and make the user aware of this kind of inconsistency in a debate (Walton 1998). Concerning the latter two options, Moore’s (1993) experimental analysis suggests that one would normally reply with a carefully chosen ground if available. In DE, there is no guidance within the rules as to the content of the ground. The selection between alternative grounds may be influenced by the profile of the agent. Given the definition of the profile of a partially honest agent, the computer should give a ground according to its knowledge structure honestly rather than invent one which may not be a suitable support. In addition, it can be suggested that a support which can be further supported is preferred
over one which cannot be further supported, since a further challenge might be expected from the user. Given this, the heuristics after a challenge of P are proposed as follows.

(1) If P is a modus ponens consequence of the user’s commitment, then pose a resolution demand.
(2) Else if there is only one acceptable ground available in the knowledge base, then state the ground.
(3) Else if there is more than one acceptable ground available, then state the one that can be further supported.
(4) Else if all the available acceptable grounds are equally supported, then randomly choose one of the grounds.
(5) Else if no acceptable ground is available, then withdraw P.

The concept of an “acceptable” ground is specified in chapter six and aims at preventing the fallacy of question-begging. A statement S made by participant B is acceptable to participant A at stage n, just in case that S is at stage n (i) a commitment or (ii) a de facto commitment or (iii) a new commitment of A’s store.

To make the above decisions, the computer needs to consider its knowledge base and the user’s commitment store. The example dialogues below show the proposed heuristics in action.

01: C> Is it the case that CP is acceptable?
02: S> Yes, I think CP is acceptable.
03: C> I think CP is not acceptable.
04: S> Why do you think that CP is not acceptable?
05: C> Because innocent people may get killed. .................................................................(3)
06: S> Why do you think that innocent people may get killed?
07: C> Because there are mistakes during judicial process. ...............................................(2)
08: S> Why do you think that there are mistakes during judicial process?
09: C> Because there is political and racial bias. .................................................................(2)
10: S> Why do you think that there is political and racial bias?
11: C> I don’t know why there is political and racial bias. ...............................................(5)
12: S> Why do you think that there are mistakes during judicial process?
13: C> I don’t know why there are mistakes during judicial process. ....................................(5)
14: S> I think CP is a good deterrent.
15: C> Is it the case that statistic show CP having countries like USA have higher murder rate than non-CP having counties like UK.
16: S> Yes, I think statistic show CP having countries like USA have higher murder rate than non-CP having counties like UK.
The game is set up in turn 01-03. The user adopts the view of “CP is acceptable” and the computer automatically adopts the opposite view of “CP is not acceptable”. In turn 05, the computer has two acceptable grounds: “innocent people may get killed” and “murderers should be given chances for rehabilitation”, the former has a longer chain of support. The computer therefore fires the heuristic (3) and prepares for a possible further challenge from the user.

In turn 07 and 09, the computer has only one acceptable ground available and therefore fires the heuristic (2). In turn 11, the computer cannot find a suitable support in its KB and therefore speaks the truth following heuristic (5). In turn 13, the computer faces the same challenge as in turn 09. The computer now finds that the only ground “there is political and racial bias” available in its KB is neither a commitment nor a de facto commitment nor a new commitment of the user’s store and it is therefore not acceptable to the user. Should the computer give the unacceptable ground as an answer, it would be begging the question. The computer therefore fires heuristic (5) and admits that no further reason can be provided. Turn 21 demonstrates heuristic (1) in action. In this situation, the user has committed to an inconsistency since the user has accepted the reasons in turn 16 and 18 for the proposition “CP is not a good deterrent”.

A further example dialogue shows heuristic (4) in action:

The game is set up in turn 01-03. The user adopts the view of “CP is not acceptable” and the computer automatically adopts the opposite view of “CP is acceptable”. In turn 05, the
computer finds two grounds in its KB: “CP is a good deterrent” and “most people want CP back”; and the support chain for the two grounds are equal (see figure 8.1). The computer therefore randomly chooses one of them following heuristic (4).

3) A resolution demand made by the user

A resolution demand made by the user concerns an allegation that the computer has committed to an inconsistency in its commitment store. In the most likely event, the computer would face a resolution demand like resolve \{¬P, P\} in that the computer has committed to both P and ¬P. In this situation, the computer is allowed and required to withdraw one of them to keep consistent. Moore (1993) suggests that the computer should withdraw whichever conjunct is the least harmful. However, given the definition of a partially honest agent, the computer is required to be honest regarding the publicly inspectable stores. It is therefore suggested that the computer should withdraw the one which is less supported according to its commitment store. The example dialogue below shows the computer withdrawing (in line 15) the commitment which is least supported.

01: C> Is it the case that CP is acceptable?
02: S> No, I think CP is not acceptable.
03: C> I think CP is acceptable.
04: S> Is it the case that innocent people may get killed?
05: C> No, I think it is unlikely innocent people get killed.
06: S> Why do you think it is unlikely innocent people get killed?
07: C> Because scientific techniques such as fingerprinting will increase the success of justice.
08: S> Why do you think scientific techniques such as fingerprinting will increase the success of justice?
09: C> I don't know why scientific techniques such as fingerprinting will increase the success of justice.
10: S> Is it the case that there are mistakes during the judicial process?
11: C> Yes, I think there are mistakes during the judicial process.
12: S> Is it the case that innocent people may get killed?
13: C> Yes, I think innocent people may get killed.
14: S> Please resolve ‘innocent people may get killed’ and ‘it is unlikely innocent people get killed’ in your commitments.
15: C> I don't think it is unlikely innocent people get killed.

In turn 05, the computer poses its view “it is unlikely innocent people get killed”. In turn 13, the computer accepts the user’s view “innocent people may get killed”. This makes it therefore possible for the user to pose a resolution demand in turn 14. In this situation, the computer needs to assess the acceptable supports for both propositions in the resolution demand: “innocent people may get killed” and “it is unlikely innocent people get killed”.
The computer finds that there is no acceptable reason for the proposition “innocent people may get killed” due to the non-committal answer in turn 09, and there is a prima facie reason for the proposition “it is unlikely innocent people get killed” due to the acceptance in turn 11. The computer therefore withdraws the proposition “innocent people may get killed” which is less supported with respect to the publicly inspectable stores.

The user might invoke another type of resolution demand (i.e. resolve \((Q, Q\supset P, \text{why } P)\) or resolve \((Q, Q\supset P, \text{withdrawal } P)\)) in the event of the computer’s challenging or withdrawing a modus ponens consequence of its commitments. In this situation, the computer is required, by the game DE, to withdraw either \(Q\) or \(Q\supset P\) or to affirm \(P\). Moore (1993) argues that use of such a resolution demand would suggest that, in the user’s view at least, the computer has challenged or withdrawn a proposition to which it ought to be committed given the remainder of its commitment store. However, the current debating system’s algorithm prevent it from challenging or withdrawing such a consequence, and therefore no examples are provided regarding this.

**4) A “no commitment” made by the user**

After a “no commitment”, DE places no restrictions on either move type or contents. The computer’s options are therefore more open than in the previous situations considered above. It might be argued that the computer should deal with this dialogue situation differently depending on the content of the withdrawn statement. On this argument, the heuristics after a “no commitment” are proposed as follows:

1) If \(P\) supports the user’s thesis
   a. If \(P\) is a unique support of the user’s asserted proposition \(Q\), and \(Q\) is not the user’s thesis, then challenge \(Q\).
   b. Else check whether the user retains adherence to the thesis.
2) If \(P\) supports the computer’s thesis
   a. If the non-committal statement is a modus ponens consequence of the user’s commitments, then pose a resolution demand.
   b. Else switch the current focus.

Heuristics (1) and (2b) are taken from Moore (1993), heuristic (2a) is proposed by the author.

Heuristic (1) will be used when the computer is facing a “no commitment” to a statement
supporting the user’s thesis. Moore (1993) suggests that in the event of withdrawal of a proposition at a lower level of a support hierarchy, seeking withdrawal of propositions uniquely supported by that proposition. Heuristic (1a) is therefore suggested to challenge the statement supported by that proposition being withdrawn. If no such statement supported by the withdrawn proposition exists, heuristic (1b) can be invoked to check whether the user has given up his thesis given the situation that, from the computer’s point of view, the user might surrender since it has lost some part of the debate.

Heuristic (2) can be used if the computer is facing a “no commitment” to a statement supporting the computer’s thesis. Heuristic (2a) suggests using a resolution demand if available. Walton (1998) argues that this kind of inconsistency cannot be passed unchallenged if the statement being withdrawn is a modus ponens consequence of the remainder of the speaker’s commitments. If there is no such inconsistency in the user’s store, it might be suggested that the computer should switch the current focus since there is nothing to attack arising directly from “no commitment”. The example dialogue below shows the proposed heuristics in action.

01: C>Is it the case that CP is acceptable?
02: S>Yes, I think CP is not acceptable.
03: C> I think CP is acceptable.
04: S>I think innocent people may get killed.
05: C>Is it the case that scientific techniques such as figure printing will increase the success of justice.
06: S>I am not sure about it.
07: C>Why do you think innocent people may get killed? .................................................................(2b)
08: S>Because there are mistakes during judicial process.
09: C>Why do you think there are mistakes during judicial process?
10: S> I don’t know why there are mistakes during judicial process.
11: C> Why do you think innocent people may get killed? .................................................................(1a)
12: S> I don’t know why innocent people may get killed.
13: C>Is it the case that CP is not acceptable? .................................................................(1b)
14: S>Yes, I think CP is not acceptable
15: C>Is it the case that CP stops murderers from killing?
16: S>Yes, I think CP stops murderers from killing.
17: C>Is it the case that CP stops murderers from killing is a prima facie reason for CP is a good deterrent?
18: S>Yes, I think CP stops murderers from killing is a prima facie reason for CP is a good deterrent.
19: C> I think CP is a good deterrent.
20: S> I don’t think CP is a good deterrent.

21: C> You already commit the reasons for this, please resolve “CP stops murderers from killing” and “CP stops murderers from killing is a prima facie reason for CP is a good deterrent” in your commitments. ………………………………………………………………………………………………………………………………………………………………………(2a)

22: S> I don’t think CP stops murderers from killing.

23: C: I think most people want CP back. ………………………………………………………………………..(2b)

In turn 06, the user gives a non-committal answer to the question “scientific techniques such as figure printing will increase the success of justice”, heuristic (2) is therefore applied. The non-committal proposition is not a modus ponens consequence of the user’s commitments, heuristic (2a) is therefore not applicable; the computer therefore fires heuristic (2b) and abandons the line of questions.

In turn 10, the user withdraws the proposition “there are mistakes during judicial process” which is a unique support of the user’s previous commitment “innocent people may get killed”. The computer therefore fires the heuristic (1a) in turn 11 and challenges the proposition “innocent people may get killed”. In turn 12, the user withdraws the proposition “innocent people may get killed” in response to a challenge. Since the withdrawn proposition is a direct support of the user’s thesis, heuristic (1a) is therefore not applicable, and the computer therefore fires the heuristic (1b) and checks whether the user still adheres with his thesis.

In turn 20, the user issues a “no commitment” to the statement “CP is a good deterrent”, a statement supporting the computer’s view. However, the user has accepted the reasons for “CP is a good deterrent” in turn 16 and 18, the computer therefore fires the heuristic (2a) and poses a resolution demand in turn 21. In turn 22, the user withdraws the proposition “CP stops murderers from killing” which he has previously accepted in turn 16. The withdrawn statement is not a modus ponens of the user’s store, heuristic (2a) is therefore not applicable and the computer fires the heuristic (2b) and switches the focus to build its own thesis in turn 23.

5) A statement made by the user

After a statement, there is no restriction on either move types or move contents in DE. In the most likely event, the computer would face a statement which supports the user’s view or opposes the computer’s view. However, it is possible that the user may unwisely make a statement which supports the computer’s view or militates against his own view.
The computer may need to deal with these two kinds of statement differently. When the computer is facing a statement (say P) which supports the computer’s thesis or militates against the user’s view, two heuristics are proposed as follows.

a) If P is a support of the computer’s thesis, then use P as the starting point to build toward the computer’s thesis.

b) Else check whether the user still retains adherence to his thesis.

An example dialogue shows these heuristics in action below.

01: C> Is it the case that CP is acceptable?
02: S> Yes, I think CP is acceptable.
03: C> I think CP is not acceptable.
04: S> I think innocent people may get killed.
05: C> Is it the case that innocent people may get killed is a prima facie reason for CP is not acceptable? ……………………………………………………………………………………………………………………………(a)
06: S> Yes, I think innocent people may get killed is a prima facie reason for CP is not acceptable.
07: C> I think CP is not acceptable.
08: S> I think CP is not a good deterrent.
09: C> Is it the case that CP is acceptable? ……………………………………………………………………………………………………………………………(b)

In turn 04, the user unwisely states the proposition “innocent people may get killed” which, from the computer’s point of view, is a support of the computer's thesis. The computer therefore takes the advantage of this and uses the proposition as the basis to build an immediate plan toward its thesis as shown in turn 05 and turn 07 following heuristic (a).

In turn 08, the user states the proposition “CP is not a good deterrent”, which, from the computer’s point of view, is a proposition against the user’s thesis “CP is acceptable”. Heuristic (b) suggests the computer should check whether the user still adheres with his thesis given the user’s irrational behaviour, and this occurs in turn 09.

When the computer is facing a statement (say P) which supports the user’s view or militates against the computer’s view, a set of heuristics are proposed as follows.

a) If there is an expressed inconsistency (e.g. (P, ¬P)) in the user’s commitment store, then ask for resolution.

b) Else if there is a piece of hard evidence (say E) in support of ¬P, then state E.

c) Else if there is any support (say Q) for ¬P and Q can be further supported, then (i) state ¬P or state Q if ¬P has been uttered, or (ii) form a plan of questions aimed at
d) Else if there is any support (say R) for ¬P and R cannot be further supported, then form a plan of questions aimed at making the user accept ¬P.
e) Else if P is challengable, then challenge it.

Heuristics (a), (b), (d) and (e) are taken from Moore (1993) (see section 8.5.4 below).

Heuristic (a) suggests the computer should point out the user’s obvious inconsistency. Walton (1998) argues that this kind of inconsistency should not be passed unchallenged. Moore (1993) also suggests that this heuristic can be regarded as the strongest attack of the opponent’s positions. Therefore, this heuristic has highest priority.

Heuristic (b) suggests the computer should state a piece of hard evidence which directly contradicts the user’s view. There are two options in heuristic (c), the first option can be considered as a rebuttal of the user’s view, and is borrowed from Amgoud and Maudet (2002); the second option considers forming a plan of questions. Heuristic (d) suggests the computer should form a plan of questions only for a less supported point. The priority between heuristics (b), (c) and (d) concerns how the computer would select the strongest argument. Moore (1993) suggests that one would like to state a piece of hard evidence (e.g. official statistics) rather than to pose it as a question. Heuristic (b) is therefore considered as the first option. An argument whose support can be further supported is considered as more secure than an argument whose support cannot be further supported since the former can provide reasons for the user’s potential forthcoming challenge while the latter cannot. Heuristic (e) is therefore considered to have higher priority than heuristic (d). The selection from the two options within heuristic (c) is currently made on an arbitrary basis.

Heuristic (e) could be used if the user’s view P is challengable. To decide whether a statement is challengable, the computer needs to consider the nature of that statement (e.g. whether it is a piece of hard evidence) and the relevant DE dialogue rules. If it is not considered hard evidence, and if a challenge would be legally permissible, then it is challengable. Following Moore (1993), heuristic (e) is regarded as having the lowest priority.

A further concern is that of how the plan of questions in heuristic (c) and (d) are organised. Following Walton’s (1996b) scheme of argument from gradualism, the plan is currently started by asking a question of a proposition (say A), followed by a series of connected conditionals (say A\(\rightarrow\)B, B\(\rightarrow\)C….C\(\rightarrow\)P) toward the conclusion (say P). Moore (1993) argues
that the computer should hand over the initiative by stating the conclusion P at the end if the plan is executed successfully, with a view to avoiding a one-sided dialogue.

The following example dialogue shows heuristics (a) to (e) and a plan (in line 07 to 11, and line 19 to 25) in action.

01: C> Is it the case that CP is acceptable?
02: S> Yes, I think CP is acceptable.
03: C> I think CP is not acceptable.
04: S> I think CP is a good deterrent.
05: C> But statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK ………………………………………………………………………………(b)
06: S> I think CP is a good deterrent.
07: C> Is it the case that statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK? ………………………………………………………………………………(d)
08: S> Yes, I think statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK
09: C> Is it the case that statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK is a prima facie reason for CP is not a good deterrent?
10: S> Yes, I think statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK is a prima facie reason for CP is not a good deterrent
11: C> I think CP is a not good deterrent.
12: S> I think it is not the case that statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK.
13: C> Please resolve “statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK” and “it is not the case that statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK” in your commitment.
………………………………………………………………………………………………………. (a)
14: S> I don’t think statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK.
15: C> I think innocent people may get killed.
16: S> I think it is unlikely innocent people get killed.
17: C> I think there are mistakes during the judicial process. …………………………………(c)
18: S> I think it is unlikely innocent people get killed.
19: C> Is it the case that there is political and racial bias. ……………………………………………………(c)
20: S> Yes, I think there is political and racial bias.
21: C> Is it the case that there is political and racial bias is a prima facie reason for there are mistakes during the judicial process?
22: S> Yes, I think there is political and racial bias is a prima facie reason for there are mistakes during the judicial process.
23: C> Is it the case that there are mistakes during the judicial process is a prima facie reason for innocent may people get killed?
24: S> Yes. I think there are mistakes during the judicial process is a prima facie reason for innocent may people get killed.
25: C> I think innocent people may get killed.
26: S> I think most people want CP back.
27: C> Why do you think most people want CP back? ……………………………………………………….(e)
28: S> Because the recent survey shows that 60% of British people support CP.
29: C> I think murderers should be given chances for rehabilitation.

The above dialogue example shows that the user holds the view “CP is acceptable”, and the computer automatically adopts the contrary. In turn 05, the computer is facing the proposition “CP is a good deterrent” made by the user. The computer finds that there is no expressed inconsistency in the user’s commitment store, heuristic (a) is therefore inapplicable. There is directly contradictory evidence “statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK” in its knowledge base. The computer therefore fires the heuristic (b) and asserts the piece of hard evidence (line 5).

In turn 07, the computer faces the same proposition “CP is a good deterrent” as in turn 05. The piece of contradictory hard evidence found in its knowledge base has been asserted in turn 05, and heuristic (b) is therefore inapplicable. There is no further support for the piece of hard evidence, and heuristic (c) is therefore inapplicable as well. However, it is possible for the computer to fire the heuristic (d) and form a plan. The plan contains three ordered elements: namely {(i) statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK; (ii) statistics show CP having countries like USA have higher murder rate than non-CP having countries like UK is a prima facie reason for CP is not a good deterrent; (iii) CP is not a good deterrent}. The computer executes the plan by questioning the first two elements in the plan as shown in turn 07 and turn 09. Given the user’s positive responses in turn 08 and turn 10, the computer ends the plan by stating the last element in the plan as shown in turn 11. In turn 13, the computer fires the heuristic (a) and points out the user’s inconsistency in that the user has uttered contradictory statements in turn 08 and turn 12.

In turn 17 and 19, the computer faces the same proposition “it is unlikely innocent people get killed”. There is no expressed inconsistency in the user’s store and there is no direct contradictory hard evidence. Heuristic (a) and (b) are therefore inapplicable. The computer finds that there is a support “there are mistakes during the judicial process” for the proposition “innocent people may get killed” and that the support can be further supported. Both options within heuristic (c) are therefore available, and the computer
chooses them on an arbitrary basis. In turn 17, the computer chooses option (i) and therefore states the proposition “there are mistake during the judicial process” since the computer has uttered “innocent people may get killed”. In turn 19, the computer chooses option (ii) and therefore forms a plan, and the plan is successfully ended in turn 25.

In turn 27, the computer faces the proposition “most people want CP back” made by the user. The computer finds no objections to the proposition in its knowledge base, heuristic a-d are therefore inapplicable. However, the computer finds that the proposition is challengable since it is not a piece of hard evidence and it is legally permissible to challenge the proposition according to the DE rules. The computer therefore fires the heuristic (e) and challenges it. In turn 29, the computer faces a piece of hard evidence which is unchallengable according to its KB. The computer therefore decides to switch the focus and, in this example, to build its own thesis by asserting an immediate support of its thesis.

The adoption of these plans shown in the above example dialogue presumes that the user always gives wanted answers (i.e. answers favourable to the computer’s plan). In practice, the user might give unwanted answers. The approach taken here is that the computer tries to remove the obstacles and put the plan back on track while the initiative is still held. The unwanted answer could be either a non-committal response or a statement. For a non-committal response, the only attacking method is to pose a resolution demand if the user is refusing to commit to a modus ponens consequence of his commitments. Then, if the user responds by affirming the disputed consequence, the computer can put the plan back on track by reposing the original questions. Any other responses from the user would possibly make the plan into a blind alley, and it is suggested that the computer should abandon the line of questions (cf. Moore 1993).

If the unwanted answer is a statement rather than a “no commitment”, it might be thought that the computer should fire the heuristics (a-e) above, against it. However, heuristic (b), (c) and (e) might make the computer lose its initiative in which case the plan would become difficult to execute. The computer therefore might need to fire the heuristic (a) or (e) since its initiative is still held. Assuming that there is either a resolution demand or a challenge available for the computer, and the user has, as the computer hopes, withdrawn the unwanted statement, the computer can put the plan on its way by reposing the original questions. Any other responses from the user would make the plan much more complex, and it might be suggested that the computer should drop the line of questions (cf. Moore 1993). Given the above discussion, a plan execution process is proposed as follows.
1) If a wanted answer is given, then carry on with the execution of the plan

2) If a non-committal answer is given

(2.1) If there is an expressed inconsistency in the user’s commitment store, then pose the appropriate resolution demand
   a) If the user affirms the disputed consequence, then resume the plan
   b) Else abandon this line of questions
(2.2) Else abandon this line of questions

3) If an unwanted statement (e.g. ¬P rather than P) is given

(3.1) If there is an expressed inconsistency in the user’s commitment store and the unwanted answer ¬P is an element of the inconsistency, then pose the appropriate resolution demand
   a) If the unwanted answer is withdrawn, then resume the plan and re-pose the question.
   b) Else abandon this line of questions
(3.2) Else if the unwanted statement is challengable, then challenge the unwanted statement
   a) If the unwanted answer is withdrawn, then resume the plan to repose the question of P.
   b) Else abandon this line of questions
(3.3) Else abandon this line of questions

The following example dialogues show the proposed heuristics for a plan in action.

