

Plot Generation with Character-Based Decisions

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ABSTRACT

The method proposed here to determine, in a simplified but still plausible way, the behaviour of the characters participating in a story is based on rules that associate a given situation with a list of different goals. In view of the rules whose situation holds at the current state, each character engages in a decision-making process along three steps: goal selection, plan selection, and commitment. The selection criteria reflect individual preferences originating, respectively, from drives, attitudes and emotions. Four kinds of inter-character relations are considered, which may lead to goal and plan interferences. A prototype logic programming tool was developed to run experiments.

1 INTRODUCTION

Character-based storytelling [1] depends on a specification of personality traits able to adequately motivate the behaviour of the various acting characters. When research in this area addresses the characters' personality traits, it usually does so by incorporating affect constructs in the underlying model or system architecture, but at such an abstract level that it does not ensure their psychological plausibility. Moreover, the role each construct plays in the characters' behaviour is usually unclear. In this paper, we propose a decision making process in which each step is responsible for a certain kind of decision (namely: goal selection, plan selection, and commitment to executing the plan), taking into account a set of personality traits inspired in the literature (namely: drives, attitudes, and emotions). We draw on the canonical four ends or aims of human life of Hinduism to represent drives [14], on the "Big Five" model of personality [20] to represent attitudes, and on Ekman's six basic emotions [24] to influence the characters' behaviour. As the characters do not behave

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independently of each other, in addition to the individual influences of the personality traits, we define inter-character relations — syntagmatic, paradigmatic, antithetic and meronymic — that may influence their behaviour at all decision levels. These relations were defined based on the four master tropes identified in Semiotics [10] (namely: metonymy, metaphor, irony and synecdoche). Here we shall not try to assume a rigorous psychological approach, which would be overly ambitious, and shall merely strive for enough plausibility, so as to make the actions of the various characters believable [2].

Our proposed decision-making process requires the previous formulation, by the author in charge, of a set of *situation-goals* rules, associating a given situation with a list of goals. Both situations and goals are described by logical expressions asserting or denying the existence and properties of persons, places and all kinds of objects, animated or not.

Suppose that, at the current state σ_0 of the mini-world of the story, one or more such rules of the form $S_i \rightarrow [G_{i1}:V_{i1}, G_{i2}:V_{i2}, \dots, G_{in}:V_{in}]$ are triggered, in the sense that their S_i situation components hold at the moment. Each term $G_{ij}:V_{ij}$ refers to a goal G_{ij} , with value V_{ij} , motivated by S_i . In our simple method, the first decision step to be accomplished by each character is to select a goal, after inspecting all lists of goals of the triggered rules. After finding *what* to do, the next step is to choose *how* to proceed.

Here, as in previous works [3], we employ a predefined repertoire of operations, defined by their pre- and post-conditions, whose execution is equated with the occurrence of the events constituting the narrative plot. So, a character who proposes to achieve a goal will have to execute an appropriate *plan*, i.e. a sequence of one or more operations able to lead to a target state wherein the goal will hold, possibly together with a number of other effects which may or may not be to the character's liking. Plans can either be ready-made – as assumed in the present paper – or be produced on demand by a plan-generation algorithm [3]. So, at the second step of the decision process, a character desiring to pursue a goal G_{ij} will choose a plan P_{ijk} with value V_{ijk} , after inspecting *goal-plans* rules of the form $G_i \rightarrow [P_{ij1}:V_{ij1}, P_{ij2}:V_{ij2}, \dots, P_{ijm}:V_{ijm}]$.

Once both a goal and a plan have been selected, the character is in a position to assess the prospects [4] of the target state σP_{ijk} resulting from the actions to be executed which, as noted, may bring about any number of side-effects besides the achievement of the intended goal. The third decision step is then to commit or not [5] to executing plan P_{ijk} – i.e., to find whether or not it is *worthwhile* to act so as to move from the present state to state σP_{ijk} . This decision uses specific *emotional-factor* rules F^C for each character C , of the form $F^C \rightarrow [S_{k1}:V_{k1}, S_{k2}:V_{k2}, \dots, S_{kp}:V_{kp}]$, enumerating and attributing values to situations whereat factor F has any emotional significance to C .

Thus, on the one hand, we duly recognize the importance of affect in decision making [6][7][8]. At each step, we use distinct classes of personality traits to provide a decision criterion: *drives* to select goals, *attitudes* to select plans, and *emotions* to assess the anticipated gain or loss resulting from the prospective state transition. And, on the other hand, the personality profile of each character provides positive, negative or null weights to be applied to the values attached to drives, attitudes and emotions by the rules governing the three steps. If necessary, the weights and values set initially should be gradually tuned by the author until all characters behave in close agreement with their assumed “style”.

Until this point we have considered the characters in isolation, having in mind goals of their own direct interest, but plan-based models have to cope with the complexities of multi-agent narrative generation. In this connection, inter-character relations are a key factor: a character may act independently, but may instead turn to what might be called indirect goals, in an attempt to interfere either in favor or against others, helping or hindering their actions [9]. And, besides the main acting characters, there may exist groups of lesser participants, whose individual actions will need to be described if the story is to be told at a more detailed level.

The inter-character relations treated here are suggested by the so-called four *master tropes* of semiotic research [10]. They provide a standpoint to examine the meta-planning issues arising from goal or plan interference [11], taking into consideration how each character feels about each of the others [12].

A prototype, implemented in Prolog, was developed to run experiments. After ranking the goals according to the proposed method, it selects the best one but only discards those whose global computed value is null or negative (or lies below some prescribed threshold). Then, if at the plan-selection step no suitable plan is found to achieve the chosen goal, the standard Prolog backtracking feature picks up the next best goal. Plans are similarly ranked, so that backtracking is again activated if the commit decision is negative for the selected plan.

The paper is organized as follows. Using a small example as illustration, Section 2 describes each step of the decision process, leaving inter-character relations and their consequences to be briefly sketched in Section 3. Section 4 describes ongoing work for tailoring the characters. Section 5 presents related work and Section 6 contains concluding remarks.

2 THE THREE-STEP DECISION PROCESS

Before going into details, some general remarks are in order. The personality factors considered here are drives, attitudes and emotions. Thus, according to our proposed model, each character is described in terms of these three factors, using numerical *weights* to indicate the relevance of each drive, attitude and emotion with respect to the character's behaviour. It may happen that a character is immune to some factor, or may even react in opposition to it. For example, a character may be totally unconcerned with sense of duty (one of the drives mentioned in Section 2.1), or may like the idea of breaching the existing rules, as a typical villain. Thus, weights can be positive, in the range [1 : 4], negative, in the range [-4 : -1], or null if the character's behaviour is unaffected by the corresponding specific factor. This 9-point scale is used to measure the weights in the form of a *semantic differential scale* [13], a measurement technique widely used in attitude research.

