Interactive Drama in Real and Virtual Worlds

Ruth Aylett, MACS, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, UK. E-mail: r.s.aylett@hw.ac.uk

Abstract

How do we resolve the paradox of computer-supported interactive drama – that the human participant requires the very freedom to interact that the authored narrative structure denies them? This paper reports work around the concept of Emergent Narrative – the development of narrative structure through interaction itself. We cover both systems using a virtual world and those using a virtually-augmented real world, exploring how far reworking narrative structure as a loop between the causal (plot) and affective (character) can produce engaging experiences for participants. We discuss the key role of a cognitive-affective architecture for characters and the process of cognitive appraisal as an engine for both in-character and in-role dramatic action.

Keywords: Augmented Reality, Emergent Narrative, Interactivity, Holodeck, Synthetic Characters, Affective Architectures

Introduction

Story is of central importance in human culture and society as well as in the individual's sense of self. Theoretical discussion of story goes back in the west to Aristotle, and has also been the subject of extensive work in psychology (especially around autobiographic memory), drama (Improv and interactive theatre), film and television, education and training (role-play, experiential learning) and art and digital-media (interactive installations). As a distinctively human activity, it was also an early topic in Artificial Intelligence research, beginning with work on story-grammars in the 1970s [1], aimed at the non-interactive generation of text-based stories. For example, Meehan's TALESPIN [2] used character goals and planning to produce very short fable-like stories.

The advent of multi-media systems and then Virtual Reality – immersive real-time interactive graphic environments – in the 1990s, created a new vision of a dramatic 'holodeck'-like experience [3, 4] or virtual theatre [5]. Here a highly-immersed user could act as a character interacting with other artificial characters in a graphical narrative experience qualitatively different from existing media – whether novels, theatre or film. With the advent of mobile technology and augmented reality, this vision extended into interactive dramatic or narrative experiences in which the real world would also be a component [6, 7].

A fundamental challenge in realising this vision is how to resolve the clash between the interactive freedom expected by the user in such environments and an authorial demand for guaranteed narrative structure. On the one hand, interactive freedom is a defining characteristic of virtual environments, with users now able to participate actively in shaping a narrative process as characters within it, rather than as the passive spectators of a narrative artefact. On the other, the demand for a satisfying and coherent narrative structure has classically required authorial creation that predetermines the actions of the characters in a narrative. We have called this the *narrative paradox* [8]. It can be recast as a conflict between plot and character since a user actively participating in an interactive narrative can be thought of as a character whose actions need not be those selected by a prior plot.

Computer games often avoid this problem altogether by using non-interactive 'cut' scenes for narrative content, isolating the substance of the narrative from the interaction of the gameplay. Less commonly, pre-authored branching structures have been applied, allowing the user a limited degree of interactive freedom by offering a controlled set of choices the author can anticipate, an approach first conceived in children's book form as 'Choose Your Own Adventure' [9]. However this illusion of interactive freedom [10] soon becomes obvious to the user as a mechanism for forcing them back into the pre-authored plot, alienating them from their own creative potential in the story-world.

Generating Structure

While modern theory has attacked the dominance of the authorial perspective ('the death of the author' [11]) it has retained the view of story-as-artefact in its focus on 'the text'. The spectator is allocated a more active role in conceptualising and internalising the narrative experience (a process we have referred to as 'storification' – [12]), but this does not encompass the co-creator role needed to support interactivity. We argue that co-creation requires us to abandon the idea of story-as-artefact for a dynamic process in which 'a story' becomes a specific traversal of a landscape of many possible narratives.

What then becomes of narrative structure? Here we turn to the concept of emergence, in which structure is dynamically generated by interaction between entities without being ascribable to any one of them. Goldstein [13] defines emergence as: "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems". A characteristic of emergence is that these structures, patterns or properties cannot be directly attributed to the individual entities within the complex system. The system is defined by the set of entities and their initial configuration, and by the interaction rules that drive it. However knowing these does not mean one can predict what structure will emerge – the system must actually run to determine this. Very different structures may emerge from the same entities and interaction rules just by varying the initial configuration.

Weather patterns are a good example of emergence in the natural world, but similar ideas have also been applied within the social sciences, for example to the development of human social organisations [14].

