On Automatically Motivating Story Characters

Alireza Shirvani, Stephen G. Ware
Narrative Intelligence Lab, University of Kentucky
Lexington, KY 40506
{ashirvani, sgware}@uky.edu

Abstract

Motivation establishes the framework within which goals are pursued. Different characters are motivated differently based on their personality, emotions, relationships, and social norms. In this paper, we propose a motivation model that incorporates these concepts into multi-agent narrative planning. Using our model, characters automatically adopt new goals, find plans to achieve those goals, and choose between those plans based on their personality.

Introduction

Characters are a crucial aspect of interactive narratives and virtual environments. Believable characters enhance the immersion and user experience of virtual worlds and many story generation systems can benefit from them. There is extensive research on applying various psychology models to virtual characters but they rarely combine those models into a multi-agent story generation system.

We propose a motivation model based on narrative planning that takes into account personality, relationships, social norms, and affect. Using our model, the predefined or empty sets of character goals are dynamically updated during the story generation process. We hope that this model improves believability when characters automatically adopt new goals in different situations.

Related Work

Narrative planning is a widely-used approach to automatic story generation (Samuel et al. 2018; Shirvani and Ware 2019; Ware et al. 2019; Young et al. 2013; Riedl and Young 2010). In order to make their characters appear more believable, many narrative planners implement intentionality by having characters only consent to actions that causally contribute to their goals. In that case, we say that the action is *explained* for that character or the character *consents* to that action. Intentional planners generate a story that starts from an initial state defined by the author, ends in a state where all author goals are satisfied, and every action in that story is explained for its consenting characters.

Our motivation model extends Glaive (Ware and Young 2014) to include personality and emotions in the reasoning process. Glaive's model of motivation is described as follows: characters adopt goals as defined by the author in the initial state and as the effects of some actions. We extend this process to also allow characters to adopt goals automatically based on their personalities and emotions.

Next, Glaive non-deterministically selects a set of explained actions that achieve the author's goals. At this stage, we distinguish between different actions based on the character plans they belong to. In other words, we allow characters to have preference for different plans that satisfy their goals based on the characteristics of that plan. We propose that those characteristics are determined based on personality, relationships, social norms, and affect.

Personality

Personality refers to the characteristics of an individual that represent consistent patterns of behaviour over situation and time (Pervin and John 1999). The Big Five is one of the most well-known personality models, which defines five main factors to convey all personality traits (DeYoung, Quilty, and Peterson 2007; Goldberg 1992). The big five factors are openness, conscientiousness, extraversion, agreeableness, and neuroticism.

Existing narrative planners rarely incorporate a model of personality. Those who do either consider a subset of the Big Five or manually label actions to represent certain personality traits. CB-POCL incorporates the Big Five to extend intentional planners (Bahamón and Young 2013). The authors define a set of rules that map actions to certain personality traits. At the time of writing this paper, their model has only implemented Agreeableness (Bahamón and Young 2017). SPOT uses neural networks to model personality. Their knowledge representation is manually encoded using known predispositions and common sense about human behaviors (Poznanski and Thagard 2005). The Big Five has also been extensively studied for virtual humans, e.g. (Gebhard 2005; André et al. 1999; Egges, Kshirsagar, and Magnenat-Thalmann 2003). However, they mostly focus on human-computer user interfaces and dialog or physiological manifestations rather than reasoning or decision making.

Our model of personality is inspired by the Big Five. Our decisions on how each of the Big Five affects character motivation is derived from the descriptions and examples of personality traits in relevant psychology research (Goldberg 1992; Hofstee, De Raad, and Goldberg 1992; DeYoung, Quilty, and Peterson 2007).

Relationships

A character may act independently or instead in favour or against others, helping or hindering their actions (Propp 2010). If characters have positive relationships, e.g. friends, they are more likely to support and help, whereas negative relationships are more likely to cause conflict (Porteous, Charles, and Cavazza 2015).

