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Player Agency in Interactive Narrative: Audience, Actor & Author

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Abstract. The question motivating this review paper is, how can computer-based interactive narrative be used as a constructivist learning activity? The paper proposes that player agency can be used to link interactive narrative to learner agency in constructivist theory, and to classify approaches to interactive narrative. The traditional question driving research in interactive narrative is, 'how can an interactive narrative deal with a high degree of player agency, while maintaining a coherent and well-formed narrative?' This question derives from an Aristotelian approach to interactive narrative that, as the question shows, is inherently antagonistic to player agency. Within this approach, player agency must be restricted and manipulated to maintain the narrative. Two alternative approaches based on Brecht's Epic Theatre and Boal's Theatre of the Oppressed are reviewed. If a Boalian approach to interactive narrative is taken the conflict between narrative and player agency dissolves. The question that emerges from this approach is quite different from the traditional question above, and presents a more useful approach to applying interactive narrative as a constructivist learning activity.

1 INTRODUCTION AND MOTIVATION

How can computer-based interactive narrative be used as a constructivist learning activity? The question is significant because computer-based narrative is increasingly being used in education: in schools, in corporate training, and elsewhere. In the academic literature some theory does exist that allows us to approach the question, yet not much is known about the learning effects of interactive narrative. Pursuing this question will shed light on new approaches to interactive narrative in education and will inform new designs for interactive narrative environments.

For the purposes of this review, a *constructivist* learning environment is one in which active and critical (not passive and receptive) learning is produced, and in which learners construct their own understanding of the content (they are not led to specific truths by the teacher). A constructivist learning environment involves some degree of structure in order to ensure learning objectives are achieved. But within that structure, the emphasis is on maximising free exploration, interaction, and enjoyment for the learner — maximising *learner agency* — to ensure that learners arrive at their own understanding.

The question of interactive narrative as a constructivist learning activity will be pursued by looking at existing approaches to interactive narrative, and using *learner agency* as a key analytical tool with which to formally classify them. Learner agency is a crucial aspect of constructivist learning, and will be shown to be antagonistic to traditional approaches to interactive narrative. The review concludes by proposing a way to resolve this conflict.

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2 A BRIEF INTRODUCTION TO INTERACTIVE NARRATIVE

The model of narrative most frequently found in the interactive narrative literature is that of the structuralist approach to narratology. As Lindley explains, "the model is very useful when applied to the analysis and design of interactive narrative and story construction systems, and the identification of several levels of narrative meaning clarifies the relationships between different strategies for interactive narrative and story construction" [11, p.7]. This structuralist model makes a distinction between a *story*, defined as "the narrated events, abstracted from their disposition in the text and reconstructed in their chronological order, together with the participants in these events" [20, p.3] and the *text*, defined as the "spoken or written discourse which undertakes the telling" of the events of the story [20, p.3]. The reader (or listener) does not have direct access to the story, only to the text, and in the text "the events do not necessarily appear in chronological order, the characteristics of the participants are dispersed throughout, and all the items of the narrative content are filtered through some prism or perspective" [20, p.3]. The word 'narrative' is understood to refer to this text: "The text itself is *the narrative*" [11, p.6]. Although narratology traditionally considers spoken or written narrative fiction, Lindley explains that "the concept of a text has been generalised to cover audio-visual media, since many of the ways narrative functions semiotically are the same across different media forms" [11, p.5]. The motivation for this distinction between *story* and *narrative* is to clarify that "the same story may be expressed in many different narratives, either within the same medium or across different media" [11, p.6].

Meadows gives the following definition of *interactive narrative*:

> "An interactive narrative is a time-based representation of character and action in which a reader can affect, choose, or change the plot. The first-, second-, or third-person characters may actually be the reader." [15, p.62]

The key is that 'interactive narrative' is not merely the presence of interaction and narrative in the same experience. An interactive narrative is understood as an experience in which the reader (player), through meaningful interaction, is able to change the events that occur in the narrative. This can mean affecting the events themselves, or affecting which events occur and which do not, or a combination of both. The interaction can be on a moment-by-moment basis as in 'emergent narrative' (see 'Emergent Narratives' in section 3) or can

consist of fewer decisions with longer-term effects as in a 'branching story' (see 'Modulated Plot' in section 3) or a combination of both.

This definition raises the question of how to define 'plot.' The idea of *continuity of action* by means of *causal relations* between the events represented has traditionally been central to the notion of plot, as Forster's definition shows:

> "We have defined story as a narrative of events arranged in time-sequence. A plot is also a narrative of events, the emphasis falling on causality. 'The king died and then the queen died' is a story. 'The king died and then the queen died of grief' is a plot." [4, p.93]

Alternatively, Meadows describes plot as "the author's planned organisation of the events of the story...a planned topology that has an implied opinion and perspective" [15, p.27].

Forster and Meadows describe two different aspects of causality in the definition of plot. Forster focuses on the chain of cause and effect within the narrative: the queen died because she felt grief because the king died. Meadows focuses on the author's role: the queen died because the author required it to fulfil the needs of the plot. In an interactive plot both aspects of causality are present. The defining property is that the plot consists of chronologically ordered and causally interconnected events.

3 PLAYER AGENCY: AUDIENCE, ACTOR AND AUTHOR

A *player* in an interactive narrative can be a spectator in the sense that she is a witness to the dramatic spectacle. She can be an actor in the sense that she plays the role of one of the characters in the narrative. And she can be an author in the sense that she collaborates with the system (and perhaps with other players) to produce the resulting narrative experience. The player is not exclusively a spectator, nor an actor, nor an author, but in any given example of interactive narrative the role of player combines these three traditional roles to different degrees.[2]

Player agency is a concept that is crucial to the formal nature of interactive narrative as a medium, and that relates interactive narrative theory to learner agency in constructivist learning theory. In the context of interactive narrative, Murray defines agency as:

> "the satisfying power to take meaningful action and see the results of our decisions and choices." [16, p.125]

and Mateas as:

> "the feeling of empowerment that comes from being able to take actions in the [virtual] world whose effects relate to the player's intention" [13, p.2]

Mateas further clarifies that agency is a phenomenal category: it depends "on what's going on in the interactor's head, on what's communicated between the technical system and the person, not only on technical facts like counting the number of system actions that are available at each moment." [3]

[2] The role of *game designer* is a separate role, distinct from the role of player. Because 'author' is used in this review to denote one of the traditional narrative roles with which the role of player in interactive narrative is described, care has been taken to use the word *designer* rather than author to refer to the procedural designer of an interactive narrative environment.

[3] Michael Mateas commenting on his weblog *Grand Text Auto*, the post is titled *Interaction and Agency* and dated 6th August 2003, http://grandtextauto.gatech.edu/2003/08/06/interaction-and-agency/

The form of agency experienced by an audience member, an actor and an author is different:

Audience: an audience member can critically analyse the narrative (she can think about it) but she has no power to act within the narrative.

Actor: an actor can act within the narrative, from the perspective of one of the characters in the narrative, but only within the limits and from the perspective of the role designed for her.

Author: an author shapes the narrative experience from without, acting on the structures and processes that make up the narrative as an artificial construct in order to express some form or opinion. But an author is limited by the tools at her disposal, her distance from the audience, and her reliance on actors to manifest her intentions and on the audience to comprehend her intentions.

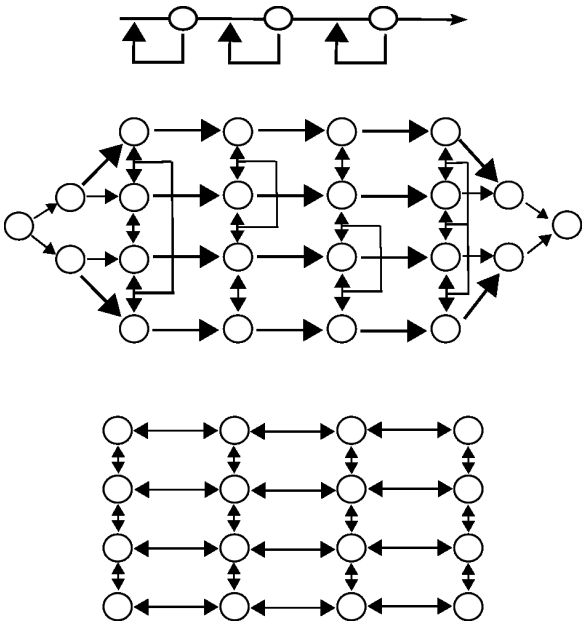

Figure 1. Meadows' nodal (top), modulated (middle) and open (bottom) plot structures [15, p.64]. The lines represent possible plot transitions, the circles represent decision points at which player behaviour can choose between plot transitions.

Meadows and Jenkins provide two classifications of some of the narrative structures and devices available to interactive narrative designers. Meadows describes three plot structures for interactive narrative[4] [15, see figure 1] that exist along a continuum from *Impositional* (the plot is heavily controlled by the game designer, only allowing the player a narrow margin of decisions, or particular moments of interactivity) to *Expressive* (the plot is heavily controlled by the player, the game behaves more like architecture, the player roams freely, explores, investigates, and changes the environment, the breadth of interactivity is much wider but the specifics of a narrative plot are far less defined). The three plot structures represent key descriptive points on the impositional—expressive continuum.

[4] Meadows explains that "interactive plot structure is more a system of connections than a curve or arc" [15, p.63], and that these plot structures are an "analysis tool" and "don't have much to do with emotional punch or aesthetic interest." Meadows is aiming to differentiate his plot structures from formal descriptions of plot that focus on dramatic or emotional progression, such as the rising and falling dramatic action of the Aristotelian theory of theatre.

Nodal Plot "a series of non-interactive events, interrupted by points of interactivity" [15, p.64]. This is the most impositional plot structure, with the most support for the classic dramatic arc. Stories of this form have one beginning and two endings. The player fails and must start again from an earlier point in the narrative (this can happen at many points) or the player succeeds and finishes the game. This plot structure provides few affordances for player agency. The player cannot change the direction of the plot, but can only change the pace at which the plot progresses along its linear path. At each decision point, player action decides whether the player fails (and the game restarts from an earlier point in the plot) or succeeds (and the plot progresses).

Modulated Plot player action chooses which path the plot will follow by choosing from finite sets of pre-defined options at fixed decision points in the plot. The player chooses a path through a finite 'plot graph.' These decision points provide affordances for player agency, but their finite nature means that agency is somewhat limited.

Open Plot this structure is "the most expressive for the [player], far less so for the [designer]" [15, p.66], providing the most points of interactivity for the player. The player affects the plot through many small decisions, rather than a few big decisions. The classical dramatic arc may be completely abandoned in the interests of exploration, modification, and investment from the player. The story is usually based on the development of character or the development of environment, or both. The potential for player agency is great. But if the player cannot find meaningful ways to express her intentions on the plot and assess the consequences of that expression, a sense of agency may fail to materialise.

Jenkins describes four devices with which to create "the preconditions for an immersive narrative experience" [7, p.3] in what he calls 'environmental storytelling':

Evocative Spaces an interactive environment can build on stories or genres known to the players, painting the narrative world only in broad outlines and leaving it to the player to fill in the rest. This device provides no affordances for player agency in terms of player *action*, but may provide the player with a degree of agency similar to that of a traditional narrative audience as the player's imagination is given some freedom to help paint the narrative world.