A well-known computational example is Conway's *Game of Life* [15] in which a small set of simple rules about survival or not in the next round are attached to cellular automata (CAs) which can be visualised as white squares on a black grid. The rules concern how many neighbouring CAs an entity has, thus modelling a simple form of interaction. Exploration of the outcomes of various initial configurations has revealed that a number of them generate coherent patterns, some static, and some moving across the grid. Figure 1 shows an initial configuration that produces an oscillation between two patterns after step 6.

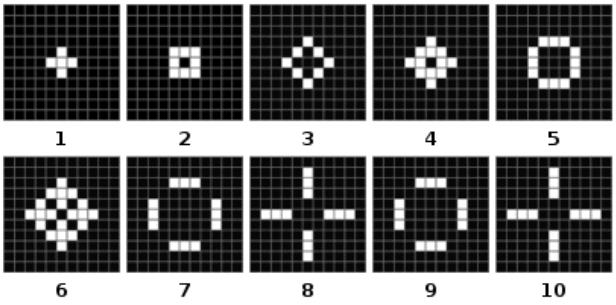

Figure 1: Game of Life, producing an oscillator

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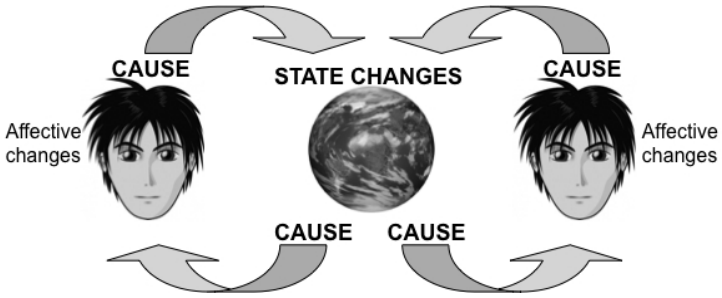

Figure 2: Narrative as a loop between affective and causal change

Emergent Narrative

Narrative may seem far from the *Game of Life*. However, defining the required entities as characters and the interaction rules as a control architecture for each character that takes percepts of other characters and generates responding actions, gives the same type of system. This produces a character-based rather than a plot-based view of narrative and raises the issue of affective impact as a principle of narrative interaction.

Forster [16] argued that 'the king died and then the queen died' is only a sequence of events, while 'the king died and then the queen died of grief' is a plot because it includes a causal link between the events. Significantly, it highlights an affective change in one of the characters. Many narrative formalisms have omitted character affective state altogether, focusing on external causal structure [17, 18]. However we can view the unfolding of a dynamically-generated story as an iteration between events in the world and affective changes characters that are both responses to events and causes of them [19], as in Figure 2. Causal chains that contain no affective impact upon characters are arguably more like the problem-solving of adventure games than narrative, while affective change in characters with no causal impact on the world are more like social environments than narrative.

The computational consequence is that the character control architecture must be an affective one. Rather than invent such an architecture from scratch, it seems more sensible to start from an appropriate psychological theory. One used since the early 1990s [20] for such architectures is Cognitive Appraisal, and in particular that articulated in [21], often referred to as OCC after its authors, Ortony, Clore and Collins. Cognitive Appraisal theory asserts that we do not act as pure observers of events around us but always evaluate them with respect to our own goals. Events congruent with our goals generate positive emotions; those frustrating our goals generate negative emotions. The attraction of OCC computationally was that it proposed a taxonomy of event types and resulting emotions that is straightforward to encode in executable rules [22].

While OCC can be used to deal with the percept part of the architecture, we still require a link between the generated affective state and the action that the character will take as a result of it. This provided by Coping Theory [23], asserting that we cope with our emotions in one of two ways. Problem-focused coping produces actions in the world, while emotion-based coping results in internal changes to beliefs and goals. Say you are confronted in the street by a stranger who shouts at you. This will probably generate anger and fear. With problem-focused coping, anger might lead you to shout back. On the other hand, fear might lead you to walk away quickly. Emotion-based coping might lead you to control the anger or fear and take no notice.