On the other hand, positive, null or negative *values*, in the same ranges, are assigned to goals (in situation-goal rules) and plans (in goal-plans rules), to assess goals with respect to the various drives, and plans with respect to the attitudes. Values are also attributed to situations with an influence on the emotions of specific characters (in emotional-factor rules). For a given character, at each of the three decision steps, the *contribution* of each factor is first computed as the product of corresponding weights and values (noting that,

whenever weight and value are both negative, a positive contribution results), and then the totals obtained by adding the contributions are applied for ranking purposes.

Only goals (Section 2.1) and plans (Section 2.2) for which the totals are positive are retained, being exhibited in a normalized form so as to lie inside the interval [1 : 10]. The total influences (positive or negative) of prevailing situations on the level of each emotion (Section 2.3) are added together to assess their overall contribution to emotional satisfaction at the current state and at the state to be reached by executing the plan under consideration, and, if the latter is greater than the former, the estimated gain is computed as a percentage.

Frame structures are used extensively. The single example that illustrates the functioning of the decision-making process will be shown step by step at the end of each section, in the Prolog notation adopted for our prototype tool.

2.1 Goal selection – drives

The example deals with one among the several plots that can emerge from a tiny subset of the chivalric romance *genre*, formally specified as in [3]. It is staged in a mini-world whose initial state can be thus summarized:

Duke Baldwin is absent on a mission, leaving his wife, the lady Elaine, in the solitude of the White Palace. Count Duncan, Baldwin's sworn enemy, sees the duke's temporary absence as an opportunity to invade his domains. Sir Wilfrid, the bravest knight in the realm, is in love with Elaine, but is too shy to confess his feelings; moreover by doing so he would betray the duke, who absolutely trusts him. At the Black Castle lives Prince Morvid, who hates Sir Wilfrid and envies his high reputation.

At this state, one of the currently holding situations, relevant enough to motivate action, is the typical lady-in-distress predicament, with Elaine left unprotected in the White Palace due to her husband's absence. The other male characters living in the neighbouring regions may regard this situation as an opportunity to try one of the following goals:

- g1)** to protect the lady
- g2)** to conquer the castle
- g3)** to seduce the lady
- g4)** to promote peace between the lord and his rival

It looks natural to assume that the power of a specific goal, such as those above, to motivate the conduct of a given character mostly depends on the extent to which attaining the goal could serve to satisfy that character's needs. Associated with the fundamental needs of individuals, some suitable repertoire of *drives* must be postulated [6], as providing the prime motivations behind goals. We shall consider the following very basic drives:

- d1)** sense of duty
- d2)** material gain
- d3)** pleasure seeking
- d4)** spiritual endeavor

These drives correspond to the “*purusharthas*”, the canonical four ends or aims of human life of Hinduism, respectively named “*dharmā*”, “*ārtha*”, “*kama*” and “*moksha*” in the Sanskrit language [14]. World literature provides extreme examples of characters who seem to remain obsessively under the spell of just one of these drives: **d1** for Rama in the *Ramayana* [15];

d2 for Sindbad the Sailor in the *One Thousand and One Nights* [16]; **d3** for Don Juan in *The Trickster of Seville* [17]; **d4** for Galahad in the *Quest of the Holy Grail* [18].

As mentioned in Section 1, situation-goals rules have the form $S_i \rightarrow [G_{i1}:V_{i1}, G_{i2}:V_{i2}, \dots, G_{in}:V_{in}]$. We now add that each V_{ij} is in turn a frame $[d1:v1_{ij}, d2:v2_{ij}, d3:v3_{ij}, d4:v4_{ij}]$, where goal G_{ij} is valued with respect to each of the four drives. The values initially arbitrated by the author are of course subject to later calibration in the course of experiments (the same being true for all numerical measures to be mentioned in the sequel).

On the character's side, frames of the form $[d1:w1, d2:w2, d3:w3, d4:w4]$ must be specified to express by means of weights the influence of each drive in the character's conduct. The expression for the overall evaluation of a goal G_{ij} for a character C is then:

$$V_{Gij}^C = \Sigma [wn^C \times vn^{Gij}], \text{ for } n = 1, \dots, 4$$

which resembles ordinary utility functions [19], except that, in the latter, weights usually represent probabilities. Also recall that, when both weight and value are negative, their product yields a positive contribution – which equally applies to the formulas in the next sections. For instance, the sense of duty drive takes on a negative value for the goal to take the unprotected White Palace, but a villain, such as Morvid, with a negative weight for this drive, would count that as an asset.

Example 1. Assume that, at the current state, the following facts hold, among others:

```
married('Elaine', 'Baldwin'),
owns('Baldwin', 'White Palace'),
menaced('Baldwin', 'Duncan'),
current_place('Baldwin', 'Lyonnesse'),
current_place('Elaine', 'White Palace'),
loves('Wilfrid', 'Elaine'),
loves('Morvid', 'Elaine'),
hates('Morvid', 'Wilfrid'),
home('Morvid', 'Black Castle').
```

and that one of the defined rules is:

```
situation_goals(Agent/(married(W,L), owns(L,C), menaced(L,V),
not current_place(L,C), not (Agent == W), not (Agent == L)),
[protected(W,Agent): [d1:4,d2:0,d3: 0,d4: 2],
conquered(Agent,C): [d1: 0,d2: 4,d3: 0,d4: 0],
seduced(W,Agent): [d1: 0,d2: 0,d3: 4,d4: -3],
pacified(Agent,V,L): [d1: 1,d2: 0,d3: 0,d4: 2]]).
```

Assume further that the weights attributed to Wilfrid's drives are those indicated by frame **D** in the character clause below (the **A** and **E** parameters will be explained in the next sections):

```
character('Wilfrid',D,A,E) :- D = [d1: 4,d2: 0,d3: 4,d4: 1], A = ..., E = ...
```

Consider the following command:

```
:- rank_goal('Wilfrid',G,V).
```

The `rank_goal` command triggers all rules whose situation component initially holds, Wilfrid being treated as `Agent` (just one rule, in the present example). It yields in decreasing value order, upon backtracking, each positive-valued goal available to him:

```
G = protected(Elaine, Wilfrid), V = 10 % g1: protect the lady
G = seduced(Elaine, Wilfrid), V = 6 % g2: seduce the lady
G = pacified(Wilfrid, Duncan, Baldwin), V = 1 % g3: make peace between Duncan
and Baldwin
```

2.2 Plan selection – attitudes

Having ranked the goals suggested by what currently holds in his world, Wilfrid's next task is to pick up the highest ranked goal and proceed to choose a *plan* to achieve it. As mentioned before, a goal G_{ij} is associated with appropriate plans by way of goal-plans rules of the form $G_{ij} \rightarrow [P_{ij1}:V_{ij1}, P_{ij2}:V_{ij2}, \dots, P_{ijm}:V_{ijm}]$. We saw in the previous section that goal **g1** (“protect the lady”) is the preferred one, in view of the drives that govern Wilfrid's conduct. But what happens if no plan has been prearranged for that? In this case, the next best goal comes to the front (in logic programming, via the regular backtracking mechanism).

