

Interacting with Ghosts: An exploration of the notion of interactivity in digital storytelling

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Abstract

New Media enthusiasts have long extolled the digital medium as opening up new forms of storytelling. Interactive stories are said to enable the user to enact the narrative interpretations and decisions previously internal in other media. ‘Interactivity’ is meant to allow user to control and manipulate the story in many ways. This paper investigates this presumption by exploring current theories — from human-computer interaction, human-agent interaction, human-robot interaction and reader response — and analysing current applications.

Keywords

Interactivity, reader response, human-computer interaction, human-agent interaction, computer-mediated communication, ergodic literature, new media, immersion, engagement, narrative.

Introduction

Marketers and new media enthusiasts have long extolled the virtues of digital storytelling. Of the many ‘interactivity’ is a catch-cry familiar to all. New Media narrative is differentiated primarily from books, films and theatre by its ability to allow users to choose the path or presentation of the story, converse with characters and play a role in the action. The belief is that users, through their various input devices, interact with more than the computer — they interact with the story. Espen Aarseth has labeled interactive stories ‘ergodic literature’ because of the extranoematic activity of a user as opposed to the interior response of a reader (Aarseth, 1997). The computer user clicks buttons (among many inputs available) that have semiotic impact, whereas the reader of a book enacts narrative choice through thought.

Ergodic literature encompasses games, hypertext, tree-fiction, interactive film, and so on. The user of these works can for instance, enter text, click hyperlinks, chat and battle with software agents. Through these interactions with the interface the user is supposed to influence story, plot and characters. Whether this occurs and the affect these acts have on storytelling is explored in this paper.

Background

The term ‘interactivity’ is applied to all works in the digital domain whether they are a one page resume or a massively-multiplayer game. ‘Interactivity’ is a broad description and gives no insight into the degree of interactivity performed. Espen Aarseth is against

such terms as ‘interactive fiction’ for it is, as he describes, ‘a purely ideological term, projecting an unfocused fantasy rather than a concept of any analytical substance’ (ibid., p. 51). But as Graham et al have recognised, understanding interactivity will encourage articulated investigation and aid in designing user-interaction systems that improve the users’ experience (Graham, Pearce, Howard and Vetere, 2001). New Media is not in its infancy (Hayles in Tofts et al, 2003) but it is ‘pre-paradigmatic’ (Swann and Watts, 2000, p.41) and so requires whole fields of research to develop or establish effective human-computer interaction, ergodic practice and industry. There have been many taxonomies of interactivity in human-computer interaction and new media proposed and argued for the last decade — let us concentrate on an example of each today.

Brenda Laurel, a human-computer interaction designer and researcher and initiator of the concept of the ‘computer as theatre’, posits simple yet functional interactivity variables (Laurel, 1992). Laurel’s variables were initially ‘frequency (how often you could interact), range (how many choices were available), and significance (how much the choices really affected matters) (ibid, p. 20). Later, Laurel added the need for the user to feel they are ‘participating in the ongoing action of the representation’ (ibid.). This mix of empowerment and immersion can occur with effective use of the initial variables and through the effect of input devices and feedback. With this later addition Laurel considers the internal activity of the user and thus moves us closer to a reader response type category. Let us move further with this point by examining a narratologists’ perspective.

Marie-Laure Ryan has produced ‘four strategic forms of interactivity on the basis of two binary pairs’ (Ryan, 2001). Ryan’s categories are adapted from Espen Aarseth’s typology to focus on the user interaction with ergodic literature. The binary pairs are ‘internal/external and exploratory/ontological’. Internal interactivity occurs when the user participates as a member of the fictional world either through virtual embodiment through an avatar or from a first person perspective. An external mode then is when the user is outside the fictional world controlling the world like a god or when the user perceives their activity as navigating a database.

When in exploratory mode the user is free to move around but cannot alter plot and thus has no role in the destiny of the fictional world. When in an ontological mode the user’s decision and thus actions affect the world. From these binaries four combinations are possible which Ryan describes as being ‘characteristics of different genres’ and have ‘different narrative possibilities’ (ibid.).

In this paper Laurel’s and Ryan’s taxonomies of interactivity will be considered in the analysis of commercial and research project examples of ergodic literature. The aim is not to explicate a definition of interactivity in storytelling but to explore possible elements of interaction, their impact on the experience of story and their relationship with narrative. It should also be noted that I will only refer to the narrative elements of story, plot and character and not setting.