………………………………………………
06: S>I think CP is a good deterrent is a prima facie reason for CP is acceptable
………………………………………………
22: S>I think CP is a not acceptable
23: C>Is it the case that CP is a good deterrent?
24: S>No. I think CP is a not good deterrent.
25: C>Why do you think CP is a not good deterrent? ......................................................(3.2)
26: S>I don’t know why CP is not a good deterrent.
27: C>Is it the case that CP is a good deterrent? .............................................................(3.2a)
28: S>Yes, I think CP is a good deterrent.
29: C>Is it the case that CP is a good deterrent is a prima facie reason for CP is acceptable?.......................(1)
30: S>No, I think it is not the case that CP is a good deterrent is a prima facie reason for CP is acceptable.
31: C> Please resolve “it is not the case that CP is a good deterrent is a prima facie reason for CP is acceptable” and “CP is a good deterrent is a prima facie reason for CP is acceptable” ............(3.1)
32: S> I don’t think it is not the case that CP is a good deterrent is a prima facie reason for CP is acceptable.
33: C> Is it the case that CP is a good deterrent is a prima facie reason for CP is acceptable?  
……………………………………………………………………………………………………………………………..(3.1a)
34: S> I am not sure about it.
35: C> I think most people want CP back.  ……………………………………………………………..………..(2.2)
36: S> I think the recent survey shows that 60% of British people support CP.
37: C> Is it the case that the recent survey shows that 60% of British people support CP is a prima facie reason for most people want CP back?
38: S> Yes, I think the recent survey shows that 60% of British people support CP is a prima facie reason for most people want CP back
……………………………………….
51: C> Is it the case that most people want CP back?
52: S> I am not sure about it
53: C> You already commit the reasons for this, please resolve “the recent survey shows that 60% of British people support CP” and “the recent survey shows that 60% of British people support CP is a prima facie reason for most people want CP back” in your commitments. ………………………………………..(2.1)
54: S> I think most people want CP back.
55: C> Is it the case that most people want CP back is a prima facie reason for CP is acceptable?…….(2.1a)

The above dialogue shows that the computer is in turn 23 beginning to build a plan toward its thesis “CP is acceptable”. The plan contains three elements {CP is a good deterrent; CP is a good deterrent is a prima facie reason for CP is acceptable; CP is acceptable}. The computer starts the plan by posing the first element as a question in turn 23. The user responds with a statement “CP is not a good deterrent” which is not the response the computer hopes for. The computer finds that no resolution demand is available, but that the statement “CP is not a good deterrent” is challengable. The computer therefore fires the heuristic (3.2) to challenge it in turn 25. As the computer hopes, the user removes the statement “CP is not a good deterrent” from his store. The computer therefore fires heuristic (3.2a) and reposes the question of “CP is a good deterrent” in turn 27.

The user provides a positive response in turn 28. The computer therefore continues the plan following heuristic (1) and poses the second element of the plan as a question in turn 19. The user gives a negative response to this question in turn 30, and this again not the answer the computer hopes for. The computer finds the user has committed to contradictory statements “CP is a good deterrent is a prima facie reason for CP is acceptable” (in turn 06) and “it is not the case that CP is a good deterrent is a prima facie reason for CP is acceptable” (in turn 30). The computer therefore fires the heuristic (3.1) and poses the resolution demand in turn 31. As the computer hopes, the user removes the
statement “it is not the case that CP is a good deterrent is a prima facie reason for CP is acceptable” from his store in turn 32. The computer therefore fires the heuristic (3.1a) and reposes the question of “CP is a good deterrent is a prima facie reason for CP is acceptable”.

The user gives a non-committal answer in turn 34, which is not the response the computer hopes for. The computer finds the non-committal statement is not a modus ponens consequence of the user’s commitments. The computer therefore drops the line of questions according to heuristic (2.2) and chooses to build toward its thesis as shown in turn 35.

In turn 51, the computer is beginning to build a plan toward its thesis “CP is acceptable”. The plan contains three elements {most people want CP back; most people want CP back is a prima facie reason for CP is acceptable; CP is acceptable}. The computer starts the plan by posing the first element as a question in turn 51. The user responds with a “no commitment” in turn 52 which is not the response the computer hopes for. The user, however, has explicitly committed to the reasons for the statement “most people want CP back” in an earlier stage of dialogue (i.e. turn 36 and 38), and is therefore inconsistent. The computer therefore fires the heuristic (2.1) and poses the resolution demand in turn 53. In turn 54, the user affirms the disputed consequence “most people want CP back”, the computer then fires the heuristic (2.1a) and resumes the plan in turn 55.

8.4 Incorporation of the Strategy into the Debating System

The proposed strategy developed in the previous section has been computationally implemented and incorporated into the scheduling unit of the debating system developed in the previous chapter. The architecture of the scheduling unit of the debating system is shown in figure 8.2.

The scheduling unit is responsible for generating moves in the light of (i) the knowledge base, (ii) the prevailing state of both commitment stores and (iii) the dialogue rules. The system scheduler manages assertion, challenge, withdrawal, resolution and question “strategists”, each of which is designed to deal with a different dialogue situation following the set of heuristics discussed in section 8.3. When the system scheduler receives calls from the dialogue manager, it will check the current dialogue situation and schedule the corresponding strategist to produce a move. The system scheduler will then.
pass the move to the dialogue unit to make the agent’s contribution.

In addition, there are five components (focus shift manager, build manager, demolish manager, plan generator and plan executor) that are designed to provide special services to the assertion and the withdrawal strategists. The focus shift manager handles the level (1) decisions, and will be called by the assertion or withdrawal strategist to decide whether to change the current focus. The build and demolish managers handle the level (2) decision, and will be called by the focus shift manager to check whether there are methods available to either build its own positions or attack the user’s positions. The plan generator is responsible for generating a set of propositions and forming a line of questions when required by the assertion or withdrawal strategist, the build manager or the demolish manager. The plan executor is responsible for executing a plan. The assertion and withdrawal strategists will constantly look up whether there is a plan under execution, if there is, then they call the plan executor to carry on its execution.

8.5 Relationships to Other Works

This section contains a review of other work in the field of strategy in dialectic systems and a discussion of the relations between the current proposal and the existing work.
8.5.1 Walton’s Argumentation Schemes

Walton (1996b) claims that his argumentation schemes involve generalisations of everyday argumentations, which act as warrants to draw a conclusion from premises of an argument. He argues that the match between a generalisation and a particular case is never perfect, or completely certain and absolute, and therefore that these schemes are defeasible. Twenty-five schemes are identified as follows.

- argument from sign
- argument from example
- argument from verbal classification
- argument from commitment
- circumstantial argument against the person
- argument from position to know
- argument from expert opinion
- argument from evidence to a hypothesis
- argument from correlation to cause
- argument from cause to effect
- argument from consequences
- argument from analogy
- argument from waste
- argument from popularity
- ethotic argument
- argument from bias
- argument from an established rule
- argument from precedent
- argument from gradualism
- the causal slippery slope argument
- the precedent slippery slope argument
- argument from vagueness of a verbal classification
- argument from arbitrariness of a verbal classification
- the verbal slippery slope argument
- the full slippery slope argument.

Each scheme has a set of critical questions attached. An example of argument from sign is reproduced from (Walton 1996b) as follows:
Form:

B is generally indicated as true when its sign, A, is true, in this kind of situation.
A is true in this situation
Therefore B is true

Critical questions:

What is the strength of the correlation of the sign with the event signified?
Are there other events that would more reliably account for the sign?

Example:

Here are some bear tracks in the snow.
Therefore, a bear passed this way.

Walton (1997) argues that the list of argumentation schemes offers a useful account in interpreting, analysing and evaluating natural language argumentation in everyday conversation. Maudet and Moore (2001) speculate that these argument schemes may be used as a component in a computational strategy. Reed and Walton (2003) also stress that these schemes may be useful to bridge the gap between informal logic and dialogue logic. It can also be suggested that some of these schemes can help to formalise and thus computationally represent domain knowledge, e.g. the consequence relationships between propositions may be represented according to suitable argumentation schemes. A possible weakness with the list is that the scheme of effect to cause (cf. Grennan 1997) is apparently not catered for. In addition, it is not immediately obvious how some of Walton’s schemes can be adopted by the computer, e.g. the set of slippery slope arguments. Indeed, Walton and Reed (2002a; 2002b) point out that whilst these schemes formulated in Walton (1996b) are in rough form designed to be useful, some of them need more work to adopt some standard notation to put them in a consistent structure that could be useful for formalisation and computing.

The current proposal has considered using Walton’s (1996b) graduation argument scheme as a tactic of planning a line of questions. In addition, some of Walton’s (1996b) schemes have been used to represent the system knowledge base, e.g. argument from consequence (for example, ‘innocent people may get killed’ is a prima facie reason for ‘CP is not acceptable’) and argument from popularity (for example, ‘most people want CP back’ is a prima facie reason for ‘CP is acceptable’). These schemes will be invoked automatically by the system, for example, when the computer is giving the ground ‘most people want CP back’ for the user’s challenge of ‘CP is acceptable’, the computer is in
effect arguing from popularity.

### 8.5.2 Krabbe’s Dialogue Profile

A profile of dialogue is seen by Krabbe (1999) as a number of connected sequences of moves, organised as branches in a tree. Krabbe argues that the method of dialogue profile can be useful as a heuristic for the development of an argumentation system. He gives an example of dialogue profile, which is organised as a tree as shown in figure 8.3 (P and O stand for proponent and opponent of the dialogue respectively).

![Figure 8.3 A normative profile of dialogue (reproduced from Krabbe 1999)](image)

Krabbe argues that an argument can be criticised in four ways: tenability criticism, regarding the truth or acceptability or tenability of explicit premises; connection criticism, regarding the link between the premise and the conclusions; active criticism, regarding a counter argument that attacks the conclusion of an argument; and fallacious criticism, concerning something wrong with the argument (e.g. begging the question). Krabbe further argues that connection criticism is the only way to challenge the relevance of a move in formal dialogue.

In the current proposal, Krabbe’s tenability criticism is catered for by the computer’s challenge of the user’s positions, active criticism is made by the computer’s stating propositions against the user’s view, and inadmissible fallacy criticism is assigned to the DE referee to handle. Krabbe’s (1999) connection criticism regarding a challenge of the link between the premise and the conclusion of an argument (e.g. P\(\supset\)Q) is also available in the current proposal. However, the computer is not given a means of response to such a challenge (e.g. Why P\(\supset\)Q?). This might involve an enhancement of the knowledge base.
by considering Toulmin’s (1958) backing of an argument. Such an expansion of the current proposal is left for further work.

8.5.3 Amgoud and Maudet’s Strategy

Amgoud and Maudet (2002) propose a set of strategies for agents’ interaction. Their account is layered into the following three levels:

1) Agent profile
2) Choose to build or destroy
3) Choose some appropriate argumentative content

The first level of strategy concerns the profile of the agent. Amgoud and Maudet (2002) propose a very prudent agent profile, which is more reluctant to expose his argument than a non-prudent agent.

The second level of strategy is either a build or a destroy strategy. Amgoud and Maudet argue that a build strategy consists of defending some facts in its commitment store, and a destroy strategy consists of attacking some commitments in the opponent’s commitment store. They further argue that both strategies can be selected toward any statement presented in either participant’s commitment store. Amgoud and Maudet argue that the selection between build or destroy strategy depends on the result of argument assessment of level 3 given the prudence level of that agent. The agent will adopt a build strategy (e.g. assert Q, Q ⊨ P) if there is an unattacked argument (Q, Q ⊨ P) for one of its previous commitments P. The agent will adopt a destroy strategy (e.g. assert ¬P) if there is an unattacked argument (Q, Q ⊨ ¬P) and P is one of his opponent’s previous commitments. If neither of the above two conditions is met, the agent will adopt a destroy strategy (e.g. challenge P) where P is the weakest argument in the opponent’s store.

The third level of the strategy concerns how to select the strongest support or good reasons. The idea is that the agent computes the strength of an argument based on its argumentation system. Amgoud and Maudet argue that unattacked arguments are considered stronger than self-defended arguments (which can defend themselves against attacks), and self-defended arguments are considered stronger than jointly defended arguments (which are defended by other arguments).

However, it can be argued that there are several possible limitations with their proposal. The first concern is the profile of a prudent agent. Amgoud and Maudet argue that the
idea behind a prudent agent is that the more defence you need, the more you are exposed to contradiction. However, it might be argued that the more defence you have available, the more confidence you have in the statement (cf. Moore 1993).

The second concern is the level 2 strategy. Amgoud and Maudet consider a build strategy as defending some facts of its commitment (e.g. assert Q, Q ⊨ P, where P is one of its previous commitment), and a destroy strategy as attacking the opponent’s commitment (e.g. challenge P, or assert ¬P, where P is one of the opponent’s commitments). However, it might be argued that a destroy strategy could possibly be part of a broader build strategy, e.g. a goal directed plan of questions of building one’s view might involve attacking some unwanted responses from the user. It might also be argued that an attacking of the opponent’s position might also involve a build of the negative view on that statement, e.g. one is using a line of question (cf. Walton’s (1998) distance strategy) to build the case for P in order to attack the user’s view ¬P. This restriction is arguably caused by Amgoud and Maudet’s protocol (cf. Amgoud et al. 2000a, 2000b), which specifies that the legally available moves after a statement (P) are assert (H), or assert (¬P), or challenge (P). This actually leaves less room for strategy, it can be argued.

A third concern is that the agent computes the strength of an argument using the computer’s superior memory. In a human computer debate setting, the human users are unlikely to think so far ahead as a computer does (cf. Moore 1993). It might therefore be argued that there is eventually a danger here of the computational agent being too strategically wise, leading to difficulties where a human is the other agent of the dialogue (cf. Walton 1984). This is avoided in the proposed strategy discussed earlier in this chapter.

Given the above discussions, Amdoud and Maudet’s strategy might not be suitable for an educational human computer debate. However, in the current proposal of strategies for a human computer debating system, the idea of the profile that is adopted by the system is inspired by Amgoud and Maudet (2002). Amgoud and Maudet proposed a prudent agent, while the current proposal considers a partially honest agent. In addition, the current proposal uses Amgoud and Maudet’s denial of one of the opponent’s defences as a heuristic after a statement.

8.5.4 Moore’s Strategic Heuristics

Moore (1993) studied people in debate with each other via the game DC, and proposed a
set of strategies based on an informal analysis of participants’ behaviour in the debates. The decisions are argued to be at three levels.

1) Retain or change focus.

2) Build his own thesis or demolish the opponent’s supporting statements.

3) Select method to fulfil the objective set at level 1 and 2.

Moore suggests level 3 heuristics by which the objective defined by level 1 and 2 is put into effect, for each of the different game situations as shown in table 8.1.

**Table 8.1 Moore's strategic heuristics**

<table>
<thead>
<tr>
<th>Previous move</th>
<th>Strategic heuristics</th>
</tr>
</thead>
</table>
| statement     | - if S has uttered contradictory propositions then resolve.  
                - if there is any evidence directly contradicting any of the partner’s statement, state it.  
                - seek substantive objection to partner’s commitments, and pose questions with a view to making partner accept that objection.  
                - seek out by challenge partner’s arguments, with a view to ultimately rebutting them. |
| withdrawal    | - either check whether partner retains adherence to the thesis, and challenge for further reasons, or switch focus;  
                - in the event of withdrawal of a proposition at a lower level of a support hierarchy, seek withdrawal of propositions uniquely supported by that proposition. |
| start of game | - no heuristics available on evidence |
| question      | - answer in such a way to avoid unwelcome commitment.  
                - give answers for which good reasons can be given.  
                - answer truthfully |
| challenge     | - answer with some carefully chosen support |
| resolve       | - withdraw whichever conjunct is the least harmful |

A potential issue with the level-3 heuristics is that some of the decisions are highly dependent on the truth seeking nature of the system, e.g. after a question, a challenge or a resolution demand, in that a truth seeking system would always speak the truth while a non-truth seeking system may tell lies for the sake of argument. The characterisation of strategy, that is, lacks a definition of the profile of the agent, e.g. Grasso et al. (2000) define a cooperative agent and Amgoud and Maudet’s (2002) define a prudent agent. A further concern is that some of the concepts, such as “unwelcome commitment”, “good reasons” “carefully chosen support” and “least harmful”, “substantive objections” and
“direct contradictive evidence” need further work to be computationally usable.

In sum, Moore’s strategy is empirically derived from human behaviour when using the game DC. Further development work is necessary in order to computationally operationalise this strategy. The proposal developed in earlier sections of this chapter has adopted this agenda and further developed Moore’s strategy. The overall arrangement of the proposal roughly follows Moore’s three levels of decisions. This proposal keeps Moore’s level 1 and 2 decisions unchanged. Much of Moore’s level 3 heuristics have been reused and further developed for computational use. In addition, a profile that might be adopted by an educational human computer debating system has been newly defined and incorporated into the three levels of decisions.

8.5.5 Dialectical Relevance Research

Moore (1993) sees dialectical relevance as a strategic issue. Prakken (2000) argues that the aim of dialectical relevance is to allow maximum freedom while ensuring the focus of the dispute. Several attempts to define rules to enforce participants to maintain the dialogue focus can be found in the literature (e.g. Walton 1999; Prakken 2000; Maudet 2001). Walton (1999) considers dialectical relevance in persuasion dialogue as involving “topic relevance” and “material relevance”. Topic relevance captures whether a move shares some subject matter with the main topic under discussion, and material relevance captures the notion that a move is part of a chain of argumentation, which aims at supporting or denying the main claim of the dialogue. This chaining of argument could move forward based on modus ponens inference or reason backward based on abductive inference. However, Maudet (2001) argues that topic and material relevance are necessary but not sufficient to capture dialectical relevance, he therefore adds a third level- “dialectical relevance” which, he claims, captures whether a move is useful to the given dialogue situation. However, means of computationally capturing these levels of dialectical relevance are still unknown.

A further useful contribution to dialectical relevance comes from Prakken (2000; 2001). In his framework, moves available are either an initial move (claim) or an attacking move (challenge, argue) or a surrendering move (concede, retract). The notion of dialectical relevance is captured by the mechanism of dialogue status combined with the idea that each move explicitly replies to another move in the dialogue. The status of a move M is either in (+) or out (-) in a dialogue D. It is in if
1. M is conceded in D; or else
2. all attacking moves in D that reply to it are out in D.

A move is a relevant target if any attacking reply to it changes the main claim of the dialogue, and a move is relevant if it replies to a relevant target. Prakken gives an example (Figure 8.4) to explain his notion of dialectical relevance.

![Diagram](image)

**Figure 8.4** Dialectical relevance

The tree on the left shows the situation after P4; here P1 is in since every attacking move (O1) is out. The tree in the middle shows that O4 does not affect the status of the main claim and is therefore irrelevant. The right tree shows that O4 changes the status of the main claim and is therefore relevant.

Prakken’s notion of dialectical relevance forces every move to be immediately relevant in the dialogue. Prakken himself points out some restrictions of his framework, such as the concern that since each move replies to a previous move, this excludes certain pieces of dialogue, e.g. lines of questioning in cross-examination of witnesses and invitations to retract or concede. Arguably, it is the absence of move-types such as question and resolution demand in Prakken’s protocol (cf. section 3.2 above), which causes this restriction.

It might be argued that some moves in a debate may not immediately be seen as relevant, but may be shown relevant later on in the dialogue or that, conversely, apparently relevant moves may turn out to be irrelevant due to strategic failure. An example of the former is that the move maker may be making a cunning plan (e.g. via Walton’s (1998) distance strategy) to achieve his strategic goal. It is therefore difficult to define rules to immediately enforce participants to maintain relevance (at least in DE style dialogue). Given this difficulty, Moore (1993) argues that maintaining relevance might be reliant on dialogue participants’ co-operative strategic play. He further suggests that the relevance
of the system’s contributions might be provided by his heuristics. It might, though, be contended that the user’s input could be irrelevant, and that Moore’s heuristics would inevitably expand this into an irrelevant line of discussion. However, given the current arrangement of the user’s input from a prescribed list of propositions, the user’s contribution can be treated as topic relevant. Further, those prescribed propositions either support or militate against the user’s thesis, and therefore the user’s input might be seen as materially relevant. In some circumstances, e.g. the user might answer a challenge (Why P?) with an irrelevant ground (Q); the current system however leaves the option for the computer to challenge the conditional Q\(\supset\)P. It might still, however, be contended that the user’s input might not be useful given the dialogue situation and would thus fall short of Maudet’s dialectical relevance. For example, the user unwisely states a voluntary statement which supports the computer’s view, or the user voluntarily withdraws a statement supporting his thesis; the current proposal however, has provided heuristics to deal with these situations (cf. see section 8.3 above). The current system does, therefore, it is contended, handle the issue of relevance well, though more work would be needed on the relevance issue were the user allowed a freer entry of propositions.

8.6 Discussion

A set of strategic heuristics has been proposed and incorporated into the debating system. There are however several concerns with the strategy that ought to be discussed.

First, although the proposed strategy operates at three levels (cf. section 8.3 above), the decisions at level (1) and (2) heavily depend on the results of level (3) heuristics. A potential weakness with this is that level (1) and (2) decisions are in effect compiled into level (3) decisions. For example, in the current debating system, the computer checks the level 3 methods first; if there are level (3) methods available, the level (1) and (2) decisions will be automatically applied; however, if there is no level (3) method available, level (1) and (2) decisions will come into play, in that level (1) decision is to switch the current focus and level (2) decision is to build the computer’s thesis if there are build methods available.

A second weakness concerns the heuristics for dealing with a “no commitment” from the user, currently, the heuristics deal with such a move as if all “no commitments” are the same. However, there are four types of “no commitment” the computer might face in the game DE: (1) a “no commitment” in response to a challenge, (2) a “no commitment” in
response to a resolution demand, (3) a non-committal answer in response to a question and (4) a voluntary “no commitment” to (i.e. a withdrawal of) an earlier commitment. There might ideally be a need for different heuristics to handle each of these types of “no commitment”. This is left for further work.

A final weakness concerns the heuristic of “checking user’s thesis adherence” after a user’s “no commitment” or a user’s statement (in section 8.3 (4), and section 8.3 (5) above). On some occasions, there might be some other option for the computer to do, for example, the computer can build its thesis after successfully removing one of the user’s supports. This heuristic might therefore need further refinement. This is again left for further work.

