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Introducing Personality into Team Dynamics

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Abstract.
If autonomous agents interact with people, they should achieve the suspension of disbelief in order to offer a good interaction experience to users. To achieve this it is important that the agents' behaviours are consistent with a given personality since people have a tendency to attribute personality to interactive artifacts. The concept of personality is also useful to create diversity in multi-agent simulations even if users do not directly engage in the interactions, for example, to explore different strategies in simulated societies. This paper presents a computational model of personality based on the Five Factor Model of personality for the behaviour of social autonomous agents that interact in teamwork scenarios.

1 Introduction

The concept of personality has been introduced into social autonomous agents for different reasons [4]. First of all, one of the major objectives of AI as a science is to model natural intelligence and in natural societies people show different personalities, therefore, it is natural to include personality as a construct to generate intelligence [3]. This is particularly relevant if the agents interact with people. People ascribe personalities to computers [20] and are sensible to "human-like" characteristics of agents. In fact, personality was identified as one of the important factors to achieve the suspension of disbelief [17]. Furthermore, personality has been used as a construct to explore and compare different strategies in multi-agent systems. For example, it has been implicitly introduced in the different kinds of commitment defined by Cohen and Levesque [7] and it is often used to define and test different strategies for coalition formation [16] and economic games [21].

Personality can be defined as "an organized set of characteristics that uniquely influence the processes of cognition, motivation and behaviour" [27]. It has been used in agents to influence the choice of goals and plans [25], the process of perception [26], the agents' motivations [8], the generation of emotions [1] [2] and agents' facial and bodily expression [18].

In this paper, we propose a computational model of personality for agents that interact in teams. The personality is modelled explicitly by the five traits proposed in the Five Factor Model (FFM) of personality [9] and is integrated in a model for group dynamics (SGD Model) that was created to generate believable agents in teamwork scenarios [24]. The SGD Model already included a simple characterization of personality based on two of the factors of the FFM. The personality was extended to improve the individuality of the agents in the team and to explore scenarios where the agents have motivations to act against the goals of the team. The personality is one of the factors involved in the agents' decision to follow individual goals versus team goals.

The paper is organized as follows. The next section describes the base model for the generation of group behaviour (inspired by the SGD Model) followed by the description of the personality model. After that we present some notes on a case study and in the end the paper is concluded with some discussion.

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2 A Model for Group Behaviour

The base model for the agents' behaviour in the team is inspired by the SGD Model [23] [24]. The SGD Model was created to embed social intelligence in autonomous agents that interact in small teams. It implements behaviour patterns inspired by results from social sciences that allow agents to generate "human-like" group behaviours. The model focuses on the interactions within small groups and not on highly structured societies and social networks.

The model implements two principles in the dynamics of the team. First, not all agents interact with the same frequency, some interact more often than others. In addition, not all agents engage in the same type of interactions in a given situation. For example, when one agent in the team performs a bad action for the team's goal an agent may adopt a negative attitude while another may adopt a positive attitude. Second, the relevance (and valence) of an interaction depends on the agent that performs the action and on the agent that observes it (e.g. interactions are more important when performed by the agents that have a better position in the group).

These differences may come from the personality of the agents but are influenced by the social context of the group as well (e.g. the distribution of social power). These ideas will be discussed in the rest of this section.

2.1 The Motivational System

The SGD model was extended with a motivational system to support the agents' decision making. A motivation m is defined as tuple $m =< G, Pv, Rv, Th, Update() >$, where: G is a goal that is activated in the agent when the motivation is active; Pv is the value of the motivation that is generated by internal stimulus; Rv is the value of the motivation that is generated by external stimulus; Th is the threshold that defines when the motivation is active; and $Update()$ is a function that updates the value of the motivation.