Enacted Narratives an interactive narrative can allow players to perform narrative events. The designer controls the narrative by setting broadly defined goals or conflicts for the characters and inserting localised, non-interactive narrative incidents. The narrative is episodic: "each episode (or set piece) can become compelling on it's own terms without contributing significantly to the plot development" [7, p.6] and within each episode the "sequencing of actions may be quite loose" [7, p.6] allowing for much interaction. This device allows player action to affect the details and ordering of events within an episode, though this freedom is limited by the action constraints of the interactive environment and the higher level plot episodes themselves remain static.

Embedded Narratives Jenkins relates this approach to the traditional detective story. The story is seen "less as a temporal structure than a body of information" [7, p.8]. It is put together, piece by piece, by the player: "narrative comprehension is an active process by which viewers assemble and make hypotheses about likely narrative developments on the basis of information drawn from textual cues and clues." [7, p.8]. The designer controls the progression of the narrative by distributing narrative information throughout the interactive environment. The embedded narrative can be linear while still being closely tied to player agency as the player focuses on discovering and unscrambling narrative elements. The result is two narratives: one controlled by the player as she explores the environment, and another controlled by the designer and embedded in the environment to be discovered.

Emergent Narratives the narrative is not pre-structured but takes shape through game play. The game designer creates "a world ripe with narrative possibilities," "a kind of authoring environment within which players can define their own goals and write their own stories" [7, p.9]. The aim is to provide a form of player agency more similar to that of a traditional author than an actor or spectator.

Taken together the two classifications from Meadows and Jenkins describe a large portion of the approaches to interactive narrative and provide a good introduction to the field.

One way to classify approaches to interactive narrative is to use the concept of player agency to ask to what extent the player is audience, actor, and author in the narrative. In this review these three traditional roles will be used to analyse three theoretical approaches to interactive narrative. Each of the three approaches gives a different way of looking at the three roles, and each positions player agency differently with respect to the three roles.

4 AN ARISTOTELIAN APPROACH TO INTERACTIVE NARRATIVE

Lindley [10, p.2] gives a description of "the central notion of narrative in modern commercial cinema." A narrative of this type has three main parts:

1. A beginning, in which a conflict involving a dilemma of normative morality is established.
2. A middle, in which the consequences of the conflict are played out, propelled by a false resolution of the dilemma.
3. An end, in which the conflict is resolved by an act that affirms normative morality.

Each of these three acts culminates in a moment of crisis, the resolution of which propels the story into the next act (or into the final resolution). The involvement of a central protagonist in the narrative is also key, as is a sense of continuity of action represented by causal connections between events. This narrative structure is known as the three act restorative structure. It is closely related to Aristotle's concept of narrative as an imitation of action that is an organic whole, having a beginning, a middle and an end which fit together naturally and are connected by causes and effects over time.[5] It is also related to Freytag's reworking of Aristotle's model in his Freytag triangle, which expresses a narrative as a function of time in three phases: rising action in which the crisis or complexity of the plot increases, culminating in a dramatic climax, followed by a period of falling action in which the crisis and plot are resolved [6].

In *Poetics* Aristotle organises the different parts that make up a *tragedy*[6] into three hierarchical categories: Objects, Medium and Manner. The objects are the actions (the plot of the drama, made up of causally related events), the characters (the agents of the plot) and the thoughts of the characters that lead to the actions they take in

[5] Aristotle, *Poetics*, 350 B.C.E, available online http://classics.mit.edu/Aristotle/poetics.html

[6] For *Poetics* see previous footnote. *Tragedy* is a form of drama popular in Aristotle's time, involving a conflict between the protagonist and the law, the gods, or society and having a tragic ending.

the drama (if not explicitly described, these thought processes may be inferred by the audience). Medium refers to the medium through which the objects are presented, for example colour and form, voice, rhythm and harmony, or diction and song. Manner refers to the manner of presentation used, e.g. the drama can be narrated or enacted.

With his *neo-Aristotelian theory of interactive drama* [12, 13] Mateas builds on Laurel's application of Aristotle's description of tragedy to human-computer interaction [9] and Murray's description of player agency in interactive narrative [16]. To describe the role of the player in an interactive drama Mateas places *User Action* at the level of character in the Aristotelian hierarchy. That is, the player acts in the drama as one of the characters in the drama, and when the player takes action in the drama "The player's intentions become a new source of formal causation" [13, p.4] in the model that was not present in Aristotle's original model.

To support this, Mateas explains that the player's intentions are constrained by the *material for action* provided by the system "The only actions available [to the player] are the actions supported by the material resources present in the game" [13, p.4] and by *formal constraints* that provide the player with dramatic reasons to want to take particular actions: "the formal constraints afford *motivation* from the level of plot" [13, p.4].

An example from Mateas and Stern's interactive drama Façade [14] will illustrate the Aristotelian approach. In Façade, the player takes on the role of a character in the drama and sees from the first-person view of this character. Dialogue is the main form of interaction: the player communicates with the virtual agents by typing text, the virtual agents communicate by sequencing pre-recorded sound-bites and with facial expressions and hand gestures.

The Façade architecture is an attempt to break free of the plot structures and narrative devices described by Meadows and Jenkins (see section 3). Façade dynamically sequences dramatic beats from a large library. Each beat is a small collection of interactive, coordinated behaviours to be carried out by the agents of the drama, and is tagged with preconditions for selection and the consequences of each potential beat outcome on the dramatic arc of the drama. The beats can be reordered in many ways while remaining coherent, and any play of the drama need only contain a subset of the available beats. Façade attempts to select a coherent and dramatically 'good' sequence of beats while remaining responsive to player action.

The premise of the drama is that you (the player) have been invited over to the apartment of Grace and Trip (the virtual agents). The short drama takes place in the apartment, where soon after you arrive it becomes obvious that Grace and Trip's marriage is on the rocks. What happens depends partly on your actions in the 5-15 minutes that make up the drama.

Figure 2 is a transcript of an interaction with Façade [1]. The player is controlling the character named Audrey in the transcript, and Grace and Trip are the virtual agents. There are two things to notice in the transcript. First, when the player types an input that the system does not understand the agents try to gloss over the failure by acting briefly confused, then continuing with the intended narrative, ignoring the unwanted input. Second, as can be seen in the last two lines of the transcript, the agents respond to keyword triggers. The player inadvertently triggers the 'sex' topic. This topic is not supposed to come up until later in the drama, so Trip tries to redirect the player onto the topic of drinks, again trying to continue with the intended narrative despite the unwanted input from the player. If the player persists in her uncooperative behaviour, the agents will close the door on her and the game will be over. As the player who produced this transcript commented, "don't ever go to this apartment in case of emergency." [7]

(Audrey knocks on the front door.)
(Trip opens the front door.)
TRIP: Audrey!!
AUDREY: TRIP I'VE BEEN SHOT!
TRIP: Uh...
TRIP: Well come on in...
TRIP: Uh, I'll – I'll go get Grace...
GRACE: Audrey, Hi! How are you? I'm so happy to see you after so long! – (interrupted)
AUDREY: CALL 911
GRACE: Uh...
GRACE: So, come in, make yourself at home...
AUDREY: OH, F**K THIS
TRIP: Ha ha! Oh I think we're going to need some drinks first if we're going to talk about sex.

Figure 2. An edited transcript of an interaction with Façade [1]

The tendency in the Aristotelian approach to interactive narrative is to try to hide the underlying mechanics of the experience and maintain the player's 'suspension of disbelief.' In this approach, the player's role is something like that of a *passive spectator* and that of a *constrained actor*. The interactive narrative tries to "steer not only a players' action and emotions, but their perceptual behaviour and conceptualisation of events" [18, p.3] and to transport the player into the artificial reality: "the quest is to provide more immersive, more engaging and more affective experiences" [18, p.1].

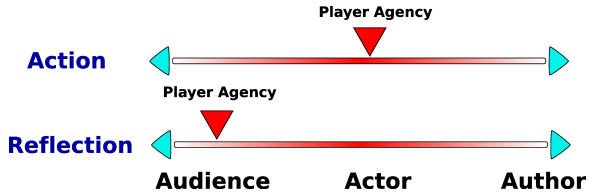

Figure 3. The role of player agency in the Aristotelian approach to interactive narrative

The key aspect here is the role of player agency in the Aristotelian approach, described by figure 3. The player *acts* from the perspective of an actor within the narrative structure with a limited range of actions. The player *reflects* on the narrative as a passive spectator, from a perspective within the narrative, thinking what her character thinks and feeling what her character feels. Player reflection is embedded within the artificial representation of reality that is the interactive narrative. To clarify, imagine the modulated plot structure that was described in section 3. In the Aristotelian approach, the player acts from the perspective of one of the characters in this narrative structure, choosing from finite options at certain points in the plot. The player is an actor within the narrative. But the game designer uses drama and spectacle to try hide this underlying plot structure from the player, so that the player does not perceive the limits within which the experience has been designed for her. Alternatively, in terms of the enacted narrative device (described in section 3), the designer guides the player's progression through the narrative by setting the player's global goals and interrupting free interaction with fixed, non-interactive plot incidents. Again the player acts within the limits defined by the designer, and the designer aims to use drama

[7] Internet forum post, accessed January 2nd, 2007, http://forums.idlethumbs.net/showthread.php?t=2895&page=2&pp=25

and spectacle to prevent the player from becoming too aware of this restriction. In both examples, player reflection on the narrative structures is passive and receptive.

In this Aristotelian approach the balance of power between game designer and player is antagonistic to player agency: player agency is inevitably restricted and the player manipulated to distract attention from this restriction. The player is given a limited role in the experience. Within the Aristotelian approach there is no solution to this problem: as the player's interactive freedom increases, the system needed to support the interaction becomes more complex, and quickly impossible. An interactive narrative cannot "be all things to all players" [1]. To resolve the conflict with player agency, alternative approaches at the formal level must be considered.

5 A BRECHTIAN APPROACH TO INTERACTIVE NARRATIVE

German dramatist Bertolt Brecht Brecht argued that the Aristotelian approach to theatre, by focusing on illusion and empathy and a passive role for the audience, places the audience in a receptive state of mind in which they are encouraged to passively accept a fictional representation of reality. In response, Brecht created a theory of theatre, the *Epic Theatre*, in which the audience are discouraged from becoming empathically immersed with the action and characters on stage, and encouraged to form a distanced, critical relationship with the drama instead. Where Aristotle employs empathy, catharsis and illusion to transport the audience into the drama, Brecht employs techniques designed to prevent empathy and catharsis and break the illusion, to get the audience to reflect on the drama as an artificial representation. Brecht's techniques are used to alienate or distance the audience from the drama, reminding them that they are witnessing an artificial representation, and drawing critical attention to the function of the drama and the real-world issues being represented.