8.7 Summary

A set of computational strategic heuristics has been developed based on literature in the area of informal logic and computational dialectics, and computer realisation of these heuristics has been demonstrated via example transcripts. The relationships between this proposal and other investigations have been discussed. Several possible weaknesses of the proposed strategy have been discussed. However, the issue of whether the proposed strategy can in practice provide adequate services for a computer as a debate participant to produce good dialogue contributions remains open. An empirical evaluation, aiming to assess the appropriateness of the proposed strategy, is therefore necessary. Such an assessment will be given in the next chapter.
CHAPTER NINE

EMPIRICAL EVALUATION OF THE STRATEGY AND THE DEBATING SYSTEM

9.1 Introduction

The previous chapter developed a set of computational strategic heuristics in order to enable a computer to act as a participant in a human-computer debate. However, it might be argued that there might be unexpected new situations, requiring new heuristics, which have been missed in the current proposal. Essentially, the issue is whether the proposed strategy can provide adequate services for a computer as a dialogue participant. This issue can not be settled on an a priori basis. To assess the appropriateness of a proposed strategy, Maudet and Moore (2001) suggest that the strategic heuristics need to be tested, and that a convenient way to do this is via generation of dialogue by the computer itself. There are two possible ways to approach this: one is to allow two computational agents to engage in dialogue with each other and study the results, the other is to enable a human user to debate with a computerised debating system. Both approaches are seen as important to evaluate the appropriateness of the proposed strategy from different perspectives. The former facilitates an assessment of the appropriateness of the proposed strategy from a philosophical point of view, and the latter involves independent assessment of the appropriateness of the proposed strategy from the users’ point of view. This chapter therefore contains empirical evaluations of the proposed strategy via both approaches. Firstly, a set of conversational agents is built adopting the proposed strategy. A set of independent evaluative criteria is then argued for (9.3) and the agent-generated dialogue transcripts are analysed against these criteria (9.4). Next, the usability of the human computer debating system operationalising the proposed strategy is evaluated. Finally, the evaluations are discussed and summarised.

9.2 Computational Agents

A pre-requisite of the agent-based approach is the construction of suitable computational agents. Two computational agents to conduct debate with each other via the proposed strategy have been built, reusing the test-bed (DE agents system in chapter six) and the
scheduling unit of the human computer debating system developed in chapter eight. The interface unit, dialogue unit, commitment unit are reused without modification except that the system interface title has been changed; the referee is given an extra function to call off the game when both agents run out of strategy and a winner is still not decided (in effect, the dialogue ends in a “stalemate”); The agent-based system was run under the three conditions below:

(1) One of the agents adopts the strategy developed in chapter eight and the other uses random argument, and both have the same knowledge base (as in appendix D2).

(2) Both agents adopt the same strategy and share the same knowledge base (as in appendix D2).

(3) Both agents adopt the same strategy. One of the agents has more knowledge in its knowledge base (as in appendix D2) than the other (as in appendix D3).

It is anticipated that using random argument (condition 1) might reveal certain failures of the heuristics (e.g. unexpected new situations) that might be overlooked by manual use of them. Conditions (2) and (3) may reveal whether relevant issues are well discussed, and condition (3) may also be used to see whether an agent with a smaller knowledge base might turn out to be the loser of the debate since both agents share the same dialogue strategy.

Three dialogue examples (DE4, DE5 and DE6 - full transcripts are available in appendix C) have been generated under the condition (1), (2) and (3) respectively for analysis. A prerequisite of such an analysis is a set of evaluation criteria that are independent of the set of debating heuristics. These criteria are proposed next.

**9.3 Evaluative Criteria**

Five criteria for evaluation are proposed. Criteria (2), (3) and (4) are drawn from Moore (1993) and Walton (1989). Criteria (1) and (5) are intuitively seen as important in this context. These criteria are outlined as below:

1) **Robustness.** The issue here is whether all dialogue situations are reasonably dealt with. In particular, this concerns whether there are unexpected dialogue situations which have not been considered in the strategy.
2) *Equal opportunity.* The issue here is whether each agent has equal opportunity to advocate their point of view. In particular, this criterion concerns whether there are frequent initiative shifts in the process of dialogue, such that the resulting debate transcripts can be described as “mixed initiative” dialogue.

3) *Coverage of issues.* The interest here is whether the knowledge in the knowledge base is well revealed and discussed. One of the potential applications of the debate system is to broaden the interaction style of computer based learning systems (cf. chapter 2 above). In such an educational setting, it might be expected that the system encourages students to look at an issue from different perspectives, and therefore it would be hoped that as many issues as possible are raised.

4) *Argument flow.* The issue here concerns whether the dialogues produced are unreasonably disjointed. It is expected that the strategic agents’ dialogue contributions are clearly related to its dialogue partner’s previous utterances, as a result of which, the flow of the developing argument can be deemed acceptable.

5) *Defeasibility.* This concerns whether the strategy is making the agent too wise to be beaten, and thus leading to difficulties where a human is another agent of the dialogue. A useful debating system, that is, should be able to reasonably lose a dialogue as well as to win, and thus avoid demoralising its human interlocutors (cf. Moore 1993, Walton 1984).

### 9.4 Analysis of the Results

This section contains the results of an analysis of the agent-generated dialogue examples DE4, DE5 and DE6. During the analysis, each utterance of the dialogues is considered in turn, via the addition of appropriate annotations (see appendix C for further details), for example:

001: C>Is it the case that CP is acceptable?
……………………………………[C starts the game by asking S’s view on the issue of Capital Punishment]
002: S>Yes, I think CP is acceptable. ……………………………………………..[S chooses to support CP]
003: C>I think CP is not acceptable. …………………………………………[C automatically adopts the opposite view]

This approach to the analysis makes it possible to examine the data under the evaluative criteria discussed in the previous section, and thus to assess whether the proposed
<table>
<thead>
<tr>
<th>Dialogue situations summary</th>
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<tr>
<td><strong>Move types</strong></td>
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<tr>
<td>Speaker's thesis (18)</td>
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<td>Supporting speaker's view (25)</td>
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<tr>
<td>Responder's thesis (1)</td>
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<td>Supporting the responder’s thesis (21)</td>
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<td>Handing over turn (5)</td>
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<td>Unrecognised statements (4)</td>
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<td>Withdrawal (11)</td>
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<tr>
<td>Game start (2)</td>
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<td>Supporting speaker’s view (24)</td>
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<tr>
<td>Responder’s thesis (9)</td>
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<tr>
<td>Supporting responder’s thesis (2)</td>
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<td>Challenge(11)</td>
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<tr>
<td>Resolution demand</td>
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strategy can provide adequate services to enable the computer to act as a dialogue participant and produce good dialogue contributions.

**Evaluation Criterion 1 - Robustness**

The interest concerning this criterion is whether all dialogue situations generated by the agents are successfully dealt with by the proposed strategy. In total, the agent systems have generated 153 dialogue situations for the strategic agents to deal with. These dialogue situations are summarised in Table 9.1 and discussed in turn below.

**a) Assertion Strategist**

74 assertions were generated. They are identified as falling into six categories: speaker’s thesis, statements supporting the speaker’s thesis, opponent’s thesis, statements supporting the opponent’s thesis, statements handing over its turn, and unrecognised statements. These are discussed below.

It might be expected that for statements standing on the side of the speaker (i.e. speaker’s thesis and statements supporting speaker’s view in Table 9.1), the strategy should provide heuristics to attack them. It can be seen from Table 9.1 that the assertion strategist does provide various means of either attacking opponent’s view or building its own view, with 7 exceptions of giving up this opportunity. On these exceptional circumstances, the assertion strategist runs out of methods and therefore hands over its turn to the opponent. This can be seen as reasonable since the opponent may have something more to say, but on the other hand, more sophisticated strategy is arguably needed if the strategic agent constantly faces this kind of situation.

For statements standing on the side of the opponent (i.e. responder’s thesis and statements supporting the responder’s thesis in Table 9.1), the assertion strategist is expected to use them rather than to attack them (cf. Walton 1998). It is shown in Table 9.1 that the assertion strategy does provide some means of handling this, e.g. using the strategy to build its thesis or continuing its plan execution, or checking the opponent’s thesis adherence. On the occasion of DE6-053, the game ends since the speaker has committed to the opponent’s thesis.

It is interesting to see that on 5 occasions the assertion strategist has to decide what to
do when its dialogue partner hands over its turn. On 1 of the circumstances, the referee calls off the game since both parties have run out of methods. Concerning the remaining 4 instances, the assertion strategist checks its opponent’s thesis adherence. This might be reasonable given the situation that its opponent can be assumed to have run out of moves.

There are four unrecognised statements (from the responder’s point of view) generated in DE6, the response from the other agent in each case is to check partner’s thesis adherence. This may not be enough in a human computer debate setting if users are allowed to input fresh propositions. This suggests a need for more sophisticated means to handle this kind of situation.

Generally speaking, the assertion strategist appears to be working well, with the exception of needing more sophisticated means to handle the situation of the speaker constantly running out of moves and to handle unrecognised statements.

b) Withdrawal Strategist

11 withdrawals (or no commitment) are present in the transcripts. They are categorised as follows: withdrawal of speaker’s thesis, withdrawal of statements supporting the speaker’s view and withdrawal of statements supporting the opponent’s view. These are discussed in turn below.

On one occasion, the speaker is withdrawing its thesis. The game is therefore ended since the speaker has given up its view.

On 2 occasions, the speaker is withdrawing statements supporting its thesis. The response of the other agent is to challenge the statement supported by the withdrawn statement, or assess whether the dialogue partner still adheres with his thesis. The former might be regarded as the agent seeking to demolish the statement which is a more direct support of its partner’s thesis. The latter may also be seen as reasonable given the situation that its dialogue partner might surrender since it has lost some part of the debate.

There are 8 instances of “no commitment” to statements supporting the opponent’s view. On 5 occasions, the withdrawal strategist deals with this by starting another line of argument. However, for the remaining 3 instances, the withdrawal strategist fails to do so. The explanation here is that the withdrawal strategist has run out of methods, and therefore hands over its turn. This needs further consideration if the strategic agent
constantly faces this kind of situation.

Given the above analysis, the withdrawal strategist seems to be working satisfactorily with the exception of needing more sophisticated approaches when running out of moves.

c) Challenge Strategist

There are 11 challenges generated. It is shown in table 9.1 that on 9 occasions the challenge strategist provides a suitable ground following its knowledge structure.

There are however 2 occasions (DE6-048 and DE6-050), on which the challenge strategist gives a non-committal answer. Concerning the former, the agent cannot find a support for the statement in its knowledge base and therefore speaks the truth with a non-committal answer. Regarding the latter, the agent does have a support in its knowledge base for the statement being challenged; however, the support is not an acceptable ground since the agent had withdrawn this support from its commitment store during the earlier stage of dialogue. The strategic agent would therefore beg the question were it to answer the challenge with this unacceptable support (cf. section 6.2). It is therefore reasonable for the challenge strategist to give the non-committal answer rather than to commit to the fallacy of question begging.

In sum, then, the challenge strategist seems to be working properly.

d) Question Strategist

In total, 37 questions are generated. They fall into four categories according to the nature of the move content: game start, statements supporting speaker’s thesis, responder’s thesis, statements supporting responder’s thesis. These are discussed in turn below.

Concerning the game start, the responder choosing either view would be considered as reasonable given the proposal (section 5.2 above) that the two parties start the dialogue with arbitrary opposing views.

The situation of a statement being questioned that supports the questioner’s view might be interpreted as the questioner asking the responder to commit to that statement, according to Walton and Krabbe (1995). The responder might be expected not to commit
to it if it has an alternative. It is shown in table 9.1 that the responder responds 18 times with a “Yes”, 3 times with a “No” and 3 times with a “no commitment”. Each of the “Yes” responses is accounted for as the only answer found in its knowledge base, and the responder speaking the truth. For the “No” responses, the responder finds the negative answer (which militates against the opponent’s view) from its knowledge base, and the answer can be further supported, the responder therefore gives the negative answer. For the “no commitment” responses, there are 3 instances (DE4-034, DE6-010 and DE6-022); on the first situation (DE4-034), the responder does have a negative answer (which militates against the opponent’s view) in its knowledge base, but the responder finds no further support for the negative answer, and giving a positive response might harm its own positions, so the responder issues a no commitment response. On the latter two situations, the responder does not recognise the questioned statement (it cannot be found in its knowledge base), and therefore answers truthfully with a no commitment. The question strategist’s responses to these questions are therefore reasonable given the above analysis.

It is interesting to see that 2 questions of statements supporting the responder’s thesis were generated by the random agent in DE4. As expected, the strategic agent takes advantage of this and gives positive responses.

There are 9 instances where the questioner checks whether the responder still adheres to its thesis. On 8 occasions, the responder insists on its view since it still has acceptable grounds for its view. On 1 occasion (DE6-052), the responder accepts the opposite view. The dialogue fragment for this instance is reproduced below.

032: S>Is it the case that nobody is willing to die?
033: C>Yes, I think nobody is willing to die.
034: S>Is it the case that “nobody is willing to die” is a prima facie reason for “CP makes people less likely to commit serious crimes”?
035: C>Yes, I think “nobody is willing to die” is a prima facie reason for “CP makes people less likely to commit serious crimes”.
036: S>Is it the case that “CP makes people less likely commit serious crimes” is a prima facie reason for “CP is a good deterrent”?
037: C>Yes, I think “CP makes people less likely commit serious crimes” is a prima facie reason for “CP is a good deterrent”.
038: S>Is it the case that “CP is a good deterrent” is a prima facie reason for “CP is acceptable”?
039: C>Yes, I think “CP is a good deterrent” is a prima facie reason for “CP is acceptable”.
040: S>I think CP is acceptable.
051: C> I don't know why innocent people may get killed.
052: S> Is it the case that CP is not acceptable?
053: C> No, I think CP is acceptable.

In the above dialogue fragment, the responder (agent C) has no acceptable ground for its thesis since its support has been withdrawn in turn 051. Further, agent C has explicitly committed to the set of propositions and conditionals which implies its dialogue partner’s thesis. Agent C therefore makes a concession and accepts the opposite view in turn 053.

The 9 instances of questions involving thesis adherence checking can be seen therefore as being reasonably answered, given the above analysis. In sum, then, the question strategist appears to be working well.

Given the above discussion, it is argued that the various agent-generated dialogue situations can be seen as being reasonably handled by the agent system. Generally speaking, the assertion strategist, question strategist, withdrawal strategist and challenge strategist are working well and can therefore be regarded as satisfying the “robustness” criterion, though more sophisticated heuristics are needed to deal with unrecognised statements and the agent running out of moves.

**Evaluation Criterion 2- Equal Opportunity**

Of concern here is the issue of initiative. Initiative is relevant because if one dialogue participant is constantly starved of the initiative, he cannot fully or freely advocate his point of view (cf. Moore 1993: 229; Walton 1989).

In DE4, the strategic agent hands over its initiative 9 times to the random agent during the 54-turn dialogue. There are 7 instances of initiative shift during the 52-turn dialogue in DE5, and there are 4 instances of initiative shift during the 54-turn dialogue in DE6. The initiative exchanges can therefore be accounted as frequent. The longest duration of one agent retaining the initiative is from turn DE5-022 to turn DE5-034, in that the agent made two challenges and four questions before making a statement to hand over the initiative.

On the whole, both agents have had opportunities to express their point of view, and the strategy therefore satisfies the “equal opportunity” criterion.
**Evaluation Criterion 3- Coverage of issues**

Of interest here is whether points implemented in the knowledge base are revealed and discussed. The knowledge base (cf. appendix D2) can be seen as containing three subtopics (deterrent issue, popularity issue and moral issue) which support the view “CP is acceptable” and two subtopics (ethical issue and consequent issue) which support the contrary view.

It can be seen that the issues in the knowledge base are raised during the evolving dialogue. Further, these issues are discussed to the maximum depth possible given the knowledge base in the DE5 and DE6 dialogues (DE4 is not considered here since one of the agents uses random argument). For example, in the following extract from DE5, the popularity issue is discussed from turn 006 to turn 008.

006: S>I think most people want CP back.
007: C>Why is it the case that most people want CP back?
008: S>Because the recent survey shows that 60% British people support CP.
009: C>I think it is wrong to take a human life.

However, it has turned out that there is no clear indication of the results of the discussion of each subtopic. On most occasions, the dialogue participants merely move to a new focus without comment (e.g. in the above dialogue fragment, agent C moves to the ethical issue in turn 009 without comment on whether it concedes the popularity point). This Mackenzie (1987:293) sees as a “formalisation of the convention that silence means assent”, arguing that “it is observed in many actual dialogues”. This might therefore be acceptable given that the strategic agent can be seen as following this convention.

In sum, it is argued that the strategy is acceptable in respect of the “coverage of issues” criterion.

**Evaluation Criterion 4- Argument Flow**

The analysis here will consider whether the arguments generated by the agents as they follow the strategy are flowing well. If participants’ contributions are clearly related to each other or appear logical, then the flow will be deemed acceptable (cf. Moore 1993).

In order to inspect the protocols for disjointedness, the process of analysis adopted includes a manual insertion of missing premises of incomplete arguments into the machine generated transcripts; this approach is in line with that adopted by Walton and
Reed (2002b). An example of this is the following extract from DE5 in appendix C (in which presumed missing premises are indicated in italics).

003: C>I think CP is not acceptable.
004: S>I think CP is a good deterrent, and “CP is a good deterrent” is a prima facie reason for “CP is acceptable”.

By doing so, it is easy to see the argument flow in this example - agent S is addressing agent C’s utterance.

In DE4, DE5 and DE6, the five strategic agents made 133 dialogue contributions. 93 of them involve directly addressing the random agent’s previous utterance. There are 11 instances of the strategic agent’s contributions which involve handing over its turn and asking the dialogue partner to continue its line of argument. There are 7 instances of checking whether the dialogue partner still adheres to its thesis given its previous statement. However, there are 22 apparent instances of disjointedness, 10 of which involve building a line of questions toward the negation of the dialogue partner’s previous statement, and 12 of which involve a shift of the current focus without explicit indication.

Generally speaking, though, the protocols can be seen as flowing well, - the total of 22 instances of disjointedness represents a relatively small proportion of the 133 strategic agents’ dialogue contributions. Further, some of the apparent examples of disjointedness might in fact be reasonable in terms of the underlying strategy of the move maker, e.g. distance strategy (cf. Walton 1998). Consider, for example, the following extract from DE5.

014: S>I think it is not always wrong to take a human life.
015: C>Is it the case that human lives are scarce?
016: S>Yes, I think human lives are scarce.
017: C>Is it the case that “human lives are scarce” is a prima facie reason for “it is wrong to take a human life”?
018: S>Yes, I think “human lives are scarce” is a prima facie reason for “it is wrong to take a human life”.
019: C>I think it is wrong to take a human life.
020: S>I think murderers should receive capital punishment.

In the above dialogue fragment, turn 015 and 020 appears at first sight to be disjointed from the previous utterance. However, turn 015 can be seen as agent C starting its distance plan to build the case “it is wrong to take a human life” (in turn 019) in order to rebut agent S’s view “it is not always wrong to take a human life”. Turn 20 might be seen
as agent S shifting the current focus from the issue of ethical issue to moral issue following Mackenzie’s (1987) “silence means assent” convention.

Overall, then, it can be argued that the strategy is generally acceptable in respect of the “argument flow” criterion.

**Evaluation Criterion 5 Defeasibility**

The interest here is whether the agent adopting the strategy is defeasible, i.e. whether the agent can ever be “beaten” in a debate. This relates to Walton’s (1984) worry that the machine might be *too good* a debater. In an educational context, the “defeasibility” criterion of the strategy is particularly important since students’ learning initiative may be frustrated if constantly being defeated by the computer. It is shown in DE6 that, the strategic agent C does lose the dialogue and does so in a manner which might be considered reasonable, as opposed to a mere “surrender” (see the dialogue fragment on page 120-121). In the process of arriving at this defeat, agent C’s thesis support has been removed by agent S, and agent S provides prima facie reasons for its own thesis in turn DE6-004, DE6-012, DE6-016 and DE6-024, and agent C is explicitly committed to them. The evidence therefore suggests that the strategy is defeasible if the other party of the dialogue makes some good argument.

The strategy therefore satisfies the “defeasibility” criterion.

In sum, the dialogues generated by the agents system (DE4, DE5 and DE6) under the three conditions (discussed in section 9.2 above) enable a thorough assessment of the proposed strategy against the criteria (discussed in section 9.3 above). In particular, DE4, DE5 and DE6 have been used to examine the “robustness”, “equal opportunity” and “argument flow” criteria, DE5 and DE6 to examine the “coverage of issues” criterion, and DE6 to examine the “defeasibility” criterion. The qualitative assessment of agent-generated debates outlined above suggests, then, that, generally speaking, the proposed strategy can provide good services enabling the computer to act as a dialogue participant. However, it might be argued that there is, in this analysis, a heavy reliance on judgements of quality by the author of the heuristics and the agent-based systems. Further independent assessment is therefore necessary in order to establish the appropriateness of the proposed strategy. This will be given next.
9.5 Usability Evaluation of the Debating System

This section contains a preliminary usability evaluation of the current human computer debating system operationalising the dialogue model DE and the proposed strategy. The choice of evaluation technique is first discussed, then the evaluation procedure is outlined and the results are discussed.

9.5.1 Evaluation Technique

There are two broad approaches to interactive system evaluation: namely expert analysis and user participation (Dix et al. 2004). The former approach involves analysis by the designer or expert evaluators, and assesses whether or not the system upholds usability principles. The latter approach involves end users for whom the system is intended, and assesses actual use of the system. Dix et al. (2004) argue that the former approach tends to occur in the early stages of development with the latter approach in later stages since it is difficult to get an accurate assessment of user experience of interaction from incomplete design and prototypes, and the former approach, on the other hand, can be used to filter and refine the designs and prototypes without expensive user involvement cost. On this argument, the expert analysis approach is adopted since the human computer debate system is at the exploration and prototyping stage and the purpose of this evaluation is to elicit useful suggestions from experts to improve and refine the design. Further, Hobbs and Moore (1998) suggest that using experts is potentially very revealing about system weaknesses which may suggest useful enhancement to a system, and that it is generally advisable to use them as part of the evaluation exercise if there are suitable experts available. This, however, does not deny the necessity of actual user testing of the system, but rather suggests that user-based evaluation might be more suitable at the later development stage of the debating system. The user-based evaluation of the debating system is left for further work and discussed in chapter ten.

The expert analysis approach contains several techniques to evaluate an implemented design: expert walkthrough, cognitive walkthrough and heuristic evaluation (cf. Hobbs and Moore 1998). Heuristic evaluation is seen as appropriate in evaluation of the human-computer prototype prior to subject user testing. It involves having a small set of evaluators who independently critique a system to come up with potential usability problems (Nielson 1994). Nielson (1994) recommends using three to five evaluators, his experience indicates that three evaluators can discover more than 60% of usability
problems, and around five usually result in 75% of the overall usability problems being discovered. Other analytical techniques such as cognitive walkthrough can also be used to come up to potential usability problems of the prototype, but are heavily reliant upon the judgment of one single evaluator (cf. Hobbs and Moore 1998). Preece et al. (1994) also suggest that it is more effective when several HCI experts criticize a system independently. Given all this, a modified version of Nielson’s (1994) heuristic evaluation technique was adopted. The original version requires the evaluation to be done independently. However, the evaluation procedure of the modified version is more flexible in that it is a hybrid of heuristic evaluation and other user-based evaluation techniques, such as cooperative evaluation and interview (cf. Dix et al. 2004). The evaluation procedure will be discussed next.