Interacting with Narrative [Story and Plot]

Hypertext

Hypertext is best explained as being text, delivered on computer, with hyperlinks to other text, either within the original text or external to other 'stories'. Interactivity in hypertext is enunciated in the ability of the user to direct their path through the text.

[SEE SCREEN SHOT]

'Marble Springs' by Deena Larsen (Larsen, 1993).

The intention behind these navigational controls is to permit the user to influence the delivery, meaning and outcome of the story. But of course the input choices are a predefined set of options with scripted responses and triggers — a hyperlink to another page is not randomly generated and chaotic. If the user does not take any of these choices the story cannot be read or experienced. Ryan situates hypertext as 'external/exploratory interactivity' for the user is not a member of the fictional world and the navigation has no impact on the narrative events only the way they develop in the users mind. The interaction with narrative, in other words, occurs in the users mind as a function of organising experience into a narrative, what David Blair and Tom Meyer term Narrative Intelligence (Blair and Meyer, 1997). For Ryan, this type of interactivity is suitable for self-referential fiction and not narrative worlds and thus hypertext could be described as having a low level of narrative interaction.

For Laurel, hypertext offers options for interacting (though not different types of input) often. The choices of the user does affect matters in that different text is displayed and most likely the text left cannot be reached again. However, how much the user feels they are affecting the plot is likely to be low since the hyperlinks are predefined — a user cannot click on a word or concept they would like to follow if it is not hyperlinked. This then also affects the level of participation in the representation process. Here a system for describing how participation with representation occurs would assist our analysis.

Herbert H. Clark applied his psycholinguistic theory of disembodied language — defined as 'language that is not being produced by an actual speaker at the moment it is being interpreted' — to human communication with virtual partners (Clark, 1999, p.43). For Clark, disembodied language requires two layers of joint activity:

'In layer 1, the producers of the disembodied language and I [user] coordinate in creating a joint pretense—namely, the world of layer 2. In layer 2, I [the user] communicate with a virtual speaker as we do things together.'

(Clark, 1999, p.47, my brackets)

Using Clark's layers of joint activity the user of hypertext needs to agree with the producer of the hypertext that the fictional world exists. If the user does not agree with the author what the interactions represent then the level of narrative participation is negligible — and therefore interactivity is low.

Ryan claims interaction with narrative cannot occur with hypertext. Laurel's system results in hypertext having high levels of frequency but low levels in the other categories. Let us look now to empirical investigations into the hypertext users' experience.

An empirical investigation was conducted by reader reception researchers David Miall and Teresa Dobson to test whether claims that hypertext freed the reader from the so-called tyranny of the fixed text (Miall and Dobson, 2001). Miall and Dobson posited, among other items, that hypertext is liable to disable a personal level of response to the extent that meaning is predetermined. After examining two groups of participants — one reading a print short story and the other a hypertext — they made the following observations (my summary):

- Hypertext readers took longer than the 'linear' readers;
- Hypertext readers tended to feel either confused or that they had missed something;
- Attention of the hypertext readers was diverted to the surface features of the text, and their reading patterns became increasingly fragmented as the story progressed;
- Hypertext readers made significantly fewer comments on the imagery evoked by the fiction;
- The hypertext version tended to evoke only generalised comments of involvement with the story rather than the more specific and emotionally engaged comments of the linear readers;
- Hypertext readers made more comments on the mechanics of reading on computer, but there was a greater sense of control through the linking;
- Hypertext readers had difficulty following the narrative;
- Hypertext readers who enjoyed the process of choosing did so because they thought it gave them control over the plot and increased suspense.

(Miall and Dobson, 2001)

Miall and Dobson concluded that hypertext appears to inhibit engagement and absorption. Another study conducted by hypertext theorist Jane Yellowlees Douglas supplied a class of undergraduates with a print version of Jorge Luis Borges short story *The Garden of Forking Paths* and others with Stuart Moulthrop's electronic *Forking Paths* (Douglas, 1992). Douglas documented responses to what they thought they had read and how they told the story back. She found the hypertext readers felt 'swamped by a multiplicity of endings and narrative possibilities' (ibid., 1992).