Pinchbeck applies Brecht's thought to modern First-Person Shooter (FPS) computer games. He argues that "Successful immersion implies, by definition, an acceptance of the rules of the artificial experience at a perceptual and behavioural level" and that these rules "are both vastly simplified and highly structured" [18, p.7]. The effect is that "users are steered towards an uncritical relationship with the affordances of the experience, even though these affect the scope of available actions as much as the content" [18, p.7]. To support this, drama is used "to detract attention from the manipulation towards an increased engagement with the reduced corridor of affect of the narrative structure" [18, p.7].

Pinchbeck suggests applying Brecht's theatre techniques to computer-based narrative, embedding devices into the game experience that reveal its innate tendencies without altering its fundamental form. The aim is "to force an audience to consider the implications of the action in the real world by highlighting the artifice and displacement of control within an artificial reality" [18, p.9]. Specifically Pinchbeck suggests pausing the game experience and using in-game narration and music to break immersion and promote critical reflection.

America's Army is an online multiplayer FPS game in which players take on the role of U.S. soldiers from a first-person perspective in combat scenarios. It is an example of Aristotelian interactive narrative, just the sort of thing Brecht might try to subvert. *Dead in Iraq*[8] is an in-progress 'online gaming intervention' being conducted by Joseph DeLappe of the University of Nevada Reno. DeLappe's intervention is an example of how the Brechtian approach could be applied to interactive narrative. DeLappe enters the online gaming environment of America's Army and uses the games text-messaging system, through which players can type messages to each-other as they play, to type the names of U.S. soldiers who have been killed in Iraq. By taking screenshots of the game that show the most recent messages from players at the time of the screenshot, DeLappe collects players' responses to his intervention (figure 4).

```
- i think they are dates of deaths of
  soldiers. are those real people??
- are you enlisted? reserve? have you been to
  iraq?
- u arent encouraging me to join the services
- bin-lad-en: i am srry
- i dunno ..was thinkin of joinin the army
  soon
- its propaganda
```

Figure 4. Selected players' responses to DeLappe's 'online gaming intervention' *Dead In Iraq*.

As the responses show, DeLappe's intervention, considered as an attempted Brechtian technique,[9] has been successful to some extent. The players' comments show some discussion of the real world consequences of the fictional actions, consequences which are not sufficiently represented in the artificial experience. But this approach is limited: DeLappe is not formally modifying the interactive medium itself, he is merely doing something novel within it.

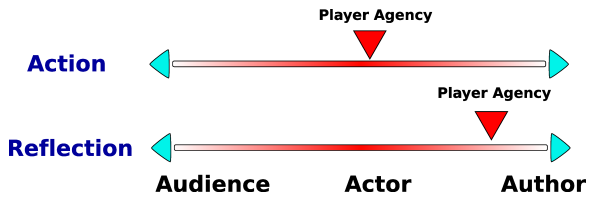

Figure 5. The role of player agency in the Brechtian approach to interactive narrative.

Figure 5 describes the key conclusion: the role of player agency in the Brechtian approach to interactive narrative. The player *acts* from the perspective of an actor within the narrative with a limited range of actions. As in the Aristotelian approach the player may find herself acting from within a modulated plot structure, choosing from fixed options at fixed points in the plot, or she may find herself acting within global goals and fixed plot incidents setup by the designer to guide the experience following an enacted narrative approach. But in the Brechtian approach the player *reflects* on the narrative from a perspective similar to that of an author, from *outside* of the narrative construct, reflecting on the structures and processes that make up the experience as an artificial representation. The player may reflect on the designed plot structure or global goals and non-interactive plot incidents, and the perspective this representation presents of the reality being simulated. The player need not necessarily accept the designer's perspective. The Brechtian approach changes the perspective of player reflection, so that manipulation of the player by the game designer is reduced. But the perspective of player action remains unchanged, so the player remains in a limited role in the experience. Ultimately, this is the limit of the Brechtian approach: the game designer tries to get the player(s) to reflect on the interactive narrative

[8] http://www.delappe.net/

[9] DeLappe himself does not relate his intervention to Brecht

as an artificial representation, rather than to accept it as reality, but retains control over player actions as in the Aristotelian approach. The Brechtian approach does not formally resolve the conflict between narrative control and player agency. An approach that formally modifies the experience is needed to give player agency a greater role in the narrative.

6 BOAL'S THEATRE OF THE OPPRESSED

A theatrical approach that may provide a suitable model for interactive narrative is Brazilian director Augusto Boal's *Theatre of the Oppressed* [2], which is used in radical popular education movements. The aim of Theatre of the Oppressed is "to change the people — "spectators," passive beings in the theatrical phenomenon — into subjects, into actors, transformers of the dramatic action" [2, p.122].

One of the interesting forms of Theatre of the Oppressed is the *Forum Theatre*. An example Forum Theatre, 'It's Too Late,' will illustrate the form. 'It's Too Late' is a short improvisational play. The stage contains three desks, and a clock on the wall. Three actors, 'the oppressors,' play clerks standing behind the desks. A fourth actor, 'the oppressed,' plays a citizen who enters the stage carrying a document, with the goal of using the document to complete a transaction with the oppressors. The rules of the improvisation are that the oppressed must visit each desk in turn and try to enact the transaction with the oppressor. The oppressors must find ways to deny the request based on the idea that 'it's too late.'

A scripted version of the play is first presented to the audience by the actors. This version ends badly — the oppressed is turned away without completing the transaction. In this version, the oppressed makes at least one clear social or political error in trying to solve the oppression. This version, called the 'anti-model,' presents a problematic view of the world to the audience. The audience are asked if they agree with the solutions advanced by the protagonist, with the expectation that they will not.

The actors then act out the play again, but this time audience members are instructed that they may put up their hand at any time to freeze the play and take on the role of the oppressed. An audience member, or 'spect-actor,' goes onto the stage when he or she feels the oppressed is making a mistake and replaces the actor playing the oppressed for a time, to try to enact a better solution to the problem. As soon as a spect-actor enters the stage the oppressors intensify their oppression, responding to the spect-actors solutions with new forms of the oppression. The actor who has been replaced moves to the side of the stage and verbally assists the spect-actor to stay in role and encourages him or her to continue attempting solutions in the face of adversity. The Forum Theatre becomes a creative game or competition which pits spect-actors against actors. The actors try to force the spect-actors to accept the world as it is, as it was presented in the anti-model. The spect-actors try to find a solution, to change the world. A sense of urgency is vital to this game. The actors, when playing oppressors or oppressed, move the narrative toward the same ending as in the anti-model. To prevent this ending the spect-actors must continuously fight the oppression until they break it.

The improvisation may be repeated several times over, and in this way the actors and spect-actors creatively discuss and enact an oppressive problem and potential solutions to the problem. In the example play 'It's Too Late,' potential solutions include: the oppressed demands to be given her rights, the oppressed tries to make friends with the clerks and convince them to give her what she wants, and the oppressed tries to use money to bribe one of the clerks.

The aim is not to produce a well-formed piece of theatre or even a solution to a problem.[10] The aim is to produce a good debate through active, critical thinking, exploration and enactment, and to empower the spect-actors through this enacted debate. The key is to realise that Theatre of the Oppressed is not simply a form of interactive drama. The drama provides a place of fiction in which spect-actors train themselves for action in the real world. As Boal puts it, the aim is "to transform the spectator into the protagonist of the theatrical action and, by this transformation, to try to change society rather than contenting ourselves with interpreting it" [3, p.224].

This approach immediately seems more suitable for the computer-based interactive narrative medium. Aristotle and Brecht's approaches are non-interactive theatre, and as such may not present the most useful models for an interactive medium. Player agency has to be 'incorporated' into the model or 'dealt with' in some way. Boal's is a fundamentally interactive form of theatre, inspired by Brecht's approach, but attempting to go one step further.

In the Aristotelian approach, the fictional character both acts and thinks for the spectator. The effect of a successful Aristotelian experience is to subdue the spectators' desire for agency.[11] In the Brechtian approach the character acts for the spectator, but the spectator thinks for herself, and may "think in opposition to the character" [2, p.122]. A Brechtian experience encourages the spectators' desire for agency: the aim is to produce critical discussion among spectators about the actions and decisions taken or not taken by the characters. Boal's theatre "focuses on the action itself: the spectator delegates no power to the character (or actor) to act or think in his place; on the contrary, he himself assumes the protagonic role, changes the dramatic action, tries out solutions, discusses plans for change" [2, p.122]. In a Theatre of the Oppressed the spectators' desire for agency is not only encouraged but actually *exercised* as spectators act within the safe, fictional environment of the drama. This fictional exercise of agency leaves behind the desire in the spectator to exercise that same agency in real life.

In Forum Theatre, a spect-actor can replace and act in place of any oppressed character[12] at any point in the play, dropping in and out of the characters as she pleases. A spect-actor is not restricted to acting from the perspective of one character, or acting within the role of one character. The role of a spect-actor in Forum Theatre is greater, in terms of agency, than the traditional role of an actor playing a single character.

Each spect-actor is constrained in two ways: by the reactions of the actors and other spect-actors to her actions on stage, and by the facilitator of the forum (the 'joker').

The spect-actors considered as a whole reshape the entire drama over several iterations. They act on the drama from an outside perspective, similar to the way in which a traditional author shapes a drama. But even the spect-actors as a group are limited by the framework set out for them. So it is not accurate to say that the spect-actors have authorship over the narrative. Rather, they have a form of

[10] This does not mean that a Forum Theatre should not be well-formed, Boal says "The most important thing, over and above anything else, is that Forum Theatre should be good theatre; that the model in itself offers a source of aesthetic pleasure. Before the 'forum' part begins, the show itself must be watchable and well constructed" [3, p.277].

[11] Think of watching a good Hollywood movie in the cinema. If you're enjoying the film and are fully immersed in the characters and action, then you don't want it to end. When the film does end and the lights come back on, you have to consciously 'drag' yourself back into reality.

[12] The example used earlier has one oppressed character and three oppressors. But many forum theatres have multiple oppressed characters, and may have characters who are both oppressor and oppressed, and who mutually oppress each other. Usually spect-actors cannot replace purely oppressive characters, as this breaks the game and results in nonconstructive solutions.

agency which has more in common with the agency experienced by a critical author than it does with the agency experienced by a passive spectator.[13]

6.1 A Boalian Approach to Interactive Narrative?

In his thesis *Videogames of the Oppressed: videogames as a means of critical thinking and debate* [5] Frasca envisions a new approach to interactive computer games: "a powerful representational form that encourages critical thinking, empowerment and social change" [5, p.114]. Frasca makes an analogy between Boal's Forum Theatre and simulation in computer games:[14]

> "Literally, what happens in a [Forum Theatre] session is a simulation. It is not the representation of something, but the simulation of how some situation would happen, depending on many factors. It analyses the world "as it is and as it could be" (Boal, 1992)" [5, p.67].

