Narrative Affordance: Towards a model of the foreseeability and perceivability of story elements in an Interactive Narrative

Rogelio E. Cardona-Rivera
Digital Games Research Center
North Carolina State University
Campus Box 8206
Raleigh, NC 27695
recardon@ncsu.edu

ABSTRACT

This paper discusses a research direction which focuses on a framework intended to help solve the problem of user-interaction versus story coherency in interactive narratives. The framework revolves around a concept named "narrative affordance," which draws from work in visual psychology and human-computer interaction and involves a declarative notion of afforded actions and a model of perceivable actions by a user of an interactive narrative. The paper also discusses motivation for the importance of the work and a future research plan.

Categories and Subject Descriptors

I.2.8 [**Artificial Intelligence**]: Problem Solving, Control Methods, and Search—*Plan execution, formation, and generation*

General Terms

Design, Theory, Human Factors

Keywords

Interactive narrative, affordance, story coherency, user control, agency

1. INTRODUCTION

Interactive narratives are subject to a problem that other non-interactive media do not have to contend with: the problem of player intervention [1, 7]. Non-interactive media (e.g. movies, books) can be considered "passive" episodes that further the author's implicit or explicit goal of providing a memorable experience. Interactive mediums (e.g. interactive narratives, games), however, explicitly invite an external entity to take part in the experience, introducing a conflict between user-interaction and story coherency [7]. Techniques from automatic plan generation have successfully modeled the intentional structures of a story character's plans as well as the causal and temporal structures of a story's plotline [12]. However, because a user typically has partial knowledge of an unfolding narrative [13], her actions might inadvertently break the causal dependencies of a narrative plan, causing it to fail. If we were to restrict what the user could do, we could diminish the user's experience in the interactive narrative, because her perceived degree of control would be lessened [7]. In this work, I correlate the user's experience with the degree of agency the player feels within the interactive narrative, and we adopt the Wardrip-Fruin *et. al.* definition of agency as "a phenomenon that occurs when the actions players desire are among those they can take (and vice versa) as supported by an underlying computational model [11]." Succinctly, by restricting the user's freedom of choice within the interactive narrative system, we could potentially diminish the user's sense of agency.

I define narrative affordance to be the opportunity for a future story action, either immediate or delayed, presented by the game to the player. This research posits that narrative affordances are intricately linked to agency, and thus they merit consideration when attempting to maintain a user's sense of agency while they traverse through a author-specified coherent storyline. To that effect, it is desirable for a computer system to be able to explicitly account for affordances within interactive narratives. Thus far, affordance in relation to agency has been considered analytically [10][11], but no declarative computational model of affordance has been explored. Throughout the rest of this paper, I use "interactive narrative" and "game" interchangeably. My focus is on games with an underlying story; games that do not have an underlying story are outside of my research scope.

2. GOAL AND MOTIVATION

The goal of this research is to build a declarative computational model of affordance; one that focuses on the discourse of game-based narratives that invite user interaction with an unfolding storyline. My affordance model will be used in estimating what the player perceives will be future afforded actions within the narrative, based on what is being presented to her throughout the story. Once the affordance-

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aware game determines what actions the user perceives to be afforded, it can estimate the user's expectations of how she can participate in the game. In other words, the system will be able to account for what the user believes her role in the game is.

This research will impact future work on interactive narrative, especially efforts that seek to enhance user experience by balancing user control with narrative coherence. The motivation behind this work in particular, lies in better understanding the relationship between a human user and a dynamic virtual world — in this case, a computer game. If a game can readily identify what the player perceives her role to be, it can determine whether or not that perceived role is in harmony with what the author intended it to be or not. If the perceived role is not the intended one, the game can pursue corrective action. This research approaches the problem of user-control versus story coherency by modeling the user's perception of narrative affordances (future opportunities for action or control) to make sure they are in harmony with the author's story. The work will provide formal, computational models that inform several related disciplines, including digital media studies, cognitive science, and narrative theory. Narrative affordance can be used to create engaging, interactive stories by ensuring that an author's intended user experience is carried out. Whether the author desires to entertain or to teach, a notion of what the player expects from the game is crucial in making sure the game lives up to it.

2.1 Hypothesis

I hypothesize that the artificial intelligence formalism of Planning can be used to accurately model a player's perceived narrative affordances. In addition, I hypothesize that a story-focused affordance-aware narrative automated planner can be more effective at tweaking a game environment so that a perceived role matches an author-specified goal. Finally, I hypothesize that as a consequence of the matching between the perceived and author-specified roles, a user will feel an increased sense of agency.

