Argument Schemes for Reasoning About the Actions of Others

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Abstract. In practical reasoning, it is important to take into consideration what other agents will do, since this will often influence the effect of actions performed by the agent concerned. In previous treatments, the actions of others must either be assumed, or argued for using a similar form of practical reasoning. Such arguments, however, will also depend on assumptions about the beliefs, values and preferences of the other agents, and so are difficult to justify. In this paper we capture, in the form of argumentation schemes, reasoning about what others will do, which depends not on assuming particular actions, but through consideration of the expected utility (based on the promotion and demotion of values) of particular actions and alternatives. Such arguments depend only on the values and preferences of the agent concerned, and do not require assumptions about the beliefs, values and preferences of the other relevant agents. We illustrate the approach with a running example based on Prisoner's Dilemma.

Keywords. practical reasoning, values, argumentation schemes, AATS

1. Introduction

In the method for value based practical reasoning proposed in [3] and later improved in [2], the reasoning goes through three stages. First there is a *problem formulation* stage in which states and actions allowing transition between them are modelled and the transitions labelled with the values they promote and demote. In [3] the modelling is done using an Alternation Action Based Transition system (AATS) [19]. Note that the transitions in an AATS are the *joint* actions of all the agents involved, since the state reached by a given action will often depend on what other agents choose to do. Next there is the *epistemic* stage in which the initial state must be determined (or assumed) and the particular joint action that will result from the agent's choice of action must be established or assumed. Finally conflicts between the various arguments that can be generated from this structure are resolved according to the preferences of the agent, using a Value Based Argumentation Framework (VAF) [7]. A significant problem with this method is the treatment of the actions of others. Although it is possible to justify the actions attributed to others, this does require assumptions to be made as to how they will formulate their part of the problem, the assumptions they themselves will make and the preferences they will use to resolve their VAF. All this can introduce rather more uncertainty than is desirable, and must be done for every other agent relevant to the scenario. An improved treatment,

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which reduces the need to make assumptions about others, was proposed in [4]. In this paper we will advance this initial work by expressing this proposal in the form of a set of argumentation schemes [16]. This will clarify the nature of the arguments, and how they can be deployed in dialogues.

Section 2 will give some essential background on the AATS and the well known *Prisoner's Dilemma* which will be used as the running example in this paper. Section 3 will summarise the proposal of [4], section 4 will give the schemes and their critical questions. Section 5 will show the use of the schemes in a dialogical setting and section 6 will offer some concluding remarks.

2. Background

2.1. Alternation Action Based Transition systems (AATS)

Based on Alternating Time Temporal Logic [1], AATS were originally presented in [19] as semantical structures for modelling game-like, dynamic, multi-agent systems in which the agents can perform actions in order to modify and attempt to control the system in some way. As such they provide an excellent basis for modelling situations in which a set of agents are required to make decisions. The definition in [19] is:

Definition 1: AATS.

An *Action-based Alternating Transition System* (AATS) is an $(n + 7)$-tuple $S = \langle Q, q_0, Ag, Ac_1, \ldots, Ac_n, \rho, \tau, \Phi, \pi \rangle$, where:

- Q is a finite, non-empty set of *states*;
- $q_0 \in Q$ is the *initial state*;
- $Ag = \{1,...,n\}$ is a finite, non-empty set of *agents*;
- Ac_i is a finite, non-empty set of actions, for each $ag_i \in Ag$ where $Ac_i \cap Ac_j = \emptyset$ for all $ag_i \neq ag_j \in Ag$;
- $\rho : Ac_{ag} \to 2^Q$ is an *action pre-condition function*, which for each action $\alpha \in Ac_{ag}$ defines the set of states $\rho(\alpha)$ from which α may be executed;
- $\tau : Q \times J_{Ag} \to Q$ is a partial *system transition function*, which defines the state $\tau(q, j)$ that would result by the performance of j from state q – note that, as this function is partial, not all joint actions are possible in all states (cf. the pre-condition function above);
- Φ is a finite, non-empty set of *atomic propositions*; and
- $\pi : Q \to 2^\Phi$ is an interpretation function, which gives the set of primitive propositions satisfied in each state: if $p \in \pi(q)$, then this means that the propositional variable p is satisfied (equivalently, true) in state q.

