Arguments as a new perspective on character motive in stories

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Abstract

We often try to teach people through stories and narratives instead of giving them explicit facts and rules. But how do these stories influence us, how do they persuade us to change our attitudes? In this paper, we aim to answer these questions by providing a computational model that offers an *internal perspective* on character motives in stories. This model allows us to represent the deliberations of the main characters and how they weighed their values and motives given their attitudes. We illustrate out model by discussing the well known fable of the *Ant and the Grasshopper* and the parable of the *Prodigal Son*.

Keywords: stories, arguments, character motive

1 Introduction

When trying to convince others to adopt particular values and preferences to guide their actions, we often tell a story, instead of giving them facts and rules. For instance, it is much more convincing to tell a child the story of *The Boy Who Cried Wolf* instead of simply saying that they should not lie because if they do, even when they tell the truth, no one will believe them. The story is used to illustrate various group cultural norms, thus encouraging the right choices by appealing to common values rather than by imposing a rule that is to be followed. Many folk tales are of this type, as are many parables. These parables often depend on a twist in the story, something which is out of the ordinary; for example, no-one expects a father to organise a feast for a son who's blown much of his money on wild living (*The Prodigal Son*). It is exactly this twist that makes these stories interesting and persuasive. So these stories about values present their argument by allowing the audience to form a view as to the nature of their characters, explaining the choices of the characters by reference to the values that motivate these choices. The audience can then consider the motives of these characters in the story in the light of their own values, and reinforce or change their own attitudes accordingly.

In many computational models of narrative [11, 24, 33, 13] stories are rendered as as sequences of particular events with causal links. In these models the exact deliberations of the characters on which goal to try and achieve and why remains implicit. Even if there are links that denote some sort of 'motivational causation' (i.e., *motive causes action*), when there are multiple possible motivations for an action the reasoning about *why* a certain choice was made by the characters remains implicit and thus the characters' decision making processes remain something of a 'black box'. Furthermore, often a story is deemed convincing if it matches a coherent and plausible script [24], a sequence of (causally connected) generic event-types. However, as was argued above, it is not the plausibility that makes a story about values convincing, but rather the unexpected twists in the story [17]. This idea of unexpectedness was discussed in [32, 20], who argue that the clashes between the goals that the characters' are expected to have (according to the standard script) and unexpected new goals make a story interesting, and hence convincing. But as of yet there exists no computational model of narratives that explicitly renders these clashes not only between goals but also between the values that motivate them.

If we want to build a computational model of character values and motives, we need an *internal perspective* that allows us to represent the reasoning and deliberation processes of the characters involved instead of a purely external, causal rendering of character motive. What is needed is a computational framework that explicitly renders the various possible choices the characters could have made, the goals and values that would motivate these choices and, perhaps most importantly, the way in which the characters have resolved clashes between goals and values in the story.

In this paper we provide such a computational model based on value-based practical reasoning [2]. Stories can be captured as *paths in a state transition diagram*, where the transitions represent possible goal-driven actions by the characters and their effects. Character motives are represented by indicating which values - abstract concepts and principles such as 'wealth' or 'honesty' - would be promoted or demoted by the

different actions. Given the action/value combinations in the story-diagram it is then possible to generate practical reasoning arguments of the form 'I should perform Action because it promotes Value' and 'I should not perform Action because it demotes Value'. Thus, a set of arguments and counterarguments representing the possible character choices are generated. Given this set, we can then determine the attitudes (i.e. value orderings) of the characters in the story.

The rest of this paper is organized as follows. In section 2 we discuss some examples of fables and parables to motivate our proposal of a computational model that is focussed on interactions between value-based motives instead of the usual focus on causal plausibility. Section 3 introduces our formal model with two examples, the *Ant and the Grasshopper* and the *Prodigal Son*. Section 4 discusses related work, section 5 briefly discusses some (possible) implementations of our model and section 6 concludes the paper.

2 Motivating Examples: from simple fables to complex parables

Fables tend to be relatively simple narratives, comprising a sequence of events, often intended to advocate or reinforce a particular behaviour. Usually one character displays deprecated behaviour which is shown to have inevitable dire consequences. In some (but not all) fables there is also another character that displays recommended behaviour, which leads to a good outcome. The story is intended to serve as a warning against the disapproved behaviour, and this is often explicitly stated in the moral of the fable.

The Ant and the Grasshopper, which is a fairly typical example of a fable, is a story about a grasshopper who sings during the summer while the ant works hard storing up food for the winter. When the winter comes, the grasshopper has no food: nor will the ant give away any of its store, and the grasshopper dies. The given moral of which the story tries to convince its readers is simple: *Idleness brings want* or *To work today is to eat tomorrow*.

The various participants are not shown as deliberating, or as having any real control over their actions. While one could object that the ant might prove to be charitable, this does not seem to be countenanced within the fable. It seems to presuppose a shared culture in which people are expected to be self-reliant and uncharitable.

A more sophisticated version of much the same story can be found in the parable of the Prodigal Son (Luke 15:11-31). In that story there are two brothers. One, like the grasshopper, takes his inheritance and wastes it in wild living while the other, like the ant, remains at home, working hard on the family farm. When times become hard the prodigal son returns and begs to be given food: while the brother is unsympathetic, in this story the father does take the son back, and not only gives him food, but restores him to his place in the family. This behaviour was not expected by the prodigal son, who had returned only as a last resort, but exceeds his expectations.

The argument in the parable is quite sophisticated. Clearly the orthodoxy of the Ant and the Grasshopper is being challenged, but how is this possible? To understand this we need to consider the reasoning of the elder brother and the father, and to consider

what it is that leads the father to choose to behave as he does. The attitudes of the elder brother will represent conventional wisdom, whereas that of the father represents a different perspective, the one that is being advocated. This is very clear from the context of the Parable: in Luke 15:2 we read that the Pharisees and the teachers of the law muttered 'This man welcomes sinners and eats with them'. In response Jesus tells first the parable of the lost sheep (Luke 15:3-7), then the parable of the lost coin (Luke 15:8-10), before giving the parable of the prodigal son. From this context the parable is therefore clearly a justification of welcoming and eating with sinners: the Pharisees and teachers of the law think like the brother, while the father thinks like Jesus.

The argument here is thus:

1. You think conventionally
2. Conventional attitudes would reject the Prodigal.
3. But the Prodigal should be accepted
4. The father's attitudes would accept the Prodigal
5. Therefore you should adopt the father's attitudes

Seen in this way, the parables of the lost sheep and the lost coin - in both of which it is shown to be natural to seek the one that was lost even though many others are not lost - are arguments intended to establish premise 3 above, that *the Prodigal should be accepted*. Without this support this premise would have to rely on an identification of the audience with the Prodigal son, which cannot be assumed in an audience of Pharisees and teachers of the law, who we assume hold fast to the conventional attitudes.

Note that the conclusion of this argument is not advice to *behave* in a particular way, but rather to *adopt an outlook*, a set of attitudes. The audience is not asked to *do* a particular thing, but to *become* a different kind of person. In order to understand what is being asked of us, however, it is necessary to reflect on the internal reasoning of the characters involved, and the different attitudes which lead them to make the choices they do. While the fable is a sequence of events, presenting two lines of behaviour and their consequences, the parable is rather a crucial choice, presenting two contrasting attitudes and the behaviours to which they give rise. But to understand this we must do more than simply label the characters involved: it is not enough to say that the father is generous and the brother is hard-hearted and we should be generous. We need to understand what it *means* to be generous, and the arguments that support and attack behaving in this way. We need to try to understand the values and the preferences of the two characters.