Suppose the following plans do exist for goal **g2** (“seduce the lady”):

- p1**) abduction
- p2**) elopement
- p3**) visit under disguise
- p4**) proposal by proxy

In the first two plans [3], the seducer goes to the place where the lady currently is, then either seizes her (in case of **p1**) or gently entreats her (in case of **p2**), and finally carries her to his dwelling. In the two rather less conventional plans **p3** and **p4**, the lady is not taken away, and the fact of her seduction is kept secret. In plan **p3**, the seducer undergoes a magic transformation and deceives the lady, making her imagine that he is a different person, typically her husband himself or else a divine creature. In plan **p4**, a third party entreats the lady on the seducer's behalf, persuading her so effectively that she agrees to entertain a love pact with the latter, of which her husband should remain unaware.

Different plans may correspond to strikingly different styles of acting, which we characterize through a slightly modified version of the “Big Five” scheme [20]. For that, we indicate by numerical value to what extent a plan manifests each of the following *attitudes*:

- a1**) pleasing
- a2**) adaptable
- a3**) outgoing
- a4**) careful
- a5**) self-controlled

Similarly to what we did with drives, we attribute a second frame to the characters' description, wherein attitudes receive weights in order to represent their habitual way of acting to obtain what they want.

In terms of **a1**, plan **p1** (“abduction”) is clearly inferior to plan **p2** (“elopement”), but a violent character, deficient therefore in **a1**, may well prefer the former to the latter. Both, however, might be suitable for characters strong in terms of **a2**: they would for example be ready to shift from one plan to the other, depending on whether the lady resists or willingly accepts their entreaties.

On the other hand, plans **p1** and **p2** have in common the danger of retaliation from the part of the duke, which makes such plans unappealing for individuals marked by a high value of **a4**. They would prefer one of the last two plans, wherein the misdeed is hidden and a confrontation with the husband is thereby avoided. This more prudent preference would be especially reinforced in favour of the imaginative plan **p3** (visit under disguise) in the mind

of adaptable characters, recalling that a “Big Five” label for **a2** is “openness to new experiences”. But **p3** requires a considerable measure of emotional control (attitude **a5**) to keep the pretense. The other less dangerous possibility, **p4** (proposal by proxy), is particularly adequate to introverted characters, with a negative weight for **a3**.

There are of course innumerable stories of abduction and elopement (cf. [3] for some examples). As to plans involving a visit under disguise, the reader may look at the seduction of Olympias, wife of King Philip of Macedon, by the magician Nectanebo, who feigned to incarnate the god Ammon and made her conceive Alexander the Great [21], and at the seduction of Igraine, wife of Duke Gorlois, by King Uther Pendragon transformed by Merlin into the semblance of the duke, from which resulted the birth of King Arthur [22]. A case of proposal by proxy is the tryst [18] between King Arthur's wife, Queen Guinevere, and Lancelot of the Lake, arranged by Lancelot's friend Galehaut¹ (Figure 1).



Figure 1. Galehaut acting as a proxy to Lancelot and Guinevere².

To find for a character C the value $V_{P_{ijk}}$ of a plan P_{ijk} able to achieve a goal G_{ij} , a formula similar to that of Section 2.1 is used:

$$V_{P_{ijk}}^C = \sum [wn^C \times vn^{P_{ijk}}], \text{ for } n = 1, \dots, 5$$

Example 2. Let parameter A register Wilfrid's attitudes frame in the character clause:

```
character('Wilfrid',D,A,E) :- D = ..., A = [a1: 3,a2: 0,a3: -4,a4: 1,a5: 1],
    E = ...
```

and consider the rules below, whereby plans are provided for two out of the three goals indicated for Wilfrid in Example 1:

```
goal_plans(Agent/seduced(W,Agent),
    [abduction(Agent,W): [a1: -3,a2: -2,a3: 2,a4: -3,a5: 0],
    elopement(Agent,W): [a1: 3,a2: -2,a3: 2,a4: -3,a5: 1],
    visit_under_disguise(Agent,W): [a1: 0,a2: 3,a3: 1,a4: -1,a5: 3],
    proposal_by_proxy(Agent,P,W): [a1: 3,a2: 2,a3: -3,a4: 3,a5: 0]]).
goal_plans(Agent/pacified(Agent,V,L),
```

¹ Dante's Galeotto - cf. *Inferno*, canto V, v. 137.

² Manuscript illustration, Bibliothèque Nationale de France, Paris


```
[peace_talk(Agent,V,L): [a1: 4,a2: 2,a3: 0,a4: 1,a5: 1]]).
```

Consider the following command:

```
:- rank_goal('Wilfrid',G,_), rank_plan('Wilfrid',G,P,V).
```

After the goal selection already shown in Example 1, the `rank_plan` command yields plans that conform to Wilfrid's attitudes are selected to achieve each goal, as follows.

Recall from Example 1 that the selected goals were, in decreasing preference:

```
G = protected(Elaine, Wilfrid)
G = seduced(Elaine, Wilfrid)
G = pacified(Wilfrid, Duncan, Baldwin)
```

Since no plan exists for the first goal, the `rank_plan` command fails, and `rank_goal` backtracks to consider the second goal, for which a plan is obtained with a positive value. Notice that one of the parameters of the plan remains uninstantiated, showing that the character who would intervene for Wilfrid's sake has still to be found – we shall refer again to that in the next section. By forced backtracking, a suitable plan is also obtained for the third goal. The results are:

```
G = seduced(Elaine,Wilfrid),
P = proposal_by_proxy(Wilfrid,_,Elaine),
V = 5;
```

```
G = pacified(Wilfrid,Duncan,Baldwin),
P = peace_talk(Wilfrid,Duncan,Baldwin),
V = 1
```

Figure 2 illustrates the computation by which the `proposal_by_proxy` plan was obtained.