AATSs are particularly concerned with the joint actions of the set of agents Ag. j_{Ag} is the joint action of the set of n agents that make up Ag, and is a tuple $\langle \alpha_1,...,\alpha_n \rangle$, where for each α_j (where $j \leq n$) there is some $ag_i \in Ag$ such that $\alpha_j \in Ac_i$. Moreover, there are no two different actions α_j and $\alpha_{j'}$ in j_{Ag} that belong to the same Ac_i. The set of all joint actions for the set of agents Ag is denoted by J_{Ag}, so $J_{Ag} = \prod_{i \in Ag} Ac_i$. Given an element j of J_{Ag} and an agent $ag_i \in Ag$, ag_i's action in j is denoted by j^i. This definition was extended in [3] to allow the transitions to be labelled with the values they promote.

Definition 2: AATS+V.
An AATS+V is defined by adding two more elements as follows:

- V is a finite, non-empty set of values.
- $\delta : Q \times Q \times V \to \{+, -, =\}$ is a *valuation function* which defines the status (promoted (+), demoted (–) or neutral (=)) of a value $v_u \in V$ ascribed to the transition between two states: $\delta(q_x, q_y, v_u)$ labels the transition between q_x and q_y with one of $\{+, -, =\}$ with respect to the value $v_u \in V$.

An *Action-based Alternating Transition System with Values* (AATS+V) is thus defined as a $(n + 9)$ tuple $S = \langle Q, q_0, Ag, Ac_1, ..., Ac_n, \rho, \tau, \Phi, \pi, V, \delta \rangle$. The value may be ascribed on the basis of the source and target states, or in virtue of an action in the joint action, where that action has intrinsic value.

2.2. Prisoner's Dilemma

In this very well known game [13], both players may either cooperate or defect. Mutual cooperation results in a pay off of 3 to each player, mutual defection a payoff of 1 to each player, and if one cooperates and the other defects the defector receives 5 and the cooperator receives 0. Note first that the "correct" strategy is to defect since that gives a better payoff whichever move the other makes (is the *dominant* strategy), and second that it is not a zero-sum game: collective utility is maximised by mutual cooperation. Note also that, as in other situations empirically tested in behavioural economics (e.g. [12], [8] and [9]), the game-theoretic choice is rarely found in practice. As explained in [15] in many social situations conventions to encourage mutual cooperation emerge or are devised, and such conventions may be reinforced by defection being the subject of punishment [11]. In the example discussed in [15], in a military situation much effort is made to build up trust and loyalty to create an *esprit de corp* in a regiment so that members will cooperate rather than defect, feeling that they are able to rely on their comrades, and in turn reluctant to let their comrades down. The explanation for this deviation from game theoretic behaviour is that the participants have values other than the payoff to themselves, and they tend to import the values established in their culture into their behaviour in the game. Some other values therefore need to be considered. Here we will use the following values, suggested by the previous studies in experimental economics. Each value is relative to the player affected.

- Player Money (M1 and M2): promoted if player 1's (or 2's) payoff is greater than 1 (which is the least that can be ensured), and demoted if it is less than 1.
- Player Guilt (G1 and G2): demoted if player 1 (or 2) defects and player 2 (or 1) cooperates.
- Player Self-Esteem (S1 and S2): demoted if player 1 (or 2) cooperates and player 2 (or 1) defects: player 1 (or 2) may feel that they have allowed themselves to be taken advantage of and that they should have known better.

In this game there are four joint actions which promote and demote values as shown in Table 1. In the case of M1 and M2 we also show the relative extent of promotion and demotion of the values. Since a player can always ensure a payoff of 1, we consider money to be promoted only if it exceeds 1, and we take the degree of promotion as $payoff - 1$. Similarly the degree of demotion is taken as relative to the neutral situation of mutual defection.