The value of a motivation has two different components: a pro-active one (Pv) and a reactive one (Rv). The pro-active component represents the inner motivation of the agent to perform in a particular way, while the reactive component represents the motivation from external stimulus that influence the agent. For example, an agent may

have an internal motivation to encourage a member of the team that comes from the agent's planning process but in a different situation the agent may have the motivation to encourage a member in reaction to an action performed by it. The overall value of the motivation is the sum of the two components. The motivation is active if this sum is higher than the threshold (Th). The motivation values (*Pv* and *Rv*) vary from 0 to 100.

The $Update()$ function is called on regular intervals and updates the values of both components of the motivation value. These values may also be changed by other events besides the $Update()$ function, these situations will be discussed later in the paper.

Furthermore, one of the main claims of the model is that both social-emotional and task-related interactions are important to generate believable behaviour. For this reason, the agents' motivational system defines motivations for two different types of goals: task related (instrumental) and socio-emotional.

Two types of motivations for task related goals are defined. A motivation $m_{GTask} =< TG, Pv, Rv, Th, Update() >$, where TG is one of the team's goals, to denote the motivation of the agent to execute a step of one of the team's tasks, and $m_{ITask} =< IG, Pv, Rv, Th, Update() >$, where IG is one of the agent's goals that does not favour the team's tasks, to denote the agent's motivation to perform actions that do not explicitly benefit the team. In addition, motivations for the socio-emotional goals of encouraging and discouraging other members of the team are defined. A motivation $m_{Enc} =< Encourage(Ag), Pv, Rv, Th, Update() >$ represents the agent's motivation to perform actions with positive socio-emotional connotation towards agent *Ag* (e.g., support the agent when it fails to perform an important action). In turn, a motivation $m_{Disc} =< Discourage(Ag), Pv, Rv, Th, Update() >$ represents the agent's motivation to perform actions with negative socio-emotional connotation towards agent *Ag* (e.g., reprove the agent when it fails to perform an important action).

Note that the agent keeps a different motivations for each task goal (individual and team) and two motivation for socio-emotional goals (m_{Enc} and m_{Disc}) for each member of the team.

2.2 Behaviour Generation

Agents' behaviour generation follows regular decision cycles. In each cycle the motivations are checked against their threshold to see if they are active (e.g., to check if the agent is motivated to act). If more than one motivation is active the more intense (with higher difference to the threshold) is used. The goal associated with the motivation is activated and the agent starts the appropriate action selection mechanism to reach the goal (e.g., planning, rule-base system, etc.). Our agents have a planning mechanism to decide which action to take.

The motivations' values change overtime and with specific events. The reactive components (*Rv*) of all motivations decay over time and the proactive components (*Pv*) of the instrumental motivations variables increase over time. The proactive components of socio-emotional motivations do not change over time, because we are designing agents that are mainly driven to perform tasks. If the agents are built with stronger social goals, such as, being popular, for example, this should be reconsidered. The decay and increment rates may vary from agent to agent and are implemented in the motivation's *Update()* function.

Apart from the regular update the motivations' values may change upon the occurrence of certain events. The occurrence of an event that fulfills the goal associated with the motivation makes its value to be reset to the neutral state ($Rv = 0$ and $Pv = 0$). For example, if the agent has a motivation to encourage another agent, then, after doing it, it will no longer maintain the motivation to encourage the same agent. Note that the motivation may be increased by other factors (e.g., the agents finds different reasons to perform the encouragement) and that it will only be reset if the encouragement is successful. The agent is persistent in its goals.

Other specific events may change the motivation values. These will be detailed in the next sections.

2.3 Group Dynamics

The dynamics of the group is expressed in the dynamics of the motivations. The motivations change according to the knowledge the agent builds regarding the world. This knowledge is defined in 4 different levels: 1) the individual level stores information regarding characteristics of the individuals (e.g. their skills); 2) the group level stores information regarding the group's composition and structure, the structure is defined by the social-relations that are established between the agents; 3) the context level stores information regarding the social norms and culture of group as well as the nature of the tasks; 4) the interactions level defines a classification scheme for the interactions that occur in the group.