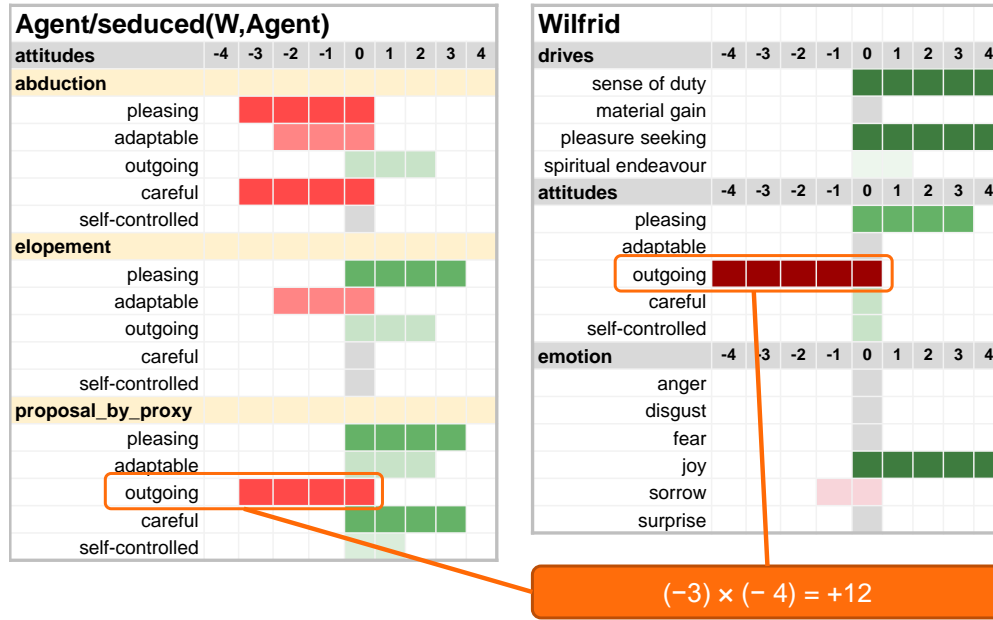


Figure 2. Obtaining a ranking value for the plan, considering the plan's values and the character's attitude weights.

2.3 Simulation and commitment – emotions

Having selected a desirable goal and a plan congenial to his habits, will the protagonist *commit* [5] to executing the plan? The utility functions rationale is not new, an early example

— with an ironic outcome — being provided by the English philosopher Herbert Spencer (1820-1903), to decide whether or not he should migrate to New Zealand [23]:

He made parallel lists of reasons for and against the move, giving each reason a numerical value. The sums being 110 points for remaining in England and 301 for going, he remained (p.270).

A character may indeed fail to move from a condition of inertness to action, unless a comparison of the prospective level of *satisfaction* at a state wherein the goal is fulfilled shows a clear advantage over the present state. The phenomenon of anticipation [4] is therefore crucial here. And, in a computerized environment, to fully determine what will hold in the target state, it is convenient to *simulate* the execution of the chosen plan, since plans usually have a number of effects besides the achievement of the intended goal, some of which may look discouraging to the character. We shall equate satisfaction with *emotional* satisfaction in terms of six basic emotions [24]:

- e1) anger
- e2) disgust
- e3) fear
- e4) joy
- e5) sorrow
- e6) surprise

Here we do not interpret sorrow as a synonym of sadness, which might be understood as negative joy, but as a distinct emotion that “implies a sense of loss or a sense of guilt and remorse”.³

We chose to represent the levels of emotion felt by the characters as virtual attributes, in the sense that the values are left to be computed both at the current state and at the state that would be reached by executing a plan, by adding all positive and negative values coming from situations previously declared as having emotional significance to a given character. For example, being together with Elaine would increase Wilfrid's joy, as also, to a lesser extent, the fact that someone regards him as a friend. On the other hand, being hated by an enemy would add to fear, whereas treasonous acts against his lord should cause sorrow.

The measure of satisfaction at the current state, or at a prospective target state, is evaluated with the help of null, positive or negative weights, expressing how strongly each emotion affects the character's overall assessment. So Wilfrid might ignore fear, admit joy as highly positive, and duly subtract sorrow, which is often the price to be paid for a joyful conquest. The formula to compute emotional satisfaction for a character C at a state σ is:

$$V_{\sigma}^C = \sum [w_n^C \times v_{\sigma}^C], \text{ for } n = 1, \dots, 6$$

At a first glance, it would appear that joy is in fact the only truly desirable emotion. But any of the other emotions may be relished by certain individuals. Fear, for instance, can be cultivated by the adepts to “living dangerously”. In the course of abduction, if the victim falls in love with the captor (the so-called “Stockholm syndrome”), the resulting surprise may come to enhance the degree of the evildoer's satisfaction. Anger and disgust may count positively to devilish characters. And, contrariwise, a saintly character may register a null or

³ www2.merriam-webster.com

even a negative weight for joy, recalling that Sir Galahad, the Grail hero, wore constantly a hair-cloth garment close to skin to avoid temptation [18].

Commitment ultimately depends on a comparison between levels of satisfaction. One may simply require that the target state level be greater than the current state level, or may establish that the former should exceed the latter by a margin of, say, 10 per cent.

Example 3. Let parameter E register Wilfrid's emotions frame be:

```
character('Wilfrid',D,A,E) :- D = ..., A = ...,
    E = [e1:0,e2:0,e3:0,e4:4,e5:-1,e6:0].
```

and let the following clauses indicate situations whose occurrence would have a positive or negative value for Wilfrid with respect to the emotion named after each “v_” prefix:

```
v_anger('Wilfrid',F) :-
    F = [(current_place('Elaine',P), current_place(C,P),
        not (C = 'Wilfrid'), not lady(C)): 3,
        current_place('Wilfrid',forest): -1].
v_fear('Wilfrid',F) :-
    F = [hates(_, 'Wilfrid'): 1].
v_joy('Wilfrid',F) :-
    F = [together_with('Wilfrid', 'Elaine'): 4,
        not together_with('Wilfrid', 'Elaine'): -4,
        loves('Elaine', 'Wilfrid'): 3,
        likes(_, 'Wilfrid'): 2].
v_sorrow('Wilfrid',F) :-
    F = [betrays('Wilfrid', 'Baldwin'): 2].
```

On the basis of these clauses, it is possible to obtain the value of each of Wilfrid's emotions at the current state. Consider the following command line:

```
:- fear('Wilfrid',V1), joy('Wilfrid',V2).
```

It displays the values of interest, which are those for fear and joy (given that the others turn out to be zero):

```
V1 = 1, V2 = -4
```

Consider now the following command line:

```
:- satisf('Wilfrid',s0,Vs0).
```

It evaluates the current overall satisfaction (*s0* denotes the current state) by applying the weights furnished in Wilfrid's emotions frame. Notice that he disregards fear (weight 0 for **e3** in the E frame of the `character` clause, shown at the first lines of this example), whereas joy is of prime importance to him (weight 200 for **e4**). The results of the `satisfy` command are:

```
Vs0 = -16.
```

The decision to commit, relying on emotional satisfaction considerations, compares the current level of satisfaction with the prospects offered by each selected plan. So, to guide the decision, we now add to goal and plan selection a third inquiry:

```
:- rank_goal('Wilfrid',G,_),rank_plan('Wilfrid',G,P,_),commit('Wilfrid',P,D).
```

Recall from Example 2 that the plans to be evaluated for commitment are:

```
P = proposal_by_proxy(Wilfrid,_,Elaine)
P = peace_talk(Wilfrid,Duncan,Baldwin)
```

The commit command fails for the first plan, because it is not completely determined, since the second parameter is uninstantiated. Upon backtracking, the second plan is considered and approved, since its effects would lead to a state at which Wilfrid's emotional satisfaction

would be enhanced to a non-negligible extent (50%). The improvement, in terms of joy exclusively, would be a consequence of gaining a friend (fact likes('Duncan', 'Wilfrid')) who would then be grateful to the man who makes his peace with the duke. The results are:

```
P = peace_talk(Wilfrid, Duncan, Baldwin)
D = 50
```

The new situation would still have a negative value though, but better future perspectives can be envisaged. As will be considered in the next section, Wilfrid's achievement of **g3** (make peace between Duncan and Baldwin) changes the relationships between the characters in such a way that, from then on, the poor faithful lover might count on somebody else's help to achieve his second goal (seduce the lady).