Table 1. Value Promotion and Demotion in the Prisoner's Dilemma

Joint Action	Player 1	Player 2	Promoted	Demoted
j1	C	C	2M1,2M2	
j2	C	D	4M2	M1,S1,G2
j3	D	C	4M1	M2, S2,G1
j4	D	D		

3. Reasoning About Others with Expected Utilities

The current approach to reasoning about others' actions based on [3] is:

1. Select a desirable transition based on the values it promotes and demotes.
2. Argue for the individual action performed by the agent in the joint action corresponding to that transition.
3. Consider objections based on the other agents choosing different actions and so causing different joint actions to be performed.
4. Attempt to rebut these objections because:
   (a) The values promoted and demoted by the alternative transition are acceptable.
   (b) It is considered that the other agents will not act in this way.

Whereas 4a can be resolved on the basis of the agent concerned, 4b, which is very often needed, requires more assumptions about the other agents than can be really justified. To remedy this defect, [4] proposed that instead of a specific joint action, the *set* of joint actions that could result from the selected individual action should be considered. This is done by calculating the *expected utility* of performing the action, in terms of the probabilities of the joint actions containing that action. In order to facilitate this calculation it is necessary to express the various benefits of performing an action in a "common currency". Therefore as well as ordering values, the agent will provide weights expressing all the values in terms of the most preferred value (which will have a weight of 1). Thus given three values[2]: $V_1 \succ V_2 \succ V_3$, the agent may rate V_2 as $0.6V_1$ and V_3 as $0.3V_1$. How sensitive the arguments are to these relative weights is something which can be explored through objections and rebuttals, as we will see when we consider the argumentation schemes.

Definition 3: Agent Preferences

The preferences of an agent $ag \in Ag$ is the set $O_{ag} = \{\langle v_0 * w_0 \rangle, \langle v_1 * w_1 \rangle, ..., \langle v_n * w_n \rangle\}$, where $v_0...v_n$ are values and $w_0...w_n$ are weights with $w_0 \geq w_1 \geq ... \geq w_n$.

Using these weights we can calculate the expected utility of agent i performing α. We will assume that if the desired joint action (j_0) does not result from the performance of α the worst case alternative joint action (j_w) will be the one that does result (since this will represent a lower bound). Informally the expected utility of performing α will be the utility of j_0 multiplied by the probability of j_0 plus the utility of j_w (which will often be negative) multiplied by (1 minus the probability of j_0).

[2]Using VAF notation [7] where $\succ$ denotes preference.

Definition 4: Expected Utility of ag performing α in state q_s

- Let $J_\alpha = \{j_0, j_1 ... j_n\}$ be the set of joint actions in which ag performs α (i.e. $j^{ag} = \alpha$) available in the starting state, q_s.
- Let P_{ag_k} be the values for ag promoted by the performance of $j_k \in J_\alpha$ in q_s. Let D_{ag_k} be the values of ag demoted by the performance of $j_k \in J_\alpha$ in q_s.
- The positive utility for ag, $pu(ag, j_k)$, of the performance of $j_k \in J_\alpha$ in q_s is $\Sigma_{i=0}^{i=n}(v_i * w_i)$ where $v_1 \in P_{ag_k}$ and the negative utility for ag, $du(ag, j_k)$, of the performance of $j_k \in J_\alpha$ in q_s is $\Sigma_{i=0}^{i=n}(v_i * w_i)$ where $v_1 \in D_{ag_k}$. The utility, $u(ag, j_k)$, for ag of the performance of $j_k \in J_\alpha$ in q_s is $pu(ag, j_k)$ - $du(ag, j_k)$.
- Let U_{ag} be the set of utilities for ag, $\{u_0, u_1 ... u_n\}$, such that $u_i = u(ag, j_i)$ for $j_i \in J_\alpha$. Let u_w be such that for all $u_i \in U_{ag}$, $u_w \leq u_i$.
- Let $prob(j_0)$ be the probability of j_0 being the joint action performed when ag performs α in q_s.
- Now the expected utility, $eu_{ag}(\alpha)$ for ag of performing α in q_s is $(u(ag, j_0) * prob(j_0)) + (u(ag, j_w) * (1 - prob(j_0)))$

By taking j_w as the alternative to j_0, we come up with the lower bound on the expected utility, which will always be "safe". If we were able to assign actual probabilities to the other members of J_α, we could be exact, but in the kind of situations we wish to consider, this is rarely possible and so we will use the worst case. In PD the question as to which alternative joint action might result from performing α does not arise as there are only two joint actions for each of the actions available in the initial state.