Frasca further explains that Forum Theatre is "a meta-simulation, an environment where spect-actors can create and question the rules of a simulation" [5, p.73]. Frasca proposes a new approach to interactive computer games in which the players have access to the rules of the simulation, and can alter them. He explains that "Since simulations are representations of the world, they cannot model it without conveying the [designer]'s idea about how the world works" [5, p.79]. Frasca proposes that like the spect-actors in a Forum Theatre construct different ideas about a problem and its solutions in successive iterations of the play, players could discuss a situation by constructing successive simulations that model the situation as a game.[15]

Combining Frasca's analogy between simulation and Forum Theatre with the review of interactive narrative presented in this paper, a Boalian approach to computer-based interactive narrative can be proposed. A Boalian approach to computer-based interactive narrative would give the player(s) access to the underlying story model to interact with directly and deliberately, to *play* with. It should blur the traditional interactive narrative roles of player and author into one. The player could jump seamlessly and at will between acting within the interactive narrative, in the role of the protagonist (or the oppressed) in the story, and acting on the interactive narrative from outside of it, manipulating the story model underlying the narrative, in the role of author. The player-authors *construct* and *experience* the interactive story at once.

Figure 6 describes the key conclusion: the role that player agency might play if the Boalian approach can be applied to interactive narrative. The player both *acts* and *reflects* on the narrative from a perspective similar to that of an author, from *outside* of the narrative construct, acting and reflecting on the structures and processes that make up the narrative as an artificial representation. Boal writes of turning passive spectators into actors. Here he is referring to the creative, critical, improvisational actors of his theatre of the oppressed. He does not consider passive actors who merely act out a role as written by an

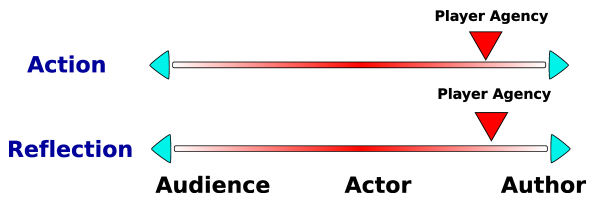

Figure 6. The role of player agency in the Boalian approach to interactive narrative.

author. Applied to interactive narrative, Boal's passive spectator corresponds to the role of player as passive actor as in the Aristotelian approach to interactive narrative. Boal's spect-actor (spectator elevated to actor) corresponds to the player elevated to co-author of the narrative with the designer of the interactive environment.

A story-model based on a nodal or modulated plot structure (section 3) seems the most obvious candidate for this approach. When in the role of actor, the player controls a character within the narrative, and may make fixed decisions at fixed points within the plot structure that drives the interactive narrative. When in the role of author the underlying plot structure is presented to the player directly, through an interface which allows the player to manipulate the structure itself. The player iteratively constructs or modifies a story by switching at will between these two roles, changing the story model, experiencing the result, changing the story model some more, and so on.[16]

This approach is non-immersive, emphasises the artificial, constructed nature of the interactive narrative, and focuses player agency on the structures and processes underlying the experience. Of the three approaches presented, the Boalian approach seems most appropriate to the constructivist motivation. Because learners are actively involved in constructing an interactive story, the form of learning is the most active and critical, least passive and receptive, of the three approaches. Learners construct their own understanding through exploring and interacting with the system. Not only are they active participants in the narrative, but the learners are fully aware of why they are participating. The Boalian approach is dialectical, not didactic as the Aristotelian approach is. It does not present a solution or model to be followed, instead it presents an anti-model to be debated. Some structure is inherent in the interaction with the envisioned system. The player-author is given a particular plot model and character roles to use as the building blocks of an interactive story, and can only construct what these building blocks, created by the designer of the environment, will allow. Yet by focusing player action *on* the underlying story model, rather than having the player act *within* this structure, player agency is maximised. The inherent conflict between narrative and player agency dissolves.

Such an interactive story player-authoring environment could be used in a *constructionist* [17] approach to learning. Players learn about the models, structures and processes, and modes of authoring that underlie interactive stories through constructing interactive stories. The constructed stories can then be *played* (with the authoring interface disabled) by peers as part of a peer review process.

The application of Boal's techniques could be fundamental to using this story construction process as a means to collaboratively discuss social issues. This aspect is most clear if you imagine the players

[13] In practice it is sometimes the spect-actors who devise a Forum Theatre for themselves to take part in, so that they have both authorship and agency over the Forum Theatre.

[14] Frasca presents a four-part semiotic model of simulation, which focuses on the process of an observer interpreting a simulation, with which he relates Forum Theatre to simulation [5, p.79].

[15] Specifically, Frasca describes a game derived from the popular series *The Sims* in which players would have access not only to surface characteristics of the game characters, but to the rules that govern character behaviours. Players would use these rules to construct models of problematic social situations and their solutions.

[16] Propp's *Morphology of the folktale* [19] may provide an ideal basis for constructing a story model for this approach. His description of the plot structure of folktales lends itself well to forming the building blocks of nodal or modulated plots, and he also provides clear descriptions of character roles and their actions with respect to the plot. Kashani [8] provides an excellent example of Propp's morphology applied to an interactive story environment using a nodal plot structure.

given an interactive story that presents a problem, an oppression of the player/protagonist character of the story. Players then discuss solutions to the problem through a series of modifications to the model underlying the interactive story. The process might be conducted as a workshop, with a person facilitating an interaction between several player-authors and a single interactive story environment.

The intention is not to claim that an interactive story authoring environment which attempts to combine the roles of game player and game designer will be a Boalian Forum Theatre applied to the digital medium. There are many ways in which this learning process will differ from Forum Theatre, and understanding these differences may be more useful than understanding the similarities. The question of how the virtual environment is used in the real world, how the learning experience goes on *around* the artifact, is crucial. The claim here is that computer-based interactive narrative is at the intersection between Boal's Forum Theatre and Papert's constructionism. Applied to interactive narrative, the two provide a promising approach.

7 CONCLUSION

When an Aristotelian approach is applied to interactive narrative the aim is for the system to deliver a well-formed narrative experience to the player. A conflict with player agency that necessitates putting the player in a passive role is inherent in this aim. The player *acts* from the perspective of a constrained actor within the narrative. But the player is encouraged to *reflect* on the narrative from the perspective of a passive spectator. This disparity between the perspectives of player agency in terms of action and reflection necessitates an attempt to maintain the player's 'suspension of disbelief' and to manipulate player perception and action, keeping them within the designed range of possibilities.

A Brechtian approach breaks 'suspension of disbelief' intentionally, aiming to highlight the artificiality of the experience. The player still acts from the perspective of a constrained actor within the narrative, but reflects on the narrative from a perspective outside of it, reflecting on the narrative as an artificial representation of reality.

A Boalian approach builds on the Brechtian approach by changing the perspective of player action to match that of player reflection. The player both acts and reflects on the narrative from an outside perspective, acting and reflecting on the story model from which the narrative is constructed. The aim is no longer to maintain a good narrative experience in spite of player agency, but to provide the player with the narrative construction kit most productive of player agency.

This review argues that the form of player agency in interactive narrative improves, with respect to the motivation of constructivist learning, as we move from an Aristotelian, to a Brechtian, to a Boalian approach.

The traditional question driving research in interactive narrative is: how can an interactive narrative environment deal with a high-degree of player agency, while maintaining a coherent and well-formed narrative? This question expresses the approach categorised here as Aristotelian interactive narrative. If the approach categorised as Boalian interactive narrative is taken, the question becomes quite different: how can an interactive narrative environment provide a story model that supports creative and critical expression through constructing interactive stories? This question motivates further research into four more specific questions: what kind of story model best supports creative and critical expression through constructing interactive stories? How can we design an interface and interface metaphors that allow intuitive interaction with this story model? How can we seamlessly combine the role of actor and author into one role for the player? How can a learning experience be structured within and around this virtual environment?

ACKNOWLEDGEMENTS

I would like to thank Mark Steedman of the Institute for Communicating and Collaborative Systems, Judy Robertson of Heriot Watt University, and John Sykes and the Games Interest Group of Glasgow Caledonian University for feedback and discussion on earlier versions of this paper, and to acknowledge the financial support of EPSRC.

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Interactive Generation of Dilemma-based Narratives

Heather Barber and **Daniel Kudenko** [1]

Abstract. This paper presents a system which automatically generates interactive stories. These are focused on dilemmas in order to create dramatic tension. The story designer is only required to provide genre specific storyworld knowledge, such as information on characters and their relations, locations and actions. In addition, the system is provided with knowledge of generic story actions and dilemmas which are based on those clichés encountered in many of today's soap operas. These dilemmas and story actions are instantiated for the given storyworld and a story planner creates sequences of actions that each lead to a dilemma for a character (who can be the user). The user interacts with the story by making decisions on relevant dilemmas and by freely choosing their own actions. Using this input, the system chooses and adapts future story lines according to the user's preferences.

1 INTRODUCTION

In recent years computer games from most genres have included a progressive story line to increase the immersive experience of the user and their enjoyment of the game. However, stories are often linear, and in almost all cases pre-defined, which reduces the replay value of these games. Research into interactive narrative generation (or interactive drama) tries to overcome these weaknesses. Most interactive drama systems (prominent examples include [15, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14]) are focused on generating short story lines and do not adapt to the user (see Section 13 for exceptions).

In this paper, we propose a system that generates interactive stories which are long (potentially infinitely so), and that adapt to the user's behaviour. To add dramatic tension, the story incorporates dilemmas as decision points for the user. These dilemmas are based on the clichés found in many contemporary soap operas, such as the trade-off between personal gain and loyalty to a friend. Overarcing stories connect these dilemmas as points of interaction within a coherent plotline that is dynamically created, based on the user's response and action choices.

Our goal is to keep the story designer's input to a minimum and the user involvement as high as possible. In the proposed system, the story designer provides the story background in the form of character information and other knowledge that relates to the world in which the story is to be created (e.g. the east end of London). The system then instantiates all generic knowledge on story actions and dilemmas accordingly and thus creates the narrative in collaboration with the user's actions. A considerably less interactive version of the system discussed here – with dilemmas only presented to the user – was introduced in [1].

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This paper is structured as follows. First a general overview of the system is first given, followed by a discussion of the story background representation. We proceed with a description of dilemmas; the story generator; integrating and responding to user actions; non-user dilemmas; and the user modelling component. The paper finishes with a brief overview of related work and conclusions.

2 SYSTEM OVERVIEW

The interactive drama knowledge base consists of: the storyworld (which contains information regarding the characters); story actions; and dilemmas which can occur in the storyworld. This information is partially genre dependent and provided by the story designer, with the remainder being hard coded. These components are drawn upon in the generation of a narrative through planning. The user is able to interact with the narrative generator, and their actions effect the story experienced. A user model is employed to ensure that the story's dramatic interest is maximised. The interactions between the system components are shown in figure 1. Each of these components is discussed further in the following sections.

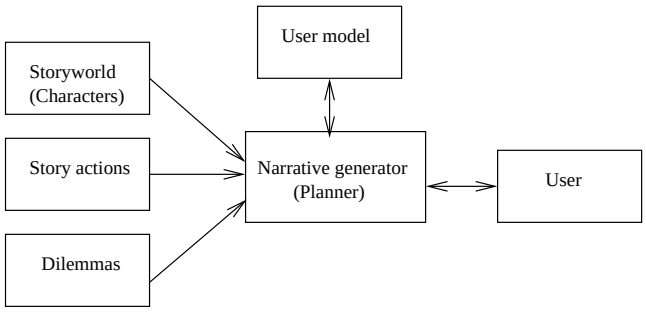

Figure 1. This figure shows the components of the system and how they interact.