3 Narrative Practical Reasoning: extracting arguments from stories

The computational model we propose is based on Atkinson and Bench-Capon's framework for practical reasoning in multi-agent systems [2]. This model contains three main elements.

1. *Action-based Alternating Transition Systems with Values* (AATS+V), for encapsulating the background knowledge necessary to build the stories (fables, parables).

2. Arguments based on the *Practical Reasoning Argumentation Scheme* (PRAS), to generate arguments concerning the individual choices a story character could make.

3. *Value-based Argumentation Frameworks* (VAF), representing the set of arguments and counterarguments the story characters use to make their choice on the basis of their preferences and attitudes.

In this section, we discuss each of these elements in turn, using the fable of *The Ant and The Grasshopper* as a running example. Notice that in the original model of [3] there is no way to represent actual stories: the AATS+V represents the background knowledge which includes *all* the (sensible) choices for each character, not just the choices they actually made in the story. In order to be able to render stories using our formal framework, we therefore define a notion of *story paths* in section 3.1.1, single paths trough an AATS+V that represent a story.

3.1 Stories based on AATS+V

Structuralist accounts of narrative argue that *actions* that represent *transitions* between *states* are among the basic building blocks of stories (see e.g. [16]). It is for this reason that we choose the mechanism of Action-based Alternating Transition Systems with Values (AATS+V) as our basic method for formalizing the background information important to stories. This representation provides us with a means to reason rigorously about actions and their effects, since an AATS+V provides a well-defined structure in which we can represent how the actions of an agent give rise to transitions from one state to another. A particular feature of the AATS+V is that it enables us to contextualise transitions so that the effects of actions can be made dependent on the actions of other agents.

AATSs were originally presented in [34] 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. To represent the values (motives) we wish to recognise within our reasoning framework, the AATS structure has been extended as in [2], where a set V of values is introduced, along with a function δ, to enable every transition between two states to be labelled as either promoting, demoting, or being neutral with respect to each value.

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* $\mathrm{i} \in \mathrm{Ag}$ *where* $\mathrm{Ac}_i \cap \mathrm{Ac}_j = \emptyset$ *for all* $\mathrm{i} \neq \mathrm{j} \in \mathrm{Ag}$*;*

- ρ *:* $\mathrm{Ac}_{Ag} \rightarrow 2^{\mathrm{Q}}$ *is an* action pre-condition function*, which for each action* $\alpha \in \mathrm{Ac}_{Ag}$ *defines the set of states* $\rho(\alpha)$ *from which* α *may be executed;*

- τ *:* $\mathrm{Q} \times \mathrm{J}_{Ag} \rightarrow \mathrm{Q}$ *is a partial* system transition function*, which defines the state* τ*(*q*,* j*) that could follow after 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*

- π *:* $\mathrm{Q} \rightarrow 2^{\Phi}$ *is an interpretation function, which gives the set of primitive propositions satisfied in each state: if* $\mathrm{p} \in \pi$*(*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 $i \in Ag$ 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 $i \in Ag$, i's action in j is denoted by j^i.

Definition 2 (AATS+V). *Given an AATS, an AATS+V is defined by adding two additional elements as follows:*

- V *is a finite, non-empty set of values.*

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

*An Action-based Alternating Transition System with Values (AATS+V) is thus defined as a (*n + *9) tuple* $\mathrm{S} = \langle \mathrm{Q}, \mathrm{q}_0, \mathrm{Ag}, \mathrm{Ac}_1, ..., \mathrm{Ac}_n, \rho, \tau, \Phi, \pi, \mathrm{V}, \delta \rangle$.

Definition 1 is taken from [34]. In that paper it is stated that every agent must have the possibility of doing nothing: that is, for all $ag \in Ag$, $doNothing \in Ac_{Ag}$. It is also stipulated in [34] that an agent can only perform one action at a time. Together these stipulations enable us to say that every joint action contains one, and only one, action for each agent in Ag. Definition 2 is taken from [2]. There the function δ was defined solely in terms of the source and destination states. It may, however, be that the performance of an action *in itself* promotes or demotes a value. Suppose Tom enjoys fishing while Dick does not. Now both the joint action where Tom fishes and Dick does nothing and the joint action where Dick fishes and Tom does nothing will result in the pair having fish, which promotes certain values. But only the first will promote pleasure, since only Tom enjoys the activity of fishing in itself. Thus there will be two different transitions, one for each of the joint actions, and only one of them should

return '+' with respect to pleasure. Thus we need to associate values promoted and demoted with the actions in the various Ac_i, and to amend δ to take account of this as well as of the source and destination states; to do this, we use a function ϵ as follows:

- $\epsilon : J \times V \rightarrow \{+, -, =\}$ is a *valuation function* which defines the status (promoted (+), demoted (–) or neutral (=)) of a value $v_u \in V$ ascribed to a joint action: $\epsilon(j_{Ag}, v_u)$ labels the joint action j_{Ag} with one of $\{+, -, =\}$ with respect to the value $v_u \in V$.

An example of an AATS+V that contains the background information for the Ant and the Grasshopper fable is presented in Figure 1. We have propositions to indicate for each of the characters whether they are alive or dead, and whether their food stocks are empty (no), adequate (yes) or more than they need (high). The final proposition indicates whether food is available to be gathered (plentiful) or not (scarce). The action for each character in the joint action is shown on the corresponding transition, as are the values promoted or demoted. We have chosen a range of values: Pleasure (P), Life (L), Self-esteem (S), Wealth (W), Generosity (G) and Justice (J). Some of these are promoted with respect to particular agents: for example Pleasure is always *somebody's* pleasure, and one character may experience pleasure while the other does not. Other values like Justice are promoted without reference to an agent: such abstract virtues are promoted whichever agent acts justly (although, of course, different agents may disagree as to what is just).

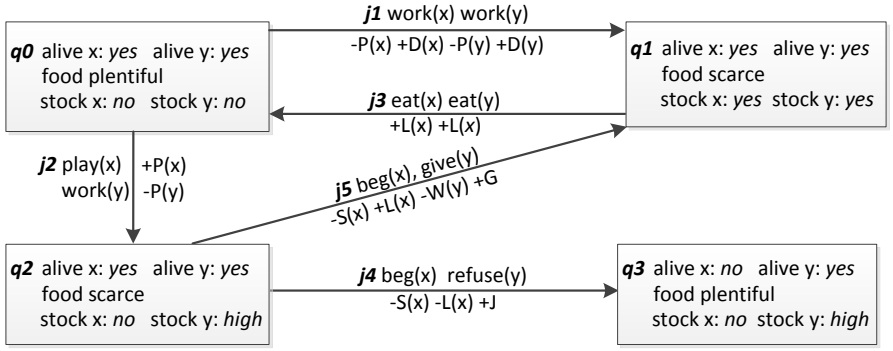

Figure 1: AATS+V representing the background information for the Ant and the Grasshopper

Note that an AATS+V is only intended to represent the knowledge relevant for the motivated actions of the characters, and that hence some information is left implicit. For example, in the AATS+V for the Ant and the grasshopper it is not indicated whether the seasons change after a transition (even though this would be possible[1]), because the seasons by themselves play no important role in the story: what matters is the abundance or scarcity of food associated with the different seasons. Similarly,

[1]For example, one could model an agent 'nature' who performs an action 'change season', and each of the seasons can be included as a proposition in the state.

the passage of time and the exact causal relations between this passage of time, the characters' actions and the state changes are all left implicit, as the point of the story does not concern these causal links: as is argued in this paper, the point of the story is not something like "the onset of winter makes food scarce", but rather concerns the internal perspective of the characters, their attitudes and motivated choices.