3 HANDLING INTER-CHARACTER RELATIONS

To deal with the influence of one character on another character's behaviour, we have defined inter-character relations, which may intervene in the decision-making process. We distinguish four types of relations between characters. Two characters may basically stand with respect to each other in one of the following relations:

- r1)** a *syntagmatic* relation, if one favours the other, so that they would be willing to pursue a joint line of action;
- r2)** a *paradigmatic* relation, if one is similar to the other, in which case they can either act independently or seek to emulate each other in the quest for some goal;
- r3)** an *antithetic* relation, if one opposes the other, in which case they behave as enemies;
- r4)** a *meronymic* relation, if one is an individual and the other is either a hierarchical superior or some group or organization of which the former is part (e.g. a troop of soldiers, the inhabitants of a town, the members of a knightly fellowship, etc.).

These relations are, respectively, associated with the *four master tropes* identified by Semiotics research [10]: metonymy, metaphor, irony and synecdoche.

Notice that among those belonging to a group (by **r4**) any of the three first relations may prevail; in King Arthur's Round Table fellowship, for instance, Lionel is related by **r1** to Lancelot, whereas Gawain's relation to Lancelot is of type **r2** and Agravain's of type **r3**.

In the context of the fairy-tales genre, a *hero* acts as the protagonist, and the other *dramatis personae* are defined relatively to him [9]. For *helpers* and *donors* the relation is clearly of type **r1**, being instead **r3** for *villains* and *false heroes*. The *dispatcher* who sends the *hero* on a mission is often a king, and hence can be considered to be related to the hero by **r4**. Type **r2** typically occurs in tales featuring more than one hero (cf. [9], Example 8, pp. 133-134).

However the distribution of roles can be more intricate than that, depending on the genre. The 'evil characters' can also find type **r1** supporters, and 'good characters' may behave as fair-playing rivals disputing for success, thus bordering on an **r3** relation, as tends to happen between 'clever' private investigators and 'obtuse' police inspectors in detective stories. Recall that irony is the rhetorical trope behind **r3** relations, and the very denomination – antithetic – suggests the notion of negation. With this in mind, one will readily recognize in Mephistopheles [25] the sharpest example of a trickster, an ambiguous mixture of (pretended) **r1** helper and **r3** enemy. As Faust asks him who he is, a revealing dialogue ensues:

Mephistopheles:

Ein Teil von jener Kraft, Die stets das Böse will und stets das Gute schafft.

[Part of that Power which always wills the Bad, and always works the Good.]

Faust:

Was ist mit diesem Rätselwort gemeint?

[What hidden sense in this enigma lies?]

Mephistopheles:

Ich bin der Geist, der stets verneint!

[I am the Spirit that Denies!]

When two or more characters take active part in the decision-making three-step process (described in Section 2), they may originate either parallel or interleaving lines of action. The latter will occur when their chosen goals and/or selected plans interfere. Negative interferences, i.e. *goal competition*, should lead to an attempt to avoid the conflict if the characters are related by **r1**; but if **r3** predominates they will pursue one of the following types of competitive behaviour [11]: the *outdo* strategy, i.e. trying to do better than the competitor, or the *undo* strategy, involving an anti-plan to hinder either the final goal or some intermediate pre-condition of the competitor's plan. Positive interferences, named *goal concord* in [11], may lead characters related by **r1** to help someone whom they favour, typically by fulfilling pre-conditions of the other's selected plan. To do that, they sometimes adapt a previously devised plan of their own.

The case of characters related by **r2** is somewhat more involved. Of course, if there are no goal interferences, their plans will remain independent. If there are negative interferences, they will either strive to resolve the conflict or will prefer the milder *outdo* competitive strategy, for example when disputing the first prize in a chivalrous contest. If a positive interference happens, they may behave as **r1**-motivated helpers. A case of that are the initially separate missions of Lancelot and Gawain to rescue Queen Guenevere, abducted by Meleagant [3]. At one point, when Lancelot's whereabouts were temporarily unknown (he had been secretly imprisoned in a tower), Gawain assumes his task of escorting Guenevere back home.

Relations of type **r4** open the possibility of varying the degree of detail of a narrative. The Grail quest [18] is in certain passages told as a joint mission of the entire Round Table fellowship, whereas in others the story concentrates on King Ban's lineage, or on the restricted group of the three predestined Grail-winners (Galahad, Perceval and Bors), but in some passages goes further down to show in detail the feats of the individual knights.

Figure 3 illustrates the three-step decision making process undertaken by each character, further impacted by the decisions of the other participants.

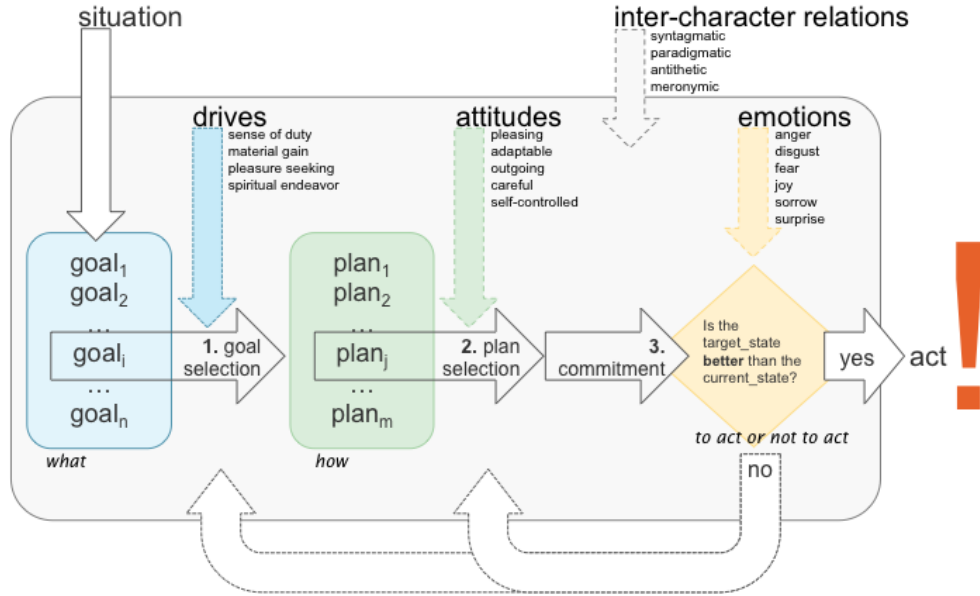


Figure 3. Our three-step decision-making process.