3 THE STORYWORLD

The storyworld consists of characters and locations at which the characters can be. These characters have various associated traits, as detailed here.

- Each character's associated domain independent attributes can include information such as attractiveness, gender, sexuality and age group.
- Characteristics are slightly more variable, for example: generosity, morality and selfishness.

- It is possible to specify particular personalities, such as bad_boy and busybody. These genre specific character descriptions are those which are not fully deducible from other character traits and which relate to specific storylines within the current domain.
- Characters have storyworld relationships with one another, including friendship and love. They are able to disapprove of one another's partnerships. This can be for any one of a variety of reasons, including an age difference or snobbery. Relationships are unidirectional and have an associated strength, although feelings of one character for another affect the reciprocity.
- The characters hold storyworld principles, such as monogamy, which make their behaviour more believable. Under specified pressures and circumstances, principles can be broken (or their associated strength of belief reduced). Characters also have aspirations, for example wanting a baby. These principles and aspirations affect which actions a character participates in and the dilemmas in which they become involved.

A range of values is associated with each attribute and characteristic. A character's nature affects which actions they can participate in and also, ideally, the user's opinion of that character. The character's personal traits should be apparent to the user from the way the character acts within the storyworld. Each character should act in a manner which is consistent with their traits and how they have acted previously, while at the same time avoiding predictability.

A series of genre-specific locations are required by the storyworld. At any given time in the story, each character is at one of these locations. Direct interactions between characters can only take place if they are at the same location.

4 ACTIONS

Those actions which can take place within the storyworld must be specified for each domain. Every possible action should be included and although these vary between domains there remains a significant overlap.

The domain specific storyworld actions can include characters falling in love, becoming pregnant and being involved in crimes – such as drugging or murder. Each of these actions has associated conditions which must be satisfied before execution (preconditions) and effects which represent changes to the storyworld following execution. For example, the action of a character moving between locations l and k has preconditions of the character being at location l and there existing a path between locations l and k. The effects of this action are that the character is at location k and is no longer at location l. This follows the STRIPS representation.

Before an action is made available to the system for use within a storyline an applicability check is carried out. This ensures that the action is of the type that the acting character is likely to make. For example, a more attractive character can start to fancy a very generous character. A character's attributes, characteristics and personalities affect which actions are possible for that particular character as an action can only be utilised if its applicability is high enough for that character.

The user is able to specify their own actions within the scope of the current genre. This is discussed further in section 7.

5 DILEMMAS

Field [7] states that "drama is conflict", that the dramatic interest in a story centralises on its conflicts. In genres which make use of clichéd storylines these are usually found to be essentially conflicts (or dilemmas). Writers utilise these dilemmas in the creation of stories. A general form of each such clichéd dilemma can be determined, and a computerised storywriter can create an interactive drama around these.

Since the focal point of an interactive drama is the user, each dilemma should represent a conflict to that user. Within the course of the experience, they will be required to make fundamentally difficult decisions which will have negative outcomes whatever choice they make. There may also be decisions in which the user has to decide how to distribute limited benefits in different areas or to different characters.

Our experience showed that when more than two characters were involved in a dilemma, it was either expandable to multiple two character dilemmas, or the characters receiving payoffs naturally divided into two groups with the same resultant utility. Therefore a user decision on a dilemma will involve only two recipients of utility payoffs. Five such dilemma categories were identified. These do not consist of all payoff matrices for two users, as many such matrices would not involve a dilemma for the character making the decision. The relevant categories are: Betrayal (dilemma 1), Sacrifice (dilemma 2), Greater_Good (dilemma 3), Take_Down (dilemma 4) and Favour (dilemma 5). In order to involve a dilemma for the user, these may require characters to be friends or enemies. Where relevant, this is stated with the dilemma utility matrices in dilemmas 1 to 5.

In these dilemmas: A_X represents the decision of character X being to take action A; u_C^i represents the utility of character C for the respective action; and i denotes the relative value of the utility, i.e., u_C^1 is greater than u_C^2.

$$\begin{array}{c|c} A_X & (u_X^1, u_Y^2) \\ \hline \neg A_X & (u_X^2, u_Y^1) \end{array} \wedge friends(X,Y) \; - Betrayal \quad (1)$$

A character having the opportunity to be unfaithful to their partner is an example of the Betrayal dilemma.

$$\begin{array}{c|c} A_X & (u_X^2, u_Y^1) \\ \hline \neg A_X & (u_X^1, u_Y^2) \end{array} \wedge friends(X,Y) \; - Sacrifice \quad (2)$$

An example of the Sacrifice dilemma occurs when a character has committed a crime which their friend has been accused of. Here a character has the opportunity to admit to their crime and thus accept the punishment rather than allowing their friend to take the blame.

$$\begin{array}{c|c} A_X & (u_X^1, u_Y^1) \\ \hline \neg A_X & (u_X^2, u_Y^2) \end{array} \wedge enemies(X,Y) \; - GreaterGood \quad (3)$$

A character deciding whether to give something (such as information or a friend) to their enemy Y in order to save themself (and possibly also their family) would be experiencing the Greater Good dilemma.

$$\begin{array}{c|c} A_X & (u_X^2, u_Y^2) \\ \hline \neg A_X & (u_X^1, u_Y^1) \end{array} \wedge enemies(X,Y) \; - TakeDown \quad (4)$$

A character deciding whether to injure (or even kill) their enemy in full awareness that they will receive a punishment for this crime would be involved in the Take Down dilemma.

$$\begin{array}{c|c} A_X & (u_Y^1, u_Z^2) \\ \hline \neg A_X & (u_Y^2, u_Z^1) \end{array} \; - Favour \quad (5)$$

When presented with a favour dilemma the character making the decision will not receive any direct utility from their action regardless of their choice. An instance of this dilemma occurs when a character must choose between potential partners. It is necessary that there is no discernible benefit to the character making the decision of choosing one partner over the other.

As can be seen, dilemmas 1 and 2 are the inverse of one another, as are dilemmas 3 and 4. This means that any dilemma which falls into one of these categories can be inverted to become a dilemma of the other category. All five categories are kept to increase ease of dilemma identification within specific genres. From these categories (as given in equations 1 to 5) dilemma instances can be found and generalised within each domain. From the generalised form of the dilemma the system will be able to create new dilemmas. In the presentation of these to the user wholly original stories are created.

It will not be possible to create great literature in this way – the use of clichéd storylines prevents this. However, such stories are enjoyed by many people and this method is common in such genres as James Bond films, soap operas (soaps) and "chick flicks". The story is built around the cliché, and it is the cliché as well as the story which the audience appreciate, the very repetitiveness and familiarity of the dilemmas adding to the dramatic interest. It can only be imagined how much more enjoyment could arise from the user becoming a character in such domains, and experiencing the dilemmas first hand.

6 THE NARRATIVE GENERATOR

Prior to a dilemma being presented to the user certain conditions must be met within the storyworld. These are the preconditions of the dilemma. It is the task of the storywriting system to achieve these preconditions. This constitutes the build-up – the essence of the story itself. Given actions within the storyworld the system can use planning to satisfy a dilemma's preconditions. In this way a plan to achieve a dilemma becomes a storyline. The interactive drama is made up of a series of such substories, dynamically selected according to dramatic interest.

The system uses a modified GraphPlan planner [3] which utilises a STRIPS-style representation of actions. On being passed a dilemma, the planner finds all plans to achieve this dilemma given the current storyworld state and background knowledge. From these plans, that which is most dramatically interesting can be selected and execution attempted. If the plan is successful the corresponding dilemma is presented to the user. Once the user has made their choice, the system updates the storyworld state in accordance with that choice. The system can then plan from the new state in order to attempt presentation of another dilemma to the user – thus continuing the interactive drama. This sequence of events is demonstrated in fig. 2. From this figure it can be seen that the planner finds all plans in the story dependent on the current state and a given dilemma. If no plan can be found for this dilemma, another is selected. Once all plans have been found, the most dramatically interesting can be followed (providing the user cooperates), resulting in a new state from which the story continues.

The potential consequences of each decision must be clear to the user before they make their choice. Once they have chosen, these repercussions on the storyworld are implemented. The resultant state is thus entirely dependent on the user's decision.

The sequence in which the dilemmas are selected for planning is dependent on the story history, the frequency of dilemma use, dramatic interest and the user model. Dilemmas must depend on what

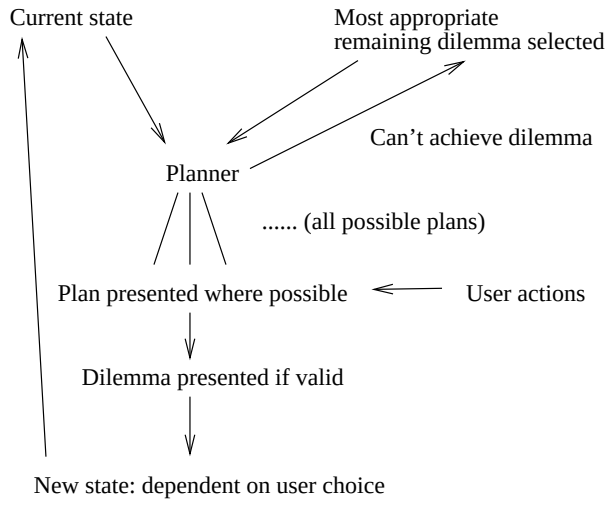

Figure 2. This figure gives an overview of the system moving between states dependent on plans, dilemmas and user decisions.

has happened previously and thus become part of a consistent story. Certain dilemmas only occur occasionally, others are more frequent. This will need to be determined for each domain, and considered when selecting each dilemma. It is necessary to plan for dilemmas which have a high dramatic interest, although this largely depends on the current user. The user model is discussed in section 10.

7 USER ACTIONS

This section discusses the methods used to integrate user actions into plans. The user should not have actions imposed on them as this would be very frustrating and unsatisfactory. The system thus allows the user to act as they desire within the storyworld. It must be ensured that the user is as free as possible while still experiencing dilemmas. The substory generated is essentially the same as that with no interaction, although its presentation may not succeed and thus replanning be required even after an appropriate plan has been found.

The planner initially assumes that the user will act in a manner consistent with the way characters with similar traits would act in soaps. Ideally a user model would give a more accurate idea of how the user will act. Once a plan has been chosen it is then presented to the user only inasmuch as is possible before it is necessary for the user to act for the plan to continue. This is the case when a precondition of an action or the dilemma requires a user action to be satisfied. If the user acts in a manner which satisfies the necessary preconditions at this stage then the presentation of the plan continues until a user action is required again. As soon as it becomes possible to present the dilemma this is done.

In its current version the system is control-based. This means that the user selects actions until they choose to pass control back to the system, which then acts until a user action is required to satisfy required preconditions. When the user has control they can take any number of actions. To ensure that the user does not feel constrained every act that other characters within the system can make is available to the user. The user can spend as long as they want considering their options.

The user inputs their action choices as two or three typed words which summarise the action they have chosen, for example 'move

club' signifies that the user wishes to move from their current location to the club. The system is capable of recognising a range of possibilities for each action. Additional options available to the user include being able to see the current state of the storyworld and information on other characters.

