

Requirements for Computational Models of Interactive Narrative

Nicolas Szilas

TECFA-FPSE
University of Geneva
CH 1221 Genève 4
SWITZERLAND
Nicolas.Szilas@unige.ch

Abstract

The aim of this paper is to revisit the fundamental requirements for building computational models for Interactive Narrative. We express the need for broader computational models of narrative and underline the fundamental difference between models for story generation and models for Interactive Narrative. Research directions are finally sketched to move towards dedicated computational models for Interactive Narrative.

Introduction

Pioneer academic work in Interactive Narrative emerged independently during the 1990's from various domains: virtual agents (Loyall and Bates 1991), Human Computer Interaction (Laurel 1993), computational linguistics (Young 1999), Artificial Intelligence (Sgouros 1999), video games (Szilas 1999). These researches aimed at combining the linear tradition of narrative with interactivity that is specific to computers. Combining interactivity and narrative is particularly relevant if one needs to produce a narrative where the user plays a main character and significantly influences the course of events in the story. Regularly, game industry claims that a particular game enables the player to really change the story (*Blade Runner* in 1998, *Black & White* in 2001, *Fable* in 2004, *Heavy Rains* in 2010), however, this change is finally limited and the player is disappointed in that respect. For example, *Fable* claims "Never Play the Same Game Twice - Once you finish your adventure, go back and try the experience again, forging your character and thereby a new tale with unexpected twists and turns, new skills, powers, influences, allies and enemies" (Fable, 2010). However a critic says: "Fable's storyline [...] is mostly linear [...] all the moral decisions you've made have little effect on what happens or how it happens."

(Kasavin, 2004). Our goal is not to criticize these games that are truly successful interactive storytelling and gaming experiences, but to point out that one of the main purposes of Interactive Narrative researches has been shared by the video game industry for years. It appears that there is no simple solution to the problem of interactive narrative, that is, a solution based on graphs and limited scripting. With the notable exception of Chris Crawford (Crawford 1999; Storytron 2010), Interactive Narrative researches have remained in the realm of academic research since it requires advanced algorithmic research, mostly in Artificial Intelligence. More precisely, we need complex solutions involving narrative events generation based on generic narrative data to accommodate with the player's action during the interactive narrative experience. In other words, Interactive Narrative requires computational models of narrative.

Research on Interactive Narrative then meets previous research on story generation, which can be traced back to 1970's (Klein et al. 1976). These systems (see (Gervas 2009) for a concise and recent overview) aim at generating a multitude of original stories based on an existing narrative material taken as input. In current academic venues of Interactive Narrative, for example, the European series of ICIDS conferences (previously TIDSE and ICVS), a large portion of papers are in fact dedicated to story generation, leaving interactivity on the side or for a future extension/adaptation. In this paper, the author wants to raise the following questions:

- What are the exact requirements for computational models suitable for Interactive Narrative?
- Are these requirements similar to those for story generation?

Levels of Interaction and Granularity of Computational Models

As explained above, the need for narrative computational models in Interactive Narrative stems from the need to generate actions according to the users' participation. Yet, narrative models used in interactive storytelling systems vary greatly: affective and cognitive models of agents (Aylett et al. 2005), partially ordered plot points (Weyrauch 1997), character-based planning (Cavazza 2001), goal-based structural models and user perception modeling (Szilas 1999; Szilas 2007), reactive character models and partial ordering of scenes (Stern and Mateas 2003), story goal-based planning (Young 1999; Young et al. 2004), dilemma-based planning (Barber and Kudenko 2008), suspense modeling (Cheong and Young 2008), etc. It is not easy to compare these models because they do not necessarily provide the same mode and level of interactivity. For example, in *Façade*, a successful Interactive Drama in terms of playability, story and user engagement does not provide significant long term influence on the story events (Mateas and Stern 2005). On the contrary, *Mimesis*, which computes this influence in terms of complex plan's management techniques, does not seem to provide large scale examples in terms of global story and user's choice. Each system has its particularities and preferred domain of applications. If one considers that the ultimate goal is to have the user the main character of the story, which still constitutes the old and ambitious goal of Interactive Drama (Loyall and bates 1991; Weyrauch 1997; Crawford 1999; Szilas 1999; Young 1999), it means that each of the user's actions has to be fully interpreted by the computer so as to generate the rest of actions and events in the story. This means that we need a model that is able to:

- Generate individual actions and events from a large space of possible actions to fit with the large choice of actions that one desires to provide to the user. Given the size of this space, author-defined specific actions are of limited usage in this context.
- Compute the narrative experience quality of each possible action so that the system can choose the best action according to this measure because it is not possible to rely on the author to define the quality of each specific sequence of actions.