The core concept for the dynamics is the position of the agents in the group. This position defines how important are their contributions and how well they are accepted by the group. For example, actions performed by members that have a better position in the group have stronger effects and are more likely to be accepted as good actions.

The position in the group is computed by summing up the social relations that the agent has with other members of the group. These relations are of two types:

1. **relations of social attraction** that define the interpersonal attraction of the members in terms of like (positive attraction) and dislike (negative attraction) attitudes. These relations are unidirectional and not necessarily reciprocal (e.g., if agent A is positively attracted to agent B, this does not necessarily mean that agent B is positively attracted to agent A).
2. **relations of social influence** that define relations of power. They quantify the capacity of one agent to influence the behaviour of another. The influence is defined as the difference between the power which one individual can exert on another and the power with which the other is able to resist [11].

An agent has a good position in the group if it has influence over the others and if the others like him. Each agent uses its subjective view of the relations, which means that agents will have different views regarding the importance each member have in the group. Equations 1 and 2 show how the value is computed. *Group(G, members)* denotes the definition *G* as a group with its *members*, *SocialAttraction(A,B,S)* denotes the social attraction that *A* has for *B* in the situation *S* and *SocialInfluence(A,B,S)* denotes the social influence that *A* has on *B* in the situation *S*.

$$\forall G, A : Group(G, members) \wedge A \in members,$$
$$Position(A, G, S) = \sum_{m \in members}^{m} SocialAttraction(m, A, S) + \sum_{m \in members}^{m} SocialInfluence(A, m, S) \quad (1)$$

$$\forall G, A : Group(G, members) \wedge A \in members,$$
$$RelPosition(A, G, S) = \frac{Position(A, G, S)}{\sum_{m \in members}^{m} Position(m, G, S)} \quad (2)$$

Furthermore, the dynamics of the group is modelled according to a classification of the interactions that occur in the group. Interactions are divided into two main categories depending on if they are related to the task (instrumental) or related to socio-emotional issues. Within this division interactions are categorized as positive or negative:

- Instrumental interactions
  - Positive
    - **Facilitate Problem:** This class of interactions represents actions of an agent that contribute to the team's goals.
    - **Gain Competence:** This class of interactions represents actions that make an agent more capable of achieving one of the team's goals. This includes, for example, the learning of new capabilities or the acquisition of information and resources.
  - Negative
    - **Obstruct Problem:** This class of interactions represents the actions of an agent that go against one if the team's goals..
    - **Lose Competence:** This class of interactions represents actions that make an agent less capable of achieving one of the team's goals, for example, by forgetting information or losing control of resources.
- Socio-emotional interactions
  - Positive
    - **Agree:** This class of interactions represents the support and agreement of an agent towards the actions of another member of the team.
    - **Encourage:** This class of interactions represents an agent's efforts to encourage another member of the team.
  - Negative
    - **Disagree:** This class of interactions show the disagreement of an agent towards the actions of another member of the team.
    - **Discourage:** This class of interactions represents an agent's hostility towards another member of the team.

Interactions have different strengths in the group according to the position in the group of its performers. For example, an encouragement performed by an agent that has a low position in the group will have lower effects than an encouragement performed by an agent with a good position in the group. Moreover, interactions are classified according to the knowledge the agent has of the situation, which can be different from agent to agent.

2.4 Motivation Dynamics

The behaviour of the agents is expressed in terms of the interactions they engage in the team. This reflects the dynamics of the motivational system. This section describes how the motivations are related to the occurrence of interactions in the team.

First of all, the frequency of an interaction (of any kind) depends on the relative position of the agent in the group. Agents with better positions interact more often. This is reflected on the $Update()$ function of the motivations. This function applies an higher increment to the proactive value (*Pv*) of the motivations (only in the instrumental motivations as stated before). In addition, the increment applied to the reactive value (*Rv*) upon the occurrence of events is higher in agents that have better positions in the group.

