A Dialogue Game Protocol for Multi-Agent Argument over Proposals for Action

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Abstract. We present the syntax and semantics for a multi-agent dialogue game protocol which permits argument over proposals for action. The protocol, called the *PARMA Protocol*, embodies an earlier theory by the authors of persuasion over action which enables participants to rationally propose, attack, and defend, an action or course of actions (or inaction). We present an outline of both an axiomatic and a denotational semantics, and discuss an implementation of the protocol for two human agents.

1 Introduction

Developers of real-world software agent systems typically desire either the system as a whole or the agents within it to effect changes in the state of the world external to the system. Whether the software agents represent human bidders in an online auction or the system collectively manages some resource, such as a utility network, the agents and/or the system usually need to initiate, maintain or terminate actions in the world [12]. Agent interaction protocols, therefore, must be concerned with argument over actions: agents in such systems may not be concerned with sharing and reconciling one another's beliefs, except insofar as these assist in sharing and coordinating their actions.

Philosophers of argumentation, however, have mostly concentrated their attention on beliefs, and not on actions.[1] Computer scientists, also, have typically not distinguished between justifications for beliefs and for actions. Attempting to fill this gap, we have previously articulated a theory of persuasion over actions, in which a proponent of a proposed action can seek to persuade another party (a human or software agent) to endorse it [5]. By classifying all the possible attacks on a proposal for action, our theory permits dialogue participants to represent, to attack and to defend a proposal for action in a systematic manner. We now extend this work by presenting a novel dialogue game protocol, which we call the *PARMA* (for Persuasive ARgument for Multiple Agents) *Action Persuasion Protocol*, in which proposals for action may be presented, and these attacks and defences may occur.

The paper is structured as follows: Section 2 reprises our general theory of persuasion over action, and indicates the possible attacks of a proposal for action. Section

[1] Stephen Toulmin's book entitled *"Knowing and Acting"* [20], for example, has 18 chapters on beliefs, and 1 on actions.

3 presents the syntax and an axiomatic semantics for the *PARMA Action Persuasion Protocol* while Section 4 outlines a denotational semantics for dialogues under the protocol. Section 5 then describes an implementation we have undertaken of the protocol, and Section 6 concludes with a discussion of some of the issues raised and possible future work.

It is important to note that dialogues under our protocol are Persuasion dialogues, in the influential terminology of Walton and Krabbe [22].[2] Both Negotiation dialogues (which concern the division of some scarce resource) and Deliberation dialogues (which concern what action to take in some circumstance) in this terminology also concern dialogues over action. A key difference between Negotiation and Deliberation dialogues, on the one hand, and Persuasion dialogues, on the other, is that Persuasion dialogues commence with at least one participant supporting the proposal for action under discussion (a proposal which may involve not acting). This is not necessarily the case with Negotiation dialogues or Deliberations, both of which may commence without any endorsement by a participant to any proposed action (or inaction), or, indeed, commence without any proposal for action before the participants.

2 A Theory of Persuasion over Action

Our focus is on rational interactions between agents engaged in joint practical reasoning, that is, seeking to agree an action or course of action. We use the word *rational* in the sense of argumentation theory, where it is understood as the giving and receiving of reasons for beliefs or actions [9]. In these interactions, we assume that one agent endorses a particular action, and seeks to have another agent do the same. This type of dialogue is a Persuasion dialogue, and our theory permits actions to be proposed, to be attacked, and to be defended by agents engaged in a Persuasion interaction. For such an interaction, we first define what it means to propose an action (Section 2.1), then consider rational attacks on it (Section 2.2), and then rational counter-attacks and resolution (Section 2.3).

2.1 Stating a Position

We give the following as the general argument schema (called *AS1*)for a rational position proposing an action:

> *Argument Schema AS1:*
> In the Current Circumstances R
> we should perform Action A
> to achieve New Circumstances S
> which will realize some goal G
> which will promote some value V.