It is clear that the user will not always act as required by the plan. Any act which satisfies the preconditions of the next stage of the plan is acceptable, but even then the user has a wide range of options. There are various methods which can be used to overcome the problem, for example:

1. Multiple valid plans are maintained. The system only acts in accordance with those which the user is following. As soon as a plan becomes impossible, it will be removed from consideration.
2. An assumption model for the way which the user is likely to act should be created. This is discussed in section 14.
3. In some cases it is possible to adapt the plan to suit user actions, such as by changing the names of characters involved in a plan. Due to the possible actions being so strongly dependent on individual character traits this proved not to be a particularly useful method.
4. Plans with a minimal number of user actions can be chosen. This is not a favourable method as it tends to reduce the user's interaction with the story.
5. Shorter plans are favoured. This means that there are less opportunities for the user to act outside the plan, while still creating plans in which their actions will have an effect. Stories of the same length will involve more drama if plotlines are shorter.
6. The user is cooerced into acting in the way required by the current plan. For example, if it is required that the user moves from location l to location k their friend can go to location l and ask the user to join them in going to location k.

Of these methods 1, 5 and 6 are implemented to good effect in the current system. Methods 3 and 4 were decided not to be of benefit, for the reasons discussed.

As the user may require time to consider their actions, threads are utilised so that planning can take place while the user thinks. Potential plans are added to a list, and the system attempts to integrate the user's actions with the most appropriate valid plan.

8 CHARACTER RESPONSES

If characters other than the user only act within the build-up to a dilemma the experience can become frustrating for the user as they would not see any response to their actions unless they only act within plans. It is also unrealistic, as there are actions which take place in genres involving clichéd storylines which do not have any direct relevance to a specific dilemma. Such actions should be incorporated in the stories produced.

Identifying patterns in large numbers of user actions is complex and requiring this would reduce the extendibility of the system. Therefore a system based on tit for tat reactions and utility scores was designed. In each story state a numerical utility value is assigned to each character. Actions change this value due to the corresponding change to the affected character's score. When the user acts in a way which decreases the score of another character, that character responds by acting to decrease the user's score by the same amount. The use of utility values makes extension to additional actions much more practical, as it requires only the association of a value with each. This method also makes system responses less predictable and more versatile.

An example would occur when a character is fancied by the user, and thus has an associated positive score in that state. If the user stops fancying this character then the character's score is resultantly decreased. In this case it could be that the character responds by ceasing fancying of the user (if this is possible). There are many other action options available to the character, some which are less obvious and possibly more 'revenge' or 'reward' based. These are always consistent with action possibilities for the current genre. In this example, the character might feel rejected and thus encourage (or bully) the user to betray their principle and to steal.

Such responses to user actions take place when the system has not yet presented a dilemma. The system should respond to all user actions since the last dilemma was presented. This is because dilemmas form turning points in the story and are likely to change the direction as dilemma implications cause drastic changes to feelings between characters (including the user). This means that a response to all preceeding acts could well be unrealistic and outdated. If the user's actions have not changed the utility scores of any other characters then there is either no response or a response which is deemed to be the most appropriate, dependent on the user's actions and how they have affected the user.

It is possible for each character to respond to the user's actions towards them with up to two actions. If this was extended the relevance would be reduced as the story would move too far from the focus of a dilemma, thus reducing the dramatic interest of the experience. It is also possible that too lengthy a response would result in the user feeling less involved.

Actions which can occur in response to user actions are not always appropriate as part of a plan. For example it would not be appropriate to have a plan involving a character ceasing liking another character without prior actions to justify this. There are thus certain actions which can only occur in response to user actions. These are used in combination with the basic actions in order to determine appropriate responses to user actions. It is necessary to maintain a focus on responses which don't diverge too far from achievement of dilemmas.

Those actions which are a response to the user's actions will be in accordance with what they require and expect from the story. The responses update the state and thus effect the future path of the story - both immediately and in the longer term. These are not unrelated actions but should become an integral part of the story while serving also to increase the effect of the user's actions.

The interest of the story is increased through use of utility-based responses as the stories and order of dilemma presentation has less predictability when actions are not always in line with the plan. These responses increase the specificity of the story to a particular participant or user. They are likely to encourage the user to act more, as they see an immediate effect of their actions. This may also increase the believability of the characters.

9 CHARACTER DILEMMAS

If characters are not themselves faced with dilemmas they suffer from a lack of depth and interest. This is because they do not participate in the narrative except inasmuch as their actions affect or directly respond to the user. The system therefore allows characters other than the user to be faced with and make decisions on dilemmas.

All of the dilemmas are possible for any characters within the storyworld (given applicability and satisfaction of preconditions) so planning takes place as before. The only difference is that a non-user character is now the deciding participant. As long as the user is not involved in the plan, it is presented as a sequence of actions prior to a

dilemma – of which the decision and outcome are shown to the user.

When the plan for a dilemma requires user involvement the issues involved in incorporating their actions into a plan resurface. These are not always negative, as here the user is able to act in a way which could lead another character to a dilemma. This increases the user's involvement as they are able to attempt to manipulate others thus extending the complexity of the world.

The outcomes of dilemmas affecting the user have been adapted. If, for example, the dilemma presented to the user would result in a character choosing to run away with the user then where necessary this now involves the character asking the user to run away with them. This means that the user feels less controlled, although with a developed user model their response should always be predictable.

Once the next most appropriate dilemma type has been identified the system tries to present an instantiation to the user. If this fails an attempt is made to present this dilemma to another character, unless a large number of such dilemmas have just been presented in succession. Planning for character dilemmas takes place as the user thinks, in another thread which continuously updates a list of possible character dilemmas and corresponding plans.

The linearity of the storyline is removed by allowing other characters to experience dilemmas. The user sees that there is more happening in the world as they think and act. In some genres a linear focus on a single character may be more appropriate, as in James Bond films. The proportion of non-user dilemmas can thus be adjusted by the story designer dependent on the genre.

The system is able to create a non-interactive story. This means that there is always a story whether or not the user chooses to act within the storyworld. This creates the illusion that these characters exist outside the user's scope and thus increases their believability. It also gives the user the option of not acting in the world should they choose not to, whether for a long or brief period of time. They experience a story which at any time they have the option to become an active participant in.

When considering the frequency of dilemma use, care is taken to ensure that the user experiences a reasonable proportion and balance of dilemmas while the overall frequency is as would be expected for the genre. The interestingness is also taken into account, although here it is less important as the user is not being presented with the dilemma.

10 THE USER MODEL

The user of an interactive drama system should be modelled rather than controlled. The story should adapt to the user's interactions rather than forcing the user to follow a particular storyline.

The user model is used to identify which dilemmas are going to be most conflicting and dramatically interesting for the current user. There is an "interestingness" value associated with each dilemma. This value is initally fixed in accordance with the values found by a survey of diverse soap viewers. The value will adapt to suit the user and their modelled personality. The system searches for the most interesting story path to a pre-defined fixed depth (dependent on the size of the search space and the speed of the search and planning algorithms).

Each dilemma has associated assumptions as to how the modelled values change dependent on the user decision. Once they have made their choice, the user model is updated accordingly. A selection probability is associated with each criterion, so that the credibility given to the user model depends on how many times it has been updated. It additionally depends on how recently the criterion being utilised was updated – since the user and their opinions are likely to change through the course of the interactive drama. This user model is then be employed to approximate the probability of a user making a particular choice within a dilemma. It then calculates the expected total "interestingness" of that path. The system selects that dilemma which has the highest chance of leading to the most dramatically interesting experience for the user. A section of this search is shown graphically in fig. 3.

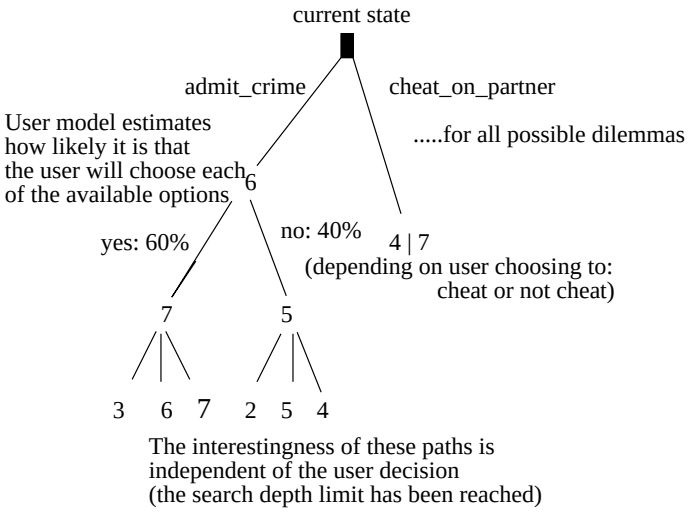

Figure 3. This figure shows a section of a potential user model. The expected interestingness (for the user) of each dilemma is given at each node, assuming that the highest score will be achieved from the final nodes. The prospected score of the admit_crime dilemma is 12.2 (6 for the admit crime dilemma summed with the expected maximum score for the following dilemma, i.e. 6 + 0.6(max(3,6,7)) + 0.4(max(2,5,4))). A similar calculation can be carried out for each path, and the most interesting subsequently selected.

In this story creation method, care must be taken to ensure that a single dilemma (or group of dilemmas) is not overused. In order to do so, the frequency of occurence for each dilemma (within the specified domain) must be considered.

11 EXAMPLE DOMAIN

The techniques discussed here are applicable in any genre which places a particular emphasis on stereotypes and clichés. It was decided to intially focus on the creation of an interactive soap. This domain does not require an overall story arc but rather involves an infinite series of 'mini-stories'.

The domain of soap operas is commonly understood to revolve around stereotypical storylines. In many cases, these involve a character being presented with a decision likely to result in negative outcomes either way. A range of such dilemmas which characters have faced in recent years from Neighbours, Home and Away, Coronation Street, Eastenders and Hollyoaks have been identified and generalised[2]. These soaps were selected for their accessibility, familiarity and popularity with the general public.

It was found that the soap dilemmas fell into only three of the five possible categories, namely Betrayal (1), Sacrifice (2) and Favour

[2] Thanks to George Barber for his knowledge of soaps and ability to identify such dilemmas.

(5). Figure 4 gives examples of these dilemmas, one of which is generalised in fig. 5.

Hollyoaks: Becca has the opportunity to cheat on her husband Jake with Justin, a schoolboy in her class.
Eastenders: Jane has to decide whether or not to cheat on her husband Ian with the local bad boy Grant.
Coronation Street: Danny has the opportunity to cheat on his wife with Leanne, his son's girlfriend.
Home and Away: Kim has to decide whether or not to cheat on his girlfriend with his best friend Hayley.
Neighbours: Stu has the opportunity to cheat on his institutionalised wife Cindy with a local pretty girl – who previously went out with his brother.