Moreover, members with better position in the group are targeted more often with positive socio-emotional interactions (i.e. *Agree* and *Encourage*) while members with low position in the group are targeted more often with negative socio-emotional interactions (i.e. *Disagree* and *Discourage*). This is reflected in the increment applied to the reactive values (*Rv*) of the motivations M_{Enc} and M_{Disc} when certain events occur. The events that trigger these changes are:

1. In the case of **instrumental interactions.** When a *Facilitate Problem* occurs the *Rv* of the M_{Enc} increases. We did not considered discouragements in reaction to *Facilitate Problem*, because we considered that agents are built with the goal to solve tasks and do not have goals, such as, to be the one that contributes more to the task. In the case of an *Obstruct Problem* the *Rv* of both M_{Enc} and M_{Disc} increase. This increments depend on the different between the position in the group of the agents. For example, if the agent that observes the interaction has a better position in the group than the agent that performers it, then the increment to the M_{Disc} will by higher then the increment to the M_{Enc}.
2. In the case of **socio-emotional interactions.** In this case a general rule of reciprocity is applied. Therefore, if an agent is target of an *Encourage* the motivation to encourage back the performers increases (i.e. the *Rv* of the M_{Enc} increases) but if it is target of a *Discourage* the motivation to discourage the agent that performed the discouragement increases. In addition, agents react to socio-emotional interactions even if they are not directly targeted, this follows the ideas proposed in Heider's Balance Theory [12]. Agents check their relations of social attraction with the target of the interaction and react to the agent that performed the interaction accordingly. If the valence of the social relation and the interaction are similar (both positive or both negative) then the motivation to encourage the performer will increase, if valences are opposite (e.g., the agent likes the target and the performer discourage it), then the motivation to discourage the performer will increase.

Furthermore, when computing the increment to *Rv* in M_{Enc} and M_{Disc} the social relations between the agent and the performer of the interaction is also taken into account. Agents encourage more often other agents they like and/or agents that have high social influence over them. In turn, they discourage more often agents that they dislike and/or that do not have influence over them. This means that the increment to *Rv* is a function of (1) the position in the group of the performer and the observer, (2) the social attraction of the observer for performer and (3) the social influence the performer has over the observer.

Finally, *Encourage* interactions have the secondary effect to increase the target's *Rv* for the M_{GTask}. Conversely, *Discourage* interactions increase the target's *Rv* for the M_{ITask}.

The *Pv* of M_{Enc} may be increased if the agent planning process decides that a given member of the team needs an encouragement. The occurs if the agent reaches the conclusion that the best action for the team has to be performed by the other member.

2.5 Dynamics of the Position in the Group

When interactions occur in the group the social relations of the agents may change and, therefore, so the positions in the group.

The instrumental interactions are related to changes in the relations of social influence and the socio-emotional interactions induce changes in the relations of social attraction. Positive instrumental interactions increase their performer's social influence over the other members of the group, by means of expert and information power [11]. Any member that demonstrates expertise to achieve one of the team's goals or obtains resources that are useful to the team, will gain influence over the others. In turn, negative instrumental interactions make the agents to lose influence.

Changes induced in the social relations by the occurrence of socio-emotional interactions follow similar rules as used in the increments of the reactive values of the motivations (i.e. reciprocity and balance). This means that agents when targeted by positive socio-emotional interactions increase the social attraction for the performers, and decrease it if targeted by negative socio-emotional interactions. In addition, agents change their relations of attraction for agents involved in socio-emotional interactions, while not being directly involved. Agents check the absolute value of the intensity of their relation with the performer and the target of the interaction. They keep the relation with the highest absolute value and change the other relation according to the situation. If the valence of the relation kept and the interaction is the same (e.g., a *Discourage* interaction was performed and the agent dislikes the target/performer) then the attraction for the other increases, if valences are different then the attraction decreases (e.g., if an agent is encouraging one of my enemies I dislike him more).