Note also that the knowledge represented by an AATS+V depends on the cultural context and that hence an AATS+V is not intended to represent any kind of ultimate, objective, truth. It is necessary that the states and the actions of the story be expressible, but details regarding alternatives and, especially, the values, are chosen depending on the cultural context. The AATS+V as shown in Figure 1 represents our own cultural assumptions, but imagine the story being told in a very different culture. For example consider the culture of the Ache tribe of South America [18], in which the notion of work producing ownership of food is entirely alien. Hence stock would not be individual, but communal, so that the state would simply contain *stock: yes, no*. Now the transition given by j_2 will be to q_1 not q_2, and problems will only arise if neither character works. Alternatively one could consider a culture in which, although people had individual stocks, sharing was the norm, and so there would be no need to beg: perhaps begging is even unknown. Here the transition between q_2 and q_3 does not exist, and the actions giving the transition between q_2 and q_1 are not *beg* and *give*, but *thank* and *share*.

An AATS+V like the one in Figure 1 encapsulates the background knowledge, or cultural context, that is necessary and sufficient for multiple related stories[2]. In the AATS+V, multiple choices of action (i.e. outgoing transitions) for the characters are given in each state, whereas in an individual story a character chooses one particular action to perform. So in order to represent stories, we need to consider the notion of a *story path*, a particular sequence of transitions in the AATS+V. One example of such a path through the AATS+V in figure 1 is $\langle q_0, j_2, q_2\rangle, \langle q_2, j_4, q_3\rangle$, which represents the story of the Ant and the Grasshopper, where the grasshopper is x and the ant is y.

Thus we can provide a bare narrative in terms of a sequence of events by simply considering the story paths through an AATS+V: each time we have more than one event possible in a state, one or more of the agents is making a choice, and the choice (or choices) determines which story is told. From our perspective, it is these choices that are central to the point of the fables and parables. To understand of the point of the stories, we have to go beyond this and consider *why* the choices were made. This is why we want to be able to generate the arguments, and form them into argumentation frameworks.

3.2 Generating Arguments

A story that incorporates character motives can give rise to practical reasoning arguments, arguments which propose, attack and defend justifications for action. In particular, we can construct an argument for performing a certain action in some state because

[2]Other examples of story contexts being expressed an an AATS+V can be found in [6], in which the parable of the *Good Samaritan* is formalised, and in [7], in which the stories surrounding the attempted murder of Sunny von Bülow are captured in an AATS+V

it will promote some value that is important to us. Such a practical reasoning argument is based on the *Practical Reasoning Argumentation Scheme* (PRAS) [3], which provides a general structure for practical reasoning arguments and associated critical questions, which can be used to critique the arguments. This argumentation scheme follows Walton and colleagues [29] in viewing argumentation as presumptive justification - *prima facie* justifications of actions can be presented as instantiations of the argumentation scheme, and then critical questions characteristic of that scheme can be used to identify ways of challenging these justifications.

The argumentation scheme itself is an extension of the *sufficient condition scheme for practical reasoning* [29]. Below we provide a natural-language rendition as well as the formal interpretation in terms of the elements of the AATS+V [2].

In the current circumstances R	In the initial state $q_0 = q_x \in Q$
We should perform action A	Agent $i \in Ag$ should participate in joint action $j_n \in J_{Ag}$, where ${j_n}^i = \alpha_i$
Which will result in new circumstances S	Such that $\tau(q_x, j_n)$ is q_y
Which will promote some value V	Such that for $\epsilon(j_n, v_u)$ is + or $\delta(q_x, q_y, v_u)$ is +

This scheme is used to argue about actions systematically and transparently; which action should be selected from the range of possibilities to be performed and how is the selection justified? Since there can be several, potentially conflicting, options, arguments can arise about which action is 'best' and why. Values play a key role in practical reasoning since different people may want to promote different values, and so may select different actions, or decide to perform an action on the basis of different arguments. Furthermore, different agents may have their own different values that they want to promote leading each to propose different actions to achieve their goals.

Note that [2] does not include goals separately in this scheme, regarding goals simply as particular truth assignments of propositions in Φ, and so included in the specification of the target state S. Moreover in [2] the reasoning was largely confined to what would become true (false) in the immediately next step rather than in the course of a story unit. Because we want to be able to consider beyond the immediate next state, we will adopt some distinctions from [1]. Suppose that j is a joint action giving a transition that takes us to q_1 from q_0. There are four possibilities regarding the next state.

E1 ϕ is true in q_0 and true in q_1: j maintains ϕ.

E2 ϕ is true in q_0 and false in q_1: j removes ϕ.

E3 ϕ is false in q_0 and true in q_1: j achieves ϕ.

E4 ϕ is false in q_0 and false in q_1: j avoids ϕ.

Now if ϕ being true is a goal, then E1 and E3 will provide reasons to participate in j, and E2 and E4 will give reasons not to participate in j. Similarly if ϕ being false is a goal, E2 and E4 will give reasons to participate in j and E1 and E3 will give reasons

not to participate in j. Moreover if performing the action required to participate in j in itself promotes (demotes) a value, this will be another reason to participate in j (or not). Now take the situation forward to consider states beyond the immediately next state. For example, take q_0 to be the initial state, q_1 to be the immediately next state, and q_2 to be the state subsequent to q_1. Suppose also that that ϕ is *contingent*, that is, it may be either true or false in states later than q_0. Then:

E5 ϕ is contingent in q_0 and becomes always true in every state following from q_1 (i.e. true in every available q_2). We say that j *ensures* ϕ.

E6 ϕ is contingent in q_0 and becomes always false from q_2 (i.e. false in every available q_2). We say that j *prevents* ϕ.

E7 ϕ is contingent in q_0 and ϕ is false in q_1 and true in q_2. We say that j *enables* ϕ.

E8 ϕ is contingent in q_1 and ϕ is true in q_1 and false in q_2. We say that j *risks* $\neg\phi$.

Taking these considerations together, and recognising the possibility of the action itself promoting and demoting a value, the following reasons to participate (or to not participate) in a joint action are identified in [1]. Reasons are labelled with the corresponding E-number and an 'N' if they are reasons not to participate. In some cases, such as ensure and prevent, we can have reasons of a given type both for and against participation.

R1 We should participate in j in q in which ϕ holds to maintain ϕ and so promote v.

R2N We should not participate in j in q in which ϕ holds since it would remove ϕ and so demote v.

R3 We should participate in j in q in which $\neg\phi$ holds to achieve ϕ and so promote v.

R4N We should not participate in j in q in which $\neg\phi$ holds which since it would avoid ϕ and so fail to promote v.

R5 We should participate in j in q to ensure ϕ and so promote v. Note that ϕ may be contingently realised or unrealised in q and that, in some variants, the promotion of v might not be immediate, or permanent. This also applies to R5N and R6.

R5N We should not participate in j in q which would ensure $\neg\phi$ and so demote v.

R6 We should participate in j in q to prevent $\neg\phi$ and so promote v. Note that $\neg\phi$ may be contingently realised or unrealised in q.