Figure 4. As can be seen from this small sample of similar dilemmas, the plotline of a character being presented with a dilemma involving cheating on their partner has been used in all of the examined soaps. This demonstrates the frequent use of clichéd storylines in soaps.

```
A_X: cheat_on_partner(character(X))
preconditions: partners(X,Y) ∧ loves(X,Z)
               ∧ loves(Z,X)
dilemma: ''Would you like to cheat on your
partner
      character Y with character Z who loves
you?''
if user chooses to cheat:
  add to state: cheating(X,Y,Z)
  update user model:
    honesty - lowered, faithfulness -
lowered,
    value_for_relationship with Y - lowered
if user chooses not to cheat:
  delete from state: loves(X,Z)
  update user model:
    honesty - raised, faithfulness - raised,
    value_for_relationship with Y - raised
```

Figure 5. A dilemma of type Betrayal which is frequently used in soaps (see fig. 1), and can be presented to the user of this interactive drama system.

All domain specific background knowledge was added to the system, including STRIPS-style actions (such as why two characters fall in love) and locations (for example club and house) which appear in the considered soaps. In fig. 6 an action from the system is shown with its pre- and postconditions.

```
Action: X starts to fancy Y
Preconds: fancies(Y,X) ∧ attractiveness X > 1
          ∧ attractiveness Y = 1
Effects: fancies(X,Y)
```

Figure 6. An action in the STRIPS representation in which any characters in the system can participate. Here, an attractive person fancies someone less attractive. In a soap world (where looks are very important) the less attractive character will begin to reciprocally fancy the more attractive.

Figure 7 shows a dilemma to a character other than the user and fig. 8 shows the user interacting with a plan and being presented with a dilemma. For clarity a single dilemma type is used throughout these examples, namely that which involves a character having to choose between potential partners. As can be seen, when the user is involved, they are free to choose their own actions, although they will be encouraged to participate in the plan as shown here. Figure 9 shows a character responding to the user in a manner unrelated to a specific plan.

```
Action is adam moves between park and club
Action is jill gets drunk
Action is adam gets drunk
adam starts to mutually fancy jill

adam has to choose whether to partner joe or
jill, where adam fancies both and the feeling
is mutual.
adam decides to go out with jill, they are
now partners, and joe no longer fancies adam
```

Figure 7. This figure shows the build-up to and presentation of a dilemma in which the user does not participate.

```
Action is john moves between shed and house
Your friend john has come to the house to ask
you to go to the club with them, would you
like to go?
y
You move between house and club
Action is john moves between house and club
Action is joe gets drunk
n
joe offers to buy you a drink. Will you
accept?
y
You accept the drink from joe and get drunk
Action is joe starts to fancy you
fancy joe
You start to fancy joe
Who would you like to partner: adam or joe?
Given that you fancy both and they both fancy
you.
adam
You have chosen adam, you and adam are now
partners.
As a result of your choice, joe fancies you
less.
```

Figure 8. This example shows the user participating in a dilemma plan and then being presented with this dilemma. Where necessary they are encouraged by other characters to participate in the current substory. User input is shown in italics. In the preceeding state the user already mutually fancies Adam.

12 EVALUATION

A sample of 8 people were asked to test the example domain discussed in section 11. Of these 4 were experienced game players

```
flirt adam
You flirt with adam
n
bert asks you to go to the club where they
will buy you a drink. Would you like to take
up this offer?
n
Action is adam flirts with you
```

Figure 9. The user's action decisions here (shown in italics) result in the system failing to present the current dilemma. The utility-based response of flirting with the user is thus created.

(group A), the remainder were not (group B). The users played for an average of 7 minutes. Although the game world was very limited at the time of testing, resulting in a lack of breadth in the stories, this serves to demonstrate the usability and potential of these techniques.

The users in group A found the story to have a reasonable level of interest, rating this and their enjoyment with an average score of 3/5. There was a strong belief that their actions were having an effect on the storyworld. None of these users believed in the storyworld but all felt that they would replay.

It was found that the users in group B struggled with the system. They felt a need for graphical depictions of other characters and their available options. In general, this group felt that the story had low interest and believability and only one enjoyed the experience. However they all felt that their actions were having some effect and all but one would almost certainly replay.

13 RELATED WORK

Other interactive drama systems in existence use planning techniques. Mimesis [15] uses planning to achieve the story goals. This is much longer-term planning and is less flexible around the user's interactions - which are either accommodated in re-planning or intervened with. In the I-Storytelling [4] system, hierarchal task network (HTN) planning is used. Each character is equipped with an HTN to follow in the story, which is defined before the story begins. There is very little allowance for user interactions in this system. In neither system is there any allowance for the story to be dynamically created, but only for it to be dynamically adjusted.

More recent systems use planning techniques to create stories in collaboration with a user. In [14] the planner is used to create each stage of a planning graph. The user is then able to choose from the subsequent options to decide which will appear in the final version of the story. The story presentation will be a mimesis-style experience. Points for re-planning and intervention by the system are specified by the user at the story creation stage, whereever a need is identified by the system. The shortcomings of Mimesis apply here also. The system described in [9] involves goal events which are planned for. The user is able to specify some of these events and to prompt re-planning for any. They may be ignored. The user must then select the final ordering of events - given any constraints. The resulting story is then graphically produced without any interaction, and at a much lower level than that at which the user aided in the story creation.

Fairclough's system [6] utilises planning techniques to dynamically create an interactive story in the fairy tale genre. There are a finite number of subplots and the user's actions determine which is experienced. A plan is then created for the subplot, which consists of a "sequence of character actions" given to the NPCs as goals. The user has a high level of freedom but they are not entirely flexible as they must adhere to a limited number of subplots. In contrast, the system proposed here will allow the user complete freedom. The user is also modelled so that the experience is more enjoyable for them personally. The dilemmas posed to the user in our system will increase the dramatic interest of the stories.

Other systems utilise a user model. In IDA [10] this is used only to direct the user within the story's pre-defined overall plot structure. IDtension [13] uses the user model to determine the user's nature and present dilemmas accordingly. In this system, the user takes turns with the system to choose actions for the story as a whole. If they are modelled to consistently choose actions which avoid violence, the system can present them with a dilemma in which they must choose a violent action in order to achieve the pre-defined goals of the story. The dilemmas here are for the user as an external observer of the system, rather than as a character.

14 CONCLUSIONS AND FUTURE WORK

In this paper we presented an interactive narrative generator that is able to create long, and potentially infinite, story lines that incorporate dilemmas to add dramatic tension. The stories are dynamically created based on user decisions and actions as well as adating to the user's tendencies.

In future work an assumption model will be created based on previous user actions, which will be used by the planner. This will involve an applicability check creating a set of user-specific actions and making these available to the planner. As a result the user should be more able to act naturally and still be presented with dilemmas. As the user model becomes more accurate through the story there will be less need for other methods.

It is intended to extend the preliminary evaluation of the system. This will involve incorporating more participants who will play for longer in an extended version of the system. The results will be statistically analysed.

The possible extension of utility-based responses to use as dilemma implications will be investigated. This would cause actions rather than just character relationship and emotion changes as a result of dilemma decisions. The stories could thus become more interesting. This is not a simple task as determining the exact score changes and maintaining relevance becomes much more difficult.

In the current system all character actions and dilemmas are shown to the user. This has the potential to adversely affect the story interest and change the manner in which the user acts. For example, if a murder is committed and the user sees all acts they will know who the murderer was and the mystery will be destroyed. This removes a wealth of story potential. It would thus be advantageous to decide when information will be presented to the user, eventually revealing everything which is relevant to explain later characters acts and dilemmas. This could also add to the realism as the characters in a story do not always see what happens to other characters. However as viewers usually will it is important to maintain a balance in this.

It may be advantageous to have a less turn-based interface, where the system and user can interrupt one another when acting. It is ultimately intended that these interactive drama worlds will be graphically simulated. In this way the user will see the storyworld as in conventional media but will be a character, and will be able to act as such. In the short term pictoral representations may be possible.

There is additionally the potential for the creation of soap-specific dramas, with characters as in real soaps, for example an interactive *Eastenders* soap.

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From the Event Log of a Social Simulation to Narrative Discourse: Content Planning in Story Generation

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Abstract.
This paper presents a proposal for implementing automated story telling of narrative threads within a multiplayer game based on selection and linearization of game logs. Our initial prototype operates on logs generated artificially by a social simulation built by a multiagent system. This provides a log of events for a large set of characters emulating real life behaviour over a certain period of time, with no need to carry out a real game involving several players over an equivalent time. The proposed method addresses tasks of content determination - filtering the non-relevant events out of the total log -, and discourse planning - organizing a possibly large set of parallel threads of events into a linear narrative discourse. Actual sentence planning and realization is not addressed, but rather performed in a crude manner to allow readable presentation of the generated material. Examples of system input and output are presented, and their relative merits are discussed. The final section discusses futures lines of work that may be worth exploring.

1 Introduction

Narrative games used for educational purposes have a great potential for improving the learning experience for students, both in terms of making it more interactive and by providing a strong entertainment component that might act as additional motivation. Part of this potential lies in the fact that there is a story underlying the game. This story is in most cases only implicit, in the sense that it arises as the game goes on. This is what makes it interactive, and it presents advantages from the point of view of entertainment. However, from a pedagogical standpoint, having access to an explicit version of the same story may provide additional advantages. On one hand, it may provide the student with a textual summary of how a particular game or gaming session developed. This may be of use when revising material that has already been covered, or in trying to understand what went wrong. The ability to revise is an important ingredient of the learning experience. If games are to take the role currently played by lectures or laboratory sessions, the explicit narratives of such games might play the part of the notes usually taken by students - as game players are unlikely to take notes as they play. On the other hand, explicit narratives reviewing particular sections of a game may constitute a useful tool in developing functionalities for assisting student/players in succesfully completing the game, maybe by explaining how a particular situation in which they find themselves has come about. It is common for current games to have a set level of difficulty, so that part of their entertainment value lies in the challenge of reaching the level of profficiency required. Players setting off to achieve it from a low level of proficiency may have a hard time at the initial stages, up to the point where many give up before achieving the goal. Providing the system with help facilities based on inserting small narratives explaining particular details required for solving puzzles may be seen as detracting from the challenge the game presents as means of entertainment, but they can be a positive addition from the pedagogical point of view if they ensure that more of the students setting out to solve the game actually reach the final goals. To make the point clear, an example is presented for a particular type of game. Some modern games, like MMORPGs[2], are played by several players over huge maps with many locations and many characters. These games usually have different agents interacting between them, and creating more or less complex relations that could be important for the global story of the gameplay. Non-player characters with coherent storylines, set in motion by the casual presence of one player, may meet other players at a later point. In order to understand their behaviour, this second player may need to know their story. This information is actually available in game logs, and it can be read by game masters, which can then write this data in a human readable form. If the system is to manage this task in an autonomous manner, capabilities for automated story telling must be provided. This paper presents a proposal for implementing such functionality: this text in natural language explaining the most interesting parts of the game can be generated by machines resorting to state of the art natural language generation technologies. The actual sequence of events that have happened is available, stored as a system log or in short-term memory. But telling it in an entertaining way, while at the same time filling in the gaps in the players knowledge of what has happened, is not a trivial task. Research in automated telling of stories attempts to fill this gap. The tasks involved will cover the basic requirements for identifying the most relevant material among a large search space of recorded events, converting a sequence of such events - or various parallel sequences of them - into a story, and presenting this selection to the user, already organised into narrative threads.