Although the hypertext reader (or user, from now on) has the 'freedom' to choose the next plot point it is clear that this does not equate to a feeling of freedom in the text. On the one hand the user is interacting by action, on the other they are inhibited intellectually. If the user is not immersed within the diegesis then they are merely triggering an interface that has been predefined by the author with an intended meaning.

It is not interaction or control over story or plot but an enunciation of the users ability to control *presentation of the publication* — interaction with the signifier not the signified, what Ryan labels as an ‘exploratory’ mode.

The phenomenon of the ‘confused’ or ‘swamped’ user is also a consequence of the immature nature of human-computer interaction in the ergodic literature context. Until the mode of interaction becomes ‘natural’ to an ergodic literature user, as turning pages in a book is to a reader, the user will be preoccupied with the hows and whys of their actions. Donald Norman, a human-computer interaction researcher, labels this the Gulf of Execution — the steps or obstacles to achieving a task — and the Gulf of Evaluation — the obstacles to receiving feedback about the success of their action (Norman, 1998, p.51).

Computer Games

We have observed that pre-defined modes of interaction do not equate to the classification, perception and experience of interactivity and that this affects the user. Another question to be asked is if users accept the mode of interaction offered as being the only path possible? The proliferation of fan fiction is an example of a particular type of reader, viewer and user that does not do so. Game producers are now providing the option of access to programming architecture for those keen to create their own stories within the producer’s world. BioWare’s *Neverwinter Nights*TM provides the ‘Aurora Neverwinter Toolkit’ free to users (BioWare, 2002). This toolkit provides the engine, images, and an interface to build an environment and story. Here are some of the elements of control described on an online fact-sheet:

‘Dungeon Masters will have the power to control the difficulty of the game in real time; place and remove creatures, items, and other objects within the gameworld; possess non-player characters and monsters to speak through them and control their actions; and use various other tools to enhance the mood and heighten the gameplay experience of their players.’

(BioWare, 2002)

In this example the user is perhaps closer to interacting with the story and plot since they are involved on a conceptual as well as ergodic level. They are still interacting with the author’s diegesis (that of BioWare’s *Neverwinter* world) but extending the world and creating their own subplots and stories. The interactive freedom may be greater on the conceptual level but there are still limits with the mode of interaction. The programming engine is not the one used by the producers, still has many prescribed elements and cannot change the original world (though it can be added to with online uploads). One example is Item 20 in the guidelines to the interface. It provides the user (now co-programmer and co-author) with the ability to insert doorways. These ‘[d]oors are special because you cannot place it just anywhere. Doors will only snap in place where a “hook” has been placed’ (BioWare, 2002). These ‘special’ doors are such because their position is determined by the initial programmers.

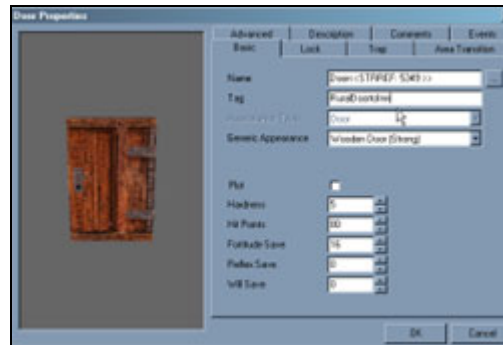


Fig.1 Interface for 'Door Properties' in the *Aurora Neverwinter Toolset* by BioWare, 2002.

These limits are necessary though in the construction of digital products because no program has been written that can respond appropriately to *any* input from the user. To avoid inappropriate and confusing responses from the program, the game crashing or taking years to develop, the temporary solution is to provide structured environments in which the user has predefined modes of interaction. *Neverwinter's* programming architecture — or programmer's game — fits in to Marie-Laure Ryan's category of 'external-ontological interactivity' (Ryan, 2001). For Ryan, the user is like a god: '[h]olding the strings of the characters, from a position external to both the time and space of the fictional world, he specifies their properties, makes decisions for them, throws obstacles in their way, and sends them toward different destinies lines by altering their environment' (ibid.).

For Laurel the measures hit the roof with frequency, range and significance. The transition from user to programmer renders participation with representation out for the user has shifted too far past co-author or collaborator to author. Does this exclude such examples of ergodic literature from the category of interactive product and even narrative therefore? Obviously categorisations, when reliant on a duality between author and reader and subject and object, quickly outdate themselves in the ergodic literature context.