Hope and fear are particularly interesting as motivators for character actions since these are defined by OCC as relating to future events. When we plan actions, these precisely relate to the future, and so hope and fear support the integration of AI planning capabilities in characters [24], generating sequences of actions for long-term goals, not just instant emotional reactions. While hope and fear allow a character to assess its planned actions against its own goals, cognitive appraisal is in fact even more versatile than this. *Any* action a character is considering can be fed into its cognitive appraisal system as if it was an event that had already happened. This allows an estimate of what its emotional impact might be on other characters – at least 'if they are like me'. If we take emotional impact as a surrogate for dramatic impact, this gives the character a capacity of human actors – to decide how to create drama around it [25].

Example systems

We have brought these ideas together over an extended period in an architecture called FAtiMA [26] (freely available on sourceforge: http://sourceforge.net/projects/fatima-modular/) with which we have built a series of emergent narrative systems of increasing complexity. We will briefly describe each and the lessons learned for applying the concept of emergent narrative.

The first and least complex of these was *FearNot!* [27] a system using virtual drama to educate 9-11 year-old children against bullying. It was an episodic story running on a desktop computer in which characters in a virtual school were involved in a variety of bullying incidents. Interaction was based on the Forum Theatre concept [28] in which the child user acted as the 'invisible friend' of a victimised character. The idea was that by advising the character between dramatic episodes, the child would identify empathically with their situation and internalise the social dynamics of the episodes (there is no magic wand solution to bullying). Figure 3 shows screen shots. We did not want the child to interact directly within the virtual school, partly because some participants were themselves victims of real-world bullying, and partly because they would not be subject to the same constraints as the virtual characters. A virtual push would not really make them fall over, and since the virtual bully could do them no real harm, we feared that learning would not transfer to the real world. From the per-

Figure 3: *FearNot!* Left – screen shot; Right – Victim asks for advice from user

Figure 4: *ORIENT*. Left - the story-world; Right – interaction

spective of emergent narrative, this also allowed us to test the idea in a reasonably small-scale and tractable setting. A number of lessors were learned.

The first lesson was that an emergent narrative requires a great deal of content compared to a linear story. If we think of a linear story as one pre-determined traversal of the space of possible stores, then by definition, only the characters, props and world scenery actually relevant to the actions in it are needed. Once the traversal is not pre-determined, then the materials for many traversals must be supplied. Not for nothing are game-masters in table-top role-play games supplied with a volume – or several – of story-world materials. In *FearNot!* we created such material for 44 episodes and more would have been desirable.

The second lesson was that in an episodic narrative, the initial conditions must be set up for each episode with great care. Remember that emergent structure is very sensitive to initial conditions, which in this case consist of the characters present in the scene; their goals and affective state; their memory of past events; the props available for use in the selected location. We added a Story Facilitator (SF) agent [29] to the architecture, whose task was to select a location, a set of characters and their goals. This was related to the advice of the child user. If they told the victim they should 'hit the bully back' the SF would set up a scene in which the bully confronted the victim. If the advice was to 'make a new friend', the SF would set up a scene in which there was a character the victim could approach. The memory and affective state of characters were continuous through episodes. This meant that if the victim had already tried hitting back and failed, it would be too scared to try it again. While the SF did not control actions within an episode, it shaped the story at a more abstract level, much as a role-play facilitator typically will in real-world role-play.

Finally, since actions in an episode emerged from character interaction, the system had to be run in order to see what happened. On the plus side, this avoided a combinatorial explosion between the history of the character and the user's advice, which was entered as free text. On the minus side, there was no obvious end to an episode other than the characters running out of interactions or getting into a repetitive loop. The SF was therefore allowed to close an episode once bullying and a reaction to it had occurred.

The challenge of interactivity

The development of new low-cost interactive hardware and in particular hand-held devices such as smart phones opens up new possibilities for interactive narrative. After *FearNot!* we made use of these technologies in two new systems: *ORIENT* [30] – see Figure 4 - and *Traveller* [31] – see Figure 5, which at time of writing is still under development. Both are aimed at developing inter-cultural sensitivity and empathy by putting the user into direct interaction with characters from other cultures. Both put the user into a physical space in front of a projected virtual world and allow interaction with almost life-size characters. Unlike *FearNot!*, the user is now operating within the story-world as a character. Like *FearNot!*, in both cases the story can be thought of as episodic, but rather than each being set up by the SF, an episode relates to a story-world location and is set up by the user moving between them.