We shall illustrate two cases of interference, one positive and one negative. The positive case involves a form of collaboration. In Example 3 we remarked that Wilfrid had to discard the *proposal_by_proxy* plan because it required the joint participation of another still undefined agent, and, as a consequence, he left aside his goal of seducing the lady. Eventually he found the *peace_talk* plan to achieve this third goal satisfactory enough, one of its favourable effects being to win Duncan's friendship. Suppose he executes the plan. Then Duncan, moved by friendship to collaborate with Wilfrid (relation **r1**) and reasoning as if he were him, would detect the desirable but incomplete *proposal_by_proxy* plan of his friend (to achieve Wilfrid's second goal, "seduce the lady"), would evaluate the plan's adequacy with respect to his own attitudes frame, and would make sure that Wilfrid be able to commit to the now fully determined plan. Our *collaborate* algorithm for this case of positive interference follows exactly these lines.

The case of negative interference that we chose to include is even simpler. Whereas Duncan might be induced to become Wilfrid's friend, Morvid always hated the hero. Providing an example of the undo strategy, our *frustrate* algorithm leads the agent to look for a goal of the hated rival that may also constitute one of his own goals, and proceeds through the selection and commitment phases of a suitable anti-plan, whose execution would preempt or reverse the attainment of the enemy's goal. In our example, Morvid will also have as a goal to seduce the lady, and his preferred plan to achieve it would involve her abduction.

Several other cases exist, which will not be examined here, except for a brief reference to one case whose implications with respect to goal and plan selection are especially intriguing. Suppose that there exist goal-plans rules associating different active goals of a character (i.e. goals whose motivating situations currently hold) **g1**, **g2**, ..., **gn**, for $n \geq 2$, with the same plan **p**. This case, classified as an "internal positive goal interference" (cf. [11]), offers an optimization opportunity of which one can only take advantage if the algorithms presently implemented are extended to recognize its occurrence and evaluate the gains obtainable by achieving more than one goal via a single plan.

Until now we have not examined the internal structure of plans, which can often be successively broken into sequences of smaller plans, until reaching the level of basic operations. It is often the case that, when one goes down to such narrative details, a number of lesser characters need be considered as participants. In this sense, the meronymic relation between operations, studied in [26], induces the **r4** meronymic inter-character relation now being discussed.

For instance, if Morvid is intent on achieving the abduction of Elaine, he must ride to the White Palace where she currently is, defeat the garrison protecting the place, seize Elaine, and carry her to the Black Palace. At this level of narrative we can deal with the entire garrison of the White Palace as a collective entity. At a deeper level, the defeat sub-plan is in turn decomposed; it involves attacking and killing each member of the White Palace's garrison, or just threatening the less courageous ones.

Example 4: The two cases of interference are handled by the predicates below:

```
collaborate(C1,C2,P) :-
    likes(C1,C2),
    rank_goal(C2,G2,_),
    rank_plan(C2,G2,P,_),
    not complete(P),
    G1 = (likes(C1,C2),G2),
    rank_plan(C1,G1,P,_),
    commit(C2,P,_).

frustrate(C1,C2,P) :-
    hates(C1,C2),
    rank_goal(C2,G2,_),
    replace(C2,C1,G2,G1),
    rank_goal(C1,G1,_),
    rank_plan(C1,G1,P,_),
    commit(C1,P,_).
```

In the `goal_plans` clause of Example 1, where the `proposal_by_proxy` plan was introduced, the seducer figured as agent. One more clause is supplied with the proxy as agent:

```
goal_plans(Agent/(likes(Agent,C), seduced(W,C)),
    [proposal_by_proxy(C,Agent,W): [a1: 10,a2: 10,a3: 20,a4: 10,a5: 0]]).
```

As said before, the example will also evoke an abduction plan of the hostile character. Its decomposition into more detailed plans is specified, in two stages, by clauses mapping plans into plan-sequences:

```
map(abduction(M,W),
    [ride(M,P1,P2),
     defeat(M,G),
     seize(M,W),
     carry(M,W,P1)]) :-
    home(M,P1),
    current_place(W,P2),
    guards(P2,G).

map(defeat(M,G), P) :-
    bagof(D, (C,V)^(member(C,G),
        (fear(C,V), V > 0,
         D = threaten(M,C);
         fear(C,V), V = 0,
         D = [attack(M,C),kill(M,C)])),
        Ps),
    flatten(Ps,P).
```

and the accompanying decomposition of the garrison to be defeated is indicated in a clause associating the place with the list of its defenders:

```
guards('White Palace', ['Eustace','Briol']).
```

Consider the following command:

```

:- rank_goal('Wilfrid',G,_),
   rank_plan('Wilfrid',G,P,_),
   commit('Wilfrid',P,_), write(P), nl,
   exec(P),
   collaborate(C1,C,P1), write(P1), nl,
   frustrate(C2,C,P2), write(P2), nl,
   maps(P2,P2d), write(P2d), nl.

```

It forces the plan selected by Wilfrid to be effectively executed and, at the new state, the plans pro and against Wilfrid to be selected and displayed, Morvid's abduction plan being also shown in detail, with the participation of secondary characters. We must now deal specifically with these meronymically related secondary characters, namely the timid Eustace and the fearless Briol. The results of the command are:

```

P = peace_talk(Wilfrid,Duncan,Baldwin)
P1 = proposal_by_proxy(Wilfrid, Duncan, Elaine)
P2 = abduction(Morvid, Elaine)
P2d = [ride(Morvid, Black Castle, White Palace),
       threaten(Morvid,Eustace),
       attack(Morvid, Briol),
       kill(Morvid,Briol),
       seize(Morvid,Elaine),
       carry(Morvid,Elaine,Black Castle)]

```

Our simple example has shown that, while drives and attitudes are relatively stable personality traits, emotions and inter-character relationships tend to change in time, following the unfolding of the story and allowing for richer, emergent forms of character behaviour. The next section describes how we can further enrich the story development, by allowing the interactive definition of the characters' own personality traits.