9.5.2 Evaluation Procedure

A preliminary usability evaluation of the human computer debating prototype has been carried out. Three HCI experts were invited to evaluate the human computer debating system. One expert preferred to evaluate the system cooperatively with the system author, in that the system author noted down the pertinent issues while the evaluator operated on the system (in effect, this is Dix et al. (2004)’s cooperative evaluation). In addition, the expert agreed to take a short interview after the cooperative evaluation session. After the evaluation, the notes of this evaluation were formalised by the system author and emailed to the evaluator to check their accuracy. The returned notes are contained in appendix E4.

Two other experts preferred to evaluate the system at their own convenience. The debating system was emailed to these experts. Formal feedbacks were emailed back to the system author after their evaluations. Details of their comments can be seen in appendix E2 and appendix E3.

9.5.3 Evaluation Results

The evaluations give evidence, albeit preliminary, of the usability of the system in general, and of the DE dialogue model and the proposed strategy in particular. This is supported by the evaluators’ views on their experiences of operating on the system, such as “definitely easy for students who are familiar with computers, very straightforward to use it”, “no procedures annoy me while operating on the system”, “the system’s overall performance is acceptable” (Appendix E4), “the system is usable”, “the system did not
crash and once I’d got started I was guided successfully to the next step. I could clearly see the computer’s argument and my responses” (Appendix E2). This is also evidenced by the evaluators’ successful playing of the game with the system, e.g. one of the evaluators played twice and eventually lost the game (Appendix E2), and one played the game twice and managed to win (Appendix E3).

There are, however two weaknesses concerning the proposed strategy that were revealed. One subject reported that she found it a bit uncomfortable when the computer constantly hands over its turn after a period of debate. She further suggests that “this is fine, to make me to explore more argument. I would say it depends on personality of the debate participants” (cf. Appendix E4). This weakness revealed is actually in line with the issue revealed in the agent-based evaluation of the strategy in that the system needs more sophisticated means to handle the situation when running out of strategies rather than simply handing over its turn (section 9.4 above).

The second weakness is that the system should make a concession at the right time. The evaluator wrote: “after two long debates with the computer, it seemed to let me win. Though it is not clear why at that point it changed its mind. During these debates I thought I had the computer agree to a series of propositions that would lead it to change its initial position, but it seemed to hold these incompatible ideas, without difficulty. When it did concede, it was a surprise to me.” (cf. Appendix E3). This reflects the issue that there is no heuristic available for the computer to voluntarily concede a debate except when the user checks its thesis adherence. At some point, the computer should concede the debate voluntarily (e.g. in turn 73 and 85 of [debate 1], and turn 169 of [debate 2] of appendix E3) since its thesis supports have all been removed from its commitment store and the user’s thesis support added into its store, however, the computer, without a heuristic for voluntary concession, simply hands over its turn to the user.

The two weaknesses can be considered together. It might be suggested that when the computer runs out of strategies, it should check whether it still adheres to its original thesis, if not, then concede; if it does retain adherence to its thesis, it should state its original thesis with a double function: declaration of its current stance and handing over the initiative to the user. This might alleviate the two weaknesses discussed above.

In addition, the evaluators also suggest some interface improvements for the future development of such a debating system. They are discussed below (some issues revealed from the previous expert evaluation (Appendix E1) but not incorporated into the current
system (see chapter seven) are also discussed here).

One such is the improvement of the help content. One of the evaluators complains that it was not clear as to what function the “implies” box serves. He suggests adding some pictures and examples in the help content. The evaluator also suggests that the presentation of the help content can be improved by the use of the word “screen” rather than the technical sounding “system’s interface”, and the use of the word “abbreviated” instead of the word “simplified” (Appendix E2). In addition, one of the evaluators suggests using buttons at the top of the help window to enable the user to go through the sequence of help pages (Appendix E1). Finally, some minor wording problems were highlighted (Appendix E2, E3 and E4).

A second area of improvement might be made on the input facilities. Concerning the flashing message bar at the bottom of the interface, one of the evaluators argues that “the changing colour text is good for attracting attention, but makes it harder to read” (Appendix E3). Another evaluator also complains that “the flashing instructions is irritating” and further explains that “the colours used were red – a large proportion of the population is colour blind to red and blue - a wavelength which we have most difficulty in perceiving, particularly on a grey background”. This evaluator suggests using bigger sized black text on white background to overcome this issue (Appendix E2). Further suggestions concerning the input facilities includes the greying out of the “Go” button until it should be clicked upon (Appendix E2) and the use of flashing colour blue rather than green for the location from which move content is to be selected, so as to attract the user’s attention (Appendix E4).

A third improvement might be made on the presentation of the system interface. One of the evaluator suggests using “Debate” instead of “Game” on the grounds that the debate does not seem to be very playful (Appendix E1). Thus, for example, the menu item “New game” may be changed to “New debate”. Another evaluator complains about the need of horizontal scrolling to see the whole propositions from the commitment store windows. He suggests using text-wrapping in the commitment stores and thus having vertical scrolling only (Appendix E3). He further suggests that it would be better to avoid the Times New-Roman fonts and use Ariel or other sans-serif fonts, also to use a colour combination such as dark blue text on a pastel background, in order to reduce the screen contrast.

A further improvement can be made when the system is launched. The evaluators
complain that when the system is started, the debate history component can not be seen unless it is set to full-screen mode (Appendix E2 and E3). To avoid this, the system can be set to un-resizable full-screen mode. Also, concerning the system start, one evaluator suggests providing a message box saying "Click ok to open new game, or cancel to close the message box” (Appendix E1). This evaluator argues that providing this message dialogue box will make it obvious for the user to decide what to do next.

The final concern with the system interface relates to Java technical issues. The evaluators discovered that after a period of debate, they had to scroll down the various Debate History and Commitment windows, to find the last stage of the argument (Appendix E3 and E4). Of course, it would be better, if possible, if the windows always showed the most recent stage and let the user scroll back to review what was said if necessary. The current system uses the “java.swing.JScrollPane” class to provide the scrolling service. The properties of this class need further consideration.

9.6 Discussion

There are two possible difficulties with the methodology that ought to be discussed. First, it might be contended that the inductive approach adopted in this study does not guarantee that the system will always work well especially since only a small number of agents dialogue transcripts (three in total from three pairs of agents) have generated for analysis. However, this study is intended not as a statistical enquiry, but rather as an investigation into details of the arguments generated by the strategy. Further, 165 utterances are generated (DE4: 59; DE5: 52; DE6: 54). Each utterance needs to be considered in depth, and as a result this study does, it is held, provide sufficient data for the purpose of the assessment of the system’s strategy.

The second difficulty may be that there is a heavy reliance on judgements of quality by the author of the heuristics and the agent-based systems, and that the criteria of quality are themselves intuitively formulated. The judgement issue may be endemic to the field, and similar criticisms could perhaps be levelled against much of the dialectics literature. Further, computationally generating dialogues from dialectical theories may represent a step forward in that the proposed strategy is illustrated by the 2-agent system, and making the various criteria clear and explicit may well localise the issues to relatively narrow concerns at any one time, and this may detract from the judgement element. In addition, these criteria have enabled the author to provide a thorough analysis of the data collected,
and to leave the results, and the data itself, available for independent inspection. Finally, inviting independent experts to give their own judgements of the system could well alleviate the judgement problem.

9.7 Summary

This chapter has documented firstly a qualitative assessment of agent-generated debates via the proposed strategy and secondly usability evaluations of the strategy in use. This analysis suggests that, generally speaking, the strategy can provide good services for the computer as a dialogue participant. This study also reveals several weaknesses of the strategy: (1) the need for sophisticated means to handle running out of strategies (2) the absence of a heuristic for voluntary concession and (3) the need for sophisticated means to handle unrecognised statements. Possible solutions to (1) and (2) have been discussed in section 9.5 above. Issue (3) is not a problem in the human debating system given the current arrangement of the user’s input from a prescribed list of propositions, however more work would be needed were the user allowed a freer entry of propositions. Further, the study gives evidence of the usability of the human computer debating system in general, and of the DE dialogue model in particular. It also suggests a number of future improvements on the human computer debating system user interface.
CHAPTER TEN

CONCLUSIONS AND FURTHER WORK

The research documented in this thesis represents an attempt to investigate issues involved in adopting a computational dialectics approach to develop a human computer debating system. The investigation has involved, first, an elucidation of the literature in the area of dialectics, informal logic and computational dialectics, as a result of which selection of Moore’s (1993) utilisation of Mackenzie’s (1979a) DC, as arguably an appropriate base system for further study, was made; second, an evaluation of DC, in the light of which development of a further system DE, as a suitable model for human computer debate, was made and justified; finally, a critical review of the literature in the field of strategy in dialectic systems, in the light of which development of a set of computational strategic heuristics, as arguably appropriate for a computer as a debate participant, was made and justified. The research has involved development of a range of computerised systems, usability studies and studies of the inter-agent dialogues.

The overall conclusion of the research is that the system DE may indeed be an effective dialogue model for the specific educational human computer debate discussed in chapter 2, when allied with appropriate strategic discretion, and that the proposed strategy may be able to provide appropriate services for the computer to act as a dialogue participant. The suitability of the dialogue model and the appropriateness of the proposed strategy have been demonstrated from both the philosophical and user point of view. From the philosophical point of view, the demonstration has been via the analysis of the agent-generated dialogues. From the user point of view, the demonstration has been via the usability evaluations of a human computer debate prototype.

In the process of arriving at this conclusion, the research aims outlined in chapter one have been met as follows: literature concerning dialogue models and strategies has been critically reviewed. A dialogue model and a set of computational strategic heuristics have been developed. A range of computational systems (agent-based DC and DE systems, and human computer debating system) have been constructed. These computational systems have used to test and justify the proposed dialogue models and strategies.

The research can be seen as a development of Moore’s (1993) work. The dialogue model DE has been developed upon Moore’s (1993) amended version of Mackenzie’s (1979b) DC system, and the set of computational strategic heuristics developed mainly based on

The chief gains from the research, in addition to providing a dialogue model and strategies for enhancing the human computer communication, are the development and use of a computational dialectics approach to test theories of dialogue, and a drawing together of work from artificial intelligence (e.g. to enable a computer to emulate human argument), human computer interaction and dialectics theory.

It is believed that the work documented makes a valuable contribution to the fields of dialectics and of human-computer dialogue. Concerning the former, a robust dialogue model has been developed (published in the *Informal Logic* Journal) and a set of strategies has been developed to be utilised with the model. Further, the computer systems, built using highly reusable Java programming language, can readily be adapted to function with a different dialogue model and/or a different set of strategies, and as such potentially provide people working in the field of dialectics with a test bed within which they can experiment with new models and new strategies they develop (cf. Maudet and Moore 2001; Amgoud and Maudet 2002).

The work contributes to human computer dialogue, it can be argued, in two ways. It indirectly contributes via the contribution to dialectics which has just been outlined. Given the usefulness of a dialectical approach to interactive computer systems (cf. Maudet and Moore 2001), any development of dialectics per se potentially has a pay-off in terms of human-computer dialogue. This work also makes a more direct contribution to human-computer dialogue, in that the debate system is a unique system and therefore makes a contribution to the broadening of the human-computer interaction “bandwidth” in general, and to the development of computer-based education research in particular.

There is a variety of interesting ways in which the research can be carried forward. In the short term, the basic human computer debate system needs to be further evaluated, to assess the user acceptability of the system, and to establish in what ways the system is effective and ineffective and why, and thus to enable iterative refinements to take place. Refinements that can immediately be suggested are: allowing conjunction and disjunction of statements, expansion of the system knowledge base by providing the backing for a warrant (cf. Toulmin 1958), enlargement of the system knowledge base to provide more input choices from which the user can select, identifying different uses of “no commitment” options in the current system and amendment of the currently weak heuristics of the system (cf. section 8.6 above). The system would ideally need to be
evaluated with a number of different domains of debate, e.g. abortion, politics, terrorism, to test the extent to which the design and knowledge representation are generic. This evaluation might be extended to encompass the use of the system to investigate pedagogic issues (cf. Du Boulay and Luckin 2001), such as the educational value of one to one debate, and how learners make inferences about the knowledge domain (Moore 1993).

Interesting enhancements to the dialogue model can also be investigated. One such is to allow different question types. The system DE allows bipolar questions only and disallows “wh-questions” or “how questions”. Moore (1993: 224) argues such questions might be treated as bids of a different game type, e.g. information seeking. Similarly, Walton and Krabbe (1995) and Reed (1998) also talk about mixed dialogue which allows embedding dialogues of a certain type as sub-dialogues into a structure of some other type. To achieve such a shift of dialogue games, the properties of the different game types need to be identified in order to incorporate them into the current debating system. In addition, Maudet and Moore (2001) argue that the computer needs to be given a means of bidding of games and of dealing with such bids from users; these are complex in real time and worthy of further research.

A further enhancement considers the system input facilities. The current system enables users to select their inputs from a number of prescribed menu options. Perhaps, the most attractive means of communicating with the system is to use natural language. This, though, remains out of the reach of current computer technology (Dix et al. 2004; Reed and Grasso 2001). In the meantime, it might be feasible to permit freer user input, initially via an option to enter fresh propositional content in addition to selecting from those made available by the system. This might involve mapping the simple input sentences to logic propositions by translating the user input into a definite clause grammar (cf. De Boni et al. 2001). During the mapping process, the machine needs to be given some means of checking a “dictionary” to avoid missing expressions which have different forms but the same meaning. The system knowledge base needs to be built up by adding new claims to it and, more importantly, to experiment with the extent to which the strategic heuristics can cope with such new input.

Another further enhancement might consider the system knowledge representation. The current system knowledge base follows Bench-Capon’s (1998) and Freeman and Farley’s (1996) utilisation of Toulmin’s (1958) argumentation schema. This might not be adequate if allowing different question types and/or free user input of new propositions. The system knowledge representation needs then to be further investigated to handle this.
It might be feasible to also consider other ways of knowledge representation (e.g. Ravenscroft and Pilkington’s (2000) utilisation of rhetorical structure theory, Grasso et al.’s (2000) truth maintenance system) and/or to consider Walton and Reed’s (2002a) “Diagramming, Argumentation Schemes and Critical Questions”. In addition, there might be an involvement of meta-knowledge in the knowledge base, for example preference values between different arguments (cf. Bench-Capon 2003).

A related enhancement to the basic system would be to incorporate multimedia. Maudet and Moore (2001) argue that to integrate multimedia within dialogue game system might enliven the debate and contribute to maintaining the student’s interest. Moore (2000) proposes three approaches toward the integration of multimedia within a dialogue system: (1) to use educational multimedia to enhance the dialectical system, (2) to use dialogue facility to enhance the educational multimedia, (3) to incorporate the above two approaches, as “full integration”. A possible initial step, it is argued, is to enhance the current text based prototype such that the computer announces and then plays the appropriate multimedia as its dialogue move. To achieve this aim, Moore (2000) points out that some substantial issues remain, for example, how to enable the student to choose fragments of the computer stored media content as his move, and how the current text based commitment stores handles the rich semantic content of the multimedia. These issues are well worthy of further research to bring together the mutual advantages of argumentation systems and educational multimedia.

A final enhancement is to move beyond two-party dialogue. The current debating system allows two-player dialogue rather than group discussion. The educational benefit of multiple participants in the learning interactions is obvious (Cumming and McDougall 2000, Pilkington 1998, 1999). Maudet and Moore (2001) envisage one computational agent that is able to discuss with two or more students. To enable such a group discussion, the students can be formed into two teams according to their views on the issue under discussion, and the computational agent will maintain a watching eye over the evolving dialogue, and proffer advice to either team in light of the reigning dialogue status. There are however, a number of interesting and important issues, such as communication protocols between students and means of suitably controlling the evolving discussion, remaining to be solved.

It is clear from this chapter, and indeed from the thesis as a whole, that many interesting and challenging issues remains to be investigated. However, by achieving the aims outlined in chapter one, the research documented in this thesis will, it is hoped, contribute
to the improving of human-computer dialogue in general and of computer-based educational dialogue in particular, and help to illuminate research issues in the field of dialectics and computational dialectics.
APPENDIX A

DC INTER-AGENT DIALOGUES

The following dialogue transcripts (DC1, DC2, DC3 and DC4) were generated by two computational agents operationalising the DC dialogue model and using the knowledge base in appendix D1 below. These computational agents are designed to use random arguments. The Java code for the computational agents is available in the accompanying CD-R. The dialogue transcripts are as follows (blue italicised type annotations, added by the thesis author, indicate the move type being made and the DC rules being invoked by each move).

C= DC random agent Chris
S= DC random agent Simon
R=DC referee
CP= Capital Punishment

DC1

001: C> Is it the case that CP is acceptable? ……………………………………………………..Move type: question
002: S> Yes, I think CP is acceptable. …………………………………………………..Move type: statement; rule: CRS, RQUEST
003: C> I think CP is not acceptable. ……………………………………………………..Move type: statement; rule: CRS
004: S> Is it the case that CP decreases violence crime implies CP is acceptable? ……Move type: question
005: C> I am not sure about it. ……………………………………………………..Move type: withdrawal; rule: CRW, RQUEST
006: S> Is it the case that mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed? ……………………………………………………………………Move type: question
007: C> I am not sure about it. ……………………………………………………..Move type: withdrawal; rule: CRW, RQUEST
008: S> I think CP decreases violence crime implies CP is a good deterrent. ……………………………………………………………………Move type: statement; rule: CRS
009: C> I think nobody wants to die implies CP is not acceptable. ………Move type: statement; rule: CRS
010: S> I think most people want CP back. ……………………………………………………..Move type: statement; rule: CRS
011: C> Is it the case that nobody has the right to kill other people? …………………Move type: question
012: S> Yes, I think nobody has the right to kill other people. ……..Move type: statement; rule: CRS, RQUEST
013: C> Is it the case that nobody wants to die implies CP is not acceptable? ………Move type: question
014: S>I am not sure about it. ...................................................................................................... Move type: withdrawal; rule: CRw, Rquest
015: C>I think nobody wants to die implies CP is not acceptable. ........ Move type: statement; rule: CRS
016: S>Is it the case that CP is acceptable? .................................................................................. Move type: question
017: C>Yes, I think CP is acceptable. .............................................................................................. Move type: statement; rule: Rquest
018: R>This statement is in both stores, you can not state it any more, please try again! ...... Rule: REPSTAT
019: C>Yes, I think CP is acceptable. .............................................................................................. Move type: statement; rule: Rquest
020: R>This statement is in both stores, you can not state it any more, please try again! ...... Rule: REPSTAT
021: C>No, I think CP is not acceptable. .............................................................................................. Move type: statement; rule: Rquest
022: R>This statement is in both stores, you can not state it any more, please try again! ...... Rule: REPSTAT
023: C>Yes, I think CP is acceptable. .............................................................................................. Move type: statement; rule: Rquest
024: R>This statement is in both stores, you can not state it any more, please try again! ...... Rule: REPSTAT
025: C>I am not sure about it. ...................................................................................................... Move type: withdrawal; rule: CRw, Rquest
026: S>I think CP is acceptable. ...................................................................................................... Move type: statement; rule: CRS
027: C>I think murderers should have the opportunity for rehabilitation. . Move type: statement; rule: CRS
028: S>Why is it that most people want CP back? ....................................................... Move type: challenge; rule: CRy
029: C>Because murderers should not receive capital punishment. ................................................ Move type: statement; rule: CRys, RCChall
030: S>Is it the case that political or racial bias will not cause prejudice? .............. Move type: question
031: C>I am not sure about it. ...................................................................................................... Move type: withdrawal; rule: CRw, Rquest
032: S>I think not everybody belongs to the God. ......................................................... Move type: statement; rule: CRS
033: C>Why is it that CP is not acceptable? ................................................... Move type: challenge; rule: CRy
034: R>Chris, you lose and Simon wins. ...................................................................................... End of dialogue
001: C> Is it the case that CP is acceptable? ……………………………………Move type: question
002: S> Yes, I think CP is acceptable. …………………………………………Move type: statement; rule: CRS, RQUEST
003: C> I think CP is not acceptable. …………………………………………Move type: statement; rule: CRS
004: S> Please resolve CP is acceptable and CP is not acceptable in your store. …………………………………………………………Move type: resolution demand; rule: RESOLVE
005: C> I don't think CP is acceptable……………………………Move type: withdrawal; rule: CRW, RESOLUTION
006: S> I think mistakes are not likely to happen during judicial process. …Move type: statement; rule: CRS
007: C> I think everybody belongs to the God. ……………………………Move type: statement; rule: CRS
008: S> I think murderers should receive capital punishment implies CP is acceptable. ………………………………………………………Move type: statement; rule: CRS
009: C> I don't think CP is not acceptable. …………………………………Move type: withdrawal; rule: CRW
010: S> Is it the case that mistakes are not likely to happen during judicial process? …Move type: question
011: C> Yes, I think mistakes are not likely to happen during judicial process. ………………………………………………………………Move type: statement; rule: RQUEST
012: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: REPSTAT
013: C> Yes, I think mistakes are not likely to happen during judicial process. ……………………………………………………………………Move type: statement; rule: RREQUEST
014: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: REPSTAT
015: C> No, I think there are mistakes during judicial process. ……Move type: statement; rule: CRS, RREQUEST
016: S> Is it the case that political or racial bias will not cause prejudice? …………Move type: question
017: C> I am not sure about it. …………………………………………Move type: withdrawal; rule: CRW, RREQUEST
018: S> Why is it that everybody belongs to the God? ………………………Move type: challenge; rule: CRY
019: C> Because everybody belongs to the God. ……………………………………………………………………Move type: statement
020: R> You are begging the question, please choose a statement not under challenge and try again!
…………………………………………………………………………………………………………………………………………………………………………………………………………………Rule: RCHALLENGE
021: C> I am not sure that everybody belongs to the God? ……Move type: withdrawal; rule: CRW, RCHALLENGE
022: S> I think not everybody belongs to the God. ………………………Move type: statement; rule: CRS
023: C> I think CP is not a good deterrent. ……………………………………Move type: statement; rule: CRS
024: S> I think mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed. ………………………………………………Move type: statement; rule: CRS
025: C> Is it the case that repeat crime rate is extremely low? …………………….. Move type: question
026: S> Yes, I think repeat crime rate is extremely low. ………. Move type: statement; rule: CRS, RREQUEST
027: C> I think CP is not a good deterrent……………………………………………………… Move type: statement
028: R> This statement is in both stores, you can not state it any more, please try again! …..Rule: REPSTATE
029: C> Why is it that repeat crime rate is extremely low? …………………….. Move type: challenge; rule: CR Y
030: S> Because political or racial bias will not cause prejudice. ………………………… Move type: statement; rule: CRYS, RCHALLENGE
031: C> Why is it that there are mistakes during judicial process? ………Move type: challenge; rule: CR Y
032: S> Because some people want to die. …………………………………………………… Move type: statement; rule: CRYS, RCHALLENGE
033: C> Is it the case that scientific techniques will not guarantee the success of justice?
…………………………………………………………………………………………….. Move type: question
034: S> No, I think scientific techniques will guarantee the success of justice.
…………………………………………………………………………………………….. Move type: statement; rule: CRS, RREQUEST
035: C> Is it the case that there are mistakes during judicial process? …………………….. Move type: question
036: S> I am not sure about it. ………………………………………………………………………….. Move type: withdrawal; rule: CRW, RREQUEST
037: C> Please resolve some people want to die and some people want to die implies there are mistakes during judicial process in your store. ………………..Move type: resolution demand; rule: RESOLVE
038: S> I don't think some people want to die implies there are mistakes during judicial process.
…………………………………………………………………………………………….. Move type: withdrawal; rule: CRW, RRESOLUTION
039: C> Is it the case that repeat crime rate is extremely low? …………………….. Move type: question
040: S> I am not sure about it. ………………………………………………………………………….. Move type: withdrawal; rule: CRW, RREQUEST
041: C> Please resolve political or racial bias will not cause prejudice and political or racial bias will not cause prejudice implies repeat crime rate is extremely low in your store.
…………………………………………………………………………………………….. Move type: resolution demand; rule: RESOLVE
042: S> I don't think political or racial bias will not cause prejudice.
…………………………………………………………………………………………….. Move type: withdrawal; rule: CRW, RRESOLUTION
043: C> I don’t think political or racial bias will not cause prejudice implies repeat crime rate is extremely low. ……………………………………………………………………………… Move type: withdrawal; rule: CRW
044: S> I think most people want CP back. ………………………………………………………………………….. Move type: statement; rule: CRS
045: C> Is it the case that killing innocent people is wrong? …………………………………………………….. Move type: question
046: S> No, I think killing innocent people is not always wrong. …..Move type: statement; rule: CRS, RREQUEST
047: C> I think murderers should not receive capital punishment. ………Move type: statement; rule: CRS
048: S>I think political or racial bias will not cause prejudice. …………… Move type: statement; rule: CRS

049: C>Please resolve CP is acceptable and CP is not acceptable in your store. 