In the traditional PD only the agent's own payoff is recognised as having utility. The utility is the actual payoff minus the guaranteed payoff (i.e. the payoff from mutual defection). For cooperation the utility is 2 when the other cooperates and -1 when the other defects. For defection it is 4 when the other cooperates and 0 when the other defects. The expected utilities for ag cooperating (dark grey) and defecting (light grey) for the various probabilities of the other cooperating are shown in Figure 1.

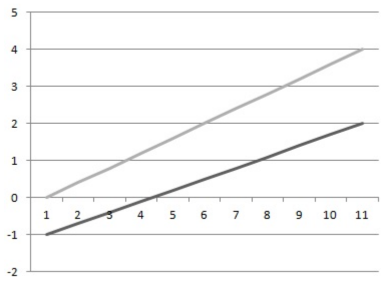

Figure 1. Expected Utilities for M1 only. Dark grey is ag cooperates, light grey is ag defects.

Suppose, however, that both the values $M1$ and $M2$ are recognised in PD, and $M2$ is weighted at $0.5M1$. Now the utility of cooperating when the other also cooperates will be 3M1, and the utility of cooperating when the other defects M1. Similarly we can calculate the expected utility of defecting for the various probabilities of the other cooperating. Defecting when the other cooperates yields a utility of $3.5M1$, and mutual defection 0 (since this is the base line case, no values are considered promoted). Again the desired joint action is performed when the other agent cooperates. This gives the graph shown as Figure 2a. The crossover is at $prob(j_0) = 0.67$.

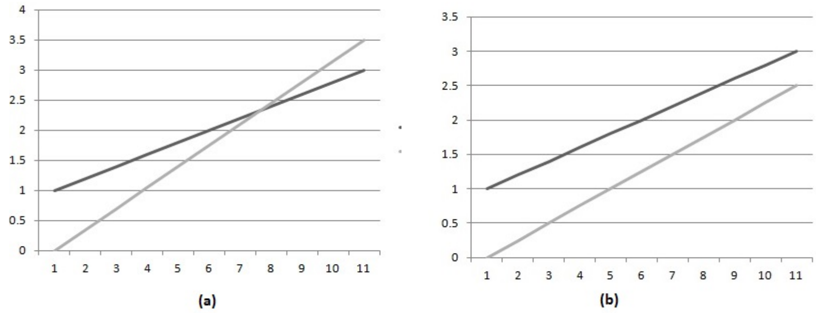

Figure 2. Expected Utilities for (a) M2 = 0.5M1 and (b) M2 =0.5M1 and G = M1. Dark grey is *ag* cooperates, light grey is *ag* defects.

If we now add in the value of Guilt (with a weight of 1), which gives a negative utility when an agent defects and the other cooperates, we get the expected utilities shown in Figure 2b.

There are three possibilities, which correspond to these three figure. In Figure 1, which shows the traditional PD, we find that defection *dominates* cooperation: the expected utility is higher for every value of $prob(j_0)$. Therefore defection is the preferred action, whatever the probability of the other cooperating. In Figure 2b the reverse is true: the inclusion of additional values means that cooperation dominates defection. In Figure 2a, there is a crossover, at $prob(j_0) = 0.7$, so that for high probabilities of cooperation, defection is preferred, but for low levels, the utility afforded to the payoff received by the other makes cooperation preferred.

3.1. Arguments Using Expected Utilities

Several types of argument can be based on the expected utilities for PD.

1. With your value preferences, you should C (respectively, D) since the expected utility is always greater than any alternative
2. With your value preferences, you should C (respectively, D) since the expected utility is always positive
3. With your value preferences, you should C (respectively, D) since the expected utility is greater than the alternative when the probability of cooperation is greater (less) than P.