TALE-SPIN characterizes relationships in terms of competition, affection, trust, etc (Meehan 1977). It uses character relationships as preconditions of actions, e.g. if a character feels competitive or hate towards another character, they won't ask them a favor, or as their effects, e.g. feeling affection for another character after receiving a gift from them.

Comme il Faut defines different forms of relationships and use them to describe social interactions in the form of rules, e.g. if exists a romantic relation between characters x and y, then x can start dating y (McCoy et al. 2010). These rules are manually defined by the domain author and may not be generalized in every context.

Relationships are not the focus of our model. However, we propose an oversimplified relationship model in service of personality and affect.

Norms

A narrative world is a form of society in which characters may choose to follow or defy a set of social norms whose collective function is to guide the characters to reach some conclusion (Thompson, Padget, and Battle 2015). Simply put, social norms are general expected behaviors within a social group (Durkheim et al. 1938; Sherif 1936).

Social norms have been modeled by automatic storytelling systems as tacit social knowledge (Mueller 1999; Pérez y Pérez 1999; Riedl and Young 2004).

MEXICA claims that defying social norms increases the interestingness of stories (Pérez y Pérez 1999). It represents rupture of social norms by labeled actions, e.g. "the knight is a coward fighter" after they escape a battle.

Again, modeling social norms is not the focus of our system; we use a simple model of author-defined social norms to allow characters to express their personalities.

Affect

Most affective models consider a three-level hierarchy with emotions, as short-term responses, at the bottom, mood, a longer lasting state in the middle, and personality, as long-term affect, at the top (Gebhard 2005; Lisetti 2002). In this paper, we consider the OCC appraisal-based emotion model and Pleasure-Arousal-Dominance (PAD) model to represent mood (Mehrabian 1996; Ortony, Clore, and Collins 1988).

Emotions are affective responses following an appraisal, an evaluation of a situation or event. Appraisal theories describe such events in terms of appraisal variables (Marsella

Table 1: Appraisal Variables

Emotion	Rule
Hope	unconfirmed desirable event
Joy	confirmed desirable event
Disappointment	disconfirmed desirable event
Fear	unconfirmed undesirable event
Sadness	confirmed undesirable events
Relief	disconfirmed undesirable event
Pride	approved action executed by self
Shame	disapproved action executed by self
Admiration	approved action executed by others
Reproach	disapproved action executed by others

and Gratch 2009). One of the most well-known appraisal models, called OCC, distinguishes 22 emotion types based on the psychologically significant situations they represent (Ortony, Clore, and Collins 1988). In this paper, we consider desirability, standards, and expectedness as in table 1.

An event is desirable/undesirable when it satisfies/thwarts a character's goals. According to Shirvani, Ware, and Farrell (2017)'s model of anticipation, characters can expect others to take certain actions (Shirvani, Ware, and Farrell 2017; Shirvani, Farrell, and Ware 2018). An expected action can have three states: unconfirmed (it has not happened yet), confirmed (it has happened), and disconfirmed (it does not occur) (El-Nasr, Yen, and Ioerger 2000).

Finally, different emotions are caused by actions that are approved or disapproved by the existing norms. The emotions triggered by this variable depend on whether the agent execute the action themselves or observes others execute them.

Mood is a longer lasting emotional state modeled by Pleasure, Arousal, and Dominance in a three-dimensional space (Mehrabian 1996), forming 8 octants, i.e. +P+A+D, +P+A-D and so on. The initial mood of a character is computed as a function of their personality (Mehrabian 1996).

After an event occurs, the emotional response is determined based on the appraisal variables (similar to table 1). This response is mapped to a point in the PAD space (Mehrabian 1996). If multiple emotions are triggered at the same time, the average of the mapped points are considered. If the mapped point is in the same octant as the current mood, the mood value is intensified, otherwise it moves towards that point (Gebhard 2005). For instance, if a character is in a slightly happy mood and a desirable event occurs, their mood changes to moderately happy in proportion to (P:0.4, A:0.2, D:0.1) representing Joy.

