Toward a Computational Model of Character Personality for Planning-Based Narrative Generation

Julio César Bahamón
Liquid Narrative Group
North Carolina State University
Raleigh, NC, USA
jcbahamo@ncsu.edu

Abstract

Authoring narrative content for interactive digital media can be both difficult and time consuming. The research proposed here aims at enhancing the capabilities of content creators through the development of a computational model that improves the quality of automatically generated stories, potentially decreasing the burden placed on the author. The quality and believability of a story can be significantly enhanced by the presence of compelling characters. To achieve this objective, I aim to develop a choice-based computational model that facilitates the automatic generation of narrative that includes characters that are made more compelling by the presence of distinct personality characteristics.

Introduction

The creation of narrative content for digital games poses a difficult challenge due to the interactive and highly dynamic nature of the medium. It is laborious to create stories that can adapt in novel ways to changes introduced by users as a result of their interaction with the game environment (Sgouros 1999). Moreover, the implementation of a quest or an adventure in a digital game may require several months of development effort that result in just a few hours of game play once the game goes live (Morningstar and Farmer 1991). The problem of content generation is further exacerbated by elements such as: the increasing richness and size of virtual game worlds, the complexity of synthetic characters within the virtual world, and user expectations of open world metaphors and game re-playability.

One of the possible solutions studied by researchers is the use of artificial intelligence (AI) planners to produce narrative content for digital games. Planning-based narrative generation focuses on the use of planners to automatically generate stories that are interesting and coherent (e.g. (Young 1999)). One of the key motivations for work in this area has been the importance of storytelling in human culture. Humans use stories to describe events to each other and also to achieve a better understanding of the world in which they live (Mateas and Sengers 1999). Additionally, computer-generated narrative can be applied to various domains where it can assist in knowledge transfer (e.g. training simulations, activity visualizations, instructional videos).

One of the key elements in the creation of narrative is the development of characters that are compelling and believable (LaPlante 2007; Bulman 2007; Chatman 1978). The importance of characters becomes more apparent when we consider the critical role they play in the composition of a story. Characters are an essential part of story elements such as events and dialog. Due to their importance, characters should be well-developed and have distinct characteristics, such as physical features, beliefs, emotions, and personality.

Personality is a key component to what in narrative is known as a round character. A character's personality can make it more believable and compelling, increasing the effectiveness of the narrative piece. A character's lack of personality can create the perception of being flat, thus detracting from the narrative and reducing its effectiveness.

The doctoral research presented here aims to develop a computational model of character personality for planning-based narrative generation. The model will operationalize methods already in use by creative writing authors in conjunction with psychological research in human personality. The expected contribution is to advance the state of the art in automated story generation by facilitating the automatic generation of narrative that is made more interesting and coherent through the inclusion of compelling characters. In the context of this research, compelling characters are defined as those whose behavior can elicit in an audience the perception of specific personality traits.

Related Work

The use of AI planners to automatically generate stories was first introduced in systems such as Tale-spin (Meehan 1977). Considerable effort has been dedicated since then to the development and improvement of AI techniques, algorithms, and architectures to enable the application of the problem solving capabilities of AI planners to the automatic generation of narrative that is both interesting and coherent (Riedl and Young 2003; 2010).

In the area of Interactive Narrative (IN), the ability to generate character behavior that adjusts to user actions or changing story conditions has not been fully addressed by researchers. Although models have been developed to direct character interaction (Riedl and Stern 2006) and com-

pose stories based on predefined character models (Lebowitz 1984), none of these focus specifically on controlling character behavior within the context of a story, i.e., a character's actions in accordance to authorial goals, story events, other characters, and the state of the story world. Furthermore, these models do not directly address the goal of eliciting in the audience the perception of specific personality types.

The personality-based character models that are addressed by existing research efforts have focused on a specific subset of character actions: utterances in dialog (Mairesse and Walker 2007; Reed et al. 2011). My research focuses on another class of actions –physical actions– and the role that this class plays in the construction of the mental model that the audience forms when experiencing a story. None of the current models address character's physical actions and their impact on audience comprehension from the point of view of the story as a whole. Finally, current narrative generation systems don't consider character personality from the perspective of the entire story. Instead, previous research has focused on personality as a localized event, specific to isolated character actions, without significant consideration for its implications with respect to other characters and story events.

Current Progress

The doctoral research presented in this paper relies on the operationalization of creative writing principles for the automatic generation of stories (LaPlante 2007; Chatman 1978). While there are a number of principles that are relevant to the automatic support of the creative writing process, my work focuses on the importance of the creation of perceivable character personality in narrative. In order to operationalize the concept of character personality, I plan to develop a computational model based on personality traits similar to that developed by Mairesse and Walker to generate character dialog (2007).