Interacting with Narrative [Characters]

In the electronic medium the authorial task moves from textual description to programming command, in consequence there is much research into how artificial characters can be visually believable. Embodied characters — avatars — are designed to communicate as a human does. Avatars can represent software agents and humans. Avatars need to replicate human movement, gesture, expression, voice, reaction time, natural language processing and have realistic image quality in order for the human interpreters to understand the visual messages. Graphics cards are now so effective that if you zoom in on an image of a virtual face instead of seeing pixels you see moles and blood vessels.¹ The demo of Nvidia's graphics card plays a short sequence of a fairy called Dawn. The effects are described in the FX Readme with a narrative of the world the character inhabits:

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‘But, what truly sets her apart from those cyborg computer zombies that used to pass for living creatures is SKIN. Beautiful human skin. She is covered with an intricate skin shader that accounts for all the subtleties of human skin. This includes consideration of the oiliness of the skin surface, the amount of blood that runs just beneath the surface, and surface highlights as light hits her skin at glancing angles. In her enchanted world, it’s unclear where fantasy ends and reality begins.’

(Nvidia, 2003)



Fig. 3: Dawn, demo for Nvidia’s GeForce graphics card

The ‘fantasy’ referred to in the above quote is not that of the artificial inhabitants being autonomous or realistic it is of the human having a life-giving power. Characters are allowed, indeed required, to be alive in the readers mind and the viewer’s eyes, but a character must never pretend to be masking a human. They can be lifelike but never alive, an intangible, non-threatening bit of code and fantasy — human-like enough so we communicate with and use them but never human offspring. How could we *use* them then? Sherry Turkle noted the MUDders’² response to the use of chatbots (software that hold conversations) in their chatworlds did not become a debate about the nature of life and living (this is left to notions of their own identity in a virtual world) but over ‘ethics’ — whether a chatbot should ‘announce their artificiality’ (Turkle, 1994).

Japanese researcher, Masahiro Mori, investigated how people react to robotic designs and dolls (discussed in Dautenhahn, 2002)³. He found people reacted well to conventional avatars but when the avatars looked realistic — healthy human beings — people react negatively. This dramatic contrast to the previously endearing relationship between the human and the object is described by Mori as the ‘uncanny valley effect’: because the too life-like ‘create an uncanny and unpleasant feeling’ (ibid, 2002). People build up expectations on how the other person (as represented by the avatar) is supposed to react and when they don’t the expectation is violated. The ‘uncanny valley’ effect is also known as the ‘zombie-effect’ — repulsion of human-living-dead. Here, the virtual or synthetic character crosses a virtual line into the human domain and is reacted to as another human (horrific and fantastical as they are). In consequence to Mori’s findings many researchers, particularly in education, are purposely not using life-like avatars and robots in their studies.⁴

This may be different in the storytelling context if the character design is sufficiently different to that of a human, e.g. a monster that does not speak only fights (as many computer games make use of). The problem of how the human interacts with this creature still needs to be mediated through human-like modes of interaction and computer modes of interaction. The owner of a pet learns to pat a cat likewise a user learns to use a joystick. Does this mean that computer-generated characters will need to be obvious robots and fantastical creatures only? It appears the computer medium necessitates, at this stage of technical advancement, a mythological or even archetypal representation of character leaving human characters out of a whole genre of storytelling.

Characters, in the computer game context are interacted with on the proviso they fulfill a human-defined function — a character in story. Interaction in this sense is with a story element as represented by the character, no matter how ‘realistic’ or not the character may appear and act. It is in this sense that characters in the digital domain are expected to function in the same manner a character in a novel does — as author description and reader imagination. It is here the user is interacting as per their experience, or taught interpretation, of a print-defined mode of character, a print culture narrative. This is expected as we have learned with Walter Ong’s observations on the effects oral culture has on print and print on high-technology (Ong, 1988).

In games where the user can hold conversations with a software agent (character) input from the user is controlled by the interactive system design and often disguised as narrative device. Some games resort to having a selection of phrases or sentences from which the player chooses from, others have particular syntax that the player quickly learns the use of results in rewards such as progression and no error messages. Whilst game events like a character talking, or a filmic sequence are executed the player has no impact that is relevant to the moment. To skip a sequence will result in loss of information or simply a fast-track to the next scene and no ‘realistic’ response like ‘Don’t interrupt me’ or ‘You’ve left the room and now your partner will be killed’. The point is not to create games that require the same manners human-to-human interaction traditionally expects but to show cause and effect.