Affective models can be used to allow story characters to express emotions using tagged sentences in text-based or facial animations in 3D virtual environments. However, in this paper, we focus on the effects of affect on character motivations. Characters tend to avoid or pursue some goal if it leads to desirable emotional states. They may also activate new goals in order to face (*cope* with) triggering emotions (Alfonso Espinosa, Vivancos Rubio, and Botti Navarro 2014). For instance, when one loses their job, they could look for

Table 2: Domain information provided by author

Item	For	Range	Default
Personality factors	Each character	[0, 1]	0.5
Relationships	Each pair of characters	[0, 1]	0
Norms	Each action	{-1, 0, 1}	0

a job or modify their beliefs such that not having a job is something to be proud of.

"Coping determines how one responds to the appraised significance of events" (Marsella and Gratch 2003). Facing a significant stressor, characters needs to cope to stabilize their emotions. According to Lazarus and Lazarus (1991), there are two main categories of coping mechanisms, emotion-focused and problem-focused. Emotion-focused coping mechanisms include mental disengagement (pursuing other goals instead), positive reinterpretation (looking for silverlining), etc. Problem-focused coping refers to planning and taking action in response to the stressor.

Motivation Model

With many existing narrative planners, the domain author must provide a domain definition, using STRIPS, PDDL, etc., that includes the definition of actions, initial world state, initial character goals, and initial character beliefs. To this definition, we add the following optional items:

Personality of a character is defined by a set of five values in $[0, 1]$ for each of the Big Five. The relationship between each pair of characters is represented by a real number in $[0, 1]$, 0 indicating no relationship [1].

Relationships affect how characters choose intentions, adopt new goals, and emotionally respond to events. For instance, characters have a stronger emotional response when a goal of another character is achieved/thwarted if they have a close relationship with them. When character $C1$ satisfies/thwarts a goal of character $C2$, relationship value of $C1$ and $C2$ is increased/decreased [2].

(Social) Norms are represented by three values, -1 for chaotic, 0 for neutral, and 1 for lawful. These values do not indicate the deviation from the norm but how positively or negatively an action is perceived in the social group. By labeling actions with a norm value, characters with lawful behavior, may be praised by society, whereas characters choosing chaotic behavior may be subject to punishment. Manually labeling actions with norm values allows the author to define socially approved/disapproved actions in the context of their world, e.g. in the land of barbarians, fighting may reflect courage and thus be admired by others.

Figure 1 presents the components that may cause characters adopt new goals and form plans to achieve them. Based

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[1]We do not take into account negative relationships yet in which case the value could be in [-1, 1]

[2]Here, we assume the same values for Relationship(C1, C2) and Relationship(C2, C1). However, the impacts of considering different values can also be investigated.

Figure 1: The Motivation Process
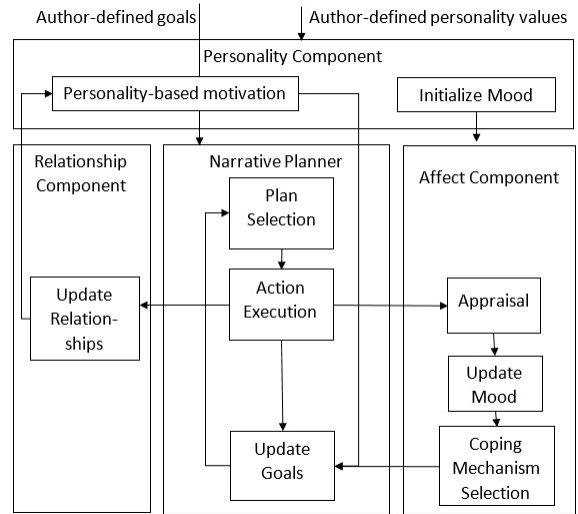
on these components, our motivation model considers what motivates characters and how they choose to act on them.