A desktop system can take user input from a keyboard, but systems like *ORIENT* and *Traveller* in which users carry out role-play in physical space would ideally be based on natural language interaction between user and character. However while text-to-speech is now able to produce quite natural speech output, speech recognition is still not robust enough to pick up more than a small set of key phrases. We have therefore focused on gesture as an interaction modality, exploiting the physicality of movement in real space.

In *ORIENT*, the characters are aliens in a world threatened by disaster and it is easy to define them as having a substantially gesture-based language. At the time *ORIENT* was developed, the WiiMote had just been released and was used by one of a group of three users (collectively role-playing a Space Patrol team) to produce appropriate gestures. Training users in a set of gestures proved harder than expected and far too much cognitive effort had to be put into the interaction mechanism at the expense of focus on the story.

By the time *Traveller* was developed, the Kinect was widely available, and to make interaction less demanding [32], the gestures for possible user actions

Figure 5: *Traveller*. Left – screen shot showing interaction prompts; Right - Interaction

were displayed on the screen using a Kinect skeleton, as seen above in Figure 5. This removes the need for user training, though some gestures are easier than others for the Kinect to correctly recognise and taller users seem to register better than shorter ones, probably due to limb length.

In both cases the interaction modality is independent of the underlying story mechanism, which is still driven by the affective state of the characters. In the case of Traveller, the architecture has been extended once more to support a parametrised set of cultural features derived from the work of Hofstede [33]. Using these features, characters will display negative emotional behaviour if the user commits social blunders, for example if the user fails to recognise power hierarchy in a hierarchical society or social decision making in a collectivist one. The affective architecture means that there is a direct link between the cognitive appraisal of events carried out by the characters and the appropriate expressive behaviour, and the use of emergent narrative means that the many possible stories do not have to be explicitly programmed.

The future

How far are we from the visions outlined at the start of this paper? Many researchers, ourselves included, have retreated from the idea of 'the Holodeck' in which users would experience a story within an immersive graphical system. The growth of pervasive games [34] in which the story is taken out into the real world of the user allows us to finesse the problems of mobility in virtual environments and interaction purely with virtual characters and without the advantages of natural language. An augmented reality approach can supplement story with the physicality of the real world and the full bandwidth interaction of other humans with each other, using virtual characters and other scaffolding for an engaging interactive narrative experience. We have called this Intelligent Computer-Assisted Role-Play (iCARP) [35] and see it as an exciting agenda for future research.

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References and Notes

1. J.B. Black & R. Wilensky. "An evaluation of story grammars". *Cognitive Science*, **3**, 1979. pp. 213-230.

2. James Meehan. "TALE-SPIN", in: R. C. Shank & C.K. Riesbeck. (eds.), *Inside Computer Understanding: Five Programs plus Miniatures*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1981

3. J. Bates. "Virtual reality, art, and entertainment". *Presence: The Journal of Teleoperators and Virtual Environments* **1** no.1, 1992, pp.133-138.

4. J. Murray. *Hamlet on the Holodeck*. Cambridge, MA: MIT Press, 1998.

5. Barbara Hayes-Roth, R. van Gent, & D. Huber. "Acting in Character", in R. Trappl and P. Petta (eds.) *Creating Personalities for Synthetic Actors*. Springer, 1997.

6. S. Benford, A. Crabtree, R. Reeves, M. Flintham, A. Drozd, J.G. Sheridan, & A. Dix. "The frame of the game: blurring the boundary between fiction and reality in mobile experiences", Proc. *CHI '06*, pp.427-436, 2006, ACM.

7. M.L.Lim, R.S. Aylett, S. Enz, M.Kriegel, N.Vannini,N, L.Hall and S. Jones. "Towards Intelligent Computer Assisted Educational Role-Play", Proc. 4th Int. Conf. on E-Learning and Games, pp. 208-219, Banff, Canada, August 9-11, 2009, Springer.