R6N We should not participate in j in q which would prevent ϕ and so fail to promote v. Here we suggest that to make the reason worth consideration we should only use variants which do prevent ϕ immediately and permanently.

R7 We should participate in j in q in which $\neg\phi$ to enable ϕ to be achieved and v to be promoted on the next move.

R8N We should not participate in j in q in which ϕ which will risk ϕ being removed on the next move which would demote v.

R9 We should participate in j in q because participation in j itself promotes v.

R9N We should not participate in j in q because participation in j itself demotes v.

We can now generate the following arguments applicable to the grasshopper. Based on R5, both can work to ensure that both stay alive, promoting the value of life in respect of them both.

A1 In q_0 I should work to reach q_1 and so ensure that I stay alive and so promote Life.

But based on R9 we have an argument to play, since the action is intrinsically pleasurable.

A2 In q_0 I should play and reach q_2 since playing will promote Pleasure.

R9N provides an objection[3] to A1.

Obj1 In q_0 I should not work to reach q_1 because working demotes pleasure.

We also have some objections to A2, since bad things can happen in q_2. First based on R5N, if we play we must beg in the winter. So:

Obj2 In I should not play because that will reach q_2, which will ensure that self esteem will be demoted.

Based on R8N we need to recognise that if the ant refuses our request we risk dying and so demoting life.

Obj3 In q_0 I should not play because that will reach q_2, from which life risks being demoted.

Because Obj3 is only a risk, it can be met by the counter argument that the bad consequence may not ensue. Life will only be demoted if the ant refuses to give the grasshopper food.

CA1 In q_0 I can play because the ant may give me food, and so life will not be demoted.

In the AATS+V of Figure 1, there were no immediate reasons to work. But suppose we are in a culture where the work ethic is normal, so that working was seen as good in itself, promoting the value of Duty. Now we can use R9 to provide an argument for working:

A3 In q_0 I should work, reaching q_3 to promote the value of duty.

[3]Here we call arguments based on "N" reasons *objections*. Prolog code to generate the arguments and objections is given in Appendix A.

Note that we now have two arguments advocating work, one based on duty (A3) and one based on life (A1). We could, perhaps, treat this as a single argument promoting the set of values {duty, life}. The formalism in the next section allows only one value in an argument: if a transition promotes two (or more) values, there are two arguments rather than a single argument promoting two (or more) values. This will mean that we can have several arguments for the same action: which means that we may need a way combining the strength of two (or more) arguments. A pragmatic solution is to compare two sets by ignoring the common values and choosing the one containing the most preferred value. Effectively this is choosing the argument with the most highly rated distinct value.

3.3 Generating Attacks and Forming the VAF

Given the arguments generated from the AATS+V, we need to determine the attacks between these arguments so we can form a Value-based Argumentation Framework (VAF). For current purposes, it makes sense to identify two ways in which arguments can attack each other: rebuttal and undercutting. We say that two arguments rebut each other if their conclusions are contrary, and that rebuttals always give rise to mutual (symmetric) attacks. So, for example, the contraries of the conclusion *I should perform action A* are its negation *I should not perform action A* (based on a reason labelled with an 'N') and *I should perform action B*, where B is different action than action A (e.g., *I should work* vs. *I should play*)[4]. In our example, A2 and A1 rebut-attack each other, A2 and A3 rebut-attack each other, Obj1 rebut-attacks both A1 and A3 and vice versa, and Obj2 and Obj3 both rebut-attack A2 and vice versa.

One argument undercuts another argument if it attacks the inference from premise to conclusion. For example, CA1 undercuts Obj3: the modalities involved mean that CA1's conclusion *I can play* does not directly negate Obj3's conclusion *I should not play*, but rather attacks the applicability of the argument Obj3. Because the ant may give me food, the fact that life may be demoted cannot be used to infer that *I should not play*. Undercut-attacks only have one direction, so CA1 attacks Obj3 but not vice versa.

The arguments and attacks are then used to build a VAF. A VAF [4] is an extension of the standard Argumentation Frameworks (AF) introduced by Dung [14], which provide a formal means of evaluating arguments based on consideration of the attacks between a set of conflicting arguments. An AF can be pictured as a directed graph with the nodes representing arguments, and the edges an attack of one argument by another. In [14] an AF is defined as a pair of a set of arguments and a binary attack relation between them. An AF can be pictured as a directed graph with the nodes representing arguments, and the edges an attack of one argument by another. In a VAF, the AF of [14] becomes the first term of a triple:

Definition 3 (VAF). *A* Value-based Argumentation Framework *(VAF) is defined by a triple* $\langle H(X, A), \nu, \eta \rangle$*, where* $H(X, A)$ *is an argumentation framework, where* X *is a set of arguments and* A *is a binary attack relation between pair of arguments,* $\nu =$

[4]It is part of the notion of joint action that an agent can only perform one action in a joint action, so performing action B automatically means one cannot perform action A.

$v_1, v_2, ..., v_k$ *a set of* k values*, and* η *:X*$\rightarrow$ ν *a mapping that associates a value* $\eta(x) \in \nu$ *with each argument* $x \in X$*. A* specific audience*,* α*, for a VAF* $\langle H(X, A), \nu, \eta \rangle$*, is a total ordering of* ν*. We say that* v_i *is preferred to* v_j *in the audience* α*, denoted* $v_i \succ_\alpha v_j$*, if* v_i *is ranked higher than* v_j *in the total ordering defined by* α*.*

Figure 2 shows the VAF for the Ant and the Grasshopper example, where the nodes are the various arguments and the edges are attacks between arguments. In each argument, the action that is advocated or deprecated and the value that would be promoted or demoted is shown. This VAF nicely illustrates the grasshopper's and the ant's deliberations. Unlike previous models, which only showed a single motive as an explanation for an action (e.g., 'The grasshopper likes pleasure *causes/motivates* the grasshopper plays'), VAFs allow us to represent the choice by providing arguments for the action to be chosen as well as possible objections and their associated values.

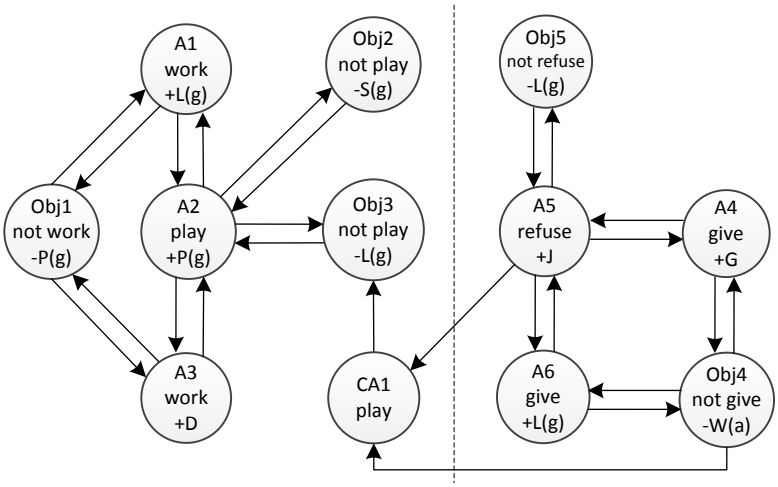

Figure 2: VAF showing the grasshopper's (left) and the ant's (right) deliberations

Note that while the arguments and objections are all associated with values, CA1 is not. This, however, is not a problem, since undercutters always succeed ([22]) irrespective of priorities and so no value comparison is needed here. If CA1 is to be defeated it must be done so by showing that the ant will not perform the action the grasshopper argues he will, namely give the food. Because this involves the choices and deliberations of the ant, we must extend the VAF with the ant's deliberations in q_2. This extension of the VAF will consist of five arguments, two based on R9, an argument based on R5, an objection to A4 and A6 based on R2N, and an objection to A5 based on R2N[5].