These requirements are hard requirements since a full model of narrative is needed, not just a model that captures one or two features of what a narrative is. Although the building of this model could make use of stastical methods based on a corpus of stories (Chambers & Jurafsky, 2009), we will not investigate this option further in this paper, because such a corpus is difficult to obtain, especially in the case of interactive narratives (see last section).

An explicit full model of narrative is going to be outlined in the following parts. It will remain at a general level since each narrative theory provides its own viewpoint of

what is considered as essential in narrative, which is not easily compatible with the other theories. In other words, there is no universal narrative theory, but a significant amount of work that gives us a good insight of each necessary trait of the required full model of narrative for Interactive Narrative.

1. Genericity: To ensure the large space of possible action mentioned above, going beyond a large space of combination of predefined actions (as in (Weyrauch 1997)), actions must be defined in a generic manner, with variable that can be instantiated among several specific objects in the computational fictional world. Typically, a predicate-based formalism enables this level of genericity. Higher order predicates (Witzel, Zvesper, and Kennerly 2008; Szilas 2007) increases the level of genericity.

2. Causality: These actions must be arranged in a causal manner, as causality is one of the main characteristics of narrative. Defining the type of causality that exists in narrative should be far from straightforward. Causality of characters' own plans, causality of actions between characters and between character and story events, causality of the discourse (Genette 1972) are all valid forms of causality that a computational model of narrative for Interactive Narrative will implement. It is certainly the case that multiple forms of causality intervene in a single narrative, therefore, it is necessary to investigate further what is narrative, which cannot be reduced to a mere causal chain of events.

3. Characters: These actions involve characters. This obvious feature should be reminded because characters are not only (by definition) the subject of actions, but also the focus of the audience's attention and interest. Therefore, a full model of narrative should ensure that main characters be perceived as rich and complex entities and be able to promote empathetic viewing.

4. Transformation: A narrative must concern a transformation (Adam 1994). To achieve a goal, for example, is a transformation that goes through from an initial state in which the goal is not reached to the final state where the goal is reached.

5. Unity of action: In a traditional narrative, all actions are organized around a single line of action, which is called the unity of action (Adam 1994). In modern narrative, this principle is accommodated to take into account episodic forms and subplots. However, for the sake of story understanding and cohesion, the number of lines of action should be limited and controlled.

6. Narrative Sequence: Main actions in a narrative are usually spread in a sequence that consists of the initial information on the possibility to perform an action, the influence regarding the performance, the performance itself, and the final sanction (Greimas 1970; Todorov 1970; Bremond 1973).

7. Message: Going beyond the story/fabula level, narrative should also be taken into consideration from its pragmatics point of view, that is, at the discourse level. Each narrative contains a general intention/message that it aims to convey to its audience (Barthes 1979; Adam 1994). It is typically

contained within the handling of a system of values according to which story events are explicitly or implicitly evaluated (Hamon 1984; Adam 1994; Jouve 2001).

8. Emotional involvement: This is also a key dimension to make a narrative successful. Triggering audience's emotions are not only an enjoyable feature of the narrative, but also a necessary condition for story understanding (Carroll 2001).

This flat list of requirements for the computational model of Interactive Narrative is not meant to constitute the definitive features for such a model, but to show that these requirements are numerous and complex. This is a consequence of managing computational narrative at the level of actions. Do existing systems meet those requirements? Yes, but only partially.

Character-based planning systems do meet the first five traits, but not the last three ones. As a consequence, there is a high risk of obtaining uninteresting stories.