For current purposes, we need recognize no difference between resolving on a future action and justifying a past action. Moreover, an action may achieve multiple goals, and

[2] Although not Persuasion dialogues in the revised typology of [21].

each goal may promote multiple values. For simplicity, we assume that the proponent of an action articulates an argument in the form of schema *AS1* for each goal realized and value promoted. We assume the existence of:

- A finite set of distinct actions, denoted *Acts*, with elements, A, B, C, etc.
- A finite set of propositions, denoted *Props*, with elements, p, q, r, etc.
- A finite set of states, denoted *States*, with elements, R, S, T, etc. Each element of *States* is an assignment of truth values $\{T, F\}$ to every element of *Props*.
- A finite set of propositional formulae called goals, denoted *Goals*, with elements G, H, etc.
- A finite set of values, denoted *Values*, with elements v, w, etc.
- A function *value* mapping each element of *Goals* to a pair $< v, sign >$, where $v \in$ *Values* and $sign \in \{+, =, -\}$.
- A ternary relation *apply* on *Acts* $\times$ *States* $\times$ *States*, with *apply(A, R, S)* to be read as: *"Performing action A in state R results in state S."*

The argument schema *AS1* contains a number of problematic notions which are not readily formalized in classical logic. We can, however, see that there are four classical statements which must hold if the argument represented by schema AS1 is to be valid:

Statement 1: R is the case.
Statement 2: *apply(A, R, S)* $\in$ *apply*.
Statement 3: S $\models$ G. ("G is true in state S.")
Statement 4: *value(G)* $=< v, + >$.

We can represent a position expressed according to *AS1* in the following diagrammatic form:

$$R \xrightarrow{A} S \models G \uparrow v.$$

The possible attacks on a position presented in the next sub-section may be viewed as attacking one or more elements of this representation, or the connections between them.

2.2 Attacking a Position

A position proposing an action may be attacked in a number of ways, and we have identified what we believe is a comprehensive list of rational attacks. In Table 1 we summarize these attacks, and indicate the number of variants for each. The fourth column of this table indicates the basis for resolution of any disagreement, which we discuss in the next subsection. Some attacks (Attacks 1–4) deny the truth or validity of elements of a position, such as the validity of the inference that S $\models$ G, for a state S and goals G. A second group of attacks (Attacks 5–7) argue that the same effects can be achieved by a different action. A third group (Attacks 8–9, 11) argue against the action proposed because of its undesirable side effects or because of interference with other, preferred, actions. Attack 10 agrees with the action proposed, but offers different reasons from those stated in the position. Such an attack may be important in domains, such as legal reasoning, where the reasons given for actions act as precedents for future decisions. Finally, the last group of attacks (Attacks 12–15) argue that elements of the stated position are invalid or impossible, as, for example, when the attacker disagrees that the proposed action is possible.

The variants on these attacks follow a pattern. An attacker may simply express disagreement with some aspect of a position, as when an attacker denies that R is the current state of the world. Beyond this minimalist attack, an attacker may also state an alternative position to that proposed, for example, expressing not only that R is not the current state of the world, but also that T is the current state. A full list and description of the attacks and their variants are given in [1, 5].

Table 1. Attacks on a Proposal for Action

Attack	Variants	Description	Basis of Resolution
1	2	Disagree with the description of the current situation	Empirical investigation
2	7	Disagree with the consequences of the proposed action	Causal theory
3	6	Disagree that the desired features are part of the consequences	Logical theory
4	4	Disagree that these features promote the desired value	Social theory
5	1	Believe the consequences can be realized by some alternative action	Preferences over actions
6	1	Believe the desired features can be realized through some alternative action	Preferences over actions
7	1	Believe that an alternative action realizes the desired value	Preferences over actions
8	1	Believe the action has undesirable side effects which demote the desired value	Causal theory
9	1	Believe the action has undesirable side effects which demote some other value	Preferences over values
10	2	Agree that the action should be performed, but for different reasons	Judgment
11	3	Believe the action will preclude some more desirable action	Preferences over actions
12	1	Believe the action is impossible	Empirical investigation
13	2	Believe the circumstances or consequences as described are not possible	Empirical investigation
14	1	Believe the desired features cannot be realized	Social theory
15	1	Disagree that the desired value is worth promoting	Preferences over values

2.3 Responding to an Attack and Resolution

How a proponent of a proposal for action responds to an attack depends upon the nature of the attack. For those attacks which explicitly state an alternative position, the original proponent is able to counter-attack with some subset of the attacks listed in Table 1. For example, if a proponent argues for an action on the grounds that this will promote some value v, and an attacker argues in response that the proposed action will also demote some other value w, then the proponent may respond to this attack by arguing that the action does not have this effect on w (Attack 4), or that an alternative action can promote w, or that w is not worth promoting (Attack 15), etc.