A4 In q_2 I should give, reaching $q1$ to promote generosity.

A5 In q_2 I should refuse, reaching $q3$ to promote justice.

[5]Again we term reasons to act 'arguments' and reasons not to act 'objections'.

A6 In q_2 I should give, reaching $q1$ because giving will ensure alive(grasshopper) and so promotes life(grasshopper).

Obj4 In q_2 I should not give because that will reach q_1 and so demote my wealth.

Obj5 In q_2 I should not refuse because that will reach q_3 and so demote life(grasshopper).

A4 and A5, A4 and Obj4, A5 and A6, A5 and Obj5, and A6 and Obj4 all mutually attack. Note that A5 and Obj4 both attack CA1 and vice versa. This is an example of what [22] calls *undermining*: the conclusions of A5 (refuse) and Obj4 (not give) attack the premise of CA1, that the ant will give the food to the grasshopper.

3.4 Determining the Preferences

The purpose of building a VAF is to find a subset of the arguments which is at once conflict free (i.e. no two arguments in the subset attack one another), and collectively able to defend itself (i.e. any attacker of an argument in the subset is itself attacked by an argument in the subset). The maximal such subset is called a *preferred extension*, and represents a maximal consistent position given the arguments presented. The key feature of VAFs is that they allow a distinction to be made between successful attacks (defeats) and unsuccessful attacks, on the basis of the values associated with the arguments: attacks succeed only if the value associated with the attacking argument is ranked by the character evaluating the VAF as equal to, or higher than, the argument it attacks. The VAF thus accounts for elements of subjectivity in that the arguments that are acceptable are dependent upon the character's ranking of the values involved in the scenario.

It is fairly is straightforward to determine the arguments accepted by a particular character, which is characterised by a complete ordering on the values concerned (see e.g. [4] for a polynomial time algorithm). It is less easy to determine which character will accept a particular argument: in the worst case, and using a naive algorithm, this could involve checking every possible value ordering, of which there are the factorial of the number of values. One way of tackling this is to use dialogue games (e.g. [5]). In VAFs, the essence of these games is that a player can defend against an attack not only by citing an argument that attacks the attacker, but also by expressing a value preference that renders the attacker ineffective. Of course, these preferences must be consistent and not in conflict with preferences already expressed by that player. Here we will not present a formal protocol, but give the flavour through an informal dialogue.

A dialogue in q_0 may take the following course. For each move we give the speaker, their argument or preference and some commentary in italics.

1. grasshopper: A2. *Grasshopper wants to play to promote pleasure.*
2. ant: A3. *The ant says she should work to promote duty.*
3. grasshopper: Obj1 and P $\succ_g$ D. *The grasshopper attacks A1 and defends A2 by preferring pleasure to duty.*
4. ant: Obj2. *The ant says that self esteem will be demoted if the grasshopper plays.*

5. grasshopper: P $\succ_g$ S. *The grasshopper prefers pleasure to self-esteem.*

6. ant: Obj3. *The ant says that life may be demoted by playing*.

7. grasshopper: CA1. *The grasshopper says that the ant may share his food.*

8. ant: CA1 fails since A5 and J $\succ_a$ G. *The dialogue now shifts to what the ant will do in q_2, The ant prefers justice to generosity and may be taken as knowing how he will resolve the VAF in q_2*[6].

9. grasshopper: A6. *The grasshopper argues that giving in q_2 will ensure that she stays alive.*

10. ant: A5 and J $\succ_a$ L(grasshopper). *The ant must now explicitly prefer justice (or its own wealth), to the life of the grasshopper. Again justice is the reason more likely to be offered (and more likely to be seen as socially acceptable*[7]*, even if one suspects that wealth is the "real" motive).*

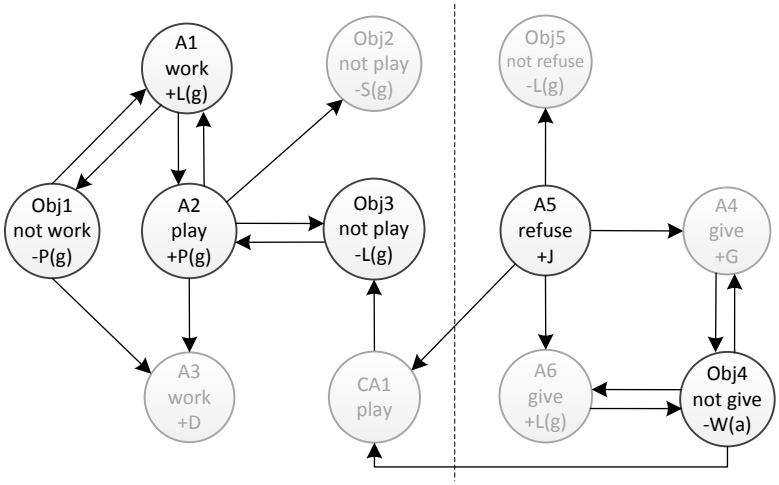

Figure 3: Preferences applied to VAFs for the grasshopper (left) and the ant (right).

Figure 3 shows the updated VAFs from Figure 2 with the unsuccessful attacks removed and the arguments that are not in a preferred extension (i.e. clearly defeated) greyed out. From this, it becomes clear that the grasshopper is left with a final choice. She can do what is expected of her, either changing her original attitude $P \succ_g D$ into $D \succ_g P$ and thus living the life of the ant, or accepting $A1$ and $L(grasshopper) \succ_g P$ so admitting that ensuring life is more important than immediate pleasure. Either

[6]CA1 can also be defeated by Obj4, and a preference for the ant's own wealth over generosity, but the ant may prefer not to make this selfish argument.

[7]That the "hardworking" have no duty to support the idle poor is a constant refrain of UK politicians of all political parties in 2014.

makes the attack $Obj_1 \rightarrow A1$ unsuccessful and puts $A1$ (supporting work) in the preferred extension. Alternatively, she can make the heroic choice of preferring pleasure over life ($P \succ_g L$), saying that a short and merry life is better than a long and miserable one. This last choice would make the attack $Obj_3 \rightarrow A2$ unsuccessful and make $A2$ the winning argument. Moreover this preference allows $Obj1$ to defeat $A1$ and $A3$.

The VAF tells us what a particular choice of actions means in terms of the value preferences it reveals. It shows what the consequences of adopting a particular attitude (i.e., a value ordering) are. If the grasshopper really prefers pleasure over duty, she must also accept that this may cost her her life. Similarly, if the ant really thinks Duty and Justice are the correct options, he must also accept that this may cost someone else's life; there simply is not a situation in which Duty, Justice and Life(grasshopper) are all promoted by arguments in the preferred extension. Thus, the possible *point* or *moral* of the story is represented by the preferred extension of the VAF: *Idleness brings want* is a classic moral that has been attached to the story of the Ant and the Grasshopper, and this is represented by the fact that it is impossible, given the attitude of the ant, to have a preferred extension containing A without $P \succ_g L$.