Typical narrative actions that constitute the narrative sequence have been implemented in Defacto (Sgouros 1999), Storytron (2010) and IDtension (Szilas 2007). In other systems, it is the author who defines these actions, which makes it difficult for the engine to reason on these typical actions.

The narrative's message is rarely considered in Interactive Storytelling except for Defacto, with the concept of *norms* (Sgouros 1999) and IDtension, with the concept of *ethical values* (Szilas 2007).

Emotional involvement is tackled indirectly when modeling conflicts in narrative as in (Szilas 2007; Barber and Kudenko 2008). In these systems, promoting conflicting situation is motivated by the need of creating emotions in the user. The concept of a model of the user to drive a story generation algorithm has also been proposed by Bailey (1999). In (Louchart and Aylett 2007), actions are chosen to maximize the emotional impact on other characters, assuming that this will have an impact on the user. Researches on computational models of suspense (Cheong and Young 2008) typically aims at adding additional constraints in the calculus of actions so as to maximize emotional impact.

IDtension has attempted to include all these eight traits, but the emotional involvement is only carried out by the conflict management, which appears to be not sufficient. Furthermore, causality is only partial as some actions are triggered without being part of a long term strategy.

The temporary conclusion is that in order to enable the user to fully influence the story, a highly complex computational model of narrative is needed. So far, existing systems have only tackled parts of this hypothetical model.

Why Interactive Narrative differs from Story Generation?

In the previous section, we have assumed that, as long as they were relevant from the computational point of view, narrative models of linear narrative were applicable to

Interactive Narrative. In other words, we have assumed that in order to produce an interactive narrative experience it was necessary and sufficient to produce an interactive experience in which fictional events would constitute a well formed narrative, as described by classical narrative theories. However, this assumption needs to be questioned. Experiencing a narrative as one of its main characters (Interactive Narrative case) is different from observing a narrative as an audience. In the former case, acting as a character involves the user directly, as he is asked to make choices and he observes not only narrative events but also events he has provoked. Depending on his choice and its consequences, the user might experience feelings like hope, pride, disappointment, frustration, etc. The motivation of such interaction is related to these emotional effects as well as other factors such as challenge, as described in games (Malone and Lepper 1987) or agency (Murray 1997). Linear narrative also generates emotions to the user, but differently, notably indirectly via the empathy for fictional characters. Literature on emotions and films has shown that although similar to emotions in real life, filmic emotions are of different nature (Carroll 2001). The passive position of the viewer who sees actions happening but cannot intervene on them is even what creates a specific tension that is inherent to linear narrative (Tan 1996).

To fully understand the difference between the acted story and the observed story, it is worth considering the case of tabletop role-playing games, which constitute a typical example of non digital interactive narrative. In these games, while the player might feel a strong narrative experience, an external observer of the playing session has a totally different experience, usually rather boring, from a narrative point of view.

Consequently, equating the quality of an interactive narrative to that of the list of events that are produced during the experience is certainly wrong. The role playing game example above clearly illustrates that a perfectly valuable interactive narrative does not necessarily produce, as a linear output, a valuable story. We have thus shown that any computational model of narrative used for story generation, and in particular the hypothetical ideal model for Interactive Narrative sketched in the previous section is not necessary (in the logical sense) for the purpose of Interactive Narrative. As Aylett and Louchart put it: "One must move from narratology to psychology and consider not the narrative artifact but the process through which the user engages with it and internalizes it as a narrative experience" (Aylett and Louchart 2007).

Many computational models for Interactive Narrative proposed so far have been tested in the case of story generation, with the assumption that if one is able to generate a story dynamically, the same algorithm could be employed with the user who, as an "influencing force", would create a specific variant of the story recalculated by the story generation algorithm (Szilas 2003; Young et al. 2004; Barber and Kudenko 2008). Should we reject these approaches, given our current line of argumentation that

Interactive Narrative and linear narrative are fundamentally different? To answer this question, we need to know how different a computational model really dedicated to Interactive Narrative would be, compared with the computational models that have been developed so far, mostly inspired by linear narratives.

Exploring Existing Forms of Interactive Narrative.