4 TAILORING THE CHARACTERS' PERSONALITY TRAITS

In the previous sections, the values and weights were fixed in a rather ad-hoc way. It would be interesting, however, to provide an environment in which several users are involved, each participant being invited to play a role. Through a suitably user-friendly interface, they should be allowed to fix, or at least to adjust to some extent, the personality traits of the characters they wish to impersonate, in terms that the interface could appropriately translate into numerical values and weights. People often want to play, in fiction, a part completely at variance from their real selves. Sometimes, on the contrary, they may want the chosen character to act just as they usually do, in which case the interface could first submit them to some psychological test based on documented studies, such as those concerning the Big-Five factors [27]. We have begun to explore these two strategies to tailor the characters' personality traits, as outlined in what follows.

We have modified the prototype to allow one or more users to choose a strategy for establishing the weights of the characters' personality traits: either by explicitly choosing each weight or by answering a few questions of a psychological test. Users can only adjust the weights of "active characters", i.e., characters that may take action and therefore influence the story plot. For each one of the characters, default weights are assigned, in case there are fewer users interested in impersonating or adjusting a character than the number of characters in the story cast.

When first started, the prototype presents a scenario to introduce the mini-world to the user and offers an opportunity to impersonate one of the active characters:

Duke Baldwin is absent on a mission, leaving his wife, the lady Elaine, in the solitude of the White Palace. Count Duncan, Baldwin's sworn enemy, sees the duke's temporary absence as an opportunity to invade his domains. Sir Wilfrid, the bravest knight in the realm, is in love with Elaine, but is too shy to confess his feelings; moreover by doing so he would betray the duke, who absolutely trusts him. At the Black Castle lives Prince Morvid, who hates Sir Wilfrid and envies his high reputation.

Please choose the character you want to impersonate:

- [1] Sir Wilfrid
- [2] Count Duncan
- [3] Prince Morvid
- [0] to finish character selection.

Your choice -->

Upon selecting a character, the user is prompted to choose between the two different tailoring strategies:

Your choice --> 1

Viewer has chosen to impersonate Sir Wilfrid. Please choose how you want the character to be modeled:

- [1] I want to model the character explicitly.
- [2] I want to be submitted to a short personality test and have the character modeled after me.

Your choice --> |: 1

Here are a number of personality traits associated to the character that you chose to impersonate. Please write a number next to each personality trait to indicate how strongly you want that trait to affect the character's personality (in a positive, negative or neutral way).

```

-----
very strong|strong|average|weak|neutral|weak|average|strong|very strong
negative   | neg  | neg  | neg|          |pos | pos  | pos  |positive
<-----<-----<-----<----->----->----->----->----->
          1         2         3         4         5         6         7         8         9
-----

```

```

1. Pleasing.          Your choice --> |: 3
2. Adaptable.         Your choice --> |: 4
3. Outgoing.          Your choice --> |: 2
4. Careful.           Your choice --> |: 1
5. Self controlled.   Your choice --> |: 7
Outgoing:             -3
Pleasing:              -2
Careful:               -4
Self Controlled:       2
Adaptable:             -1
Wilfrid:

```

```

Before:[a1: 3,a2: 0,a3: -4,a4: 1,a5: 1]
After :[a1: -2,a2: -1,a3: -3,a4: -4,a5: 2]

```

For the sake of simplicity, users were presented with a scale of positive numbers, in the range [1 : 9]. The selected weights are then shifted to the range [-4 : 4] used internally by the prototype and directly attributed to the character's model.

Using the default values, without any adjustment in the characters' traits, we obtain the following goal and plan rankings for Sir Wilfrid:

```

?- rank_goal('Wilfrid',G,_), rank_plan('Wilfrid',G,P,_).

```

The execution of the rank_goal command results in:

```
G = seduced(Elaine,Wilfrid), P = proposal_by_proxy(Wilfrid,_G91,Elaine);
G = pacified(Wilfrid,Duncan,Baldwin), P = peace_talk(Wilfrid,Duncan,Baldwin);
```

After adjusting Sir Wilfrid's personality traits, the rankings change to

```
G = seduced(Elaine,Wilfrid), P = abduction(Wilfrid,Elaine) ;
G = seduced(Elaine,Wilfrid), P = visit_under_disguise(Wilfrid,Elaine) ;
G = seduced(Elaine,Wilfrid), P = elopement(Wilfrid,Elaine) ;
```

Sir Wilfrid's new personality provokes the finding of three new plans to achieve the goal seduced(Elaine,Wilfrid), one through abduction and another one through a visit under disguise and a third one through elopement. However, the plans for proposal by proxy and peace talk have disappeared, because Sir Wilfrid's new attitudes now evaluate those plans to non-positive values.

After the adjustment of each character's personality, the prototype presents an opportunity to adjust another character. Suppose now the user chooses to take the personality test:

```
Please choose the character you want to impersonate:
[1] Count Duncan
[2] Prince Morvid
[0] to finish character selection.
Your choice --> |: 2
Viewer has chosen to impersonate Prince Morvid. Please choose how you want
the character to be modeled:
[1] I want to model the character explicitly.
[2] I want to be submitted to a short personality test and have the character
modeled after me.
Your choice --> |: 2
```

For the personality test, our approach is to use the Big Five dimensions to set the weights of the characters' attitudes. To capture the user's Big Five dimensions, we have used the Ten-Item Personality Inventory (TIPI), a reliable yet very short instrument for personality testing [28]. Although not as accurate as longer instruments, the precision shown in the studies conducted by Gosling *et al.* [28] is more than what could be considered necessary for a simple simulation with entertainment purposes. Moreover, most users would probably find it quite boring to be submitted to a long, very comprehensive psychological test when their intention was just to have some fun. TIPI, on the contrary, takes only about a minute to complete.

When the user chooses the personality test, the prototype presents the TIPI items:

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

```
-----
Disagree|Disagree |Disagree|Neither agree|Agree |Agree |Agree
strongly|moderately|a little|nor disagree |a little|moderately|strongly
<-----<-----<-----<----->----->----->----->
      1           2           3           4           5           6           7
-----
I see myself as:
```

```

1. Extraverted, enthusiastic.      Your choice --> |: 7
2. Critical, quarrelsome.         Your choice --> |: 1
3. Dependable, self-disciplined.  Your choice --> |: 1
4. Anxious, easily upset.        Your choice --> |: 2
5. Open to new experiences, complex. Your choice --> |: 6
6. Reserved, quiet.              Your choice --> |: 2
7. Sympathetic, warm.            Your choice --> |: 4
8. Disorganized, careless.       Your choice --> |: 6
9. Calm, emotionally stable.     Your choice --> |: 7
10. Conventional, uncreative.    Your choice --> |: 1
Extraversion:                     6.5
Agreeableness:                   5.5
Conscientiousness:               1.5
Emotional Stability:             6.5
Openness to Experiences:         6.5
Outgoing:                        3
Pleasing:                        2
Careful:                         -3
Self Controlled:                 3
Adaptable:                       3
Morvid:
  Before:[a1: -3,a2: -3,a3: 3,a4: -3,a5: 0]
  After :[a1: 2,a2: 3,a3: 3,a4: -3,a5: 3]
Please choose the character you want to impersonate:
[1] Count Duncan
[0] to finish character selection.
Your choice --> |: 0

```

In TIPI, each item consists of two descriptors, separated by a comma, using the common stem, “I see myself as:” Each of the ten items was rated on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). There are two items for each Big Five dimension, one that is a positive representation of that dimension, and other that represents the negation of it. So, for instance, the Big Five dimension “Extraversion” is represented by the items “Extraverted, enthusiastic” (positive) and “Reserved, quiet” (negative). Negative items have their scores recoded symmetrically within the range [1 : 7], so that 1 is replaced by 7, 2 is replaced by 6, and so on. The average of the score for the positive item and the recoded score for the negative item gives the score for the dimension. For our purposes, these scores were normalized to fit inside the range [-4 : 4] before they are mapped onto the corresponding character’s attitude.