Note, also that the winning arguments, $A3$ and $Obj3$, are based on a consideration of future states. If only the next state is considered, the preferences required to prefer play to work do not include $P \succ_g L$ and so seem not unreasonable. A secondary message of the fable is thus the need to look at the longer term as well as the shorter term consequences.

3.5 The Prodigal Son

The same AATS+V we used for the *Ant and the Grasshopper* (Figure 1) can be used to model the parable of the *Prodigal Son*. Like the grasshopper, the prodigal son chooses pleasure over duty and chooses to play rather than work. Like the grasshopper the prodigal son ends up with no food and must rely on the generosity of others. In the parable the elder brother reacts like the ant. But the father who, from the context is representing the desired behaviour, prefers Generosity and the life of the grasshopper to Justice and Wealth. This makes that the story for the prodigal son is captured by a different story path (i.e. $\langle q_0, j_2, q_2\rangle, \langle q_2, j_5, q_1\rangle, \langle q_1, j_3, q_0\rangle$) than the ant and the grasshopper (which is $\langle q_0, j_2, q_2\rangle, \langle q_2, j_4, q_3\rangle$).

Thus the decision in q_0 which was the focus in the *Ant and the Grasshopper* is part of the set-up in the *Prodigal Son*. Essentially, the deliberations of the prodigal son mirror those of the grasshopper: either he pays no heed to the longer term consequences of his action, or he hopes that his father will give him food when he returns, making CA1 defeat A1 and A3. What is important here is the decision of the father in q_2, which is the same decision as that which faced the ant, and the arguments that need to be considered are thus those which we identified when thinking about q_2 in the fable (A4-A6, two based on R9 and one on R5). We also have arguments based on R2N, Obj4 and Obj5. The self-esteem of the prodigal son does not give rise to an objection, since it is demoted by the need to beg, however the father responds, and so the prodigal has no choice to make.

Now we can envisage a dialogue such as:

1. Father: A4. *The father may enjoy acting generously.*

2. Brother A5. *The brother says that the father cannot indulge himself. It is obligatory that* $J \succ_f G$.

3. Father: A6 and L(prodigal son) $\succ_f$ J. *The father could defend with* $G \succ_f J$, *but this sounds a bit self-satisfied. Moreover the notion of 'generosity' is rather nebulous. Instead the father choose to rely of the value of the prodigal son's life. This is the preference the parable is intending to establish, and it makes concrete what is meant by 'generosity'.*

4. Brother: Obj4. *The brother now appeals to wealth rather than justice.*

5. Father: L(prodigal son) $\succ_f$ W(father). *The father explicitly commits to preferring the life of the prodigal son to his own wealth.*

Father can further make Obj5, forcing the brother to explicitly state his preference J $\succ_b$ L(prodigal son), which is a tenable, if hard-hearted, position and perhaps expresses the conventional position being questioned by the parable. After all, if idleness has no consequences, perhaps no one will work. The final VAF, with the unsuccessful attacks deleted and the arguments not in the preferred extension greyed out, is shown in Figure 4. Note that the structure of the VAF is the same as the one for the Ant and the Grasshopper, but that the choices are different (the father is not the ant).

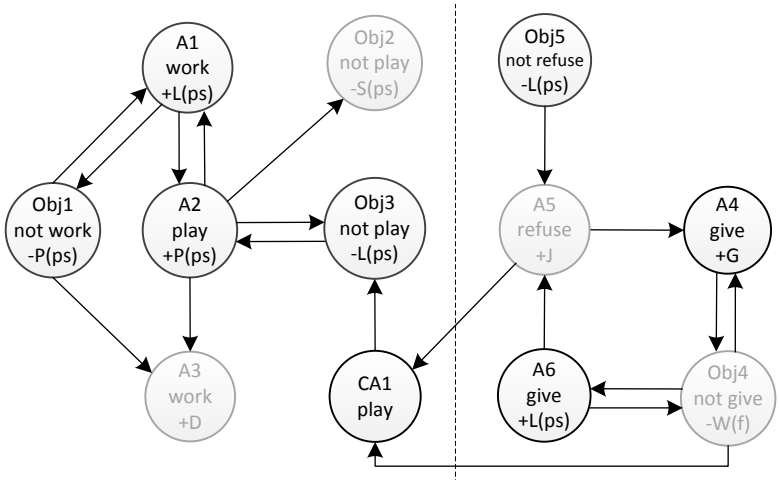

Figure 4: VAF showing the father's preferences

4 Implementing our model

Generating arguments from stories and presenting the different possible extensions based on the value orderings allows one to gain insight into the point of the story:

why did the characters act as they did, and which attitudes are advocated in the story? Whilst this is interesting as a theoretical exercise, one additional aim is to implement a system that allows people to explore the stories and character motives in an interactive and intuitive way. One option is to allow humans to engage in a dialogue akin to the ones in sections 3.4 and 3.5, thus allowing users to for example, interrogate an agent representing father of the prodigal son about his motives, and thus gain a better understanding of the story. This can then be used for educational purposes, for example, schoolchildren learning about values through stories.

For such a system, the following separate elements need to be implemented.

1. *Construct initial AATS+V on the basis of a story*.
2. *Include additional hypothetical transitions: 'what could the characters have done and why?'*.
3. *Generate a VAF of arguments and critiques based on AATS+V*.
4. *Execute a dialogue based on the VAF*.

Elements 1 and 2 have been done for a few stories: the fable of the *Ant and the Grasshopper* and the Parables of the *Prodigal Son* and the *Good Samaritan*. Ideally part of this process is automated if we want to build a more substantial corpus. For element 1, we can first automatically extract the characters and events from stories, especially from fairly short and simple stories such as fables. This is certainly not trivial but very well possible (see e.g. [19]). However, as was discussed earlier, the values expressed by the story depend on the cultural background of the reader: the same story may have different interpretations. Furthermore, element 2 is also hard to fully automate as additional hypothetical transitions are often implicit in the stories, so for elements 1 and 2 human annotation will have to be used, based on skeleton AATS+V's that are constructed using event extraction.

For element 3, currently, Prolog and PHP implementations[8] exist [35, 30]. The PHP tool is based on [2] and so does not include arguments based on look ahead.

Once the arguments are available, it becomes possible to reason with them in a dialogue. Recently a dialogue game for arguing about the motives found in fables and parables was proposed [6]. This protocol can be implemented in a dialogue game execution engine [9], which allows for mixed initiative dialogues between software agents and humans through a simple interface (see [10]), making it possible to reason with the agents in a story in a similar way as shown in sections 3.4 and 3.5. Furthermore, users can input new, value-based arguments about what they think the characters' choices in the story were. These arguments can then relatively easily be inserted as a new transition in the AATS+V (cf. [23]), using the mapping given in this article. Thus, the interface may also serve as a knowledge ellicitation tool to find different interpretations of the stories.

[8]The PHP application can be used at http://cgi.csc.liv.ac.uk/∼maya/ACT/. A Prolog program that represents the AATS in Figure 1 and systematically generates the full suite of arguments and objections based on that structure is included in Appendix A.