Of these (1) is appropriate when the action advocated is dominant, and is the strongest of the three. Argument (2) is rather weak: although the expected utility is always positive, the proposed action may be dominated by the alternative for some (or even all) values of $prob(j_0)$. It may, however, be useful if we wish to reach the target state in order to enable some more beneficial action, since it indicates that no harm is done, and so can be used to rebut objections. The argument shows that we suffer no loss, although there is an opportunity cost. Argument (3) can be effective provided we can give reasons to suppose that probability of cooperation is in the desired range.

4. The Argumentation Schemes

The above arguments (1)-(3) for PD can be generalised and presented as argumentation schemes in the manner of [16]. Note that the users of these schemes are not to be identified with the players in the PD. The dialogues below are supposed to represent one player being given advice (likely to be a persuasion situation), or two people acting as a team in the PD discussing their best course of action (likely to be a deliberation situation). The schemes have a number of premises, and the conclusion in common. These are the premises that set up the situation and identify the key elements. Then additionally there is one key premise for each scheme, characteristic of the scheme. All the schemes have

- **Conclusion**: *ag* should perform α

4.1. Common Premises

Each scheme will have four premises in common:

- **Values Premise**: V is the set of values considered to be relevant by *ag*
- **Weighting Premise**: The relative valuation of the members of V given by *ag* is *S* set of $\langle value, relativeweight \rangle$ pairs
- **Joint Action Premise**: $\{j_0, j_1, ... j_n\}$ is the set of joint action *S* in which *ag* performs α
- **Expected Utility Premise**: $eu_{ag}(\alpha, prob(j_0))$ returns the expected utilities of agent *ag* performing α for values of $prob(j_0)$ $0 \leq prob(C) \geq 1$ where j_0 is the desired joint action.

The first premise identifies the values which the agent will consider and the second weights them in terms of the most important value. The joint actions containing the advocated action α as the action of *ag* are then taken from the AATS to give the third premise. The fourth premise then establishes the expected utilities for the various probabilities of the desired joint action, j_0, resulting from *ag* performing α.

4.2. Characteristic Premises

We have three schemes bases of the arguments (1)-(3) of section 3. We will name these as follows:

1. Argument from Dominance
2. Argument From Positive Expected Utility
3. Argument From Probable Compliance[3]

Each has its own characteristic premises. For Argument from Dominance:

- **Dominance Premise**: $eu_{ag}(\alpha, j_0) \geq eu_{ag}(\beta, j_0)$ for any alternative action β available to *ag*, for all values of $prob(j_0)$; where j_0 is the joint action compliant with the action of *ag*.

For Argument From Positive Expected Utility:

- **Positive Utility Premise**: $eu_{ag}(\alpha, j_0) \geq 0$ for all values of $prob(j_0)$

[3] We call the other agents acting so that j_0 results from *ag* performing α *compliance*.

Finally, for Argument From Probable Cooperation:

- **Probability Range Premise**: $eu_{ag}(\alpha, j_0) \geq eu_{ag}(\beta, j_0)$ for all values of $prob(j_0) \geq$ (respectively, $\leq$) *crossover*, where *crossover* is the point at which $eu_{ag}(\alpha, j_0)$ becomes greater (respectively, less) than $eu_{ag}(\beta, j_0)$

Here we are taking the joint action resulting from *ag* performing β to be the best alternative, namely the joint action containing β which yields *ag* the highest expected utility, i.e j_0 is the joint action compliant with the action of *ag*.

5. Critical Questions

These schemes can be associated with critical questions, as in [16]. Some will be common to all three schemes, while those associated with the characteristic premises will applicable only to the particular scheme. We begin with those common to all schemes.

5.1. Critical Questions Applicable to All Schemes

- **CQ1** Are all the members of V relevant?
- **CQ2** Are any other Values (i.e values in the AATS+V, but not included in V for this argument) relevant?
- **CQ3** Are any members of V over weighted?
- **CQ4** Are any members of V under weighted?

CQ1 and CQ2 are directed at the Values Premise and CQ3 and CQ4 at the weighting premise. We have no CQs directed at the other two premises, which are taken directly from the AATS and so considered beyond challenge at this stage. If there are only two joint actions containing α, the Expected Utility Premise is fully determined by the labelling of transitions in the AATS, together with the Values and Weighting premises. If there are more that two such joint actions, the worst case should be used, as described in definition 4.