3. PREVIOUS APPROACHES

The problem between user-interaction and story coherency can be interpreted in different ways. These interpretations lend themselves to different approaches for resolution, which are not necessarily mutually exclusive. It is useful to distinguish between them so as to identify unique paths to the same goal: a great interactive user experience with a coherent story. I distinguish the following approaches due to their relevance in my initial formalism of narrative affordance.

One approach to the problem is to allow the user to play through the game insofar as her gameplay does not threaten the story. *Mimesis* uses "proactive mediation" [13], which identifies potential conflicts and pre-caches possible modifications to a story-plan structure, to intervene when the user inadvertently acts against the story-plan. The drawback of this approach is that it is computationally expensive to pre-compute all possible modifications to plan structure.

Another approach uses a drama manager that exerts a *computational model of influence* (CI) to persuade players to make decisions that are consistent with the author's goals [8]. While the CI model could effectively steer the player in a particular direction, it assumes (at least) two things: 1) the player's play style is in harmony with the author's intent and 2) the player can readily identify what the author intends for the player to do.

A third approach to the problem interaction versus coherency focuses on agency itself. Mateas asserts that agency within a game happens when there is a balance between what the game allows a player to do and the context provided by the game that motivates action [3]. Wardrip-Fruin *et. al.* ask "how might one build an experience that provides materials for action?" [11] and posits that the model to follow for building such an experience lies in the requirements specification for Mateas and Stern's game Façade [4], which includes: believable computer-controlled characters capable of human-interpretable internal states and new approaches to natural language understanding.

An alternate perspective that discusses control versus coherency in games characterizes a player's play style and delivers content that the player finds relevant according to the player's desires [10]. The theoretical base for this approach lies in the Control Heuristic [9], which also focuses on agency. Thue *et. al.* derive that a player's sense of agency is maximized when four conditions within the narrative are satisfied for all events: *foreseeability*, *ability*, *desirability* and *connection* [10].

4. MY APPROACH

My narrative affordance model explicitly deals with the foreseeability of events that Thue *et. al.* discuss, and I adopt a plan-like formalism for story actions based on the *Mimesis* architecture. As mentioned, narrative affordance deals with opportunities for a future story action, either immediate or delayed, presented by the game to the player. Ideally, a player perceives narrative affordances exactly the way the game author intended, and the player effectively "acts out" the role the author cast. I envision that an affordance-aware game could react to detected role mismatches by tweaking the discourse until the user model of forward directed action matches with the author-specified experience. My approach is novel in that it combines cognitive models, AI planning and reactive discourse, along with the concept of "affordance", which has not been used in interactive narratives explicitly. Affordance is not a new concept, but rather has been studied from a variety of perspectives. The most relevant to my initial definition of narrative affordance are explained in the subsections that follow.

4.1 Gibson's Psychological Approach

Gibson's approach is centered around direct perception [2] a form of perception that does not require an actor to consciously think of how an object affords something; this is possible when there is information in the environment that uniquely alerts the actor of the affordance, and depends on the actor perceiving the alert. McGrenere and Ho note Gibson's three fundamental properties of an affordance [5]:

- An affordance exists relative to the action capabilities of a particular actor
- The existence of an affordance is independent of the actor's ability to perceive it
- An affordance does not change as the needs and goals of the actor change

4.2 Norman's HCI Approach

Whereas Gibson discusses an object's affordance independent of whether or not the actor perceives it, Norman proposes that designers of computing systems intended for human use should design for what is *perceived* to be possible, rather than what really is [6].

5. CURRENT PROGRESS

I have developed an initial formalism for narrative affordance. I distinguish three entities, originally identified by Norman [6]:

5.1 Real Affordance

Real affordances are narrative action opportunities that the game actually allows. I modify Gibson's view on real affordances being binary in the world; a game world either supports an action, or it does not.

Action $\boldsymbol{a}$ *is afforded in story* $\boldsymbol{N}$ *at time* $\boldsymbol{t}$ *just when:*

1. *All preconditions of* $\boldsymbol{a}$ *are obtained at* $\boldsymbol{t}$*.*

Note that this distinction is binary; either all preconditions hold or they do not. Also, a real affordance does not consider an actor's needs or goals.

5.2 Perceived Affordance

Perceived affordances are narrative action opportunities perceived by the player; they do not necessarily have to match with real affordances.