The development of the computational model will also utilize principles that have been empirically validated by research in behavioral psychology. I intend to develop a computational model of character behavior based on personality traits using results from studies that have focused on the behavioral manifestations of personality (Funder and Sneed 1993; Mehl, Gosling, and Pennebaker 2006).

A Choice-based Model of Personality

In the proposed model, personality is operationalized as behavior that results from choices for actions and action sequences made by a character in the course of a story. Considering narrative structure, specifically plot points where branching occurs (Barthes and Duisit 1975), we intuitively expect instances when the actions of characters follow a choice. For example, in *The Iliad*, Achilles must choose whether to help the Greeks in the Trojan War. It follows from this reasoning that choices made by characters can have a direct impact in determining the actions they perform. Furthermore, it may be argued that the resulting choices are linked to and intended by the author to communicate specific personality traits. This idea is supported by research in behavioral psychology that has found correlation between people's actions and their personality (Mehl, Gosling, and Pennebaker 2006; Funder and Sneed 1993).

I posit that the link between choice and personality can be applied in narrative generation to enable the perception of specific personality traits. That is, an audience that is made aware of the existence of multiple choices available to a character will form an opinion of such character's personality based on (1) the choices made and (2) the causal chain of events or circumstances that precede the choices. I have identified two key aspects where choice and character personality intersect:

1. Stories can be constructed ensuring that choices made by characters express their personality traits, i.e. characters' choices are consistent with their assigned personality traits. For instance, a highly *agreeable* character only makes choices that result in honest actions.
2. Stories can be constructed to include events that facilitate the presence of choices that justify or explain a character's actions, including choices that contradict the character's personality. This type of structure may be used to show more complex or surprising characters. For instance, an *agreeable* character makes a choice that results in dishonest behavior after multiple attempts to engage in honest alternatives.

Initially I am focusing on aspect (1), under the assumption that once a computational model of choice is developed, aspect (2) will be an extension that can be derived from it.

Computational Approach

In order to design a planning-based story generator that can create characters with distinct personalities I will first develop a computational model of behavior based on personality traits. The model will follow the Big Five structure defined by Goldberg (1990). This structure provides a behavior-based taxonomy for the classification of personality using the following five factors: Extroversion, Agreeableness, Dependability, Emotional Stability, and Culture (or Openness). Within each classification there are distinct bi-polar personality traits that can be mapped to a set of behavioral manifestations, e.g. honesty vs. dishonesty.

According to results obtained by social psychologists Mehl et al. (2006) and Funder and Sneed (1993), there is a high correlation between personality traits and specific, observable, behaviors, i.e., witnessing a certain behavior can elicit the perception of a personality trait associated with it.

Planner Modifications

A simplistic approach to the development of a computational model of behavior would be to annotate the actions in the action library of a planning-based story generator (e.g., Riedl and Young (2003)) with specific personality traits. Actions would be chosen by the planner during narrative generation using the annotations in a filter mechanism. However, this approach would not adequately achieve our purpose for multiple reasons. Among these we note that actions may need to be annotated to indicate all the cases where their use is appropriate. Considering that there could be many situations

that justify or preclude the validity of an action it is evident that such a scheme would be intractable.

Intelligent Action Selection: I propose a process that intelligently chooses and adds character actions to the story after considering the context in which they execute and without requiring their extensive hand-annotation. In this approach, the execution context is used to determine the appropriateness of actions for specific story characters in order to create desired behaviors. For example, the action $Kill(actor, target)$ may only be appropriate for an agreeable character if the context indicates either that she is behaving in self defense or that the target is an evil enemy who must be destroyed. However, the same action may always be valid for a disagreeable character.

Actions are selected after analyzing the current execution context and evaluating the space of possible story plans. The execution context is derived from the current state of the story world, the properties of the characters and other actors in the story, and the set of goals that are yet to be achieved in the story. Information obtained from the execution context is used to advise the planning process on the selection and placement of actions, in order to produce desired behaviors.

Choice in a Planning Context: An initial model of character choice is based on modifying the process used by a least commitment planning algorithm, such as POP (Weld 1994), to select actions. At the most primitive level, a choice occurs when an open goal has been selected from the agenda and a new action needs to be added to the plan to directly achieve the goal's condition. The choice process only considers actions that are performed by characters. Additionally, two key factors are taken into account during action selection: (1) the action must be relevant, i.e., its effects establish the effects required by the goal and (2) the action can be performed by the character, i.e., the value that represents the character who executes the action can be bound to the parameter in the action that designates the main actor. This process works under the assumption that the planner's data structures and knowledge representation have been modified to enable reasoning about who or what performs an action.