Grim Fandango, a game brought out by Lucas Arts in 1998, provided a clever addition to agent and human interaction by allowing the player to choose comments to make whilst listening to the agent’s speech (Lucas Arts, 1998)⁵. The character (agent) persist in speaking of course, unless you select the perlocutionary sentence, but the player has fun responding with the usual responses a human who is listening and not being listened to does. *Grim Fandango* is set in the Land of the Dead but *all* games at this stage have not only zombie agents but players that are ghosts in a virtual world.



Fig. 5: Screen shot from Grim Fandango™ by Lucas Arts, 1998.

Conclusion

Interactivity does not need to be the actuation of all decisions and interpretations. What is lacking is consideration and observance of the conceptual interaction that takes place between a user and the diegesis, author and society when designing stories in the digital domain. Ergodics have the potential to complement and indeed be new forms of interaction rather than acting out of the inner processes that already occur.

To summarise, current interactive entertainment is akin, for me, to a Tattersall's Instant Lottery game — 'scratchies'.⁶ I 'played' an uncharacteristically complicated game the other day that had three panels. My task was to scratch a panel of twenty letters that once each one was revealed, by me the player, I was then to scratch off the corresponding letter(s) in another crossword panel consisting of twenty words. I also had a bonus panel with a word that if all the letters matched I could win a bonus prize. It took me a few minutes and ended of course with the disappointing conclusion of lost time and wasted money. It occurred to me that my choice of sequence of letter to scratch and how much I prayed for a just and generous return had no impact on the outcome. I could easily have bought the ticket and given it back to the attendant, without scratching it at all, to scan and immediately tell me whether I was a winner and if so how much. But then I would of lost the experience, the discovery, hope, crisis, reaffirming of my belief in myself and repudiation of external salvation. It is only when, not if, interactive entertainment moves from scratching surfaces to adaptive systems that it will truly be a new media. The question we have to answer before this can be achieved is: Do we want to have a say in the outcome?

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Footnotes

¹ Nvidia 'Geoforce' chip, released 2003. Demo of graphics capability with 'Dawn' character available at: http://www.nvidia.com/object/demo_dawn.html [2003, September 6]

² Define MUders as per Turkle

³ Thankyou to Ruth Aylett for sending this paper in my direction.

⁴ Two researchers are: Ruth Aylett's VICTEC [Online] Available at: <http://www.victec.org/> [Last Accessed: 2003, Nov 22] and Kerstin Dautenhahn's AURORA Project [Online] Available at: <http://homepages.feis.herts.ac.uk/~strrjh/Aurora/index.html> [Last Accessed: 2003, Nov 22].

⁵ I credit this observation to Mark Terrano, Technical Game Manager, Xbox Advanced Technology Group, Microsoft, for identifying this in a talk he gave to the Interaction Design Group Seminars, Department of Information Systems, University of Melbourne, 19th November 2003.

REFERENCES

Aarseth, E. (1997). *Cybertext: Perspectives on Ergodic Literature*, Maryland, The Johns Hopkins University Press. [Online] Introductory chapter available at: <http://www.hf.uib.no/cybertext/default.html> [Last Last Accessed: 2003, Nov 17]

BioWare (2002) 'Aurora Neverwinter Toolset' on the Builders Page, *Neverwinter Nights*, Infogrames [Online] Available at: <http://nwn.bioware.com/builders/> [Last Accessed: 2003, October 12]

—'Fact Sheet' *Neverwinter Nights*, Infogrames [Online] Available at:

http://www.bioware.com/bioware_info/press_releases/factsheets/factsheet_nwn.html [Last Accessed: 2003, Oct 12]

—'Intro to the Toolset – Part 8', *Neverwinter Nights*, Infogrames [Online] Available at:

<http://nwn.bioware.com/builders/toolsetintro8.html> [Last Accessed: 2003, October 12]

Blair, D. and Meyer, T. (1997) 'Tools for an Interactive Virtual Cinema' in Trappl, R and Paolo Petta (eds) *Creating Personalities for Synthetic Actors: Towards Autonomous Personality Agents*, Springer Verlag: Berlin.