As Interactive Narrative on computer is still a form that is under construction, corresponding narrative models need to be spotted in existing narrative practices. There exists a range of non digital interactive narrative practices that might be valuable sources of inspiration for building computational models of Interactive Narratives: role-playing games, improvisational theater, participative theater, oral storytelling, etc. (Louchart and Aylett 2006). However, starting from these narrative forms raises two main difficulties:

- There is very limited theoretical investigations on these forms. Despite some recent works in this direction (Louchart and Aylett 2003; Medler and Magerko 2009), knowledge on these forms is much more limited than knowledge on linear narrative.
- These forms involve a social activity between the audience/user and one or more other person: the game master, the improvisation player, the theater player, the storyteller, etc. This person, let us call him the "teller", is responsible in part of the narrative quality of the experience. Since narrative is considered as a process rather than as an artifact in these forms (Aylett and Louchart 2003), they are far more difficult to analyze because no "text" is available as an objective trace of the narrative experience. Modeling the reasoning of the teller is a great challenge for AI since it is one of the most complex human behavior that sometimes requires years of training.

These forms have inspired the design of theoretical and concrete architectures and computational models for Interactive Storytelling (Aylett and Louchart 2003; Szilas 2005; Swartjes and Vromen 2007). However, it would be an exaggerated claim to state that the corresponding systems (Aylett et al. 2005; Swartjes and Theune 2008) are based on a fully described computational model of interactive narratives, as these systems are at first based on the principle of narrative emergence (Aylett 1999). Narrative emergence consists in "letting go" the narrative according to local character-based (or more recently actor-based (Louchart and Aylett 2007)) rules, in order that the narrative *emerges* from these local rules, rather than being described by an explicit computational model. Emergence does not offer a solution to the difficulty of combining narrative and interactivity (described in Introduction) because conditions for emergence are not known, nor do

we have clue of how such conditions could be found theoretically (contrary to other emergence phenomena, that has been theoretically proven, such as some models of Neural Networks). Emergence should rather be understood as an empirical approach of the domain, which consists of an experimental investigation of the conditions of emergence. Based on hints rather than on models, these hints being found in existing forms of non digital interactive narrative forms (Louchart and Aylett 2006), systems are developed and tested, in search for the materialization of emergent narrative phenomena.

At the end of the previous section, we have raised the question of the difference between a computational model really dedicated to Interactive Narrative and a computational model based on linear narrative adapted to the requirement of interactivity (described above). Finally, one has to conclude that a computational model "really dedicated to Interactive Narrative" does not exist (emergence being an research approach rather than a model). Furthermore, if we worked towards the establishment of such a model, for example, based on research on role playing games, we would be faced with the following issue: how to adapt a model that concerns a human to human activity, to a case where a human (the user) is interacting with an artifact (the interactive narrative system)? Do we expect the user to feel the same, between a situation in which he is interacting with other people (other players and a game master in role-playing games, other actors in improvisational theater, a storyteller in a tale storytelling session, etc.) and a situation in which he is only facing the computer? The answer is certainly negative. Therefore, one needs to accept the following situation: one cannot fully rely on an existing narrative activity to build the corresponding computational narrative model suitable for Interactive Narrative. And this is certainly a second paradox of Interactive Narrative: one would need a computational model of narrative to drive actions and events according to user's actions, but the activity of reference from which one would attempt to build the model does not exist... until a system supposedly based on such a model is build!

Leaving aside the pure emergence approach that constitutes an answer "by avoidance" to this second paradox (forget about the full model, build a system based on a few principles, and let it go), the following and last section will investigate how search of computational models for Interactive Narrative could still be conducted.