5 Related Work

The combination of computational narratives and argumentation has been investigated in the context of criminal legal cases [11], where arguments based on evidence are used to support a story about the case, and it has been argued that stories can be seen as abductive arguments for choosing alternative explanations [7]. The same type of reasoning has also recently been applied to story understanding: in [13] the authors propose a logical framework that combines abductive and modus-ponens style reasoning with the aim of capturing updates to a reader's knowledge when they read a story. While not explicitly mentioning argumentation, [31] use a similar framework to [13] for handling conflicting plans. Further formal work on argument and narrative is [8], which shows how similarities between stories can be explored and how stories can be used in arguments from analogy (i.e., *Character X does action A*, *Character Y is in a similar situation/is a similar person as X* ***Therefore*** *Character B has done/will do action A*).

In all the formal frameworks mentioned above, stories are rendered as sequences of particular events with causal links, which are deemed convincing if they match a coherent script [24]. As was argued earlier in this paper, the coherence requirement does not hold for stories aimed at changing values. Furthermore, causal sequences are not very well suited to reasoning about the various possible values that might have motivated a character, as the reasoning about *why* a certain choice was made by the characters remains implicit.

In [7], we contrasted an early version of our current model with Thagard's explanatory coherence model [26]. In Thagard's model events in a story can be linked through explanatory (excitatory) or contradictory (inhibitory) links, and a connectionist algorithm is then used to determine the degree of coherence of a story. Whilst Thagard's model is, as he claims, psychologically plausible it suffers from the same problems as the models using causal sequences [11, 24, 33, 13], namely that the reasoning about *why* a certain choice was made by the characters remains implicit. The problem with Thagard's approach, from our perspective, is that although in his representation he distinguishes between causal explanations and motives, their effect on execution is identical, both acting as excitatory links in the same way. Thus, for Thagard, an excitatory link between *Claus wants to end his marriage* ***causes*** *Claus to inject Sunny with insulin* is no different from that between *injection* ***causes*** *coma*. In particular there is no consideration of the alternative choices that Claus could have made, and no attempt to rationalise why Claus should have chosen to act on any particular motive.

The connection between stories and arguments has also been explored in more informal models of argumentation and reasoning. Walton [28], for example, has explored the required similarities between stories and arguments from analogy. Munson [21] sees parables as analogies. While, according to Munson, analogies may either be illustrative or form the basis for argument, he sees parables as exclusively illustrative analogies, intended to reinforce an accompanying argument by making it vivid and memorable. However, in [17] it is argued that in fact some parables can be presented as arguments in themselves. We endorse this: there are no accompanying arguments for the *Prodigal Son* as the story itself is supposed to be sufficient to change attitudes.

Fisher's narrative paradigm [15] is perhaps closest to our current model: the sto-

ries *are* the arguments (rather than an instantiation of a part of an argument, as [17] claim). According to the narrative paradigm, a story is persuasive if the characters behave as expected (narrative coherence) and the story matches our own beliefs (narrative fidelity). Fisher further has a central place for values in his theory, arguing that we are concerned with the values within a story and the relevance of those values to the choices that we make. So a story has fidelity not just if it affirms our shared beliefs, but if its values ultimately influence our own beliefs and values. One criticism of the narrative paradigm is that it does not account for possible changes is values because it is too much focused on existing knowledge and beliefs for coherence and fidelity. More recent work [25] extends the narrative paradigm by looking at stories that include seemingly contradictory values or positions that force a reader to reconstruct their meaning, thus enabling an increased understanding of the story and the adoption of new values. The computational model proposed in this paper allows us to perform this reconstruction in a rigorous and partly automated fashion.

6 Conclusions

In this paper, we have provided a computational model that offers an internal perspective on character motives in stories. This model allows us to represent the deliberations of the main characters as sets of incompatible arguments, VAFs. Different character attitudes are shown as value preferences, and how the characters weighed various values and motives is then expressed as the VAF's different preferred extensions. Thus, we have an *internal* perspective on character motives, which allows for a more subtle analysis and explanations of motives than a purely external, causal perspective. This is made clear in, for example, our rendering of the Prodigal Son. In an external causal model, character traits or attitudes like 'Father is generous' and 'Brother is hard hearted' are treated as facts. Now if another agent makes a request, the father will say 'yes' and the brother will say 'no'. But we have no explanation here: we explain the choice in terms of psychological attribute, but the meaning of that attribute is simply 'makes this choice in this situation' (i.e. it is tantamount to tautologous). The VAF approach allows us to say that Generosity means 'prefers Life/Pleasure of another to Justice/Wealth'. Similarly 'hard hearted' means 'prefer Justice/Wealth to Life/Pleasure of another'. We can now replace the black box of a causal 'explanation' which uses terms only understood through their consequences, with an explanation in terms of values and attitudes displayed by the character in the story.

The internal, deliberative view on character motives in stories tells us something about how we understand complex stories. Standard fables, like the *Ant and the Grasshopper*, can be explained and understood using standard scripts: ants are hard workers, grasshoppers are idle, workers shall reap the benefits and freeloaders will be punished. In contrast, stories with a twist in the tale, like many parables, are not suited to script-based explanation, and these stories can be difficult to understand for people not acquainted with them. Twining [27] tells of how law students often misinterpret and misuse the parable of the prodigal son in their speeches; for example, they claim the prodigal son was the smartest and most dilligent son, or, like the Pharisees, they are surprised by the father's reaction. If we do not have a script in memory, we need

to explain the choices of the characters by reference to the values that motivate these choices, and the values that are clearly not important for the characters.

The idea that the VAF and the associated preferences serve as the *point* or *moral* of the story is a powerful one. In simple fables, the moral is often given as a rule: you should (not) behave in a particular way because it will lead to good (bad) consequences. Essentially the moral is then a single instantiation of the PRAS scheme from section 3.2. This can also be done for parables, as shown by [17], who turn parables into arguments directly advocating particular behaviour. For example, they argue that the conclusion of the parable of the Good Samaritan, in which a Samaritan helps a wounded traveller who was left for dead by a priest and a Levite, should be 'One should treat other people, when they are in need [...] with mercy and kindness.' We, however, would contend that the conclusion of the parable should not be of the form *in certain situations you should do this* - a norm, but rather an invitation to adopt different attitudes, to recognise that duties between people arise from their common humanity rather than any social or religious ties. This will lead people to act in accordance with the norm, but motivated by a 'change of heart' which makes them *want* to act properly, rather than recognition of, and compliance with, a norm. Certainly the Samaritan acts as he does because he is the sort of person he is, not because he wishes to comply with a norm not acknowledged by the priest and the Levite. Without the detailed account of the reasoning of the Samaritan offered by our approach (see [6], we cannot articulate the differences in attitude between the three characters, and so cannot identify the attitude we are being urged to adopt. On our account the conclusion of the parable is intended to be written 'not on tablets of stone but on tablets of human hearts' (2 Corinthians 3.3).

The so-called *psychological novel* places emphasis on emphasis on interior characterisation, and on the motives, circumstances, and internal actions which springs from, and develop into, external action. Similarly much literary criticism, for example the highly influential Shakespeare criticism of Bradley [12], is concerned with understanding works in terms of the inner motivations of the characters. It is the subtlety of characterisation, exploring the reasons why Hamlet acts (or does not act) as he does, that makes *Hamlet* a masterpiece, far superior to the other contemporary revenge plays such as Kyd's *Spanish Tragedy*. By exploiting current developments in Artificial Intelligence, we are able bring this dimension to our understanding of fables and parables, to get inside characters and understand what 'makes them tick'. This in turn allows us to see stories as arguments to become a different sort of person, which is certainly the intention of the parables of Jesus, rather than to merely accept a fact or recognise a norm.