Whether or not two participants may ultimately reach agreement on a proposed action will depend on the participants and on the precise nature of the disagreement. A basis for any resolution between participants for each type of attack is shown in the fourth column of Table 1. If the disagreement concerns the nature of the current world-state (Attack 1), for example, then some process of agreed empirical investigation may resolve this difference between the participants. Alternatively, if the participants disagree over which value should be promoted by the action (Attacks 9 or 15), then resolution will require agreement between them on a preference ordering over values. Such resolution may require other types of dialogue, and some of these interactions have received considerable attention from philosophers, for example [6, 16, 17]. We leave this topic for another occasion.

3 The *PARMA Protocol*

In this section we present the syntax of the *PARMA Action Persuasion Protocol* together with an outline of an axiomatic semantics for the protocol. We assume, as in recent work in agent communications languages [11], that the language syntax comprises two layers: an inner layer in which the topics of conversation are represented formally, and an outer, wrapper, layer comprising locutions which express the illocutionary force of the inner content.

Table 2. Locutions to Control the Dialogue

Locution	Pre-conditions	Post-conditions
Enter dialogue	Speaker has not already uttered enter dialogue	Speaker has entered dialogue
Leave dialogue	Speaker has uttered enter dialogue	Speaker has left dialogue
Turn finished	Speaker has finished making their move	Speaker and hearer switch roles so new speaker can now make a move
Accept denial	Hearer has made an attack on an element of speaker's position	Speaker committed to the negation of the element that was denied by the hearer
Reject denial	Hearer has made an attack on an element of speaker's position	Disagreement reached

The locutions of the *PARMA Protocol* are shown in the left-most columns of Tables 2–6. These tables also present the pre-conditions necessary for the legal utterance of each locution under the Protocol, and any post-conditions arising from their legal utterance. Thus, Tables 2–6 present an outline of an axiomatic semantics for the PARMA Protocol [19], and imply the rules governing the combination of locutions under the protocol [13]. We further assume, following [7] and in accordance with recent work in agent communications, that a *Commitment Store* is associated with each participant, which stores, in a manner which all participants may read, the commitments made by that participant in the course of a dialogue. The post-conditions of utterances shown in Tables 2–6 include any commitments incurred by the speaker of each utterance while the pre-conditions indicate any prior commitments required before an utterance can be legally made. Commitments in this protocol are dialogical — ie, statements which an agent must defend if attacked, and may bear no relation to the agent's real beliefs or intentions [7].

Table 3. Locutions to Propose an Action

Locution	Pre-conditions	Post-conditions
State circumstances(R)	Speaker has uttered enter dialogue	Speaker committed to R Speaker committed to R $\in$ States
State action(A)	Speaker has uttered enter dialogue Speaker committed to R Speaker committed to R $\in$ States	Speaker committed to A Speaker committed to A $\in$ Acts
State consequences(A,R,S)	Speaker has uttered enter dialogue Speaker committed to R Speaker committed to R $\in$ States Speaker committed to A Speaker committed to A $\in$ Acts	Speaker committed to apply(A,R,S) $\in$ apply Speaker committed to S $\in$ States
State logical consequences(S,G)	Speaker has uttered enter dialogue Speaker committed to R Speaker committed to R $\in$ States Speaker committed to A Speaker committed to A $\in$ Acts Speaker committed to apply(A,R,S) $\in$ apply Speaker committed to S $\in$ States	Speaker committed to S $\models$ G Speaker committed to G $\in$ Goals
State purpose(G,V,D)	Speaker has uttered enter dialogue Speaker committed to R Speaker committed to R $\in$ States Speaker committed to A Speaker committed to A $\in$ Acts Speaker committed to apply(A,R,S) $\in$ apply Speaker committed to S $\in$ States Speaker committed to S $\models$ G Speaker committed to G $\in$ Goals	Speaker committed to (G,V,D) Speaker committed to V $\in$ Values