Clark, H. H. (1999) 'How do real people communicate with virtual partners?' in *Proceedings of 1999 AAAI Fall Symposium, Psychological Models of Communication in Collaborative Systems*, November 5-7th, 1999, North Falmouth, MA, pp.43-47.

Dautenhahn, K. (2002) 'The Design Space of Life-Like Robots' presented at the *5th German Workshop on Artificial Life*, Lübeck, 18-20 March 2002. Article available through CiteSeer:

<http://citeseer.nj.nec.com/cache/papers/cs/28426/http:zSzzSzhompages.feis.herts.ac.ukzSz~comqkdzSzromankd2web.pdf/dautenhahn02design.pdf> [Last Accessed: 2003, Nov 18]

Graham, C., Pearce, J., Howard, S. and Vetere, F. (2001). *Levels of Interactivity and Interactivity Maps*. OZCHI2001, Freemantle, Australia. [Online] Available at:

<http://www.dis.unimelb.edu.au/staff/connorg/int-imaps.pdf> [Last Accessed: 2003, Nov 15]

Larsen, D. (1993) *Marble Springs*, Eastgate Systems: Massachusetts [Online] Available at:

http://www.eastgate.com/MS/Title_184.html [Accessed: 2003, Dec 9]

Lucas Arts (1998) *Grim Fandango*TM [Computer Game] Information and demo download available at:

<http://www.lucasarts.com/products/grim/default.htm> [Last Accessed: 2003, Nov 21]

Miall, D. and Teresa Dobson (2001) 'Reading Hypertext and the Experience of Literature' in *Journal of Digital Information*, vol.2, issue 1. [Online] Available at: <http://jodi.ecs.soton.ac.uk/Articles/v02/i01/Miall/> [2003, June 9]

Dena, C. (2003) 'Interacting with Ghosts: An exploration of the notion of interactivity in digital storytelling' presented at School of Creative Arts Postgraduate Seminar Day, Pierre Gorman Room, University of Melbourne, 11th Dec, 2003.

Norman, D. A. (1998) *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution*, MIT Press, Massachusetts, [Online] Available at: <http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=3484&xid=4&xcid=0> [Last Accessed: 2003, June 9]

Ong, W. (1982) *Orality and Literacy*, London: Methuen. pp.136–138.

Ryan, M-L. (2001) 'Beyond Myth and Metaphor: The Case of Narrative in Digital Media' in *Game Studies*, vol.1, issue 1, July 2001 [Online] Available at: <http://www.gamestudies.org/0101/ryan/> [Last Accessed: 2003, November 13]

Swann, G.M.P. , Watts, T. P. (2000) 'Visualization Needs Vision: The Pre-Paradigmatic Character of Virtual Reality' in Woolgar, S. (Ed.) *Virtual Society?: Technology, Cyberbole, Reality*, New York, Oxford University Press.

Tofts, D., Jonson, A., Alessio Cavallaro (eds) (2003) *Prefiguring Cyberculture: An Intellectual History*, Power Publications: Sydney.

Turkle, S. (1994) 'Constructions and Reconstructions of Self in Virtual Reality' in *Mind, Culture, and Activity*, vol.1, issue 3, Summer. (Reprinted in *Electronic Culture: Technology and Visual Representation*, Timothy Druckrey (ed.). Aperture Foundation, 1996 and *Culture of the Internet*, Sara Kiesler (ed.). Hilldale, New Jersey: Lawrence Erlbaum Associates, 1997.) Available at: <http://web.mit.edu/sturkle/www/constructions.html> [Last Accessed: 2003, Nov 10]

Yellowlees Douglas J. (1992) 'Gaps, Maps and Perception: What Hypertext Readers (Don't) Do' in *Perforations* 3, vol.2, no. 3[Online] Available at: <http://web.nwe.ufl.edu/~jdouglas/perforations.pdf> [Last Accessed: 2003, Nov 10] Also available at: http://www.pd.org/topos/perforations/perf3/douglas_p3.html

Dena, C. (2003) 'Interacting with Ghosts: An exploration of the notion of interactivity in digital storytelling' presented at School of Creative Arts Postgraduate Seminar Day, Pierre Gorman Room, University of Melbourne, 11th Dec, 2003.