Towards a Computational Model of Interactive Narrative

Interactive Narrative is concerned with the experience of *living* a story, rather than simply *seeing* it. Although we have claimed above that the two experiences are different, they are not totally decorrelated. Thus, the ideal model set as a requirement for Interactive Narrative described in the Section "Levels of Interaction and Granularity of Computational Models" should not be totally discarded,

but considered as a first approximation of a dedicated model. If we follow this hypothesis, a research question would arise: "What should be added and discarded to this model to fit the specific need of Interactive Narrative?". This question is related to the fundamental question: "What does it mean, for the user, to interact with a narrative?". In a more concrete manner, it would be worth exploring two kinds of cases:

- Interactive positive cases: cases when narrative events seem valuable in an interactive narrative, yet contradict or are not covered by "linear narrative laws".
- Linear negative cases: cases when narrative events that are valuable according to "linear narrative laws" seem not relevant in an interactive situation.

This section does not perform a systematic exploration of these cases, but only provides some examples found in the literature or in our own experience. At the end of the Section, research directions will be given to lead to a more systematical exploration of these cases.

A first example of an interactive positive case is given by P. Weyrauch (1997). Within the list of relevant criteria for evaluating the quality of an interactive drama, he defines *manipulation* as the measure of how much the user might feel manipulated when an event is triggered to attract him in one direction rather than in another. For example, two actions –music is being played in a room; someone calls the user from that room– are possible in the story, but the former is better than the latter, because it attracts less visibly the user. From the linear narrative point of view, the two actions are similar, but from an interactive point of view, one is better than the other. A similar phenomenon is observed in the Mimesis system, based on narrative planning. In this context, *intervention* that consists of, for example, hindering the user to shoot his target in order to maintain the storyline, is clearly less valuable than *accommodation* that consists in adding/suppressing a non player character's action for the same goal of maintaining the storyline (Riedl, Saretto, and Young 2003).

At a general level, Marie-Laure Ryan provides an example of a linear negative case (Ryan 2001). She takes the example of a classical tragedy *Anna Karenina*, and simply observes that if the user were to play Anna Karenina, he would not want to behave the way she behaves and finally cause the death of his character. Pure tragedy, while consisting a perfect example of linear narrative, does not fit with the interactive context, because the user would not want to be more or less forced to go into such a tragic solution.

Finally, from our own experience in building and using an Interactive Narrative System (Szilas 2007), while authoring and testing interactive narrative scenarios, we could observe the following linear negative case. We naturally implemented some narrative functions because they are part of the typical narrative sequence, typically the *influences* (encourage/dissuade). However, these narrative functions would not attract the user who prefers

performative actions rather than dialogical actions. Similarly, it seems that simple transmission of information such as "I could not open the door" is less preferred than "Could you help me to open this door?". Both actions are possible within the system, but the "asking for help" action would not be offered as often. The engine had to be modified accordingly.

Besides these few examples, we believe that an efficient way to capture a more significant corpus of such cases would be to design "Wizard of Oz" kind of experimental protocol in which the user would interact with a system, believing it is only a computer-based system, but with a human intelligence behind. Beside an early experiment from the Oz Project (Kelso, Weyhrauch, and Bates 1992), we are not aware of such investigation. Such experimental protocol would be an efficient way to test hypothesis with limited cost (without having to implement the corresponding computational model), and would help to understand better the player's "interactive narrative psychology". From this understanding, an optimal computational model of Interactive Narrative could be derived.

Conclusion

From a careful examination of the requirements for *highly* Interactive Narrative, a computer-based narrative form in which the user can fully influence the story as one of the main characters, we came to the conclusion that existing computation models of narrative need to be improved in two directions:

- A broad model of narrative is needed, in addition to the simple chain of causal events. In particular, the way the user receives the narrative (emotionally, pragmatically) needs to be integrated.
- This model must also be reorientated to take into account the fact that a story lived by the user from the inside, as an active participant, is different from a story observed by an audience.

This later direction puts Interactive Narrative research in a challenging position. "Traditional" computational models of narrative can take the corpus of existing narratives as the object of reference. But the dedicated computational models of Interactive Narrative that we are searching for needs to be built simultaneously to concrete examples of interactive narratives. This co-creation of the computational model and the system that implements it is explained by the nature of the research on Interactive Narrative: It is finally a design-oriented research in which scientists and artists seek to create innovative participative narrative forms, based on the unique potentialities of the computer.

Acknowledgement

This work has been funded (in part) by the European

Commission under grant agreement IRIS (FP7-ICT-231824).

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