Table 4. Locutions to ask about an Agent's Position

Locution	Pre-conditions	Post-conditions
Ask circumstances(R)	Hearer has uttered enter dialogue Speaker has uttered enter dialogue Speaker not committed to circumstances(R) about topic in question	Hearer must reply with state circumstances(R) or don't know(R)
Ask action(A)	Hearer has uttered enter dialogue Speaker has uttered enter dialogue Speaker not committed to action(A) about topic in question	Hearer must reply with state action(A) or don't know(A)
Ask consequences(A,R,S)	Hearer has uttered enter dialogue Speaker has uttered enter dialogue Speaker not committed to consequences(A,R,S) about topic in question	Hearer must reply with state consequences(A,R,S) or don't know(A,R,S)
Ask logical consequences(S,G)	Hearer has uttered enter dialogue Speaker has uttered enter dialogue Speaker not committed to logical consequences(S,G) about topic in question	Hearer must reply with state logical consequences(S,G) or don't know(S,G)
Ask purpose(G,V,D)	Hearer has uttered enter dialogue Speaker has uttered enter dialogue Speaker not committed to purpose(G,V,D) about topic in question	Hearer must reply with state purpose(G,V,D) or don't know(G,V,D)

4 A Denotational Semantics

We now outline a denotational semantics for the *PARMA* protocol, that is a semantics which maps statements in the syntax to mathematical entities [19]. Our approach draws on the semantics proposed by Charles Hamblin for imperative statements [8], which itself may be viewed as a process theory of causality. The main proponent of such theories has been Wesley Salmon, whose theory of causal processes *"identifies causal connections with physical processes that transmit causal influence from one spacetime location to another"* [18, p. 191]. Our approach draws on elements of category theory, namely topos theory. Our reason for using this, rather than (say) a Kripkean possible worlds framework or a labelled transition system, is that topos theory enables a natural representation of logical consequence ($S \models G$) in the same formalism as mappings between spaces ($R \xrightarrow{A} S$ and $G \uparrow v$). To our knowledge, no other non-categorical denotational semantics currently proposed for action formalisms permits this.

We begin by representing proposals for action. We assume, as in Section 2.1, finite sets of Acts, Propositions, States, Goals, and Values, and various mappings. For simplicity, we assume there are n propositions. Each State may be considered as being equivalent to the set of propositions which are true in that State, and so there are 2^n States. We consider the space $\mathcal{C}$ of these States, with some additional structure to enable the representation of actions and truth-values. We consider values as mappings from Goals to some space of evaluations, called $\mathcal{S}$. This need not be the three-valued set *Sign* $= \{+, =, -\}$ we assumed in Section 2.1, although we assume that $\mathcal{S}$ admits at least one partial order. The structures we assume on $\mathcal{C}$, $\mathcal{S}$ and between them is intended to enable us to demonstrate that these are categorical entities [3]. We begin by listing the mathematical entities, along with informal definitions.

- The space $\mathcal{C}$ comprises a finite collection $\mathcal{C}_0$ of objects and a finite collection $\mathcal{C}_1$ of arrows between objects.
- $\mathcal{C}_0$ includes 2^n objects, each of which may be considered as representing a State. We denote these objects by the lower-case Greek letters, $\alpha, \beta, \gamma, \ldots$, and refer to them collectively as *state objects* or *states*. We may consider each state to be equivalent (in some sense) to the set of propositions which are true in the state.
- $\mathcal{C}_1$ includes arrows between state objects, denoted by lower case Roman letters, $f, g, h, \ldots$. If f is an arrow from object α to object $beta$, we also write $f : \alpha \rightarrow \beta$. Some arrows between the state objects may be considered as representing actions leading from one state to another, while other arrows are causal processes (not actions of the dialogue participants) which take the world from one state to another. There may be any number of arrows between the same two objects: zero, one, or more than one.
- Associated with every object $\alpha \in \mathcal{C}_0$, there is an arrow $1_\alpha \in \mathcal{C}_1$ from α to α, called the identity at α. In the case where α is a state object, this arrow may be considered as that action (or possibly inaction) which preserves the status quo at a state α.
- If $f : \alpha \rightarrow \beta$ and $g : \beta \rightarrow \gamma$ are both arrows in $\mathcal{C}_1$, then we assume there is an arrow $h : \alpha \rightarrow \gamma$. We denote this arrow h by $g \circ f$ (*"g composed with f")*. In other words, actions and causal processes may be concatenated.
- We assume that $\mathcal{C}_0$ includes a special object *Prop*, which represents the finite set of all propositions. We further assume that for every object $\alpha \in \mathcal{C}_0$ there is a monic arrow $f_\alpha : \alpha \rightarrow Prop$. Essentially, a monic arrow is an injective (one-to-one) mapping.
- We assume that $\mathcal{C}_0$ has a terminal object, **1**, ie, an object such that for every object $\alpha \in \mathcal{C}_0$, there is precisely one arrow $\alpha \rightarrow \mathbf{1}$.
- We assume that $\mathcal{C}$ has a special object Ω, and an arrow $true : \mathbf{1} \rightarrow \Omega$, called a *sub-object classifier*. The object Ω may be understood as the set comprising $\{True, False\}$.
- We assume that $\mathcal{S}$ is space of objects over which there is a partial order $<_i$ corresponding to each participant in the dialogue. Such a space may be viewed as a category, with an arrow between two objects α and β whenever $\alpha <_i \beta$. For each participant, we further assume the existence of one or more mappings v between $\mathcal{C}$ and $\mathcal{S}$, which takes objects to objects, and arrows to arrows. We denote the collection of all these mappings by $\mathcal{V}$.