……………………………………………………… Move type: resolution demand; rule: RRESOLVE

050: S>I don’t think CP is not acceptable. ………………… Move type: withdrawal; rule: CRW, RESOLUTION

051: C>Why is it that murderers should not receive capital punishment? ………………… Move type: challenge; rule:CRY

052: S>I am not sure that murderers should not receive capital punishment? ………….. Move type: withdrawal; rule: CRW, RESOLUTION

053: C>I think everybody belongs to the God. ……………………… Move type: statement; rule: CRS

054: S>I think CP decreases violence crime implies CP is acceptable. … Move type: statement; rule: CRS

055: C>Why is it that most people want CP back? …………………………… Move type: challenge; rule: CRS

056: S>I am not sure that most people want CP back? ………………… Move type: withdrawal; rule: CRW, RESOLUTION

057: C>Is it the case that innocent people get killed implies CP is not acceptable? ………….. Move type: challenge; rule: CRS

058: S>I am not sure about it. …………………………… Move type: withdrawal; rule: CRW, RREQUEST

059: C>Is it the case that most people don't want CP back? ………………… Move type: question

060: S>No, I think most people want CP back. ………………………………… Move type: statement; rule: CRS, RREQUEST

061: C>Why is it that mistakes are not likely to happen during judicial process?

…………………………………………………………………………… Move type: challenge; rule: CRY

062: S>Because not everybody belongs to the God. ………………… Move type: statement; rule: RREQUEST

063: R>This statement is in both stores, you can not state it any more, please try again! … Rule: RREPSTAT

064: S>Because political or racial bias will not cause prejudice. ………… Move type: statement; rule: RREQUEST

065: R>This statement is in both stores, you can not state it any more, please try again! … Rule: RREPSTAT

066: S>Because some people want to die. ………………………………… Move type: statement; rule: RREQUEST

067: R>This statement is in both stores, you can not state it any more, please try again! … Rule: RREPSTAT

068: S>Because it is unlikely innocent people get killed. ………… Move type: statement; rule: RREQUEST

069: C>Is it the case that murderers should not receive capital punishment implies CP does not decrease violent crimes? …………………………………………………………………………………… Move type: question

070: S>Yes, I think murderers should not receive capital punishment implies CP does not decrease violent crimes. …………………………………………………………………………………… Move type: statement; rule: CRS, RREQUEST

071: C>Why is it that mistakes are not likely to happen during judicial process?

…………………………………………………………………………… Move type: challenge; rule: CRY

072: S>Because most people want CP back. …………………………………………… Move type: statement

073: R>You may be begging the question, please choose a statement not under challenge and try again!
074: S> Please resolve it is unlikely innocent people get killed and it is unlikely innocent people get killed implies mistakes are not likely to happen during judicial process in your store.

Move type: resolution demand; rule: RRESOLVE

075: C> I think mistakes are not likely to happen during judicial process.

Move type: statement; rule: CRS, RRESOLUTION

076: S> I don't think killing innocent people is not always wrong.

Move type: withdrawal; rule: CRW

077: C> Is it the case that there are mistakes during judicial process implies innocent people get killed?

Move type: question

078: S> Yes, I think there are mistakes during judicial process implies innocent people get killed.

Move type: statement; rule: CRS, RREQUEST

079: C> Why is it that not everybody belongs to the God?

Move type: challenge; rule: CRY

080: S> Because CP decreases violence crime.

Move type: statement; rule: CRY, RCHALLENGE

081: C> I don’t think mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed.

Move type: withdrawal; rule: CRW

082: S> Is it the case that 60% British people support CP implies most people want CP back?

Move type: question

083: C> Yes, I think 60% British people support CP implies most people want CP back.

Move type: statement; rule: CRS, RREQUEST

084: S> I think some people want to die.

Move type: statement

085: R> This statement is in both stores, you can not state it any more, please try again!

Rule: RREPSTATE

086: S> Is it the case that scientific techniques will guarantee the success of justice?

Move type: question

087: C> No, I think scientific techniques will not guarantee the success of justice.

Move type: statement; rule: CRS, RREQUEST

088: S> I think a state has the right to kill murderers.

Move type: statement; rule: CRS

089: C> Is it the case that CP is not acceptable?

Move type: question

090: S> No, I think CP is acceptable.

Move type: statement; rule: CRS, RREQUEST

091: C> Please resolve not everybody belongs to the God and everybody belongs to the God in your store.

Move type: resolution demand; rule: RRESOLVE

092: R> Chris, you lose and Simon wins.

End of dialogue
001: C> Is it the case that CP is acceptable? ..............................................Move type: question
002: S> Yes, I think CP is acceptable. ..............................................Move type: statement; rule: CRS, RQUEST
003: C> I think CP is not acceptable. ..............................................Move type: statement; rule: CRS
004: S> I think truth is always on the side of most people. ..................Move type: statement; rule: CRS
005: C> I think CP is not a good deterrent. ......................................Move type: statement; rule: CRS
006: S> I think all murderers are hanged. ..............................................Move type: statement; rule: CRS
007: C> Is it the case that CP does not decrease violent crimes? .................Move type: question
008: S> Yes, I think CP does not decrease violent crimes. ..............Move type: statement; rule: CRS, RQUEST
009: C> Please resolve CP is acceptable and CP is not acceptable in your store.
..............................................................................................................Move type: resolution demand; rule: RRESOLVE
010: S> I don't think CP is not acceptable. ..............................................Move type: withdrawal; rule: CRW, RRESOLUTION
011: C> Why is it that CP is not a good deterrent? ..............................Move type: challenge; rule: CR Y
012: S> I am not sure that CP is not a good deterrent? ...........Move type: withdrawal; rule: CRW, RCHALL
013: C> I think truth is sometimes on the side of fewer people. ..........Move type: statement; rule: CRS
014: S> I think scientific techniques will guarantee the success of justice. Move type: statement; rule: CRS
015: C> I think CP is not a good deterrent. ..............................................Move type: statement; rule: CRS
016: S> Is it the case that scientific techniques will guarantee the success of justice? ..Move type: question
017: C> I am not sure about it. .......................................................Move type: withdrawal; rule: CRW, RQUEST
018: S> Why is it that truth is always on the side of most people? ..........Move type: challenge; rule: CR Y
019: C> Because truth is sometimes on the side of fewer people. .......Move type: statement; rule: RCHALL
020: R> This statement is in both stores, you can not state it any more, please try again! ......Rule: RREPSTAT
021: C> Because CP is not acceptable. ................................................Move type: statement; rule: CRS, RCHALL
022: S> Is it the case that murderers should receive capital punishment? ........Move type: question
023: C> I am not sure about it. .......................................................Move type: withdrawal; rule: CRW, RQUEST
024: S> I think not everybody belongs to the God. ...............................Move type: statement; rule: CRS
025: C> Is it the case that there are mistakes during judicial process? .............Move type: question
026: S> I am not sure about it. .......................................................Move type: withdrawal; rule: CRW, RQUEST
027: C> Is it the case that CP does not decrease violent crimes? ...................Move type: question
028: S> Yes, I think CP does not decrease violent crimes. ....................Move type: statement; rule: RQUEST
029: R> This statement is in both stores, you can not state it any more, please try again! ......Rule: RREPSTAT
030: S>I am not sure about it. ………………………………….Move type: withdrawal; rule: CRW, RQUEST

031: C>I don't think CP is not acceptable implies truth is always on the side of most people. 
…………………………………………………………………………………………..Move type: withdrawal; rule: CRW

032: S>Is it the case that 60% British people support CP implies most people want CP back? 
…………………………………………………………………………………………..Move type: question

033: C>Yes, I think 60% British people support CP implies most people want CP back. 
…………………………………………………………………………………………..

034: S>Is it the case that scientific techniques will guarantee the success of justice? ..Move type: question

035: C>Yes, I think scientific techniques will guarantee the success of justice. 
…………………………………………………………………………………………..

036: S>Is it the case that scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process? .................................Move type: question

037: C>Yes, I think scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process. ...........................

038: S>Is it the case that CP is a good deterrent? ............................................Move type: question

039: C>No, I think CP is not a good deterrent. ...............................Move type: statement; rule: RQUEST

040: R> This statement is in both stores, you can not state it any more, please try again! ....Rule: REPSTAT

041: C>No, I think CP is not a good deterrent. ...............................Move type: statement; rule: RQUEST

042: R> This statement is in both stores, you can not state it any more, please try again! ....Rule: REPSTAT

043: C> Yes, I think CP is a good deterrent.......................Move type: statement; rule: CRS, RQUEST

044: S> Why is it that not everybody belongs to the God? .........................Move type: challenge; rule: CRY

045: C> Because CP is not a good deterrent. ...............................Move type: statement; rule: RCHALL

046: R> This statement is in both stores, you can not state it any more, please try again! ....Rule: REPSTAT

047: C> Because suicide bombers are not willing to die. ..............Move type: statement; rule: CRYS, RCHALL

048: S> Why is it that CP is not a good deterrent? ...............................Move type: challenge; rule: CRY

049: C> Because it is wrong to take a human life. ...............................Move type: statement; rule: CRYS, RCHALL

050: S> Is it the case that CP is a good deterrent implies CP is acceptable?  .............Move type: question

051: C> Yes, I think CP is a good deterrent implies CP is acceptable. 
…………………………………………………………………………………………..

052: S> I think CP decreases violent crime implies CP is acceptable. ......Move type: statement; rule: CRS

053: C> I don't think CP decreases violent crime implies CP is acceptable. 
…………………………………………………………………………………………..

Move type: withdrawal; rule: CRW
S>I don't think all murderers are hanged. ..............................................Move type: withdrawal; rule: CRW

C>I think truth is sometimes on the side of fewer people. ............................Move type: statement

R>This statement is in both stores, you can not state it any more, please try again! ......Rule: REPSTAT

C>I don't think not everybody belongs to the God. ..................................Move type: withdrawal; rule: CRW

S>Please resolve suicide bombers are not willing to die and suicide bombers are not willing to die implies not everybody belongs to the God in your store. ..............................................................Move type: resolution demand; rule: RESOLVE

C>I don't think suicide bombers are not willing to die implies not everybody belongs to the God. ..............................................................Move type: withdrawal; rule: CRW, RESOLUTION

S>Is it the case that it is not wrong to take human life? ..............................Move type: question

C>Yes, I think it is not wrong to take human life. .......................................Move type: statement; rule: CRS, REQUEST

S>I think CP is a good deterrent implies CP is acceptable. .........................Move type: statement

R>This statement is in both stores, you can not state it any more, please try again! ......Rule: REPSTAT

S>Why is it that it is not wrong to take human life? .................................Move type: challenge; rule:CRY

C>I am not sure that it is not wrong to take human life? ..........................Move type: withdrawal; rule: CRW, RCHALLENGE

S>Why is it that CP is acceptable? .............................................................Move type: challenge; rule: CRY

R>Simon, you lose and Chris wins. .............................................................End of dialogue
Is it the case that CP is acceptable?  

Yes, I think CP is acceptable.  

I think CP is not acceptable.  

I think not everybody belongs to the God.  

Please resolve CP is acceptable and CP is not acceptable in your store.  

I don't think CP is not acceptable.  

Is it the case that most people don't want CP back?  

No, I think most people want CP back.  

I think truth is sometimes on the side of fewer people.  

Is it the case that some people want to die?  

I think scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process.  

I think innocent people get killed.  

Is it the case that CP decreases violent crime implies CP is a good deterrent?  

Because it is not wrong to take human life.  

Is it the case that most people don't want CP back?  

Yes, I think most people don't want CP back.  

Why is it that some people want to die?  

Is it the case that nobody has the right to kill other people implies it is wrong to take a human life?
026: S>Yes, I think nobody has the right to kill other people implies it is wrong to take a human life.

……………………………………………………………………………………..Move type: statement; rule: CRS, REQUEST

027: C>I think there are mistakes during judicial process implies innocent people get killed.

……………………………………………………………………………………..Move type: statement; rule: CRS

028: S>Is it the case that 60% British people support CP implies most people want CP back?

……………………………………………………………………………………..Move type: question

029: C>Yes, I think 60% British people support CP implies most people want CP back.

……………………………………………………………………………………..Move type: statement; rule: CRS, REQUEST

030: S>Why is it that it is not wrong to take human life? ……………..Move type: challenge; rule: CRy

031: C>Because innocent people get killed. ………………………….Move type: statement; rule: RCHALL

032: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

033: C>Because truth is sometimes on the side of fewer people. ………………Move type: statement; rule: RCHALL

034: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

035: C>Because innocent people get killed. ………………………….Move type: statement; rule: RCHALL

036: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

037: C>Because most people don't want CP back. ………………………….Move type: statement; rule: RCHALL

038: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

039: C>Because everybody belongs to the God. ………………………….Move type: statement; rule: CRy, RCHALL

040: S>I think scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process. …………………………………………………………Move type: statement

041: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

042: S>Is it the case that most people want CP back? ………………………….Move type: question

043: C>Yes, I think most people want CP back. ………………………….Move type: statement; rule: REQUEST

044: R>This statement is in both stores, you can not state it any more, please try again! ……Rule: RREPSTAT

045: C>I am not sure about it. ………………………….Move type: withdrawal; rule: CRw, REQUEST

046: S>I think a state has the right to kill murderers. ………………………….Move type: statement; rule: CRS

047: C>I think it is wrong to take a human life. ………………………….Move type: statement; rule: CRS

048: S>Is it the case that all murderers are hanged implies CP decreases violent crime?

……………………………………………………………………………………..Move type: question

049: C>I am not sure about it. ………………………….Move type: withdrawal; rule: CRw, REQUEST

050: S>Is it the case that political or racial bias will not cause prejudice? ………………Move type: question

051: C>Yes, I think political or racial bias will not cause prejudice.
052: S>Why is it that innocent people get killed? ..........................Move type: challenge; rule: CY
053: C>Because CP is not a good deterrent. ..............................Move type: statement; rule: CY, RCHALL
054: S>I don't think some people want to die. .............................Move type: withdrawal; rule: CW
055: C>Why is it that it is wrong to take a human life? ..................Move type: challenge; rule: CY
056: S>I am not sure that it is wrong to take a human life? ............Move type: withdrawal; rule: CW, RCHALL
057: C>I think innocent people get killed. .................................Move type: statement; rule: CY
058: S>Please resolve not everybody belongs to the God and everybody belongs to the God in your store. ..................................................Move type: resolution demand; rule: RRESOLVE
059: C>I don't think not everybody belongs to the God. ...Move type: withdrawal; rule: CW, RRESOLUTION
060: S>I don't think CP is not a good deterrent implies innocent people get killed. ..................................................Move type: withdrawal; rule: CW
061: C>Why is it that most people want CP back? ..........................Move type: challenge; rule: CY
062: S>Because it is not wrong to take human life. .......................Move type: statement; rule: CY, RCHALL
063: C>Please resolve not everybody belongs to the God and everybody belongs to the God in your store. ..................................................Move type: resolution demand; rule: RRESOLVE
064: S>I don't think everybody belongs to the God. ........Move type: withdrawal; rule: CW, RRESOLUTION
065: C>Why is it that political or racial bias will not cause prejudice? ..........................Move type: challenge; rule: CY
066: S>Because scientific techniques will guarantee the success of justice. ..................................................Move type: statement; rule: CY, RCHALL
067: C>Is it the case that murderers should have the opportunity for rehabilitation implies CP is not acceptable? ..................................................Move type: question
068: S>I am not sure about it. ....................................................Move type: withdrawal; rule: CW, RREQUEST
069: C>Is it the case that CP is not a good deterrent? ..............................Move type: question
070: S>I am not sure about it. ....................................................Move type: withdrawal; rule: CW, RREQUEST
071: C>I think nobody wants to die implies CP is not acceptable. .........Move type: statement; rule: CY
072: S>Is it the case that 60% British people support CP? ....................Move type: question
073: C>Yes, I think 60% British people support CP. .......................Move type: statement; rule: CY, RREQUEST
074: S>I don't think not everybody belongs to the God. ...................Move type: withdrawal; rule: CW
075: C>I don't think it is not wrong to take human life implies some people want to die. ..................................................Move type: withdrawal; rule: CW
076: S>Why is it that CP is not a good deterrent? ......................Move type: challenge; rule: CR Y
077: C>Because suicide bombers are not willing to die. ..............Move type: statement; rule: CRYS, RCHALL
078: S>Why is it that most people don't want CP back? ....................Move type: challenge; rule: CR Y
079: C>Because truth is sometimes on the side of fewer people. ..........Move type: statement; rule: RCHALL
080: R>This statement is in both stores, you can not state it any more, please try again! ......Rule: RREPSTAT
081: C>Because truth is sometimes on the side of fewer people. .............Move type: statement; rule: RCHALL
082: R>This statement is in both stores, you can not state it any more, please try again! ......Rule: RREPSTAT
083: C>Because there are mistakes during judicial process. ..........Move type: statement; rule: CRYS, RCHALL
084: S>Is it the case that not everybody belongs to the God? ..................Move type: question
085: C>I am not sure about it. ..............................................Move type: withdrawal; rule: CR W, RQUEST
086: S>Is it the case that repeat crime rate is high? ........................Move type: question
087: C>I am not sure about it. ..............................................Move type: withdrawal; rule: CR W, RQUEST
088: S>I don't think truth is sometimes on the side of fewer people. .........Move type: withdrawal; rule: CR W
089: C>I don't think CP is not a good deterrent implies innocent people get killed.
............................................................................................................Move type: withdrawal; rule: CR W
090: S>Why is it that 60% British people support CP? .........................Move type: challenge; rule: CR Y
091: C>Because CP does not decrease violent crimes. .......................Move type: statement; rule: CRYS, RCHALL
092: S>I don't think nobody wants to die implies CP is not acceptable.
............................................................................................................Move type: withdrawal; rule: CR W
093: C>I think innocent people get killed implies CP is not acceptable. ...Move type: statement; rule: CR S
094: S>Why is it that innocent people get killed? ...............................Move type: challenge; rule: CR Y
095: C>Because murderers should not receive capital punishment.
............................................................................................................Move type: statement; rule: CRYS, RCHALL
096: S>I don't think there are mistakes during judicial process implies innocent people get killed.
............................................................................................................Move type: withdrawal; rule: CR W
097: C>Is it the case that repeat crime rate is extremely low? ...............Move type: question
098: S>No, I think repeat crime rate is high. .................................Move type: statement; rule: CR S, RQUEST
099: C>Please resolve scientific techniques will guarantee the success of justice and scientific techniques
will guarantee the success of justice implies mistakes are not likely to happen during judicial process and there are mistakes during judicial process in your store.
............................................................................................................Move type: resolution demand; rule: RRESOLVE
100: S>I don't think there are mistakes during judicial process.
101: C> I think 60% British people do not support CP.

102: S> Why is it that scientific techniques will guarantee the success of justice?

103: C> Because innocent people get killed.

104: R> You may be begging the question, please choose a statement not under challenge and try again!

105: C> Because repeat crime rate is extremely low.

106: S> I don't think repeat crime rate is extremely low.

107: C> Why is it that murderers should not receive capital punishment?

108: S> Because not everybody belongs to the God.

109: C> I think CP does not decrease violent crimes.

110: R> This statement is in both stores, you can not state it any more, please try again!

111: C> I don't think there are mistakes during judicial process implies innocent people get killed.

112: S> Why is it that 60% British people do not support CP?

113: C> Because murderers should not receive capital punishment.

114: S> Is it the case that CP decreases violent crime implies CP is acceptable?

115: C> I am not sure about it.

116: S> I think CP decreases violent crime implies CP is acceptable.

117: C> I think nobody has the right to kill other people.

118: S> Please resolve everybody belongs to the God and not everybody belongs to the God in your store.

119: C> I don't think everybody belongs to the God.

120: S> Why is it that 60% British people support CP?

121: C> Because murderers should not receive capital punishment.

122: R> This statement is in both stores, you can not state it any more, please try again!

123: C> Please resolve CP does not decrease violent crimes and CP does not decrease violent crimes implies 60% British people support CP in your store.