3 Personality Model

There are many different theories that model people's personality. Most of these theories try to categorize people in types or define certain dimensions to fit people's particular patterns of behaviour. Some examples are: Eysenck's [10] two-dimension model that define personality in the dimensions of Extraversion and Stability; Cloninger's Temperament Theory [6] that delineate Self-directedness, Cooperativeness and Self-transcendence as character traits and Novelty seeking, Harm avoidance, Reward dependence and Persistence as temperament traits; Myer-Briggs [19] core types, which are based on Jungs' psychological types [15], and built on top of four dichotomies Extraversion/Introversion, Sensing/Intuition, Thinking/Feeling and Judging/Perceiving; or Catell [5] model that used 16 different trait descriptors to rate behavior of people.

There is not much agreement on the traits the should be used to classify personality, nevertheless, the Five Factor Model of personality [9] consists of an effort to reach some consensus. We adopted the FFM to model personality to add personality to our agents because it has been widely studied, inclusively it as been applied to other agent systems, although seldom to teamwork scenarios.

Next we present how each of the five dimensions change the dynamics of the model described above.

Extraversion implies an energetic approach toward the social and material world and includes traits such as sociability and activity [13]. For this reason, extraversion influences the general frequency of interactions. More extroverted members interact more often. The increment rates of the proactive values (*Pv*) are higher and the decay rates of the reactive values (*Rv*) are lower. This changes are made in the $Update()$ function.

Furthermore, extraversion is correlated to positive emotionality [13], therefore it influences the interpretation of positive versus negative interactions. Extravert agents give more importance to positive events than negative ones. Hence, the effects of *Encourage*, *Agree*, *Facilitate Problem* and *Gain Competence* interactions are increased as extraversion increases, while the effects of *Discourage*, *Disagree*, *Obstruct Problem* and *Lose Competence* are reduced. This means, for example, that an extrovert agent will increase the *Rv* of M_{Enc} in reaction to an *Encourage* more than a non extrovert. At the same time, the social attraction for the performer of the *Encourage* interaction will increase more in the case of an extrovert agent.

Agreeableness is related to a pro-social and communal orientation towards others [13]. Therefore, it influences the frequency of positive socio-emotional interactions. More agreeable agents agree more often with others and encourage others more often. The increments in the *Rv* of M_{Enc} increase with the level of agreeableness of the agent. This is relevant, for example, in the case of the occurrence of negative instrumental interactions (*Obstruct Problem* and *Lose Competence*). In this case, agreeable agents will increase more the motivation to encourage than the motivation to discourage.

Agreeableness is also related with altruism [13], therefore, agreeable agents perform more actions for the group than actions for themselves. The increment rates of the *Pv* for M_{GTask} are higher and increments in the *Pv* for M_{ITask} are lower.

Conscientiousness describes socially prescribed impulse control that facilitates task and goal-directed behavior, such as thinking before acting, planning, organizing, and prioritizing tasks [13]. For this reason, conscientiousness influences the interpretation of instrumental versus socio-emotional interactions. Agents with higher values of conscientiousness give more importance to instrumental interactions in detriment of socio-emotional interactions. This means, that the *Facilitate Problem*, *Gain Competence*, *Obstruct Problem* and *Lose Competence* interactions have their effects increased, while the *Encourage*, *Discourage*, *Agree* and *Disagree* interactions have their effects decreased. For example, an agent that succeeds well in the performance of a group task (*Facilitate Problem*) will gain more influence over the agents that have higher values of conscientiousness.

In addition, agents with high conscientiousness will put more effort in the execution of task related actions (either for the team or individual). This is reflected in the agents in two different ways. First, the probability of success of the agent with such actions is increased. The result of an action depends on the agent proficiency level with the action with a bonus from the level of effort put in its execution. Therefore, for agents with similar proficiency level in a given action the more conscientious will have an higher probability of success. Second, the level of conscientiousness affects the planning algorithm. High levels of conscientiousness imply more CPU time for planning (e.g., higher depth, higher node expansion limits).