Once we have established which values we wish to consider, we can only challenge the characteristic premise of the Argument from Dominance by coming up with an alternative action γ for which $eu_{ag}(\gamma, j_0) > eu_{ag}(\alpha, j_0)$ for at least some probabilities of compliance. But if the dominance premise is indeed true, this would challenge the AATS, and so it considered outside the scope of this stage of the argumentation. Therefore there are no CQs peculiar to the Argument from Dominance. Similarly the Argument From Positive Expected Utility has no individually applicable CQs. The Argument From Probable Cooperation does, however, have its own CQ:

- **CQ5** Can $prob(j_0)$ be assumed to be $\geq$ (respectively, $\leq$) *crossover*?

5.2. Rebuttals

These critical questions will have their own typical rebuttals, but these may depend on the context supplied by the original scheme. For example CQ3 could be met by

> *even if the relative weight of v is reduced to n%, $eu_{ag}(\alpha, j_0)$ remains greater than its alternatives for all values of $prob(j_0)$.*

in the context of the Argument from Dominance, but by

> *even if the relative weight of v is reduced to n%, $eu_{ag}(\alpha, j_0)$ remains ≥ 0 for all values of $prob(j_0)$.*

in the context of Argument From Positive Expected Utility. These rebuttals can be preempted by posing a more specific challenge: for example, to the Argument From Positive Expected Utility:

> *if the relative weight of v is reduced to n%, $eu_{ag}(\alpha, j_0)$ becomes < 0 for values of $prob(j_0) < p$.*

Perhaps a more natural way of making the last move in a dialogue is first to pose the appropriate CQ and then to put forward an argument of ones own. Thus the last challenge would be made using both CQ3, and an Argument from Probable Cooperation for an alternative to α.

6. Dialogue Based on These Schemes

These schemes, challenges based on the critical questions and rebuttals can be deployed in an adversarial discussion. As an example we will consider a dialogue between *Coop* and *Def*, concerning the action to take in the Prisoner's Dilemma.

In the dialogue, we will take it that the participants agree on the AATS, so that the schemes can be summarised in the form

> Given *ListOfValueWeightPairs*, one should α because *CharacteristicPremise*.

Def begins the dialogue:

D1 Given $\langle M1, 1 \rangle$, one should defect because the expected value of defection is always greater than the expected value of cooperation.

Coop can now challenge this using CQ2. As there is only a single value, the other CQs cannot be used here. *Coop* needs to find a value demoted by defection. As Table 1 shows, there are three possibilities: the payoff of the other player, Guilt, or the self-esteem of the other player. *Coop* can make the challenge (here *Coop* uses the payoff of the other player) and then counter with an Argument From Probable Cooperation:

C1 You must take some account of the payoff to the other player.
C2 Given $\langle M1, 1 \rangle$, $\langle M2, 0.5 \rangle$, one should cooperate since the expected utility is greater for probability of the other cooperating less than 0.67.

At this point *Def* has several possibilities:

> **R1**, based on CQ1: *There is no reason to care about the payoff of the other*. This simply refuses to modify the position of *D1*.
> **R2**, based on CQ2: Introduce another value, demoted by cooperation. Self Esteem is a possibility. A weight of 1 for $S1$ will restore D to dominance,
> **R3**, based on CQ3: Argue that M2 is overrated. For example, reducing the weight to 0.2 will restore defection to dominance. Any greater weight will give some value of $prob(j_0)$ at which cooperation is better.

R4. Since C2 expresses an Argument From Probable Cooperation, CQ5 is also available.

How *Coop* responds will depend on the move made by *Def*. For R1, much will depend on the context. If *Def* is trying to persuade *Coop*, *Coop* gets to choose the values [6], and so the move is not available to *Def*, since *Coop* has, in C1, already shown that M2 is, in his opinion, something to care about. In other situations, such as deliberation, they are in a different dialogue type, and a nested persuasion dialogue in which *Coop* will attempt to persuade *Def* that the value should be recognised must be entered. Unless *Coop* is trying to persuade *Def* (when *Def* has the last word on what values should be considered), R1 is probably best avoided at this point. R2 similarly depends on context. If it is *Coop* being persuaded, *Coop* can simply reject this challenge, but if *Def* is being persuaded, or in a deliberation it may be an effective move.