Character Motivations

As shown in figure 1, after the execution of an action, characters may appraise that event, as well as update their relationships. Consequently, a character's set of goals may be updated based on their personality traits and coping mechanisms.

Personality indicates how different characters are motivated. Achieving a goal has two main effects. If a character satisfies a goal of another character, their relationship is improved and they also feel positive emotions based on how strong their relationship is. The opposite occurs when a goal is thwarted. Agreeable characters are motivated by fostering relationships and want to actively improve and avoid deteriorating their relationships. In other words, agreeable characters are likely to adopt new goals in order to help others. Extroverts are motivated by positive emotions and one of the ways to accomplish this is by helping others achieve their goals if they have a good relationship with them. Therefore, a character $C1$ may adopt a goal of character $C2$ with the likelihood of $Agreeableness(C1) \times Extraversion(C1) \times Relationship(C1, C2)$. Although Agreeableness and Extraversion are motivated by helping others, the rationale for doing so is different for each factor.

Furthermore, highly conscientious characters are motivated by being active and orderly. When observing disapproved behavior, they are motivated to *punish* the consenting characters of such actions. In order to punish a character, if action A has a low norm value, its consenting character is $C2$, and $C2$ has goal G, when $C1$ observes A, they will adopt goal $Not(G)$ with probability of $Conscientiousness(C1) \times (1 - Relationship(C1, C2)) \times (1 - Agreeableness(C1)) \times (1 - Openness(C1))$. The Openness score is considered in this equation, since open characters enjoy adventurous behavior. Finally, neurotic

Table 3: Coping Mechanisms

Strategy	Description	Condition	Personality
Denial/Wishful Thinking	Changes beliefs to allow replanning	Impossible to pursue	High Neuroticism/ High Openness
Acceptance	Accepts the reality and moves on	Impossible to pursue	High Agreeableness
Replanning	Finds a new plan to achieve goal	Possible to pursue	High Agreeableness/High Conscientiousness
Shifting Blame	Blame/Punish the causal agent	Causal agent	Low Agreeableness/High Conscientiousness

Table 4: Summary of Plan Features

	Description	Plan Feature
O	Adventurous Creative Unconventional	Plans with minimum average norm value
C	Stern Industrious Dutiful	Plans with minimum number of actions
E	Sociable Enthusiastic Gregarious	Plans that involve maximum other characters Plans that maximize positive emotions
A	Compassionate Cooperative Altruistic	Plans with maximum other consenting characters Plans with minimum conflicts with others
N	Anxious Compulsive Sensitive	Plans that minimize negative emotions

characters are motivated by reducing stress and anxiety. They also feel negative emotions stronger than others and therefore, reach the coping mechanism selection faster.

Coping is triggered if the distance between the current and initial mood is larger than a predefined threshold, the character selects a coping mechanism to stabilize their mood.

Several factors affect the selection of coping mechanisms, including personality, the causal agent, and possibility to pursue. If the triggering event can be causally linked to a character other than the coping character, that character is considered the causal agent for the coping mechanism. If the triggering event is linked to a specific goal, i.e. a specific goal is thwarted, possibility to pursue refers to whether there is any plan that still can satisfy that goal. Table 3 presents coping mechanisms, conditions to select them, and the personality factor that increases the likelihood of selecting it.

If a goal is rendered impossible, the character may choose to change certain beliefs that makes achieving that goal possible (referred to as denial if Neuroticism is high or wishful thinking if Openness is high) or accept that the goal can no longer be achieved and move on. Otherwise, the character finds another plan to achieve that goal. Furthermore, If there is a causal agent, a low agreeable character may blame that character and decrease their relationship value or a high conscientious character may choose to punish them.