Neuroticism contrasts emotional stability and with negative emotionality [13], therefore, similarly to extraversion, it influences the interpretation of positive versus negative interactions. Agents with high values of neuroticism give more importance to negative events than positive ones. The effects of *Discourage*, *Disagree*, *Obstruct Problem* and *Lose Competence* interactions are increased as the value of neuroticism increases, while the effects of *Encourage*, *Agree*, *Facilitate Problem* and *Gain Competence* are reduced. This means, for example, that agents with high neuroticism increase more *Rv* of M_{Disc} an agent that just discourage them than *Rv* of M_{Enc} an agent that just encourage them. At the same time the social attraction for the performer will decrease more in the first case than increase in the second.

Openness to Experience assesses proactive seeking and appreciation of experience for individual's own sake [13]. Therefore, openness to experience influences the frequency of instrumental interactions. Agents with high values of openness to experience conform less with the group and give more importance to individual goals. The *Pv* for M_{ITask} increases more and the *Pv* for M_{GTask} increases less in the case of an agent with high scores in openness to experience.

In addition, since agents with high values of openness to experience care less for the success of the team, the effects of positive instrumental interactions are less intense. For example, the occurrence of (*Facilitate Problem* and *Gain Competence*) will increase less the social influence of the performers over agents with high openness to experience and the increments of the *Rv* of the socio-emotional motivations will increase less.

Moreover, openness to experience is correlated with toleration for and exploration of the unfamiliar [13]. For this reason, openness to experience also influences the planning algorithm. In cases of higher values of openness to experience, the agent uses heuristics that allow it to explore more unusual solutions.

4 Case Study

The extended SGD Model, with the personality system presented here, was used in the mind of autonomous agents that act as characters in the game "Power Pentagram". This game is an adapted version of the game "Perfect Circle: the Quest for the Rainbow Pearl" that was designed to evaluate the effects of the first version of the SGD Model.

The game places four autonomous characters and one user-controlled character in a virtual environment and defines a context of interaction and a task for the group. The group's goal is to search the world for a magic item. To achieve this, the group must travel around the world through magic portals that are activated by the powers of gemstones. Their task is to gather and manipulate the gemstones in order to get the required ones that will open the portal. To achieve this, characters need to apply their individual abilities in order to change the gems' forms, sizes and colours. For example, if the group has two small rubies but it needs one medium-sized ruby, one character can use its ability to merge the small stones into a bigger one. In addition, two or more characters can combine their efforts if they all have the same ability. As a result, the probability of success of the action becomes higher.

The difference from the first version is that now the characters and have a secondary goal besides the common goal to open the portal and proceed with the quest. The secondary goal is to get some wealth while going on the quest. To achieve this, characters may use some of the gems in the group's common stash for own profit. The catch is that they will only get that individual profit if the group's task is successful within a given time.

The actions concerning the resolution of the group's task are discussed by the group before being executed. Therefore, once a character believes it has a good action to perform it proposes the action and waits for the opinion of the other members. Then, if the proposal gathered sufficient support the agent starts the execution of the corresponding action. The notion of support depends on the perspective that the proposing agent has of the group. Opinions are identified as *Agree* or *Disagree* interactions and will have different strengths according to the position in the group of their performers. For example, if two members in the group express themselves against the action while just one agrees with it, this does not necessarily means that the action is not going to be executed. If the member that agreed with the action has a better position in the group than the other two together in the perception of the proposing member, then it feels supported and will execute the action.

Agents have the choice to join the execution of an action if they agree with a proposal and have the ability to execute the action, although they can only do that if are not already executing an action. By joining the action agents add efforts and increase the action's probability of success.

The group interactions are not restricted to the execution of the task. Each member can at any time engage in social-emotional interactions, by expressing their opinion about other members or the group. Characters have different personalities and different abilities that are generated in the beginning of the game.