124: S> I don't think CP does not decrease violent crimes.
125: C> I think scientific techniques will not guarantee the success of justice implies there are mistakes during judicial process. ............................................................Move type: statement; rule: CRS

126: S> Is it the case that mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed? ............................................................Move type: question

127: C> Yes, I think mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed. ............................................................Move type: statement; rule: CRS, REQUEST

128: S> I think CP decreases violent crime. ............................................................Move type: statement; rule: CRS

129: C> I think CP is not acceptable. ............................................................Move type: statement; rule: CRS

130: S> Is it the case that CP is a good deterrent implies CP is acceptable? ............Move type: question

131: R> Simon, you lose and Chris wins. ............................................................End of dialogue
APPENDIX B

DE INTER-AGENT DIALOGUES

The following dialogue transcripts (DE1, DE2 and DE3) were generated by two computational agents operationalising the DE dialogue model and using the knowledge base in appendix D1 below. These computational agents are designed to use random arguments. The Java code for the computational agents is available in the accompanying CD-R. The raw dialogue transcripts are as follows (blue italicised type annotations, added by the thesis author, indicate the move type being made and the DC rules being invoked by each move).

C= DE random agent Chris
S= DE random agent Simon
R=DE referee
CP= Capital Punishment

DE1

001: C>Is it the case that CP is acceptable? Move type: question
002: S>Yes, I think CP is acceptable. Move type: statement; rule: CRS, RQUEST
003: C>I think CP is not acceptable. Move type: statement; rule: CRS
004: S>I think a state has the right to kill murderers. Move type: statement; rule: CRS
005: C>I think everybody belongs to the God. Move type: statement; rule: CRS
006: S>I think 60% British people support CP implies most people want CP back. Move type: statement; rule: CRS
007: C>I think scientific techniques will not guarantee the success of justice. Move type: statement; rule: CRS
008: S>I think most people want CP back implies CP is acceptable. Move type: statement; rule: CRS
009: C>Is it the case that most people don't want CP back? Move type: question
010: S>Yes, I think most people don't want CP back. Move type: statement; rule: CRS, RQUEST
011: C>I think nobody wants to die implies CP is not acceptable. Move type: statement; rule: CRS
012: S>I think 60% British people support CP implies most people want CP back. Move type: statement
The statement '60% British people support CP implies most people want CP back' has already in both positions, it is not necessarily to say it, please try other options. ..........Rule: REPSTAT

I think suicide bombers are willing to die. .........................Move type: statement; rule: CRS

Is it the case that 60% British people do not support CP? ....................Move type: question

Yes, I think 60% British people do not support CP. ........Move type: statement; rule: CRS, REQUEST

Is it the case that nobody has the right to kill other people implies it is wrong to take a human life? .........................................................Move type: question

I am not sure about it. .................................Move type: withdrawal; rule: CR W, REQUEST

Is it the case that CP does not decrease violent crimes? ....................Move type: question

I am not sure about it. .................................Move type: withdrawal; rule: CR W, REQUEST

Is it the case that political or racial bias will cause prejudices implies scientific techniques will not guarantee the success of justice? .........................................................Move type: question

Yes, I think political or racial bias will cause prejudices implies scientific techniques will not guarantee the success of justice. ..................................Move type: statement; rule: CRS, REQUEST

Please resolve CP is acceptable and CP is not acceptable in your store. .........................................................Move type: resolution demand; rule: RESOLVE

I don't think CP is not acceptable. .........................Move type: withdrawal; rule: CR W, RESOLUTION

Is it the case that innocent people get killed? ....................Move type: question

No, I think it is unlikely innocent people get killed. ..........Move type: statement; rule: CRS, REQUEST

I think CP is not a good deterrent. ..................................Move type: statement; rule: CRS

Is it the case that repeat crime rate is high? ....................Move type: question

No, I think repeat crime rate is extremely low. ..........Move type: statement; rule: CRS, REQUEST

I don't think CP is not acceptable. ..................................Move type: statement; rule: CRS

I don't think suicide bombers are willing to die. .................Move type: withdrawal; rule: CR W

I think murderers should receive capital punishment...............Move type: statement; rule: CRS

I think there are mistakes during judicial process implies innocent people get killed. .........................................................Move type: statement; rule: CRS

Is it the case that mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed? .........................................................Move type: question

I am not sure about it. .................................Move type: withdrawal; rule: CR W, REQUEST

I don't think CP is not a good deterrent. .................................Move type: withdrawal; rule: CR W
037: C>Is it the case that repeat crime rate is extremely low implies murderers should have the opportunity for rehabilitation?  
………………………………………………………………………………………………………Move type: question
038: S>I am not sure about it.  
………………………………………………Move type: withdrawal; rule: CR W, REQUEST
039: C>Why is it that murderers should receive capital punishment?  
………………………………………………………………………………………………………Move Type: challenge; rule: CR Y
040: S>Because not everybody belongs to the God.  
………………………………………………………………………………………………………Move type: statement; rule: CRYS, RCHALL
041: C>Is it the case that CP is not a good deterrent?  
………………………………………………………………………………………………………Move type: question
042: S>No, I think CP is a good deterrent.  
………………………………………………………………………………………………………Move type: statement; rule: CRS, RREQUEST
043: C>Is it the case that murderers should not receive capital punishment implies CP does not decrease violent crimes?  
………………………………………………………………………………………………………Move type: question
044: S>Yes, I think murderers should not receive capital punishment implies CP does not decrease violent crimes.  
………………………………………………………………………………………………………Move type: statement; rule: CRS, RREQUEST
045: C>I think CP is not a good deterrent.  
………………………………………………………………………………………………………Move type: statement; rule: CRS
046: S>Why is it that scientific techniques will not guarantee the success of justice?  
………………………………………………………………………………………………………Move Type: challenge; rule: CR Y
047: C>Because CP is not acceptable.  
………………………………………………………………………………………………………Move type: statement
048: R>You are begging the question 'CP is not acceptable' which is under dispute, please try again!  
………………………………………………………………………………………………………Rule: RCHALL
049: C>Because repeat crime rate is extremely low.  
………………………………………………………………………………………………………Move type: statement; rule: CRYS, RCHALL
050: S>Is it the case that CP decreases violent crime?  
………………………………………………………………………………………………………Move type: question
051: C>No, I think CP does not decrease violent crimes.  
………………………………………………………………………………………………………Move type: statement; rule: CRS, RREQUEST
052: S>Why is it that everybody belongs to the God?  
………………………………………………………………………………………………………Move Type: challenge; rule: CR Y
053: C>Because murderers should have the opportunity for rehabilitation.  
………………………………………………………………………………………………………Move type: statement; rule: CRYS, RCHALL
054: S>Please resolve CP is not acceptable and CP is acceptable in your store.  
………………………………………………………………………………………………………Move type: resolution demand; rule: RRESOLVE
055: C>I don't think CP is not acceptable.  
………………………………………………………………………………………………………Move type: withdrawal; rule: CR W, RRESOLUTION
056: R>Chris, you lose and Simon wins.  
………………………………………………………………………………………………………End of dialogue
DE2

001: C> Is it the case that CP is acceptable? ...........................................Move type: question

002: S> Yes, I think CP is acceptable. ..............................................Move type: statement; rule: CRS, RQUEST

003: C> I think CP is not acceptable. ..............................................Move type: statement; rule: CRS

004: S> I think CP is a good deterrent. ..............................................Move type: statement; rule: CRS

005: C> I think political or racial bias will cause prejudices. ...............Move type: statement; rule: CRS

006: S> I think some people want to die. ...........................................Move type: statement; rule: CRS

007: C> Why is it that CP is a good deterrent? ..................................Move type: challenge; rule: CRYS

008: S> Because CP is acceptable. ....................................................Move type: statement

009: R> You are begging the question 'CP is acceptable' which is under dispute, please try again!

010: S> Because murderers should receive capital punishment. ..........Move type: statement; rule: CRYS, RCHALL

011: C> I think it is wrong to take a human life. ..............................Move type: statement; rule: CRS

012: S> I think murderers should receive capital punishment implies CP is acceptable.

013: R> The statement 'murderers should receive capital punishment implies CP is acceptable' has already
    in both positions, it is not necessarily to say it, please try other options. .................Rule: RREPSTAT

014: S> I think all murderers are hanged. ...........................................Move type: statement; rule: CRS

015: C> I don't think murderers should receive capital punishment implies CP is a good deterrent.

016: S> I think 60% British people support CP. .................................Move type: statement; rule: CRS

017: C> Is it the case that innocent people get killed implies CP is not acceptable? …Move type: question

018: S> Yes, I think innocent people get killed implies CP is not acceptable.

019: C> I think nobody has the right to kill other people implies it is wrong to take a human life.

020: S> I don't think some people want to die. .................................Move type: withdrawal; rule: CRW

021: C> I think CP does not decrease violent crimes. .........................Move type: statement; rule: CRS

022: S> I don't think political or racial bias will cause prejudices. .......Move type: withdrawal; rule: CRW

023: C> I don't think nobody has the right to kill other people implies it is wrong to take a human life.

............................................................Move type: withdrawal; rule: CRW
024: S>I think it is not wrong to take human life. ..............................................Move type: statement; rule: CRS

025: C>Is it the case that repeat crime rate is extremely low implies murderers should have the opportunity for rehabilitation? .............................................................Move type: question

026: S>Yes, I think repeat crime rate is extremely low implies murderers should have the opportunity for rehabilitation. .................................................................Move type: statement; rule: CRS, RREQUEST

027: C>I don't think political or racial bias will cause prejudices. ......................................................Move type: withdrawal; rule: CRW

028: S>I don't think 60% British people support CP. ......................................................Move type: withdrawal; rule: CRW

029: C>Why is it that CP is acceptable? .............................................................Move type: challenge; rule: CRY

030: S>Because mistakes are not likely to happen during judicial process.

031: C>I don't think it is wrong to take a human life. ......................................................Move type: withdrawal; rule: CRW

032: S>I think political or racial bias will not cause prejudice. ......................................................Move type: statement; rule: CRS

033: C>I think murderers should have the opportunity for rehabilitation. .................................Move type: statement; rule: CRS

034: S>Is it the case that repeat crime rate is high? .............................................................Move type: question

035: C>I am not sure about it. ......................................................................................Move type: withdrawal; rule: CRW, RREQUEST

036: S>I think not everybody belongs to the God. ......................................................................Move type: statement; rule: CRS

037: C>I don't think mistakes are not likely to happen during judicial process implies CP is acceptable.

038: S>Why is it that CP does not decrease violent crimes? ......................................................Move type: challenge; rule: CRY

039: C>Because nobody has the right to kill other people. ......................................................Move type: statement; rule: CRS, RREQUEST

040: S>Is it the case that CP is a good deterrent implies CP is acceptable? ..............................Move type: question

041: C>I am not sure about it. ......................................................................................Move type: withdrawal; rule: CRW, RREQUEST

042: S>Why is it that it is not wrong to take human life? ......................................................Move type: challenge

043: R>Illegal Challenge, the statement 'it is not wrong to take human life' is not advanced by your partner, please try again! ............................................................................Rule: RLEGALCHALLENGE

044: S>I think mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed. .................................................................Move type: statement; rule: CRS

045: C>Please resolve CP is acceptable and CP is not acceptable in your store.

046: S>I don't think CP is acceptable. .............................................................Move type: withdrawal; rule: CRW, RESOLUTION

047: R>Simon, you lose and Chris wins. ..................................................................................End of dialogue
DE3

001: C> Is it the case that CP is acceptable? .........................................................Move type: question
002: S> Yes, I think CP is acceptable. ..................................................Move type: statement; rule: CRS, RQUEST
003: C> I think CP is not acceptable. ..................................................Move type: statement; rule: CRS
004: S> Is it the case that murderers should receive capital punishment? ................Move type: question
005: C> Yes, I think murderers should receive capital punishment. ..................................................Move type: statement; rule: CRS, RREQUEST
006: S> Is it the case that a state has the right to kill murderers? ............................Move type: question
007: C> Yes, I think a state has the right to kill murderers. ................Move type: statement; rule: CRS, RREQUEST
008: S> Is it the case that scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process? ..............................Move type: question
009: C> Yes, I think scientific techniques will guarantee the success of justice implies mistakes are not likely to happen during judicial process. ................Move type: statement; rule: CRS, RREQUEST
010: S> I think CP is a good deterrent. ..................................................Move type: statement; rule: CRS
011: C> I think murderers should have the opportunity for rehabilitation implies CP is not acceptable. ..................................................Move type: statement; rule: CRS
012: S> I think CP is acceptable. ..................................................Move type: statement; rule: CRS
013: C> I think murderers should not receive capital punishment. ..........Move type: statement; rule: CRS
014: S> I think scientific techniques will guarantee the success of justice. Move type: statement; rule: CRS
015: C> Why is it that CP is a good deterrent? ..........................Move type: challenge; rule: CRY
016: S> Because it is not wrong to take human life. ................Move type: statement; rule: CRYS, RCHALL
017: C> Why is it that scientific techniques will guarantee the success of justice? ...........................................................................................................Move type: challenge; rule: CRY
018: S> Because murderers should receive capital punishment. ...Move type: statement; rule: CRYS, RCHALL
019: C> Why is it that CP is acceptable? ..........................Move type: challenge; rule: CRY
020: S> Because most people want CP back. ................Move type: statement; rule: CRYS, RCHALL
021: C> Is it the case that 60% British people do not support CP? ................Move type: question
022: S> Yes, I think 60% British people do not support CP. ........Move type: statement; rule: CRS, RREQUEST
023: C> I think nobody has the right to kill other people implies it is wrong to take a human life. ...........................................................................................................Move type: statement; rule: CRS
024: S> Why is it that it is not wrong to take human life? ..........................Move type: challenge
025: R>Illegal Challenge, the statement 'it is not wrong to take human life' is not advanced by your partner, please try again! .................................................................Rule: RLEGALCHALL
026: S>I think CP decreases violent crime implies CP is acceptable. ....................Move type: statement; rule: CRS
027: C>I think nobody wants to die implies CP is not acceptable. ......................Move type: statement; rule: CRS
028: S>I think CP decreases violent crime implies CP is acceptable. ..................Move type: statement
029: R>The statement 'CP decreases violent crime implies CP is acceptable' has already in both positions, it is not necessarily to say it, please try other options. ......................................Rule: RREPSTAT
030: S>I think murderers should not have the opportunity for rehabilitation. ..........................................................Move type: statement; rule: CRS
031: C>Is it the case that repeat crime rate is extremely low? .............................Move type: question
032: S>Yes, I think repeat crime rate is extremely low. .................................Move type: statement; rule: CRS, REQUEST
033: C>I think CP does not decrease violent crimes. .............................................Move type: statement; rule: CRS
034: S>I don't think most people want CP back. ..............................................Move type: withdrawal; rule: CRW
035: C>Is it the case that murderers should have the opportunity for rehabilitation? .............................Move type: question
036: S>Yes, I think murderers should have the opportunity for rehabilitation. ..........................................................Move type: statement; rule: CRS, REQUEST
037: C>I don't think it is not wrong to take human life. ......................................Move type: withdrawal; rule: CRW
038: S>Is it the case that mistakes are not likely to happen during judicial process implies it is unlikely innocent people get killed? ..........................................................Move type: question
039: C>I am not sure about it. .....................................................................Move type: withdrawal; rule: CRW, REQUEST
040: S>I think truth is always on the side of most people. .................................Move type: statement; rule: CRS
041: C>Is it the case that truth is sometimes on the side of fewer people? ..........Move type: question
042: S>No, I think truth is always on the side of most people. ..............................Move type: statement; rule: CRS, REQUEST
043: C>Is it the case that everybody belongs to the God? .................................Move type: question
044: S>Yes, I think everybody belongs to the God. ..........................................Move type: statement; rule: CRS, REQUEST
045: C>Why is it that 60% British people do not support CP? ...............................Move Type: challenge; rule: CRY
046: S>Because scientific techniques will guarantee the success of justice. ..............................Move type: statement; rule: CRYS, RCHALL
047: C>Why is it that repeat crime rate is extremely low? ...............................Move Type: challenge; rule: CRY
048: S>Because it is not wrong to take human life. .................................................Move type: statement
049: R> You are begging the question 'it is not wrong to take human life' which is under dispute, please try again! .................................................................Rule: RCHALL
050: S>Because murderers should not have the opportunity for rehabilitation.

051: C>I think scientific techniques will not guarantee the success of justice implies there are mistakes during judicial process.

052: S>I think CP decreases violent crime.

053: C>I think murderers should not receive capital punishment.

054: S>I don't think murderers should not have the opportunity for rehabilitation implies repeat crime rate is extremely low.

055: C>Is it the case that there are mistakes during judicial process?

056: S>Yes, I think there are mistakes during judicial process.

057: C>Is it the case that everybody belongs to the God?

058: S>No, I think not everybody belongs to the God.

059: C>Is it the case that CP is not acceptable?

060: S>No, I think CP is acceptable.

061: C>Why is it that murderers should not receive capital punishment?

062: R>Illegal Challenge, the statement 'murderers should not receive capital punishment' is not advanced by your partner, please try again!

063: C>Why is it that murderers should not receive capital punishment?

064: R>Illegal Challenge, the statement 'murderers should not receive capital punishment' is not advanced by your partner, please try again!

065: S>I don't think CP is not acceptable.

066: R>Chris, you lose and Simon wins. End of dialogue
APPENDIX C

STRATEGIC AGENT-GENERATED DIALOGUES

The following dialogue transcripts (DE4, DE5 and DE6) were generated by two computational agents operationalising the DE dialogue model and the strategy proposed in chapter eight. The Java code for the computational agents is available in the accompanying CD-R. The blue coloured annotations were added by the thesis author. In addition, presumed missing premises are indicated in italics.

DE4

C= DE strategic agent Chris
S= DE random agent Simon
CP= Capital Punishment
C and S use the same knowledge base depicted in appendix D2

001: C>Is it the case that CP is acceptable?

..............................................................................[C starts the game by asking S’s view on the issue]

002: S>No, I think CP is not acceptable.

003: C>I think CP is acceptable.

..............................................................................[C automatically adopts the opposite view]

004: S>Is it the case that CP is not a good deterrent?

005: C>No, I think CP is a good deterrent.

..............................................................................[C gives an answer which supports its own view for the sake of argument, since both answers “CP is a good deterrent” and “CP is a good deterrent” are found in C’s knowledge base]

006: S>Is it the case that mistakes rarely happen during judicial process is a prima facie reason for it is unlikely innocent people get killed?

007: C>Yes, I think mistakes rarely happen during judicial process is a prima facie reason for it is unlikely innocent people get killed.

..............................................................................[C gives the only answer found in its knowledge base]

008: S>Is it the case that suicide bombers want to die is a prima facie reason for some people are willing to die?

009: C>Yes, I think suicide bombers want to die is a prima facie reason for some people are willing to die.
010: S> Is it the case that CP definitely stops murderers commit further crimes is a prima facie reason for CP is acceptable?
011: C> Yes, I think CP definitely stops murderers commit further crimes is a prima facie reason for CP is acceptable.

012: S> I think CP definitely stops murderers commit further crimes.
013: C> Is it the case that CP definitely stops murderers commit further crimes is a prima facie reason for CP is acceptable?

014: S> I am not sure about it.
015: C> I think murderers should receive capital punishment.

016: S> I think CP is not acceptable.
017: C> Is it the case that the recent survey shows that 60% British people support CP?

018: S> I am not sure about it.
019: C> I think most people want CP back.

020: S> Is it the case that chances should be given to murderers for rehabilitation is a prima facie reason for murderers should not receive capital punishment?
021: C> Yes, I think chances should be given to murderers for rehabilitation is a prima facie reason for murderers should not receive capital punishment.

022: S> I think scientific techniques will increase the success of justice is a prima facie reason for mistakes rarely happen during judicial process.
023: C> Is it the case that CP is not acceptable?

024: S> Yes, I think CP is not acceptable.
025: C> Is it the case that execution of murderers is fair for the people being murdered?
026: S>No, I think execution of murderers is not fair for the people being murdered.

027: C>Is it the case that nobody is willing to die?

028: S>I am not sure about it.

029: C>Is it the case that CP definitely stops murderers commit further crimes?

030: S>I am not sure about it.

031: C>I think if you have anything more to say, you can go on.

032: S>Is it the case that political and racial bias often causes prejudices is a prima facie reason for there are mistakes during judicial process?

033: C>Yes, I think political and racial bias often causes prejudices is a prima facie reason for there are mistakes during judicial process.

034: S>Is it the case that some people are willing to die?

035: C>I am not sure about it.

036: S>I think murderers should not receive capital punishment.

037: C>Why is it the case that murderers should not receive capital punishment?

038: S>Because the recent survey shows that 60% British people support CP.

039: C>Is it the case that the recent survey shows that 60% British people support CP is a prima facie reason for most people want CP back?

040: S>Yes, I think the recent survey shows that 60% British people support CP is a prima facie reason for most people want CP back.

041: C>Is it the case that most people want CP back is a prima facie reason for CP is acceptable?
No, I think it is not the case that most people want CP back is a prima facie reason for CP is acceptable.

I think if you have anything more to say, you can go on.

I don't think mistakes rarely happen during judicial process is a prima facie reason for it is unlikely innocent people get killed.

I think if you have anything more to say, you can go on.

Why is it the case that most people want CP back?

Because the recent survey shows that 60% British people support CP.

I think CP definitely stops murderers commit further crimes.

Is it the case that CP definitely stops murderers commit further crimes is a prima facie reason for CP is acceptable?

I am not sure about it.

I think if you have anything more to say, you can go on.

I think there are mistakes during judicial process.

Is it the case that scientific techniques will increase the success of justice?

No, I think scientific techniques will not increase the success of justice.

I think if you have anything more to say, you can go on.

I think a state has the right to deliberately execute the wrong people.

Is it the case that CP is not acceptable?

I am not sure about it.

Simon, you seem to have given up your view, and so the game ends.
……………………………………………[Referee stops the game since S has given up its view]
DE 5

C= DE strategic agent Chris
S= DE strategic agent Simon
CP= Capital Punishment
C and S use the same knowledge base depicted in appendix D2

001: C> Is it the case that CP is acceptable?

..............................................[C starts the game by asking S’s view on the issue of capital punishment]

002: S> Yes, I think CP is acceptable.

..............................................................[S chooses to support CP]

003: C> I think CP is not acceptable.

..............................................................[C automatically adopts the opposite view]

004: S> I think CP is a good deterrent, and “CP is a good deterrent” is a reason for “CP is acceptable”.

..............................................................[S issues a direct support of its thesis, a subtopic is raised]

005: C> But CP having countries like USA has higher murder rate than UK, and “CP having countries like USA has higher murder rate than UK” is a reason for “CP is not a good deterrent”.

...........[C issues a piece of direct contradictory evidence to S’s statement “CP is a good deterrent”]

006: S> I think most people want CP back.

..............................................................[S issues a direct support of its thesis, another subtopic is raised]

007: C> Why is it the case that most people want CP back?

...........[C has doubt on but no objection to the popularity point, C therefore elicits further grounds]

008: S> Because the recent survey shows that 60% British people support CP.

..............................................................[S provides an evidential support]

009: C> I think it is wrong to take a human life.