8. R.S.Aylett. "Narrative in virtual environments – towards emergent narrative"; Proc. AAAI Symposium on Narrative Intelligence. pp 83-86, AAAI Press. 1999

9. Choose Your Own Adventure official website: http://www.cyoa.com accessed 5/6/2013..

10. M.L.Ryan. *Narrative as virtual reality*. Baltimore, MA: Johns Hopkins University Press, 2001

11. R.Barthes. *The death of the author*. Richard Howard, trans.pub. 1977. http://evans-experientialism.freewebspace.com/barthes06.htm accessed 12/8/13

12. R.S.Aylett. "Emergent narrative, social immersion and "storification". Proc. 1st Int. Workshop on Narrative and Interactive Learning Environments pp. 35-44, http://www.academia.edu/544496/Emergent_narrative_social_immersion_and_storification_ accessed 12.8.13

13. Jeffrey Goldstein. "Emergence as a Construct: History and Issues." *Emergence: Complexity and Organization* **1** no 1 1999, pp 49–72.

14. John F. Padgett & Walter W. Powell. *The Emergence of Organizations and Markets*. Princeton University Press, 2012.

15. M.Gardner. "Mathematical games: The fantastic combinations of John Conway's new solitaire game "life"". *Scientific American*, **223**, 1977, pp.120–123.

16. E.M.Forster. *Aspects of the Novel*. Edward Arnold, 1927

17. M.Mateas. "A preliminary poetics for interactive drama and games". Proc. SIGGRAPH 2001, Art Gallery, Art and Culture Papers, pp51-58. ACM Press, NewYork 2001.

18. V.Propp. *Morphology of the Folktale*. Laurence Scott, trans. University of Texas Press, 1968

19. R.S.Aylett, S.Louchart & A.Weallans. "Research in Interactive Drama Environments, Role-Play and Story Telling". Proc. ICIDS 2011, LNCS **7069** pp1-10 Springer, 2011

20. Bates [3]

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

22. S.Marsella & J.Gratch. (2003) "Modeling Appraisal in Virtual Humans: Don't Worry, Be Happy". Proc. 2nd Int. Joint Conf. Autonomous Agents and Multiagent Systems, pp.313-320, ACM Press, 2003

23. R.Lazarus & S.Folkman. *Stress, Appraisal and Coping*. Springer, 1984.

24. R.S.Aylett, J.Dias, J &A. Paiva. "An affectively-driven planner for synthetic characters". Proc, Int. Conf on AI Planning and Scheduling, ICAPS 2006, pp2-10 AAAI Press.

25. R.S.Aylett & S.Louchart. "If I were you - Double appraisal in affective agents". Proc. Autonomous Agents and Multi-0agent Systems AAMAS 2008 pp 1233-1236 ACM Press.

26. J.Dias & A.Paiva. "Feeling and reasoning: A computational model for emotional agents" Proc. .12th EPIA 2005, Portugal, LNCS **3808,** pp127-140, Springer 2005

27. R.SAylett, S.Louchart,S, J.Dias, A.Paiva & M.Vala. "FearNot! - an experiment in emergent narrative". Proc. Intelligent Virtual Agents, IVA 2005, LNAI **3661**, Springer pp 305-316, 2005

28. Augusto Boal. *The Theatre of the Oppressed*. New York: Urizen Books, 1979.

29. R.Figueiredo, A.Brisson, R.SAylett & A.Paiva. "Emergent Stories Facilitated: An Architecture to Generate Stories Using Intelligent Synthetic Characters". Proc. Int. Conf. Interactive Digital Storytelling, ICIDS 2008, LNCS **5334**, pp 218-229, Springer, 2008

30. R.S.Aylett, N.Vannini, E. André, A.Paiva, S.Enz, & L.Hall. "But that was in another country: agents and intercultural empathy". Proc. 8th Int. Conf. Autonomous Agents and Multiagent Systems-Vol **1** pp. 329-336. IFAAMAS, 2008.

31. S.F.Mascarenhas, A. Silva, A.Paiva, R.S.Aylett, F.Kistler, E.André, E, N. Degens, GJ. Hofstede & A.Kappas. "Traveller: an intercultural training system with intelligent agents". Proc. 12th Int. Conf Autonomous agents and multi-agent systems pp. 1387-1388. IFAAMAS.

32. F.Kistler, B. Endrass, I. Damian, C. T. Dang, and E. André. "Natural interaction with culturally adaptive virtual characters", *J. Multimodal User Interfaces*, no. **6,** pp. 39–47, 2012.

33. G. Hofstede. *Culture Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations*, SAGE Publications, 2001.

34. Benford et al [6].

35. Lim et al [7].