The assumptions we have made here enable us to show that $\mathcal{C}$ is a category [3], and we can thus represent the statement $R \xrightarrow{A} S$, for states R and S, and action A. Moreover, the presence of a sub-object classifier structure enables us to represent statements of the form $S \models G$, for state S and goal G, inside the same category $\mathcal{C}$. This structure we have defined for $\mathcal{C}$ creates some of the properties needed for $\mathcal{C}$ to be a topos [3]. Finally, each space $\mathcal{S}$ with partial order $<_i$ is also a category, and the mappings v are functors (structure-preserving mappings) between $\mathcal{C}$ and $\mathcal{S}$. This then permits us to represent statements of the form $G \uparrow v$, for goal G and value v.

We define a denotational semantics for the *PARMA* Protocol by associating dialogues conducted according to the Protocol with mathematical structures of the type defined above. Thus, the statement of a proposal for action by a participant in a dialogue

$$R \xrightarrow{A} S \models G \uparrow v$$

is understood semantically as the assertion of the existence of objects representing R and S in $\mathcal{C}$, the existence of an arrow representing A between them, the existence of an arrow with certain properties[3] between *Prop* and Ω, and the existence of a functor $v \in \mathcal{V}$ from $\mathcal{C}$ to $\mathcal{S}$. Attacks on this position then may be understood semantically as denials of the existence of one or more of these elements, and possibly also, if the attack is sufficiently strong, the assertion of the existence of other objects, arrows or functors.

Thus, our denotational semantics for a dialogue conducted according to the *PARMA* Protocol is defined as a countable sequence of triples,

$$\langle \mathcal{C}_1,\ \mathcal{S}_1,\ \mathcal{V}_1 \rangle,\ \langle \mathcal{C}_2,\ \mathcal{S}_2,\ \mathcal{V}_2 \rangle,\ \langle \mathcal{C}_3,\ \mathcal{S}_3,\ \mathcal{V}_3 \rangle,\ \ldots,$$

where the k-th triple is created from the k-th utterance in the dialogue according to the representation rules just described. Then, our denotational semantics for the *PARMA* Protocol itself is defined as the collection of all such countable sequences of triples for valid dialogues conducted under *PARMA*. This approach views the semantics of the protocol as a space of mathematical objects, which are created incrementally and jointly by the participants in the course of their dialogue together. The approach derives from the constructive view of human language semantics of Discourse Representation Theory [10], and is similar in spirit to the denotational semantics, called a *trace semantics*, defined for deliberation dialogues in [14], and the *dialectical graph* recording the statements of the participants in the Pleadings Game of Thomas Gordon [4]. We are currently engaged in specifying formally this denotational semantics in accordance with the outline presented here.

5 Implementation of the Dialogue Game

We have also implemented the *PARMA Action Persuasion Protocol* in the form of a Java program. The program implements the protocol so that dialogues between two human participants can be undertaken under the protocol, with each participant taking turns to propose and attack positions uttering the locutions specified above. The program checks the legality of the participants' chosen moves by verifying that all pre-conditions for the move hold. Thus, the participants are able to state and attack each other's positions with the program verifying that the dialogue always complies with the protocol. If a participant attempts to make an illegal move then they are informed about this and given the opportunity to chose an alternative move. After a move has been legally uttered, the

[3] This arrow is the characteristic function for the object representing G, and the properties are that a certain diagram commutes in $\mathcal{C}$.

commitment store of the participant who made the move is updated to contain any new commitments created by the utterance. All moves, whether legal or illegal, are entered into the history, which records which moves were made by which participant and the legality of the move chosen. After a move has been legally made, the commitment store of the player who made the move is printed to the screen to show all previous commitments and any new ones that have consequently been added. By publicly displaying the commitment stores in this way each participant is able to see their own and each other's commitments. Thus, participants can determine which of their commitments overlap with those of the other participant, and thereby identify points of agreement. Conversely, this also allows each participant to identify any commitments of the other participant in conflict with their own, and thus which commitments are susceptible to an attack.