Probably the best tactic for *Def* is to use R3, since this explores the sensitivity of *Coop*'s challenge to the the weight used and so can establish the least weight that may be accorded to the payoff the other. Even if *Def* and *Coop* agree to compromise and accept a value for M2 between 0.2 and 0.5, then having made R3 means that R4 becomes more effective because of the reduction in the crossover point. For example, splitting the difference at 0.35 will reduce the crossover to 0.29.

Suppose, however, the dialogue in fact continues as follows (e.g *Coop* is the persuadee, and so is able, in this context, to have the final say as to weights and values.)

D2 You have overrated M2. At 0.5, you would be happy for the other to defect when you cooperate[4]. Suppose we weight it at no more than 0.25M1.
D3 Given $\langle M1, 1\rangle$ and $\langle M2, 0.25\rangle$ one should defect because the expected value of defection is always greater than the expected value of cooperation.
C3 I think that 0.5 is the correct weight for M2.

Coop may now introduce a third value, say Guilt, which will enable the Argument from Dominance:

C4 Given $\langle M1, 1\rangle$, $\langle M2, 0.5\rangle$ and $\langle G1, 0.5\rangle$, one should cooperate because the expected value of cooperation is always greater than the expected value of defection.

This will work well if *Coop* has the final say as to values. But if this is not so, Coop may still defend cooperation with the Argument From Positive Expected Utility:

C4a Given $\langle M1, 1\rangle$ and $\langle M2, 0.5\rangle$, I can cooperate because the expected value of cooperation is always greater than zero.

Suppose now that *Def* had responded to C2 with R4, arguing that there is no reason to think that the probability of cooperation will be below 0.67. Here *Coop* could try to argue why cooperation is unlikely (e.g. the game-theoretic dominance of defection) or reply with the Argument From Positive Expected Utility, which licenses the performance of the action while acknowledging that it may not be the best choice.

[4]This could be so in many concrete situations, depending on the relationship between the two players. A parent will often give preference to the needs of a child, or a cooperator may expect a present (or compensation) from one who defects. Normally, however, a player would be expected to wish to avoid the situation in which he cooperates and the other defects.

6.1. Discussion

As can be seen from the preceding section, the dialogue can take a variety of paths. The particular path taken will depend greatly on the context in which the dialogue is taking place, in particular the dialogue type [18]. If it is a persuasion dialogue, one participant (the person being persuaded) can decide on the values to be used, and the weights that they should be given. The other player can suggest additional values, and question the weights, and even present arguments for values to recognised and for weights to be different, but is powerless to compel the acceptance of these suggestions.

In contrast in a deliberation dialogue (e.g [5], [17]), the participants need to agree on the values, and we would expect the values to be a union of the proposals of both participants, and the weights to represent some sort of compromise between them.

While studies of these sorts of game in behavioural economics such as [8], [12] and [9] make it clear that the best game theoretic choice is often not made since payoff seems rarely to be the only consideration, they make it equally clear that there is a great deal of inter-cultural (and even inter-cultural) variations in the additional values considered, and in the weights given to them. In deliberations, dialogues of this form are especially useful in refining proposals by including additional values so that the interests of the whole group are reflected, and the weights are such that the group as a whole considers them acceptable. Note that the arguments remain valid over a range of weights (and probabilities of success), so that the group can agree on a course of action without necessarily needing to reach full agreement on the weights and the probabilities, provided they can agree on a range acceptable to them all.

7. Concluding Remarks

We have provided a new way of capturing reasoning about the actions of others using argumentation and expected utilities. This account rectifies a serious defect in the account of practical reasoning procedure in [3] which required assumptions to be made about the beliefs, values and preferences of other agents whose choice of action affects the result of an agent's action. Modelling the other participant in a dialogue is difficult enough (e.g. [14] and [10]) and modelling several unseen agents is likely to be very much harder. In the proposed method here we avoid the need to make such assumptions, by considering not a particular joint action in which an agent performs α, but the set of joint actions which can result from the performance of α. Instead of the values promoted and demoted by a selected joint action, we considered the expected utility (with utility calculated in terms of the values promoted and demoted) of performing α.