A choice at a time t represents a commitment to (a) a character's execution of the chosen action over a set of viable alternative actions achieving the same goal, (b) a set of states prior to the moment when the chosen action executes ($time < t - 1$), and (c) a set of states immediately after the same moment ($time > t + 1$). When a character chooses a particular action from a set of viable alternatives, it commits to a set of side effects caused by the instantiation of such action. The choice also implies a commitment to a set of additional preconditions that must be true if the action is to be part of the plan. In the context of this process, side effects are defined as members of the action's effects list that are not included in the desired effects of the target goal. Likewise, additional preconditions are those specific to the chosen action and not shared by any of the other viable alternatives.

A preliminary version of the algorithm I am developing is described in (Bahamón and Young 2012). An abbreviated version is included here.

1: Given a character (C), the required effects (F), the library of actions (L), and the current plan (P).
2: Find the set of actions in L that establish F and that can be performed by C.
3: Rank the actions by measuring their level of compliance with the personality traits of C.
4: Add the first action on the list to P and attempt to form a plan. Actions are tried in sequence until a plan is found or the failure condition is detected.

The compliance of an action is measured by evaluating the consistency of its effects with behavior associated with a personality trait. For this purpose, I am developing a declarative representation that uses an extensible library of mappings between behavior and personality traits. For example, if C_l is an agreeable character the effect $(dead\ C_m)$ is consistent only if C_m is not a friend of C_l and C_l has motive to eliminate C_m. On the other hand, if C_l is highly disagreeable the effect is consistent regardless of the relationship between the two characters or C_l's motives. The evaluation process is informed by character properties and the current plan. To this effect, I am currently working on a mapping between observable behaviors and personality traits using empirical results from social psychology (Funder and Sneed 1993; Jackson et al. 2010).

Discussion and Future Work

The next step in my research plan is to define the algorithm that evaluates an action's compliance with a character's personality. The algorithm must avoid the computationally intensive option of generating all the possible plans and then selecting those that facilitate the expression of specific personality traits. The process must also guarantee the coherence of the resulting story, i.e., added actions are part of a valid causal chain of events. Due to the complexity of the process, one of the alternatives that I am considering is the implementation of a modified Heuristic Search Planner such as that described by Bonet and Geffner (2001).

Preliminary analysis of the plan structure characteristics needed for the proposed model indicates that a solution solely based on new constraints and heuristics may not be sufficient. Instead we should consider changes to the algorithm used by the planner to select, instantiate, and order actions. The modified algorithm should enable operations such as: re-ordering actions already in the plan, increasing or reducing action decomposition, changing or introducing causal chains of events, and dynamically introducing behavior-related constraints.

My plan to implement a modified planning algorithm arises from the need to treat choice as a first-class object at the core of the plan construction process. A mechanism that creates stories using established plan-based story generation algorithms and then evaluates them to select those that best meet specific personality constraints would likely be inefficient due to the potentially large search space that may need to be processed before a solution is found. In contrast, a mechanism that incorporates personality criteria in the form of choices made by characters as the story is being constructed could reduce the search space by limiting the set

of alternate versions of the story that must be considered.

Proposed Evaluation

I plan to implement and evaluate the proposed model in a digital game environment. The preliminary experimental design presented here has two main objectives: (1) Determine whether results from social psychology can be replicated in an interactive digital environment and (2) validate the claim that the resulting system generates interesting and coherent stories without increasing the level of effort on the author.

HYPOTHESIS 1: *Behavior observed in characters within a digital game environment elicits the perception of personality traits that are associated with such behavior.*

I will test this hypothesis using various story scenarios in a digital game. Scenarios will be designed to include characters that present specific behavior. Users will be asked to observe character behavior and complete a survey to indicate what they perceive to be personality traits of the characters.

HYPOTHESIS 2: *A plan-based narrative generation system that utilizes a computational model of personality can produce interesting and coherent stories without increasing the authorial burden.*

I will test this hypothesis using an ablation study. Multiple narrative generation use cases will be devised to evaluate discrete tasks. Users will be asked to complete the test cases with and without the use of the choice-based computational model of personality. The time it takes users to complete a test case will be measured to calculate effort.

Conclusion

The goal of this doctoral research is to develop an intelligent mechanism that enables the automatic generation of narrative that elicits the perception of distinct character personalities without the need for a labor-intensive manual process. My solution aims to develop a declarative approach, in which characters' properties and the story context are used to dynamically determine the set of actions that they perform. An essential property of such an approach would be its scalability and I will seek to demonstrate that my method will scale to complex domains and generalize to applications beyond simple test cases or academic story generators.

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