..............................................................[C changes the focus and raises a subtopic- ethical issue]

010: S> Is it the case that a state has the right to deliberately execute the wrong people?

...........[S has objections to C’s statement “it is wrong to take a human life”, and then plans a line of questions to make C accept the objection as in turn 12 and 14]

011: C> Yes, I think a state has the right to deliberately execute the wrong people.

..............[C answers truthfully and responds with the only answer found in its knowledge base]

012: S> Is it the case that a state has the right to deliberately execute the wrong people is a prima facie reason for it is not always wrong to take a human life?
13: C> Yes, I think a state has the right to deliberately execute the wrong people is a prima facie reason for it is not always wrong to take a human life.

014: S> I think it is not always wrong to take a human life.

015: C> Is it the case that human lives are scarce?

016: S> Yes, I think human lives are scarce.

017: C> Is it the case that human lives are scarce is a prima facie reason for it is wrong to take a human life?

018: S> Yes, I think human lives are scarce is a prima facie reason for it is wrong to take a human life.

019: C> I think it is wrong to take a human life.

020: S> I think murderers should receive capital punishment, and “murderers should receive capital punishment” is a reason for “CP is acceptable”.

021: C> I think chances should be given to murderers for rehabilitation, and “chances should be given to murderers for rehabilitation” is a reason for “murderers should not receive capital punishment”.

022: S> Why is it the case that chances should be given to murderers for rehabilitation?

023: C> Because statistics shows that repeat offences of murders are extremely low.
024: S> Is it the case that nobody is willing to die?
 ......[S switches the focus and builds a distance plan (asking C to accept statement not directly supporting S’s thesis), and tries to make C accept its thesis gradually]

025: C> No, I think some people are willing to die.

026: S> Why is it the case that some people are willing to die?

027: C> Because suicide bombers want to die.

028: S> Is it the case that execution of murderers is fair for the people being murdered?

029: C> Yes, I think execution of murderers is fair for the people being murdered.

030: S> Is it the case that execution of murderers is fair for the people being murdered is a prima facie reason for murderers should receive capital punishment?

031: C> Yes, I think execution of murderers is fair for the people being murdered is a prima facie reason for murderers should receive capital punishment.

032: S> Is it the case that murderers should receive capital punishment is a prima facie reason for CP is acceptable?

033: C> Yes, I think murderers should receive capital punishment is a prima facie reason for CP is acceptable.

034: S> I think CP is acceptable.

035: C> Is it the case that political and racial bias often causes prejudices?
……[C has its own point of view concerning whether “CP is acceptable”, then builds its thesis by making a plan as well]

036: S>Yes, I think political and racial bias often causes prejudices.

……………[S answers truthfully and responds with the only answer found in its knowledge base]

037: C>Is it the case that political and racial bias often causes prejudices is a prima facie reason for there are mistakes during judicial process?

………………………………………………………………………………………………………………………[C continues to execute its plan]

038: S>Yes, I think political and racial bias often causes prejudices is a prima facie reason for there are mistakes during judicial process.

……………[S answers truthfully and responds with the only answer found in its knowledge base]

039: C>Is it the case that there are mistakes during judicial process is a prima facie reason for innocent people may get killed?

………………………………………………………………………………………………………………………[C continues to execute its plan]

040: S>Yes, I think there are mistakes during judicial process is a prima facie reason for innocent people may get killed.

……………[S answers truthfully and responds with the only answer found in its knowledge base]

041: C>Is it the case that innocent people may get killed is a prima facie reason for CP is not acceptable?

………………………………………………………………………………………………………………………[C continues to execute its plan]

042: S>Yes, I think innocent people may get killed is a prima facie reason for CP is not acceptable.

……………[S answers truthfully and responds with the only answer found in its knowledge base]

043: C>I think CP is not acceptable.

………………………………………………………………………………………………………………………[C successfully ends its plan by stating its thesis]

044: S>I think if you have anything more to say, you can go on.

………………………………………………………………………………………………………………………[S runs out of methods and therefore hands over its turn]

045: C>Is it the case that CP is acceptable?

………………………………………………………………………………………………………………………[C checks whether S still adheres to its thesis]

046: S>Yes, I think CP is acceptable.

………………………………………………………………………………………………………………………[S still adheres to its thesis though run out of moves in turn 044]

047: C>I think innocent people may get killed, and “innocent people may get killed” is a reason for “CP is not acceptable”.

………………………………………………………………………………………………………………………[C raises a further point- the consequence issue]
048: S>I think mistakes rarely happen during judicial process, and “mistakes rarely happen during judicial process” is a reason for “it is unlikely innocent people get killed”.

..................[S has an objection to C’s consequence point, and directly states that objection]

049: C>Why is it the case that mistakes rarely happen during judicial process?

...........[C has doubt but no objection to S’s point “mistakes rarely happen during judicial process”, C therefore elicit for further reasons]

050: S>Because scientific techniques will increase the success of justice.

..........................................................[S provides an evidential support]

051: C>I think if you have anything more to say, you can go on.

..........................................................[C runs out of methods]

052: R>Ok, you both are doing very well. We need an audience vote on who wins.

.........................[Referee calls off the debate since both agents have run out of methods]
DE6

C= DE strategic agent Chris
S= DE Strategic agent Simon
S uses the knowledge base in appendix D2
C uses the knowledge base in appendix D3

001: C> Is it the case that CP is acceptable?

………………..[C starts the game by asking S’s view on the issue of capital punishment]

002: S> Yes, I think CP is acceptable.

…………………………………………………………………………………[S chooses to support CP]

003: C> I think CP is not acceptable.

…………………………………………………………………………………[C automatically adopts the opposite view]

004: S> I think most people want CP back.

………………………………………………………………………………………………………[S issues a direct support of its thesis, a subtopic is raised]

005: C> Is it the case that CP is acceptable?

……..[C does not recognise the previous statement, and then assesses whether S still adheres to its thesis]

006: S> Yes, I think CP is acceptable.

………………………………………………………………………………………………………[S adheres to its thesis]

007: C> Is it the case that there are mistakes during judicial process?

………………………………………………………………………………………………………[S makes a plan and asks C to accept a statement that supports S’s thesis]

008: S> No, I think mistakes rarely happen during judicial process.

……………………………………………………………………………………………………………………………[S gives an answer which supports its own view for the sake of argument, since both answers “there are mistakes during the judicial process” and “mistakes rarely happen during judicial process” are found in S’s knowledge base]

009: C> I think innocent people may get killed.

………………………………………………………………………………………………………[S issues a direct support of its thesis, and a subtopic is raised]

010: S> Is it the case that scientific techniques will increase the success of justice?

……..[S has objections to C’s statement “innocent people may get killed”, and then plans a line of questions to make C accept the objection]

011: C> I am not sure about it.

………………..[C does not recognise the statement being questioned, and therefore answer truthfully]

012: S> I think murderers should receive capital punishment.
170

…………………………………….[S issues a direct support of its thesis, and a subtopic is raised]
013: C>Is it the case that CP is acceptable?

……..[C does not recognise the previous statement, then, assesses whether S still adheres to its thesis]
014: S>Yes, I think CP is acceptable.

………………………………………………………………………………[S adheres to its thesis]
015: C>Why is it the case that CP is acceptable?

…………..[C hopes to find the attacking point behind it, and therefore challenges for further reasons]
016: S>Because murderers should receive capital punishment.

……………………………………………………………………………[S issues a support which can be further supported]
017: C>Is it the case that CP is acceptable?

……..[C does not recognise the previous statement, and then assesses whether S still adheres to its thesis]
018: S>Yes, I think CP is acceptable.

……………………………………………………………………………[C runs out of moves and therefore hands over the turn]
019: C>I think if you have anything more to say, you can go on.

……………………………………………………………………………[C runs out of moves and therefore hands over the turn]
020: S>Is it the case that CP is not acceptable?

………………………………………………………………………………[S checks whether C still adheres to its thesis]
021: C>Yes, I think CP is not acceptable.

………………..[C adheres to its thesis since it has a support “innocent people may get killed” which is uttered in turn 09]
022: S>Is it the case that execution of murderers is fair for the people being murdered?

……………………………………[S makes a plan and asks C to accept a statement that supports S’s thesis]
023: C>I am not sure about it.

……………………………………[C does not recognise the statement being questioned, and then answers truthfully]
024: S>I think CP is a good deterrent.

………………………………………………………………………………[S issues a direct support of its thesis]
025: C>Why is it the case that CP is a good deterrent?

………………..[C has doubt on but no objection to S’s deterrent point, C therefore elicits for further reasons]
026: S>Because statistics shows an increase in murder rate since the abolition of CP.

………………………………………………………………………………[C provides evidential support]
027: C> Is it the case that CP is acceptable?

…… [C does not recognise the previous statement, and then assesses whether S still adheres to its thesis]

028: S> Yes, I think CP is acceptable.

……………………………………………………………………... [S adheres to its thesis]

029: C> I think if you have anything more to say, you can go on.

………………………………………………………… [C runs out of moves and therefore hands over the turn]

030: S> Is it the case that CP is not acceptable?

…………………………………………………………………….. [S checks whether C still adheres to its thesis]

031: C> Yes, I think CP is not acceptable.

………. [C adheres to its thesis since it has a support “innocent people may get killed” which was uttered in turn 09]

032: S> Is it the case that nobody is willing to die?

…….. [S builds a distance plan by asking C to accept a statement not directly supporting S’s thesis, and tries to make C accept its thesis gradually]

033: C> Yes, I think nobody is willing to die.

……………… [C answers truthfully and responds with the only answer found in its knowledge base]

034: S> Is it the case that nobody is willing to die is a prima facie reason for CP makes people less likely commit serious crimes?

…………………………………………………………………….. [S continues to execute its plan]

035: C> Yes, I think nobody is willing to die is a prima facie reason for CP makes people less likely commit serious crimes.

……………… [C answers truthfully and responds with the only answer found in its knowledge base]

036: S> Is it the case that CP makes people less likely commit serious crimes is a prima facie reason for CP is a good deterrent?

…………………………………………………………………….. [S continues to execute its plan]

037: C> Yes, I think CP makes people less likely commit serious crimes is a prima facie reason for CP is a good deterrent.

……………… [C answers truthfully and responds with the only answer found in its knowledge base]

038: S> Is it the case that CP is a good deterrent is a prima facie reason for CP is acceptable?

…………………………………………………………………….. [S continues to execute its plan]

039: C> Yes, I think CP is a good deterrent is a prima facie reason for CP is acceptable.
………. [C answers truthfully and responds with the only answer found in its knowledge base]

040: S> I think CP is acceptable.

…………………………………………………………...[S successfully ends its plan by stating its thesis]

041: C> I think if you have anything more to say, you can go on.

…………………………………………………………...[C runs out of moves and hands over the turn]

042: S> Is it the case that CP is not acceptable?

…………………………………………………………...[S checks whether C still adheres to its thesis]

043: C> Yes, I think CP is not acceptable.

…….[C adheres to its thesis since it has a support “innocent people may get killed” which was uttered in turn 09]

044: S> Why is it the case that CP is not acceptable?

…………………………………………………………………...[S challenges for further reasons]

045: C> Because innocent people may get killed.

……………………………………………………………………...[C gives reasons supporting its thesis]

046: S> Why is it the case that innocent people may get killed?

……………………………………………………………………...[S challenges for further reasons]

047: C> Because there are mistakes during judicial process.

………………………………………………………………………………[C provides a support]

048: S> Why is it the case that there are mistakes during judicial process?

………………………………………………………………………………[S challenges for further reasons]

049: C> I don't know why there are mistakes during judicial process.

…….[C has no further support available in its knowledge base, and therefore speaks the truth]

050: S> Why is it the case that innocent people may get killed?

…………………………………………………………………...[S challenges the statement being supported by the withdrawn statement]

051: C> I don't know why innocent people may get killed.

…….[C withdraws the point since its support “there are mistakes during judicial process” has been withdrawn in turn 049]

052: S> Is it the case that CP is not acceptable?

…..[S assesses whether C still adheres to its thesis since C has withdrawn a direct support of its thesis “innocent people may get killed”]

053: C> No, I think CP is acceptable.
……………[C accepts S’s view since C’s only thesis support has been withdrawn in turn 051]

054: R>Chris, you lose and Simon wins.

…………………………………[The debate ends since C’s view has been converted to S’s view]
APPENDIX D

KNOWLEDGE BASE

Appendix D1 Example Knowledge Base (I)

The example knowledge bases shown below were adopted by the DC and DE agents system discussed in chapter five and six (i.e. the agents in DC1, DC2, DC3, DC4, DE1, DE2 and DE3). The knowledge base supporting the view “CP is acceptable” is separated from the one supporting the opposite view. Each knowledge base contains a set of conditionals and a set of propositions, which are organised following a Toulmin like structure (e.g. the example knowledge base in appendix D2). The contents of these knowledge bases are listed below.

Proponent Knowledge Base:

Conditionals

C1: CP is a good deterrent
implies
CP is acceptable

C2: CP decreases violent crime
implies
CP is acceptable

C3: most people want CP back
implies
CP is acceptable

C4: murderers should receive capital punishment
implies
CP is acceptable

C5: mistakes are not likely to happen during judicial process
implies
it is unlikely innocent people get killed

C6: CP decreases violent crime
implies
CP is a good deterrent

C7: 60% British people support CP
implies
most people want CP back
C8: all murderers are hanged
implies
CP decreases violent crime

C9: scientific techniques will guarantee the success of justice
implies
mistakes are not likely to happen during judicial process

C10: repeat crime rate is high
implies
murderers should not have the opportunity for rehabilitation

**Propositions:**

P1: CP is acceptable
P2: CP is a good deterrent
P3: CP decreases violent crime
P4: murderers should receive capital punishment
P5: it is unlikely innocent people get killed
P6: mistakes are not likely to happen during judicial process
P7: most people want CP back
P8: all murderers are hanged
P9: some people want to die
P10: suicide bombers are willing to die
P11: repeat crime rate is high
P12: scientific techniques will guarantee the success of justice
P13: truth is always on the side of most people
P14: 60% British people support CP
P15: it is not wrong to take human life
P16: a state has the right to kill murderers
P17: political or racial bias will not cause prejudice
P18: not everybody belongs to the God
P19: murderers should not have the opportunity for rehabilitation
Opponent knowledge Base:

Conditionals:

C1: innocent people get killed
   implies
   CP is not acceptable
C2: it is wrong to take a human life
   implies
   CP is not acceptable
C3: murderers should have the opportunity for rehabilitation
   implies
   CP is not acceptable
C4: there are mistakes during judicial process
   implies
   innocent people get killed
C5: nobody has the right to kill other people
   implies
   it is wrong to take a human life
C6: repeat crime rate is extremely low
   implies
   murderers should have the opportunity for rehabilitation
C7: political or racial bias will cause prejudices
   implies
   scientific techniques will not guarantee the success of justice
C8: murderers should not receive capital punishment
   implies
   CP does not decrease violent crimes
C9: scientific techniques will not guarantee the success of justice
   implies
   there are mistakes during judicial process
C10: nobody wants to die
    implies
    CP is not acceptable

Propositions:

P1: CP is not acceptable
P2: CP is not a good deterrent
P3: everybody belongs to the God
P4: innocent people get killed
P5: it is wrong to take a human life
P6: killing innocent people is wrong
P7: nobody has the right to kill other people
P8: truth is sometimes on the side of fewer people
P9: nobody wants to die
P10: suicide bombers are not willing to die
P11: there are mistakes during judicial process
P12: most people don't want CP back
P13: murderers should have the opportunity for rehabilitation
P14: repeat crime rate is extremely low
P15: not all murderers are hanged
P16: CP does not decrease violent crimes
P17: 60% British people do not support CP
P18: scientific techniques will not guarantee the success of justice
P20: political or racial bias will cause prejudices
P21: murderers should not receive capital punishment
Appendix D2  Example Knowledge Base (II)

The example knowledge base shown below was adopted by the strategic agents system discussed in chapter nine (i.e. the agents in DE4 and DE5, and agent S in DE6). A horizontal line shows a rebuttal relationship, a vertical line shows a supporting relationship, and a blue coloured proposition indicates that it is a piece of hard evidence, i.e. statistical evidence.
Appendix D3 Example Knowledge Base (III)

This subset of the knowledge base shown in appendix D2 was adopted by one of the strategic agents discussed in chapter nine (i.e. agent C in DE6). A horizontal line shows a rebuttal relationship, a vertical line shows an upward supporting relationship.
APPENDIX E

USABILITY EVALUATION

Appendix E1 Human Computer Debating System Comments (I)

Returned By MF on 22nd March 2004

The comments were made by an HCI lecturer who evaluated an initial human computer debate prototype. The prototype evaluated here operationalises the DE dialogue model and uses random arguments. The comments are as follows.

Hi Tommy,

I had a good look at the application and I find it generally easy to use after I went through each function at least once. Therefore, my main comments/recommendations are regarding this initial "learning phase" that everyone who uses the tool for the first time inevitably goes through.

- the initial prompt to choose "new game" is superfluous as there isn't anything else a user can do anyway. the application should start with the new game already opened (or provide a message box saying "Click ok to open new game, or cancel to quit)
- Maybe use “Debate” instead of “Game” – doesn’t seem to be very playful
- The “go” button should be more prominent, and closer to the move type choice. Maybe try the following:

![Diagram of move type choice and move content choice]

- When move types are not available, they should not be in the dropdown list (or clearly greyed out). I found myself going through the move types several times only to find out that there’s only one move type allowed in that particular situation. It wasn’t obvious.
- I don’t understand what “implies” does, couldn’t find help about it either.
- Maybe you should move the position windows to the bottom to emphasise what’s for actions, and what’s just information. Alternatively use more colour, e.g. positions grey, debate log black, move type choice red...
- When referring to the user, use first person singular (I, my) instead of third person (you). For example, the position window would have the heading “my positions”.
- What does the “S” stand for in the debate history? “C” is for computer, I suppose.
- I think the 6 buttons at the top of the help popup enable me to go through the sequence of pages. If that’s correct, then I’d order them in a top-down fashion to reflect this sequence, i.e. starting with introduction and ending with referee. At the moment, they do not imply an order and therefore look rather arbitrary.
The menu item "Guidelines" leads to the popup window titled "On Line Training" - be consistent here (and elsewhere).

Some more general comments, probably to do with java:
- What are the blueish/pinkish dotted lines round buttons? looks odd.
- the scrollbars seem to use strange colours. I would instinctively click on the grey part to slide it up and down, turns out that's not the slider. very confusing initially

Another thing, I got repeatedly stuck with an alleged conflict, but I don’t understand where the problem may be. See for example attached screenshot:

In this example, I don’t think I was in conflict with what I said earlier. In fact, the computer seems to be in conflict, saying that CP is not acceptable but admitting that it helps decreasing violent crime. But that’s only in the positions window, the computer never actually said (or implied) that…

Hope this helps.
Appendix E2

Human Computer Debating System Comments (II)

Returned By TR on 22\textsuperscript{nd} March 2004

The comments were made by an HCI researcher who evaluated the human computer debating system. The system operationalises the DE dialogue model and the proposed strategy. The original comments are as follows.

Evaluation of the debating game

I did manage to get to play the game twice so from that point of view the system is usable. Of course I lost which did not make me feel too good and I wondered if you had considered incorporating scores into the game so that at least one could loose with a sense of honour. The system did not crash and once I’d got started I was guided successfully to the next step. I could clearly see the computer’s argument and my responses so good marks for that.

Have you considered adding more contextual information to the quick tips area? I am sure this would be of interest to those wanting to beat the machine. You thoughtfully provided a quick start tips pop up box. The title of which by the way has a typographical error in it – quich. This had incorporated scroll bars in it to view the content. Again there are minor changes which could improve presentation: the word screen rather than the technical sounding system’s interface, the use of the word abbreviated in stead of the word simplified.

I think attention could be drawn to the need to fully expand the display to fill the screen in order to see the middle section and the dialogues in other areas. I discovered this by accident.

I was not at all clear as to what function the “implies” box served perhaps an example or two would help the less with it users but it was good that attention was drawn to it.

I regret to say that I found the flashing instructions irritating. They are also lower left on the screen’s layout which is one of the least prominent positions on a screen. The colours used were red – a large proportion of the population is colour blind to red and blue - a wavelength which we have most difficulty in perceiving particularly on a grey background. I think this area deserves more prominence, should use black on white and use size and position as saliency clues.

The salience of the “go” button is considerable even at times when clicking on it produces no result because what the user ought to do is go up to the drop down menus to select options there. Perhaps you could consider greying out the “go” until it should be clicked upon. I’m not sure what benefit some of the options offered are eg color?

At one stage in the game I received a advice about R and P but could not use it because these terms had not been defined. Some of the other instructions were not clear eg “It is your turn now, please select the more choice”? At the beginning I think I would have preferred a statement of the question being debated followed by options to agree or disagree rather than yes/no.

I hope this helps and is what you wanted.

Best wishes
Appendix E3

Human Computer Debating System Comments (III)

Returned By NP on 22nd March 2004

The comments were made by an HCI researcher who evaluated the human computer debating system. The system operationalises the DE dialogue model and the proposed strategy. The original comments are as follows (the evaluator made some word style comments on the extracted documents from the debating system, the evaluator also enclosed two debate transcripts between him and the system)

Tips for a quick start

1. Introduction to the game

This is a debating dialogue game, which will enable you and the computer to have a contentious debate on the issue of Capital Punishment (simplified as CP). You (simplified as S) and the computer (simplified as C) will make move in turn1. A debate will be ended if one party has accepted the other party’s thesis.

2. A quick start

Before you start a game, you’d better have a quick glance of the system interface. On the top of the interface, there are two boxes which record what you and the computer have said or accepted during the debate. The middle part of the interface records the debate history2. The bottom part of the interface provides a set of move types and a list of statement you will use as input during the debate. You are suggested to have a good look at them now.

3. Input tips

At the very bottom of the interface, a blinking message bar will provide short instructions re how you making a move. It is worth noted that there is an “Implies” checkbox at the right bottom corner which is designed for you to say something like “‘CP is a good deterrent’ implies ‘CP is acceptable’”, you need to select ‘CP is a good deterrent’ from the list first, then click the “Implies” checkbox, and finally select ‘CP is acceptable’ from the list.

4. About position stores

When you start the game3, you may noticed that some statements are marked with an “*” in the position stores, while some are not. Statements with this mark are those one has implicitly accepted or raised no objection to, and statements without this mark are those one has explicitly stated.

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1 “… take turns to make a move.”
2 This part is not visible when the application is launched, consequently this is initially confusing.
3 Strictly speaking when you start the game there are no propositions, so also none marked with a “*”, perhaps “As you play the game …”
Launch Size

The size of the application when launched does not appear to be a sensible size for the application to be operated, since:

- The central *Debate History* is not visible,
- The *Move Content Choice* is not wide enough for the full statement to be read.