We have presented this way of thinking about what the others might do in the form of a set of related argument schemes and critical questions, and considered how these schemes can be deployed in dialogues, both persuasion and deliberation dialogues. Possibly the most useful context is deliberation, as there these arguments provide a framework in which additional values can be introduced, the relative weights accorded to them discussed and possible compromises reached, and the range of probabilities of success for which the argument holds good to be established. Modelling other agents is a difficult and currently unresolved problem, and so the ability to take what others may do into account without making unfounded assumptions abut their beliefs and preferences is essential. The argumentation schemes presented here allow this to be done in the context of value-based practical reasoning based on an AATS in the manner of [3].

References

[1] R. Alur, T. A. Henzinger, and O. Kupferman. Alternating-time temporal logic. *Journal of the ACM (JACM)*, 49(5):672–713, 2002.

[2] K. Atkinson and T. Bench-Capon. Taking the long view: Looking ahead in practical reasoning. In *Computational Models of Argument - Proceedings of COMMA 2014*, pages 109–120.

[3] K. Atkinson and T. Bench-Capon. Practical reasoning as presumptive argumentation using action based alternating transition systems. *Artif. Intell.*, 171(10-15):855–874, 2007.

[4] K. Atkinson and T. Bench-Capon. Value-based reasoning and the actions of others. In *Proceedings of ECAI 2016, in press*, 2016.

[5] K. Atkinson, T. Bench-Capon, and D. Walton. Distinctive features of persuasion and deliberation dialogues. *Argument and Computation*, 4(2):105–127, 2013.

[6] T. Bench-Capon. Agreeing to differ: modelling persuasive dialogue between parties with different values. *Informal Logic*, 22:231–246, 2002.

[7] T. Bench-Capon. Persuasion in practical argument using value-based argumentation frameworks. *Journal of Logic and Computation*, 13(3):429–448, 2003.

[8] C. Engel. Dictator games: a meta study. *Experimental Economics*, 14(4):583–610, 2011.

[9] J. Henrich, R. Boyd, S. Bowles, C. Camerer, E. Fehr, H. Gintis, and R. McElreath. In search of homo economicus: behavioral experiments in 15 small-scale societies. *The American Economic Review*, 91(2):73–78, 2001.

[10] A. Hunter. Modelling the persuadee in asymmetric argumentation dialogues for persuasion. In *24th International Joint Conference on Artificial Intelligence*, pages 3055–3061, 2015.

[11] S. Mahmoud, N. Griffiths, J. Keppens, A. Taweel, T. Bench-Capon, and M. Luck. Establishing norms with metanorms in distributed computational systems. *AI and Law*, 23(4):367–407, 2015.

[12] H. Oosterbeek, R. Sloof, and G. Van De Kuilen. Cultural differences in ultimatum game experiments: Evidence from a meta-analysis. *Experimental Economics*, 7(2):171–188, 2004.

[13] A. Rapoport and A. M. Chammah. *Prisoner's dilemma: A study in conflict and cooperation*. University of Michigan press, 1965.

[14] T. Rienstra, M. Thimm, and N. Oren. Opponent models with uncertainty for strategic argumentation. In *IJCAI*, 2013.

[15] E. Ullmann-Margalit. *The emergence of norms*. Clarendon Press Oxford, 1977.

[16] D. Walton. *Argumentation Schemes for Presumptive Reasoning*. Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1996.

[17] D. Walton, K. Atkinson, T. Bench-Capon, A. Wyner, and D. Cartwright. Argumentation in the framework of deliberation dialogue. In *Arguing Global Governance: Agency, Lifeworld and Shared Reasoning*, pages 210–230. Taylor and Francis, 2010.

[18] D. Walton and E. C. Krabbe. *Commitment in dialogue: Basic concepts of interpersonal reasoning*. SUNY press, 1995.

[19] M. Wooldridge and W. van der Hoek. On obligations and normative ability: Towards a logical analysis of the social contract. *J. Applied Logic*, 3(3-4):396–420, 2005.