Appendix A

This appendix contains a Prolog program that represents the AATS in Figure 1 and systematically generates the full suite of arguments and objections based on that structure. The program is executed by typing `doit(State,Role)` where `State` is either '0', '1', '2' or '3' and `Role` is either 'one', representing the grasshopper/prodigal or 'two', representing the ant/father.

The arguments generated by the program can contain duplicates and trivial arguments; we leave these in for completeness but they can be filtered out if desired.

```
doit(State,Role):-argument(State,Role,C,D,E,F,G,H,I),fail.
doit(_,_).

% states

state(0,[alive,noStock],[alive,noStock],[foodPlentiful]).
state(1,[alive,stock],[alive,stock],[foodScarce]).
state(2,[alive,noStock],[alive,stockHigh],[foodScarce]).
state(3,[dead,noStock],[alive,stockHigh],[foodPlentiful]).

% joint actions

jointAction(j1,work,work).
jointAction(j2,play,work).
jointAction(j3,eat,eat).
jointAction(j4,beg,refuse).
jointAction(j5,beg,give).

%transitions

transition(j1,0,1,
[[duty,action,work]],
[[pleasure(one),action,work],
 [pleasure(two),action,work]]
).
transition(j2,0,2,
[[pleasure(one),action,play]],
[[pleasure(two),action,work]]
).
transition(j3,1,0,
[[life(one),maintain,alive(one)],
 [life(two),maintain,alive(two)]],
[]
).
transition(j4,2,3,
[[justice,action,refuse]],
```

```
[[life(one),remove,alive(one)],
 [selfEsteem(one),action,beg]]
).
transition(j5,2,1,
[[genrosity,action,give]],
[[selfEsteem(one),action,beg],
 [wealth(two),remove,stock(high)]]
).


%arguments

argument(S1,Role,Act,J,S2,V,maintain,P,r1):-
               transition(J,S1,S2,Prom,Dem),
               getAct(J,Role,Act),
               member([V,maintain,P],Prom),nl,
               write([for,r1,in,S1,Role,should,Act,
                      to,participate,in,J,and,reach,S2,
                     which,will,maintain,P,and,so,promote,V]).
argument(S1,Role,Act,J,S2,V,remove,P,r2n):-
               transition(J,S1,S2,Prom,Dem),
               getAct(J,Role,Act),
               member([V,remove,P],Dem),nl,
               write([for,r2n,in,S1,Role,should,not,Act,
                      to,participate,in,J,and,reach,S2,
                     which,will,remove,P,and,so,demote,V]).
argument(S1,Role,Act,J,S2,V,achieve,P,r3):-
               transition(J,S1,S2,Prom,Dem),
               getAct(J,Role,Act),
               member([V,achieve,P],Prom),nl,
               write([for,r3,in,S1,Role,should,Act,
                      to,participate,in,J,and,reach,S2,
                     which,will,achieve,P,and,so,promote,V]).
argument(S1,Role,Act,J,S2,V,avoid,P,r4n):-
               transition(J,S1,S2,Prom,Dem),
               getAct(J,Role,Act),
               member([V,avoid,P],Dem),nl,
               write([for,r4n,in,S1,Role,should,not,Act,
                      to,participate,in,J,and,reach,S2,
                     which,will,avoid,P,and,so,demote,V]).
argument(S1,Role,Act,J,S2,V,ensure,P,r5):-
               transition(J,S1,S2,_,_),
               transition(J2,S2,S3,Prom,Dem),
               member([V,_,_],Prom),
               not(alternative(S2,V)),
               getAct(J,Role,Act),nl,
```

```
          write([for,r5,in,S1,Role,should,Act,
                     to,participate,in,J,and,reach,S2,
                    which,will,ensure,that,V,is,promoted]).
argument(S1,Role,Act,J,S2,V,ensure,P,r5n):-
               transition(J,S1,S2,_,_),
               transition(J2,S2,S3,Prom,Dem),
               member([V,_,_],Dem),
               not(alternativeD(S2,V)),
               getAct(J,Role,Act),nl,
               write([for,r5n,in,S1,Role,should,not,Act,
                      to,participate,in,J,and,reach,S2,
                     which,will,ensure,that,V,is,demoted]).
argument(S1,Role,Act,J,S2,V,prevent,P,r6):-
               transition(J,S1,S2,Pro,Demo),
               transition(Jx,S1,S2x,Prox,Demox),
               not(J == Jx),
               demotable(S2x,V),
               not(demotable(S2,V)),
               getAct(J,Role,Act),nl,
               write([for,r6,in,S1,Role,should,Act,
                to,participate,in,J,and,reach,S2,
                which,will,prevent,V,from,being,demoted]).
argument(S1,Role,Act,J,S2,V,prevent,P,r6n):-
               transition(J,S1,S2,Pro,Demo),
               transition(Jx,S1,S2x,Prox,Demox),
               not(J == Jx),
               promotable(S2x,V),
               not(promotable(S2,V)),
               getAct(J,Role,Act),nl,
              write([for,r6n,in,S1,Role,should,not,Act,
                to,participate,in,J,and,reach,S2,
            since,this,will,prevent,V,from,being,promoted]).
argument(S1,Role,Act,J,S2,V,enable,P,r7):-
               transition(J,S1,S2,Prom,Dem),
               transition(J2,S2,S3,Prom2,Dem2),
               member([V,_,_],Prom2),
               not(member([V,_,_],Prom)),
               getAct(J,Role,Act),nl,
               write([for,r7,in,S1,Role,should,Act,
                to,participate,in,J,and,reach,S2,
                which,will,enable,V,to,be,promoted]).
argument(S1,Role,Act,J,S2,V,risk,P,r8n):-
               transition(J,S1,S2,Prom,Dem),
               transition(J2,S2,S3,Prom2,Dem2),
               member([V,_,_],Dem2),
               not(member([V,_,_],Dem)),
```

```
                getAct(J,Role,Act),nl,
                write([for,r8n,in,S1,Role,should,not,Act,
                to,participate,in,J,and,reach,S2,
                which,will,risk,V,being,demoted]).
argument(S1,Role,Act,J,S2,V,perform,none,r9):-
               transition(J,S1,S2,Prom,Dem),
               member([V,action,Act],Prom),
               getAct(J,Role,Act),nl,
                write([for,r9,in,S1,Role,should,Act,
                to,participate,in,J,and,reach,S2,
                since,doing,Act,will,itself,promote,V]).
argument(S1,Role,Act,J,S2,V,perform,none,r9n):-
               transition(J,S1,S2,Prom,Dem),
               member([V,action,Act],Dem),
               getAct(J,Role,Act),nl,
               write([for,r9n,in,S1,Role,should,not,Act,
                to,participate,in,J,and,reach,S2,
                since,doing,Act,will,itself,demote,V]).


alternative(S2,V):-transition(J,S2,Se,Prom,Dem),
                   not(member([V,_,_],Prom)).
alternativeD(S2,V):-transition(J,S2,Se,Prom,Dem),
                   not(member([V,_,_],Dem)).


promotable(S,V):-transition(J,S,S2,Prom,Dem),
                  member([V,_,_],Prom).
demotable(S,V):-transition(J,S,S2,Prom,Dem),
                  member([V,_,_],Dem).


getAct(J,one,A):-jointAction(J,A,_).
getAct(J,two,A):-jointAction(J,_,A).
```

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