4.1 The SGD Model in the Game

To implement the SGD Model in the game it was necessary to define the knowledge regarding context that establishes the relation between actions and events in the game and the categories of interactions of the model. These relations influence, on one hand, how particular actions are perceived by agents as group interactions and, on the other hand, how intentions to perform group interactions are generated and transformed to particular actions in the game. In this case, agents are able to use 2 instrumental interactions (*Facilitate Problem*, *Obstruct Problem*) and 4 socio-emotional interactions (*Agree*, *Disagree*, *Encourage* and *Discourage*).

The *Facilitate Problem* interaction corresponds to the event of a successful execution of a manipulation on a gemstone (e.g., merge, split, etc.) and the *Obstruct Problem* corresponds to a failure or the use of a gemstone for individual gain.

Socio-emotional interactions have direct correspondence to actions in the game. This means that there is a specific action in the game to agree, disagree, encourage and discourage. This makes the identification of socio-emotional interactions trivial. For example, every time an encouragement action is performed in the game all agents perceive it as an *Encourage* interaction. We chose to have this direct correspondence between game actions and group interactions to simplify the process of perception and identification of the group interactions.

Furthermore, agents decision process generates requests of general actions, according to their internal motivations, that need to be translated into specific actions in the game. In the case of the socio-emotional actions, this process is trivial. As seen before, the game defines an action to encourage and an action to discourage other characters. Encouragement actions take the form of positive sentences, such as: "I believe you." or "Keep the good work.". In turn, discouragement actions are negative sentences, such as: "Stop doing that!" or "I don't care, just shut up.". These sentences are predefined and are chosen automatically by the game according to the situation, for example, if the encouragement is a reply to another encouragement. Therefore, agents (and the user) can only state their intentions to encourage/discourage a character, the actual sentence used is beyond their control.

When the an agent is motivated to perform the group's task it proposes an action to the group and waits for the others opinions. The action is only started if the proponent feels supported by the group (e.g., if members with better position in the group agree with the action or if it has a very good position in the group itself). The motivation to perform individual actions corresponds to the execution of and action that removes one gem from the group belongings and

transforms ti in personal points .

Agent decisions are also influenced by the context, in particular, agents need a model of the task to properly execute the planning algorithm and to support the decision to *Agree* or *Disagree*. In this case, agents decide to *Agree* or *Disagree* with a proposal based on their planning algorithm. The nodes explored during planning are kept in the agents' memory. If the proposal matches one of the actions on these nodes the agent is inclined to *Agree*; otherwise, it is inclined to *Disagree*. Note that, since *Agree* and *Disagree* are socio-emotional interactions, this decision is not based only on the task model but also follows the socio-emotional rules.

5 Conclusions

Personality is important in the creation of interesting and coherent individualities that sustain the believability of agents that interact with users. Following this idea we presented a model of personality, based on the Five Factor trait theory, that created individuality in believable team interactions. The model is built on top of an already existent model for the generation of believable group interactions that was adapted, by the introduction of a motivational system to support the group's dynamics.

The integrated model (of group dynamics and personality) was successfully applied in a test scenario, that implements a collaborative game played by groups of five characters.

We performed a preliminary study, with this test case, where all characters were played by autonomous agents and have extreme personalities (e.g. all traits very low except one that was very high). The results showed differences in the behaviour of characters. The influence of some personality traits was easily identified (in the case of extraversion, agreeableness and openness to experience), but the influence of others was not fully identified (the case of neuroticism). In the future we plan to perform more studies to better evaluate the influence of the personality model in the behaviour of the agents. We plan to perform similar tests to the one described, but with personalities from real people. In order to perform that we got a personality data base extracted from 21588 people who answered a FFM based-personality Inventory [14]. The real personalities will be used as personality for each agent in the game. The game will be simulated hundreds of times considering the recommendations done by a Recommender System [22], which is able to recommend partners to form a group based on their personality. As a result we intend to create a supported statistical data in order to standardize agents behavioural according to personalities of real people.

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