Action $\boldsymbol{b}$ *is perceived as afforded by player* $\boldsymbol{P}$ *in story* $\boldsymbol{N}$ *at time* $\boldsymbol{t}$ *just when:*

1. *For any precondition* $\boldsymbol{p}$ *that* $\boldsymbol{P}$ *believes is a precondition of* $\boldsymbol{b}$*,* $\boldsymbol{P}$ *believes that* $\boldsymbol{p}$ *holds at time* $\boldsymbol{t}$*.*
2. *Action* $\boldsymbol{b}$ *is an action within* $\boldsymbol{P}$*'s model of reasonable future actions and is consistent within the story context.*
3. $\boldsymbol{P}$ *can find some coherent and plausible narrative plan* $\boldsymbol{N'}$ *where:*
   (a) $\boldsymbol{N}$ *and* $\boldsymbol{N'}$ *share a common prefix leading up to* $\boldsymbol{t}$*.*
   (b) *Action* $\boldsymbol{b}$ *occurs at* $\boldsymbol{t}$ *in* $\boldsymbol{N'}$*.*
   (c) *Action* $\boldsymbol{b}$ *plays a causal role in* $\boldsymbol{N'}$ *after t.*

Perceived affordances depend on a player's belief. The perceived action must conform to what the player believes is a reasonable consistent future action. I define a user's model of reasonable consistent future action in the same way *Mimesis* defines a user's model of "reasonable outcomes" to a narrative plan [7].

5.3 Feedback

Feedback is what a designer uses to advertise a real affordance in the hopes of eliciting in a user the correct perceived affordance. Similarly, a game author must provide the right feedback to the player in order to evoke a sense of opportunities for action in the story. Feedback is tricky: it is possible to incorrectly advertise a real affordance and evoke a perceived affordance that is not really there.

6. RESEARCH PLAN

The research plan consists of four phases. Phase 1, which has been put into action already, involves developing a theoretical framework for narrative affordance. The initial formalism brings together several ideas and organizes them into a framework useful for computer scientists, but several things are missing. For example, cognitive science and narratology can help define how to structure feedback given how we comprehend narrative events and how we understand and play games. Phase 2 will involve empirically verifying whether the affordance model is accurate in its prediction of what the user expects the game experience will be. Phase 3 will involve encoding the model into an interactive narrative system; the system will account for story structure, the opportunity for interaction on the part of a human user and the structuring of the story line so as to provide feedback to prompt the right action at the right time. Phase 4 will finalize the research by recruiting human participants and gauging their sense of agency across a game. This will determine the degree to which an affordance planner helps evoke a feeling of participation relative to affordance-unaware systems. The affordance-aware planner is the final deliverable.

7. REFERENCES

[1] R. Aylett and S. Louchart. Towards a narrative theory of VR. In *Virtual Reality Journal*, 2003.

[2] J. J. Gibson. *The Ecological Approach to Visual Perception*. Houghton Mifflin, 1979.

[3] M. Mateas. A preliminary poetics for interactive drama and games. *Digital Creativity*, 12(3):140–152, 2001.

[4] M. Mateas and A. Stern. Façade: An experiment in building a fully-realized interactive drama. In *GDC - Game Design track*, 2003.

[5] J. McGrenere and W. Ho. Affordances: Clarifying and evolving a concept. In *Graphics Interface*, 2000.

[6] D. Norman. Affordance, conventions, and design. *Interactions*, 6(3):38–42, 1999.

[7] M. O. Riedl, C. Saretto, and R. M. Young. Managing interactions between users and agents in a multi-agent storytelling environment. In *AAMAS*, 2003.

[8] D. Roberts, C. Isbell, M. O. Riedl, and et. al. On the use of computational models of influence for interactive virtual experience management. In *ICIDS*, 2008.

[9] S. C. Thompson, C. Thomas, and W. Armstrong. Illusions of control, underestimations, and accuracy: A control heuristic explanation. *Psychological Bulletin*, 123(2):143–161, 1998.

[10] D. Thue, V. Bulitko, M. Spetch, and et. al. Player agency and the relevance of decisions. In *ICIDS*, 2010.

[11] N. Wardrip-Fruin, M. Mateas, S. Dow, and S. Sali. Agency reconsidered. In *DiGRA*, 2009.

[12] R. M. Young. Notes on the use of plan structures in the creation of interactive plot. In *The Working Notes of the AAAI Fall Symposium on Narrative Intelligence*, 2001.

[13] R. M. Young and J. Harris. Proactive mediation in plan-based narrative environments. In *IEEE Transactions on Computational Intelligence and AI in Games*, volume 1, pages 233–244, 2009.