Acting on Motivations

When a set of plans are found that satisfy the goals of a character, they should decide which plan to pursue by taking into account their side effects. For instance, a plan may help some characters but hurt others along the way. Therefore, a plan must be described in terms of different features to allow this decision. Table 4 presents some of the features that can be used to rank plans based on different personalities. In this paper, we only discuss major features that affect decision making. A more comprehensive list of planning features is presented by Shirvani and Ware (2019).

Open characters prefer plans that breach the boundaries of social norms while respecting their other personality factors. For instance, highly open and agreeable characters do not defy norms if they cause conflicts with others. Conscientious characters are more likely to punish whomever defies social norms and tend to prefer short plans that get things done quickly.

Extroverted and agreeable characters tend to want to help other characters and involve them into their plans. In contrast to agreeableness, extroverts involve other characters even if they do not consent to the action. Moreover, agreeable characters avoid thwarting the goals of other characters, whereas extroverts may help some characters at the expense of others. Finally, neurotic characters choose plans with actions that minimize negative emotions.

Conclusions and Future Works

This paper proposes to incorporate personality and affect into narrative planners to generate more believable characters. We extended Glaive to allow characters to adopt and pursue goals based on their personality, affect, and relationships. Characters may be motivated to adopt new goals after observing new events based on their personality. They also feel differently towards characters whom they have different relationships with and actions that are approved or disapproved in the social context. Characters also demonstrate different preferences for different plans that satisfy their goals.

Our motivation model works closely with the model of personality presented by (Shirvani and Ware 2019) and we hope to combine both works into a unified system. We plan to evaluate our motivation model to investigate whether the resulting behavior is believable to a human audience and whether the model can contribute to more compelling characters.

References

Alfonso Espinosa, B.; Vivancos Rubio, E.; and Botti Navarro, V. J. 2014. Extending a BDI agents' architecture with open emotional components.

André, E.; Klesen, M.; Gebhard, P.; Allen, S.; and Rist, T. 1999. Integrating models of personality and emotions into lifelike characters. In *International Workshop on Affective Interactions*, 150–165. Springer.

Bahamón, J. C., and Young, R. M. 2013. CB-POCL: a choice-based algorithm for character personality in planning-based narrative generation. In *2013 Workshop on Computational Models of Narrative*. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik.

Bahamón, J. C., and Young, R. M. 2017. An empirical evaluation of a generative method for the expression of personality traits through action choice. In *13th AAAI International Conference on Artificial Intelligence and Interactive Digital Entertainment*, 144–150.

DeYoung, C. G.; Quilty, L. C.; and Peterson, J. B. 2007. Between facets and domains: 10 aspects of the big five. *Journal of personality and social psychology* 93(5):880.

Durkheim, E.; Catlin, G. E. G.; Mueller, J. H.; and Solovay, S. A. 1938. *The rules of sociological method*, volume 8. Free Press New York.

Egges, A.; Kshirsagar, S.; and Magnenat-Thalmann, N. 2003. A model for personality and emotion simulation. In *International Conference on Knowledge-Based and Intelligent Information and Engineering Systems*, 453–461. Springer.

El-Nasr, M. S.; Yen, J.; and Ioerger, T. R. 2000. Flame—fuzzy logic adaptive model of emotions. In *Autonomous Agents and Multiagent Systems*, volume 3, 219–257.

Gebhard, P. 2005. ALMA: a layered model of affect. In *Proceedings of the fourth international joint conference on Autonomous Agents and Multiagent Systems*, 29–36. ACM.

Goldberg, L. R. 1992. The development of markers for the big-five factor structure. *Psychological assessment* 4(1):26.

Hofstee, W. K.; De Raad, B.; and Goldberg, L. R. 1992. Integration of the big five and circumplex approaches to trait structure. *Journal of personality and social psychology* 63(1):146.

Lazarus, R. S., and Lazarus, R. S. 1991. *Emotion and adaptation*. Oxford University Press on Demand.

Lisetti, C. L. 2002. Personality, affect and emotion taxonomy for socially intelligent agents. In *The Florida Artificial Intelligence Research Society Conference*, 397–401.