Prince Morvid’s default personality traits yield the following goal and plan rankings:

```

?- rank_goal('Morvid',G,_), rank_plan('Morvid',G,P,_).
',G,P,_).

```

The execution of the rank_goal command results in:

```

G = seduced(Elaine,Morvid), P = abduction(Morvid,Elaine) ;
G = seduced(Elaine,Morvid), P = elopement(Morvid,Elaine) ;

```

After completing the aforementioned TIPI test, Prince Morvid’s goals and plans change as follows:

```

?- rank_goal('Morvid',G,_), rank_plan('Morvid',G,P,_).

```

results:

```

G = seduced(Elaine,Morvid), P = visit_under_disguise(Morvid,Elaine) ;
G = seduced(Elaine,Morvid), P = elopement(Morvid,Elaine) ;
G = seduced(Elaine,Morvid), P = abduction(Morvid,Elaine) ;
G = conquered(Morvid,White Palace), P = assault(Morvid,Baldwin,White Palace);

```

He now has two new plans, visit under disguise and assault, and the ranking order of the two plans that remained from the previous attitudes (elopement and abduction) are now reversed.

As these examples show, different plans may be selected when the weights corresponding to the characters' personality traits are adjusted.

5 RELATED WORK

Considering the narrative adaptation framework proposed in [29], our present work is mainly situated within the plot adaptation component. In our approach, the plot is indirectly adapted based on characters' personality traits and inter-character relations.

Many researchers acknowledge the need to somehow consider emotional, psychological and social aspects of characters (human and virtual agents) in an interactive narrative [6][1][30] and in human-computer interaction in general [6]. Most of them, however, do not consider the influence of such aspects on different stages of decision making. Some are limited to using motivation encoded in the characters' goals [30], and others adopt a more pragmatic approach of expected utilities and accountability [31].

El-Nasr [32] proposed an architecture for interactive narrative to integrate user modeling and user behaviour analysis techniques. To represent a character's personality, they make use of a vector of stereotypes based on the following five dimensions: heroism, violence, self-interestedness, truth seeking, and cowardice. It is not clear, however, how these dimensions were chosen, what range of narratives they make possible, and how psychologically sound or plausible they are.

Our approach is in line with recent work in human-computer interaction, in that we acknowledge psychological aspects at varying levels of complexity [6] – in our case: drives, attitudes, and emotions –, which influence in particular ways the three different stages of decision making: goal selection, plan selection, and commitment. We agree that going beyond the basic emotions may raise interesting challenges regarding cultural differences [6], but by providing a multi-faceted description of characters we try to allow more precise adjustments to their affective profiles.

6 CONCLUDING REMARKS

The decision process described in this paper was designed to work as part of storytelling systems wherein narrative plots emerge from the acting characters' behaviour and personality traits. Along three steps, the process evaluates goals and plans, to finally examine the plan-commitment issue. Personality traits – drives, attitudes, and emotions – play a major role in the process. On the basis of inter-character relations, two cases of plan/goal interference have been considered.

The process obviously assumes an over-simplified model of personality. Its clean-cut serialization of phases does not entirely encompass the complexities of human decision-making in the real world, but, nonetheless, we claim that it is a not too expensive way to emulate plausible, if not entirely realistic, characters.

Indeed, the algorithms involved do little more than evaluate utility functions and sort the results in decreasing order. When fully incorporated to our **Logtell** storytelling system, the process should not affect its performance significantly, since, working in connection with the

plan-generator, it would reside in the application server component of the client-server architecture currently under development [33].

Resorting to serialization in order to simplify a process is a commonly used strategy, an example being the division of the composition process itself into the phases of plot, story and text, proposed by literary experts [34] and widely employed as a convenient albeit artificial way to conceive the act of creating a narrative.

Moreover the three steps of our decision process are not so strictly sequential and sharply separated as they might seem, thanks to the backtracking regime enabled by logic programming. On default of a plan congenial to the character whose most valuable goal has been selected, the process goes back to the goal-selection step and starts examining the next best goal, a similar return to previous steps being provoked if the target state to be reached by the plan under consideration is found unsatisfactory and thus unworthy of commitment. On the other hand, as happens with models in general, our proposal can be enriched in various ways. For instance, non-deterministic plans can be defined, with probabilities assigned to different outcomes [19]. Also, *communicative operations* can be introduced [35], equally specified in terms of pre- and post-conditions, similarly to what was done for multi-agent Software Engineering systems as per the FIPA-ACL (Agent Communication Language)⁴ standard.

Communication among characters would of course provide a much ampler set of options to handle the many possible goal and plan interference alternatives [11]. Requests for help, sincere or deceitful exchanges of information to induce true or false beliefs, etc. can thereby be made explicit. In our example we placed the focus on Wilfrid, the protagonist, assuming that the other characters somehow “perceived” what he was doing and based their reaction on their feelings toward him. More equitable ways to orchestrate the actions of the diverse characters are needed, making room for friendly or hostile negotiations and consequent changes of conduct, to increase the degree of sophistication beyond the most simple-minded folktales.

Future work is also necessary to investigate different criteria to establish and calibrate the values and weights. The notion of *stereotypes* [36] is of prime importance in this context: one can specify character classes and assign individuals to classes on the basis of values (or value intervals) and weights chosen by sheer prejudice, and, at a later time, while experiments are running, let the system correct these initial guesses by learning from its interactions with the users. One may also wish to make room for the variation of weights along the plot, in order to accomodate both dramatic turns [1] and the gradual evolution of personalities [27] that is central to the “Bildungsroman” (novel of education) genre.

Another interesting future work would be to investigate whether and how the analysis of both human and virtual characters’ behaviour, as recorded in logs of previously developed interactive narratives [37], could contribute to the adjustment of the characters’ personality traits.

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⁴ <http://www.fipa.org/subgroups/ROFS-SG-docs/ROFS-Doc.pdf>

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