Dialogues undertaken via the program can terminate in a number of ways. A participant can decide to leave the game by exiting at any time, thereby terminating the dialogue. A dialogue can also terminate if disagreement about a position is reached. This occurs when a participant states an element of a position which is is consequently attacked by the other participant, and the first participant disagrees with the attack. If the first participant refuses to accept the reasons for the attack then disagreement has been identified and the dialogue terminates. Dialogues may also reach a natural end with agreement between the two participants on a course of action. If this occurs, both players may choose to exit the dialogue.

When a dialogue terminates, whether in agreement or disagreement, the history and commitment stores of both players are printed on screen and also to a file. The dialogue may then be analyzed, for example to see which attacks occurred, or how often or how successful they were. Such analysis may be useful for a study of appropriate strategies for dialogue conducted under the protocol. Further details of the implementation can be found in [2].

6 Conclusions

This paper has presented the syntax and semantics for a novel agent dialogue game protocol for argument over proposals for action. The protocol, called the *PARMA Action Persuasion Protocol*, implements our previous theory of persuasion over actions, which presents a general argument schema for the advocacy and justification of actions, and so supports rational discourse over proposed courses of actions. The protocol enables such persuasive dialogues to be undertaken by autonomous software agents.

There are several avenues we hope to explore in future work. Firstly, we plan to articulate in detail the axiomatic and denotational semantics we have presented in outline here. These should be straightforward, if somewhat tedious, exercises. Secondly, we note that formalisms of actions and their effects have received a great deal of attention in AI, for example, the situation calculus [15]. We hope to explore the connections between these formalisms and our approach. Thirdly, we have initially excluded from this schema any consideration of: time and temporal factors; uncertainty of consequences; or obligations and moral arguments. We hope to consider these issues in future development of the *PARMA* protocol.

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Table 5. Locutions to Attack Elements of a Position

Locution	Pre-conditions	Post-conditions
Deny circumstances(R)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States	Speaker committed to deny circumstances(R)
Deny consequences(A,R,S)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A Hearer committed to A $\in$ Acts Hearer committed to apply(A,R,S) $\in$ apply Hearer committed to S $\in$ States	Speaker committed to deny consequences(A,R,S) $\in$ apply
Deny logical consequences(S,G)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A Hearer committed to A $\in$ Acts Hearer committed to apply(A,R,S) $\in$ apply Hearer committed to S $\in$ States Hearer committed to S $\models$ G Hearer committed to G $\in$ Goals	Speaker committed to deny logical consequences(S,G) S $\models$ G
Deny purpose(G,V,D)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A Hearer committed to A $\in$ Acts Hearer committed to apply(A,R,S) $\in$ apply Hearer committed to S $\in$ States Hearer committed to S $\models$ G Hearer committed to G $\in$ Goals Hearer committed to (G,V,D) Hearer committed to V $\in$ Values	Speaker committed to deny purpose(G,V,D)

Table 6. Locutions to Attack Validity of Elements

Locution	Pre-conditions	Post-conditions
Deny initial circumstances exist(R)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R $\in$ States	Speaker committed to deny initial circumstances exist(R)
Deny action exists(A)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A $\in$ Acts	Speaker committed to deny action exists(A)
Deny resultant state exists(S)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A $\in$ Acts Hearer committed to S $\in$ States	Speaker committed to deny resultant state exists(S)
Deny goal exists(G)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A $\in$ Acts Hearer committed to S $\in$ States Hearer committed to G $\in$ Goals	Speaker committed to deny goal exists(G)
Deny value exists(V)	Speaker has uttered enter dialogue Hearer has uttered enter dialogue Hearer committed to R Hearer committed to R $\in$ States Hearer committed to A $\in$ Acts Hearer committed to S $\in$ States Hearer committed to G $\in$ Goals Hearer committed to V $\in$ Values	Speaker committed to deny value exists(V)