It may be better to launch this to a size that can display all the elements adequately for use, perhaps full screen of full screen with a space for the *Tips for a quick start* or *Help window* adjacent.

In full screen mode the menus sometimes (not always) drop down instead of up, making it impossible to read, more than the first three items.
Size of Proposition Boxes

There seems to be a difficulty with the size of the propositions, they should be long in order to express correctly what is meant. A side effect of this, however, is that it is difficult to fit in the propositions so that they can be read easily.

When trying to explore the scrolling possibilities of the textbox, I ran into a curious position where I suddenly had two sets of scrollbars for the one textbox. Parts of these textboxes and scrollbars being outside the active window.

I believe it would be better, if possible, to allow text wrapping within the text boxes and only have a vertical scrolling. For text horizontal scrolling is not good, since it means that you are scrolling to read each line, vertical scrolling is more acceptable and obviously required in this application, since there is inevitably a lot of text in the proposition stores.

By the way the *Debate History* window scrolling works fine, with the vertical scrollbar alone. If this could be replicated with word-wrapping in the Proposition windows, that would help.

Text

With my dyslexia hat on: it would be better to avoid the Times New-Roman fonts and use Ariel or other sans-serif fonts, also to use a colour combination such as dark blue text on a pastel background, in order to reduce the screen contrast. Just found that you change the background to the Debate History, which is good. Should all the background colours of all the text boxes be up-dated in the same way, at the same time? Allowing the text colour to be adjusted would also be good.

The changing colour text is good for attracting attention, but makes it harder to read.
Scrolling
As the debate progressed, I found that I had to scroll down the various Debate History and Position windows, to find the last stage of the argument. It would be better, if possible, if the windows always showed the most recent stage and let the user scroll back to review what was said if necessary. Otherwise, it becomes an additional task each turn to scroll down and see what the computer has replied.

Proposition Boxes
Progressing through the first debate the proposition boxes became a little mangled.

Restarting
When restarting, the opening statement:

01: C> Is it the case that CP is acceptable?

was scrolled up in the Debate History box, so was not visible. This should be visible, otherwise the Yes/No/I’m not sure prompt does not make any sense.

Winning
After two long debates with the computer, it seemed to let me win. Though it is not clear why at that point it changed its mind. During these debates I thought I had the computer agree to a series of propositions that would lead it to change its initial position, but it seemed to hold these incompatible ideas, without difficulty. When it did concede, it was a surprise to me. These debates are enclosed.

Propositions
The English of the propositions need checking, when I get chance.
Debate 1 [Sample debate between the evaluator (S) and the computer (C)]

01: C> Is it the case that CP is acceptable?
02: S> Yes, I think CP is acceptable.
03: C> I think CP is not acceptable.
04: S> Why is it the case that CP is not acceptable?
05: C> Because it is wrong to take a human life.
06: S> I don't think it is wrong to take a human life.
07: C> I think innocent people may get killed.
08: S> Why is it the case that innocent people may get killed?
09: C> Because there are mistakes during judicial process.
10: S> I don't think there are mistakes during judicial process.
11: C> Is it the case that political and racial bias often causes prejudices?
12: S> No, I think political and racial bias will not cause prejudices.
13: C> Is it the case that human lives are scarce?
14: S> I am not sure about it.
15: C> Is it the case that CP does not give murderers opportunities for rehabilitation?
16: S> Yes, I think CP does not give murderers opportunities for rehabilitation.
17: C> Is it the case that 'CP does not give murderers opportunities for rehabilitation' implies 'CP is not acceptable'?
18: S> No, I think it is not the case that 'CP does not give murderers opportunities for rehabilitation' implies 'CP is not acceptable'.
19: C> I think if you have anything more to say, you can go on.
20: S> I think chances should not be given to murderers for rehabilitation.
21: C> Is it the case that CP is acceptable?
22: S> Yes, I think CP is acceptable.
23: C> I think if you have anything more to say, you can go on.
24: S> I think CP is a good deterrent.
25: C> But CP having countries like USA has higher murder rate than UK.
26: S> I think CP is a good deterrent.
27: C> Is it the case that CP having countries like USA has higher murder rate than UK?
28: S> No, I think it is not the case that CP having countries like USA has high murder rate than UK.
29: C> I think if you have anything more to say, you can go on.
30: S> I think execution of murderers is fair for the people being murdered.
31: C> I think if you have anything more to say, you can go on.
32: S> I think it is unlikely innocent people get killed.
33: C> Why is it the case that it is unlikely innocent people get killed?
34: S> Because scientific techniques will increase the success of justice.
35: C> I think if you have anything more to say, you can go on.
36: S> I think CP makes people less likely commit serious crimes.
37: C> Why is it the case that CP makes people less likely commit serious crimes?
38: S> Because CP definitely stops murderers commit further crimes.
39: C> I think if you have anything more to say, you can go on.
40: S> I think the recent survey shows that 60% British people support CP.
41: C> I think if you have anything more to say, you can go on.
42: S> I think statistics shows an increase in murder rate since the abolition of CP.
43: C> I think if you have anything more to say, you can go on.
44: S> I think 'statistics shows an increase in murder rate since the abolition of CP' implies 'CP is acceptable'.
45: C> I think if you have anything more to say, you can go on.
46: S> I think 'the recent survey shows that 60% British people support CP' implies 'CP is acceptable'.
47: C> I think if you have anything more to say, you can go on.
48: S> I think 'CP definitely stops murderers commit further crimes' implies 'CP is acceptable'.
49: C> I think if you have anything more to say, you can go on.
50: S> I think 'CP definitely stops murderers commit further crimes' implies 'CP is acceptable'.
51: C> I think if you have anything more to say, you can go on.
52: S> Is it the case that CP definitely stops murderers commit further crimes?
53: C> Yes, I think CP definitely stops murderers commit further crimes.
54: S> Is it the case that 'CP definitely stops murderers commit further crimes' implies 'CP is acceptable'?
55: C> Yes, I think 'CP definitely stops murderers commit further crimes' implies 'CP is acceptable'.
56: S> Is it the case that CP is acceptable?
57: C> No, I think CP is not acceptable.
58: S>Why is it the case that CP is not acceptable?
59: C>Because CP does not give murderers opportunities for rehabilitation.
62: S>Why is it the case that CP does not give murderers opportunities for rehabilitation?
63: C>I don't know why CP does not give murderers opportunities for rehabilitation.
64: S>Is it the case that chances should not be given to murderers for rehabilitation?
65: C>No, I think chances should be given to murderers for rehabilitation.
66: S>Why is it the case that chances should be given to murderers for rehabilitation?
67: C>Because statistics shows that repeat offences of murders are extremely low.
68: S>I don't think statistics shows that repeat offences of murders are extremely low.
69: C>I think if you have anything more to say, you can go on.
70: S>Why is it the case that statistics shows that repeat offences of murders are extremely low?
71: C>I don't know why statistics shows that repeat offences of murders are extremely low.
72: S>I think 'statistics shows that repeat offences of murders are extremely low' implies 'CP is acceptable'.
73: C>I think if you have anything more to say, you can go on.
74: S>Is it the case that 'statistics shows that repeat offences of murders are extremely low' implies 'CP is acceptable'?
75: C>I am not sure about it.
76: S>Is it the case that 'CP is not acceptable' implies 'CP is acceptable'?
77: R>It is not a valid conditional, please try again!
78: S>Is it the case that 'it is wrong to take a human life' implies 'CP is acceptable'?
79: C>I am not sure about it.
80: S>Is it the case that 'innocent people may get killed' implies 'CP is acceptable'?
81: C>I am not sure about it.
82: S>I think chances should not be given to murderers for rehabilitation.
83: C>Is it the case that CP is acceptable?
84: S>Yes, I think CP is acceptable.
85: C>I think if you have anything more to say, you can go on.
86: S>Is it the case that CP is acceptable?
87: C>Yes, I think CP is acceptable.
88: R>Congratulations, You win.
Debate 2 [Sample debate between the evaluator (S) and the computer (C)]

01: C> Is it the case that CP is acceptable?
02: S> No, I think CP is not acceptable.
03: C> I think CP is acceptable.
04: S> Is it the case that CP is acceptable?
05: C> Yes, I think CP is acceptable.
06: S> Is it the case that CP is acceptable?
07: C> Yes, I think CP is acceptable.
08: S> Is it the case that CP is acceptable?
09: C> Yes, I think CP is acceptable.
10: S> Is it the case that CP is acceptable?
11: C> Yes, I think CP is acceptable.
12: S> I think CP is not acceptable.
13: C> Is it the case that nobody is willing to die?
14: S> No, I think some people are willing to die.
15: C> Why is it the case that some people are willing to die?
16: S> Because suicide bombers want to die.
17: C> Is it the case that the recent survey shows that 60% British people support CP?
18: S> I am not sure about it.
19: C> Is it the case that statistics shows an increase in murder rate since the abolition of CP?
20: S> I am not sure about it.
21: C> Is it the case that execution of murderers is fair for the people being murdered?
22: S> No, I think execution of murderers is not fair for the people being murdered.
23: C> I think murderers should receive capital punishment.
24: S> I think CP having countries like USA has higher murder rate than UK.
25: C> I think CP is a good deterrent.
26: S> I don't think CP is a good deterrent.
27: C> I think most people want CP back.
28: S> I think chances should be given to murderers for rehabilitation.
29: C> Why is it the case that chances should be given to murderers for rehabilitation?
30: S> Because chances should be given to murderers for rehabilitation.
31: R> You are begging the question 'chances should be given to murderers for rehabilitation', which is under dispute, please try again!
32: C> Because it is wrong to take a human life.
33: C> Is it the case that a state has the right to deliberately execute the wrong people?
34: S> No, I think a state does not have the right to deliberately execute the wrong people.
35: C> Is it the case that CP definitely stops murderers commit further crimes?
36: S> No, I think CP does not stop murderers commit further crimes.
37: C> I think if you have anything more to say, you can go on.
38: S> Is it the case that CP is not acceptable?
39: C> No, I think CP is acceptable.
40: S> Is it the case that CP is acceptable?
41: C> Yes, I think CP is acceptable.
42: S> Is it the case that 'chances should be given to murderers for rehabilitation' implies 'CP is not acceptable'?
43: C> I am not sure about it.
44: S> Is it the case that 'it is wrong to take a human life' implies 'CP is not acceptable'?
45: C> Yes, I think 'it is wrong to take a human life' implies 'CP is not acceptable'.
46: S> Is it the case that it is wrong to take a human life?
47: C> No, I think it is not always wrong to take a human life.
48: S> Is it the case that human lives are scarce?
49: C> Yes, I think human lives are scarce.
50: S> Is it the case that 'human lives are scarce' implies 'it is wrong to take a human life'?
51: C> Yes, I think 'human lives are scarce' implies 'it is wrong to take a human life'.
52: S> Is it the case that CP is not acceptable?
53: C> No, I think CP is acceptable.
54: S> Is it the case that CP is not acceptable?
55: C> No, I think CP is acceptable.
56: S> Is it the case that CP is not acceptable?
57: C> No, I think CP is acceptable.
58: S> Is it the case that CP is acceptable?
59: C> Yes, I think CP is acceptable.
60: S> Is it the case that CP is not a good deterrent?
61: C> No, I think CP is a good deterrent.
62: S> Is it the case that CP having countries like USA has higher murder rate than UK?
63: C> Yes, I think CP having countries like USA has higher murder rate than UK.
64: S> Is it the case that 'CP having countries like USA has higher murder rate than UK' implies 'CP is not a good deterrent'?
65: C> Yes, I think 'CP having countries like USA has higher murder rate than UK' implies 'CP is not a good deterrent'.
66: S> Is it the case that CP is not a good deterrent?
67: C> No, I think CP is a good deterrent.
68: S> Why is it the case that CP is a good deterrent?
69: C> Because statistics shows an increase in murder rate since the abolition of CP.
70: S> Is it the case that statistics shows that repeat offences of murders are extremely low?
71: C> Yes, I think statistics shows that repeat offences of murders are extremely low.
72: S> Is it the case that 'statistics shows that repeat offences of murders are extremely low' implies 'CP is not acceptable'?
73: C> Yes, I think 'statistics shows that repeat offences of murders are extremely low' implies 'CP is not acceptable'.
74: S> Is it the case that CP is not acceptable?
75: C> Yes, I think chances should be given to murderers for rehabilitation.
76: S> Why is it the case that chances should be given to murderers for rehabilitation?
77: C> Because murderers should receive capital punishment.
78: S> Why is it the case that capital punishment is fair for the people being murdered?
79: C> No, I think CP is acceptable.
80: S> Is it the case that CP is not acceptable?
81: C> Yes, I think CP is acceptable.
82: S> Is it the case that chances should be given to murderers for rehabilitation?
83: C> Yes, I think chances should be given to murderers for rehabilitation.
84: S> Is it the case that 'chances should be given to murderers for rehabilitation' implies 'CP is not acceptable'?
85: C> Yes, I think 'chances should be given to murderers for rehabilitation' implies 'CP is not acceptable'.
86: S> Is it the case that CP is not acceptable?
87: C> Yes, I think CP is acceptable.
88: S> Why is it the case that CP is acceptable?
89: C> Because most people want CP back.
90: S> Why is it the case that most people want CP back?
91: C> Because the recent survey shows that 60% British people support CP.
92: S> Why is it the case that the recent survey shows that 60% British people support CP?
93: C> I don't know why the recent survey shows that 60% British people support CP.
94: S> Is it the case that CP is not acceptable?
95: C> Yes, I think CP is acceptable.
96: S> Is it the case that capital punishment is fair for the people being murdered?
97: C> No, I think CP is acceptable.
98: S> Why is it the case that capital punishment is fair for the people being murdered?
99: C> Yes, I think CP is acceptable.
100: S> Is it the case that CP is not acceptable?
101: C> No, I think CP is acceptable.
102: S> Is it the case that statistics shows that repeat offences of murders are extremely low?
103: C> Yes, I think statistics shows that repeat offences of murders are extremely low.
104: S> Is it the case that 'statistics shows that repeat offences of murders are extremely low' implies 'CP is not acceptable'?
105: C> Yes, I think 'statistics shows that repeat offences of murders are extremely low' implies 'CP is not acceptable'.
106: S> Is it the case that CP is not acceptable?
107: C> Yes, I think CP is acceptable.
108: S> Is it the case that 'CP is acceptable' implies 'chances should be given to murderers for rehabilitation'?
109: C> Yes, I think 'CP is acceptable' implies 'chances should be given to murderers for rehabilitation'.
110: S> Is it the case that 'chances should be given to murderers for rehabilitation' implies 'CP is acceptable'?
111: C> Yes, I think CP is acceptable.
112: S> Is it the case that CP is not acceptable?
113: C> Yes, I think CP is acceptable.
114: S>I don't think statistics shows an increase in murder rate since the abolition of CP.
115: C>I think if you have anything more to say, you can go on.
116: S>I don't think 'statistics shows an increase in murder rate since the abolition of CP' implies 'CP is a
good deterrent'.
117: C>I think if you have anything more to say, you can go on.
118: S>Is it the case that CP is acceptable?
119: C>Yes, I think CP is acceptable.
120: S>Is it the case that CP is not acceptable?
121: C>No, I think CP is acceptable.
122: S>Why is it the case that CP is acceptable?
123: C>Because CP definitely stops murderers commit further crimes.
124: S>Why is it the case that CP definitely stops murderers commit further crimes?
125: C>I don't know why CP definitely stops murderers commit further crimes.
126: S>Why is it the case that CP is a good deterrent?
127: C>Because CP makes people less likely commit serious crimes.
128: S>Why is it the case that CP makes people less likely commit serious crimes?
129: C>Because nobody is willing to die.
130: S>Is it the case that suicide bombers want to die?
131: C>Yes, I think suicide bombers want to die.
132: S>Is it the case that 'suicide bombers want to die' implies 'some people are willing to die'?
133: C>Yes, I think 'suicide bombers want to die' implies 'some people are willing to die'.
134: S>Is it the case that 'some people are willing to die' implies 'CP does not make people less likely
commit serious crimes'?
135: C>I am not sure about it.
136: S>Is it the case that 'CP does not make people less likely commit serious crimes' implies 'CP is not
acceptable'?
137: C>I am not sure about it.
138: S>Is it the case that CP is not acceptable?
139: C>I am not sure about it.
140: S>Is it the case that CP is not acceptable?
141: C>I am not sure about it.
142: S>Is it the case that 'CP having countries like USA has higher murder rate than UK' implies 'CP is not
a good deterrent'?
143: C>Yes, I think 'CP having countries like USA has higher murder rate than UK' implies 'CP is not a
good deterrent'.
144: S>Is it the case that 'CP is not a good deterrent' implies 'CP is not acceptable'? 
145: C>I am not sure about it.
146: S>Is it the case that CP is not acceptable?
147: C>I am not sure about it.
148: S>Is it the case that CP is not a good deterrent?
149: C>No, I think CP is a good deterrent.
150: S>Why is it the case that CP is a good deterrent?
151: C>Because CP makes people less likely commit serious crimes.
152: S>Is it the case that CP is not acceptable?
153: C>No, I think CP is acceptable.
154: S>Is it the case that CP is not acceptable?
155: C>I am not sure about it.
156: S>Is it the case that CP is not acceptable?
157: C>I don't think CP is acceptable.
158: S>Why is it the case that if you have anything more to say, you can go on?
159: C>I don't know why if you have anything more to say, you can go on.
160: S>Is it the case that CP is not acceptable?
161: C>I am not sure about it.
162: S>Is it the case that CP is not acceptable?
163: C>I am not sure about it.
164: S>Is it the case that CP is not acceptable?
165: C>I am not sure about it.
166: S>Why is it the case that if you have anything more to say, you can go on?
167: C>I don't know why if you have anything more to say, you can go on.
168: S>I think 'chances should be given to murderers for rehabilitation' implies 'CP is not acceptable'.
169: C>I think if you have anything more to say, you can go on.
170: S>Is it the case that CP is not acceptable?
171: C>Yes, I think CP is not acceptable.
172: R>Congratulations, You win.
Appendix E4

Notes of Evaluation of Human Computer Debating System

By MS on 18th March 2004

This evaluation was made by an HCI lecturer. The system operationalises the DE dialogue model and the proposed strategy. This evaluation was carried out in two sessions: a cooperative evaluation session and an interview session. The notes of the evaluation were formalised by the system author and emailed to the evaluator to check the accuracy. The returned notes are as follows.

Cooperative Evaluation Session

During the evaluation session, the system author took the notes below:

1) Spelling: the word “quich” should be “quick”

2) The proposition “wrong people”—to be replaced with ‘criminals’ for clarity.

3) The flashing blue coloured border for the location to select move content from may attract the user’s attention more than the current green coloured border.

4) At a certain level, the scrolling bar of the dialogue history needs to be dragged down to see the latest dialogue history, and this is problematic.

Interview Session

1) Do you find the system easy or hard to learn to use?
   If you think it is difficult, please give some details.

   It is definitely easy for students who are familiar with computers, very straightforward to use it.

2) Are there any procedures annoying you when you operating on the system?
   If yes, please specify which?

   No, nothing.

3) Do you think you can carry out useful debate using the available input facilities?
   If not, what do you want to add?

   It would be better to have more available propositional options

4) Do you appreciate you and computer’s moves affect the position stores?
If not, please specify where you feel strange?

During the dialogue, I focus on the debate history rather than the commitment store. To be honest, I did not notice that.

5) Do you think computer’s performance acceptable?

Yes, the computer’s overall performance is acceptable, the computer tries to present different arguments for its view, and I try to present mine. It is a bit uncomfortable when the computer constantly asks me to go on after a period of debate. This is fine, and makes me to explore more argument. I would say it depends on personality.

6) Any more other comment?

User’s computer experience and interest in the domain is important. I wish you all the best with your PhD.
APPENDIX F

HUMAN COMPUTER DEBATING SYSTEM INPUT

FACILITIES

The user interfaces below show the user input facilities provided by the human computer debating system developed in section 7.4. These facilities dynamically provide legally available move types, locations for selecting move content from and instructive messages at the bottom of the user interface. Examples are provided according to four different categories of dialogue situations below:

Dialogue Situation (1): after a question made by the computer

After a question made by the computer, there are three move choices available for the user at the interface: ‘Yes’, ‘No’ and ‘I am not sure about it’.

It is shown in the above figure that the user needs simply to select one of the three choices following the instruction at the bottom of the user interface.
Dialogue Situation (2): after a resolution demand made by the computer

Two examples are provided for this category. After the computer makes a resolution demand for an inconsistency like \((P, \neg P)\), there are two move choices available enabling withdrawal of either of the conflicting statements.

It is shown in the above figure that the user needs simply to select one of the two choices following the instruction at the bottom of the user interface.
After a resolution demand for an inconsistency like \((P, P\not\Rightarrow Q, \text{ why } Q?)\) or \((P, P\not\Rightarrow Q, \text{ withdrawal } Q)\) made by the computer after the user has challenged or withdrawn \(Q\), there are three move choices available, withdrawal of either of the conflicting statements or affirmation of the disputed consequence \(Q\).

It is shown in the above figure that the user needs simply to select one of the three choices following the instruction at the bottom of the user interface.
Dialogue Situation (3): after a challenge made by the computer

After a challenge of P made by the computer, the ‘Because..’ move type and a move “I don’t know why P” are available; and additionally a resolution demand move type is available when the computer has committed an inconsistency by issuing the challenge.

In the above example, only two choices are provided for the user to select from. The third choice – a resolution demand is not available because the computer has not committed an inconsistency by issuing the challenge in turn 05. The above figure also shows the move content should be selected from the content choice (the box with a green border) were the user to give a ground; the instructive message was changed dynamically.
Dialogue Situation (4): after a statement or a withdrawal made by the computer

After a withdrawal or a statement made by the computer, the statement, question, challenge and withdrawal move types are always available. A resolution demand move type will be available if and when the computer has committed an inconsistency. Four examples are provided for this category.

In the above figure, after the computer made a statement in turn 18, all five move types are available. In particular, the resolution demand move type is available because the computer has simultaneously committed to “CP is a good deterrent” and “CP is not a good deterrent” in its store. The above figure also shows the move content should be selected from the content choice (the box with a green border) were the user to make a statement.
The above figure shows that there are four move types available after the computer made a “no commitment” in turn 09. The resolution demand move type is not available because the computer has not committed to inconsistency in its store. The above figure also shows the move content should be selected from the user’s commitment store (the box with a green border) were the user to make a “no commitment”; the instructive message is updated dynamically.
The above figure shows that there are four move types available after the computer made a statement in turn 03. The resolution demand move type is not available because the computer has not committed to inconsistency in its store. The above figure also shows the move content should be selected from the computer’s commitment store (the box with a green border) were the user to make a challenge; the instructive message is updated dynamically.
The above figure shows the move content should be selected from the user’s commitment store (the box with a green border) were the user to make a question.
References