Marsella, S., and Gratch, J. 2003. Modeling coping behavior in virtual humans: don't worry, be happy. In *Proceedings of the second international joint conference on Autonomous Agents and Multiagent Systems*, 313–320. ACM.

Marsella, S. C., and Gratch, J. 2009. EMA: A process model of appraisal dynamics. *Cognitive Systems Research* 10(1):70–90.

McCoy, J.; Treanor, M.; Samuel, B.; Tearse, B.; Mateas, M.; and Wardrip-Fruin, N. 2010. Authoring game-based interactive narrative using social games and comme il faut. In *Proceedings of the 4th International Conference & Festival of the Electronic Literature Organization: Archive & Innovate*, 1–8.

Meehan, J. R. 1977. Tale-spin, an interactive program that writes stories. In *Ijcai*, volume 77, 91–98.

Mehrabian, A. 1996. Pleasure-arousal-dominance: A general framework for describing and measuring individual differences in temperament. *Current Psychology* 14(4):261–292.

Mueller, E. T. 1999. Daydreamer.

Ortony, A.; Clore, G. L.; and Collins, A. 1988. The cognitive structure of emotions. *Cambridge University Press*.

Pérez y Pérez, R. 1999. *MEXICA: a computer model of creativity in writing*. Ph.D. Dissertation, University of Sussex.

Pervin, L. A., and John, O. P. 1999. *Handbook of personality: Theory and research*. Elsevier.

Porteous, J.; Charles, F.; and Cavazza, M. 2015. Using social relationships to control narrative generation. In *Twenty-Ninth AAAI Conference on Artificial Intelligence*.

Poznanski, M., and Thagard, P. 2005. Changing personalities: towards realistic virtual characters. *Journal of Experimental & Theoretical Artificial Intelligence* 17(3):221–241.

Propp, V. 2010. *Morphology of the Folktale*, volume 9. University of Texas Press.

Riedl, M. O., and Young, R. M. 2004. A planning approach to story generation for history education. In *Proceedings of the 3rd International Conference on Narrative and Interactive Learning Environments*, 41–48.

Riedl, M. O., and Young, R. M. 2010. Narrative planning: Balancing plot and character. *Journal of Artificial Intelligence Research* 39:217–268.

Samuel, B.; Reed, A.; Short, E.; Heck, S.; Robison, B.; Wright, L.; Soule, T.; Treanor, M.; McCoy, J.; Sullivan, A.; et al. 2018. Playable experiences at AIIDE 2018. In *Fourteenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Sherif, M. 1936. The psychology of social norms.

Shirvani, A., and Ware, S. G. 2019. A plan-based personality model for story characters. In *Fifteenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Shirvani, A.; Farrell, R.; and Ware, S. G. 2018. Combining intentionality and belief: Revisiting believable character plans. In *Fourteenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Shirvani, A.; Ware, S. G.; and Farrell, R. 2017. A possible worlds model of belief for state-space narrative planning. In *Thirteenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Thompson, M.; Padget, J.; and Battle, S. 2015. Governing narrative events with institutional norms. In *6th workshop on computational models of narrative (CMN 2015)*. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik.

Ware, S. G., and Young, R. M. 2014. Glaive: a state-space narrative planner supporting intentionality and conflict. In *Tenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Ware, S. G.; Garcia, E.; Shirvani, A.; and Farrell, R. 2019. Multi-agent narrative experience management as story graph pruning. In *Fifteenth Artificial Intelligence and Interactive Digital Entertainment Conference*.

Young, R. M.; Ware, S. G.; Cassell, B. A.; and Robertson, J. 2013. Plans and planning in narrative generation: a review of plan-based approaches to the generation of story, discourse and interactivity in narratives. *Sprache und Datenverarbeitung, Special Issue on Formal and Computational Models of Narrative* 37(1-2):41–64.