In order to avoid the task of collecting real data from massive multiplayer online games, we have based our initial prototype on a social simulation generated by a multiagent system. This provides a log of events for a large set of characters emulating real life behaviour over a certain period of time. The simulation we have used was initially developed for a different purpose in the field of experimental social sciences, and it has been adapted to its current purpose by customising the domain characteristics and the set of possible operations available to the agents to simulate a game-like environment.

We want to simulate a game system with many agents or game characters where the main key is the interaction between them, and

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the result is the emergent behaviour as a social group. This behaviour is a full story along a defined period of time, with interesting episodes, boring ones, communities trying to survive, and individual characters doing incredible things. We propose a multi-agent system with social capabilities, emulating a real fantasy medieval game. We have developed a multi-agent system that simulates a community of non-player characters being born, living and dying, where each agent or character saves its history. When all these histories are generated as data logs, we process them to build a structure where only the important facts are told, and that can be easily translated to natural language, freeing in this way the game masters or system administrators from writing this text themselves.

2 Previous Work

In order to develop this system, we have resorted to previous work in the fields of natural language generation and social simulations using multi-agent systems. A brief outline of the relevant studies is given in this section.

2.1 Automatic story generation

The general process of text generation takes place in several stages, during which the conceptual input is progressively refined by adding information that will shape the final text [9]. During the initial stages the concepts and messages that will appear in the final content are decided (*content determination*) and these messages are organised into a specific order and structure (*discourse planning*), and particular ways of describing each concept where it appears in the discourse plan are selected (*referring expression generation*). This results in a version of the discourse plan where the contents, the structure of the discourse, and the level of detail of each concept are already fixed. The *lexicalization* stage that follows decides which specific words and phrases should be chosen to express the domain concepts and relations which appear in the messages. A final stage of *surface realization* assembles all the relevant pieces into linguistically and typographically correct text. These tasks can be grouped into three separate sets: *content planning*, involving the first two, *sentence planning*, involving the second two, and *surface realization*.

The work presented in this paper is related to the first two tasks: content determination and discourse planning. Content determination is known to be always heavily dependent on the particular domain of operation, and tightly coupled with the particular kind of input being processed. Little generalization is possible for this task. Discourse planning determines the ordering and rhetorical relations of the logical messages, hereafter called facts, that the generated document is intended to convey. Most existing approaches to discourse planning are based on either rhetorical structure theory (RST) [5, 4] or schemata [6].

2.2 Social systems

Social phenomena are extremely complicated and unpredictable, since they involve complex interaction and mutual interdependence networks. Sociologic explanations deal with large complex models, with so many dynamic factors involved, they are not subject to laws, but to trends, which can affect individuals in a probabilistic way.

A social system consists of a collection of individuals that interact among them, evolving autonomously and motivated by their own beliefs and personal goals, and the circumstances of their social environment. Due to the mentioned complexity, techniques are required that consider how global behaviour can be derived from the real subjects' behaviours, which are fundamental in any social system. In particular, there is an interest in observing the emergent behaviour that results from the interactions of individuals as a way to discover and analyse the construction and evolution of social patterns.

A multi-agent system (MAS) consists of a set of autonomous software entities (the agents) that interact among them and with their environment. Autonomy means that agents are active entities that can take their own decisions. The agent paradigm assimilates quite well to the individual in a social system. In fact, there are numerous works in agent theory on organisational issues of MAS. Also, theories from the field of Psychology have been incorporated to design agent behaviour, being the most extended the Believes-Desires-Intentions (BDI) model, in the work of [2].

With this perspective, agent-based simulation tools have been developed in recent years to explore the complexity of social dynamics. In this way agents' reactions can be monitored in an observable environment, defining the lines of system evolution. This provides a platform for empirical studies of social systems. And because of that, the specification of characteristics and behaviour of each agent is critical, so it can manage the dimensions of the studied problem. A screenshot of one of these tools is shown in Figure 1.

In the MAS designed, as explained in [7], the agents have been developed with several main attributes: from simple ones such as sex or age, to complex ones, like for example ideology or educational level. The population in the agents' society (as in real societies) also experiments demographic changes: individuals are subject to some life-cycle patterns: they get married, reproduce and die, going through several stages where they follow some intentional and behavioural patterns.

Moreover, the agents/individuals can build and be part of relational groups with other agents: they can communicate with other close agents, leading to friendship relationships determined by the rate of similarity. Or, on the other hand, they can build family nuclei as children are born close to their parents.

Thanks to the underlying sociological model, the parameters of the social simulation system fit all together logically. In this way, the system may be configured to reflect the parameters (such as average number of children per couple, or mean of male average age of death) from a specific country or even import data from surveys that specify the attributes of the agents, reflecting the behaviour of the given population.

Besides, due to the relative simplicity of the agents, the system can manage hundreds of them, reaching the necessary amount for observing an emergent behaviour that results from the interactions of individuals, leading to the appearance of social patterns than can be studied. And for this study, during and after the execution of the simulation tool several graphs may be plotted that reflect the evolution of the main attributes of the social system.

3 Story Generation

Our approach to story generation is based on three tasks: *content determination*, *discourse planning* and *sentence planning*:

- In *content determination* we choose which data is going to be useful for the final narration. In this stage we suppress irrelevant facts present in the log, obtaining a version where redundant or useless data is removed. We can see this step as a "filter" of the log.
- *Discourse planning* consists on identifying a proper order of presentation of the previous data. We apply a particular technique (we

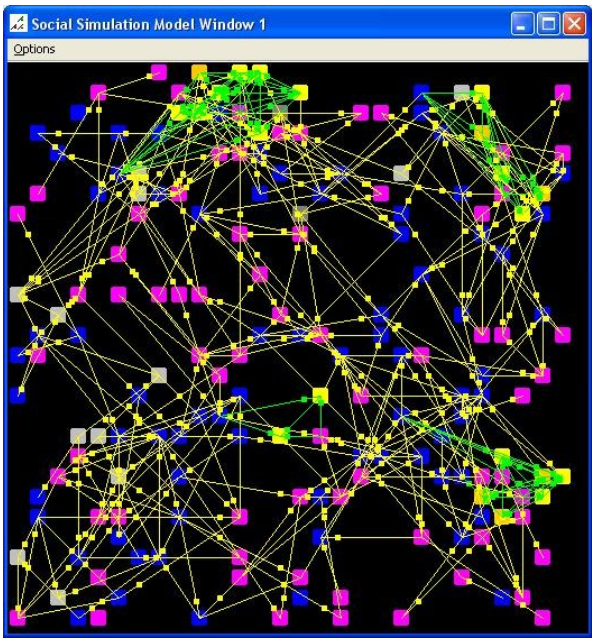

Figure 1. Screenshot of the social simulation

can use several algorithms, later this will be explained), and give the selected data generated in the *content determination* stage a particular order of narration, considered interesting for the readers of the final text.

- Then, we can perform *sentence planning*. This last step is the final process to be done, where the ordered log that represents a story in a structured form is translated to a natural language text.

It is not necessary to run these steps in sequential order. We have decided to join the two first steps into a single one; however, they could be done separated. Next we explain the solutions we have used for this work for each of these previous steps.

3.1 A Manual Story Generation Tool

Before creating a fully automatic system, we want to know which rules we, as humans, apply in story generation. That is the reason why we have created a tool for manual story generation, *Herodotus*. With this tool it is possible, with a simple few mouse clicks, to "draw" a full discourse from the facts and the logs recorded during an execution of a multi-character system.

With *Herodotus* it is possible to perform *content determination*, excluding from the final story those facts that we consider to be boring or not relevant; *discourse planning*, creating the components needed to define a particular narration: relationships between facts (nexus between consecutive facts, like "while", "then" or "before that"), *discourse atoms*, or blocks of facts which are a semantic units (can be seen as paragraphs) and start and end points of the story; and simple *sentence planning*, with template-based solutions for transforming facts into text. This tool can also export a file in each step, in this way, for example, we could do *content determination* and *discourse planning*, export the result, and run a different program to generate natural language text, or an animated summarised reproduction of the gameplay.

To use *Herodotus* one only needs to load an XML file from the multi-agent system or from the log of a real game. Then, the full list of logs for each agent/player becomes visible in the main panel, with their facts, ordered by time. Once loaded, the log can be edited just by dragging with the mouse, drawing lines that represent relationships between the facts.

The facts can also be removed from the list, as well as the full logs, just by selecting them by clicking over them with the mouse, and pressing a button on the toolbar. Also, logs and facts can be added by hand, creating new threads of action and new characters.

Once we have connected the facts in order, and having removed those facts that are not important, it is only needed to group the events in blocks, that will be the *discourse atoms*, as we have explained before.

In Figure 2 we can see a screen capture of *Herodotus* working.

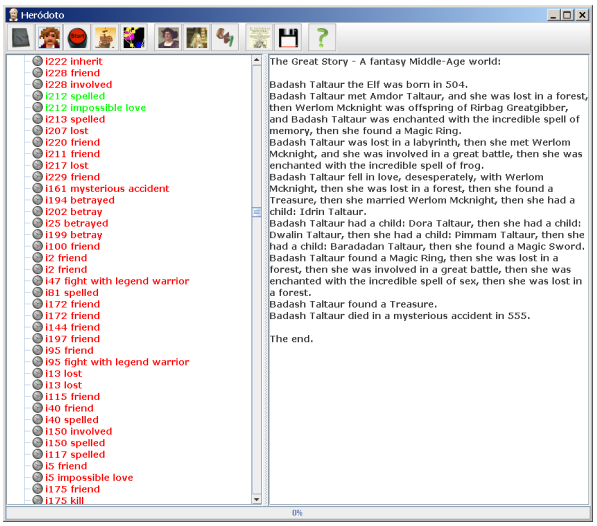

Figure 2. Screenshot of *Herodotus*

3.2 Adapting the MAS for Story Generation

The ideas expressed above concerning social simulations using multiagent systems are the core of action from which we have built the whole narrative system. Several changes to the original MAS have to be made in the perspective of execution to be able to generate full logs of action which will be the basis for the texts describing the storyline. It is necessary to shift the point of view from data acquisition to log generation. These logs must save the data in such a way that story generation can be carried out as easily as possible. We do not need numerical data, but semantic content that can be interpreted by the rules as we interpret them, because we want the story generation to be as close as possible to what humans might have done faced with similar sets of events.

We changed the meaning of the actions of the agents, not only by changing their names and the sets of them, as explained below in 3.3, but also by changing our interpretation of them, creating in this way a rather different world. For example, a value of "low" in economy has a particular meaning in the social simulation (a small house, no car), but in a Middle-Age time setting, a "low economy" means that the character is a peasant. Following this, the semantics we assign

to each fact affect the significance of that fact in particular. A “low economy” character in the medieval setting does not have the same interest than a “low economy” character in a modern society.

3.3 Adapting the MAS to a New Environment

Several minor changes have been introduced in the designed MAS for its adaptation to a new environment: a Fantasy Medieval World far from the previous Post-Modern context. Thus, we have introduced Name and Last Name apart from the ID of each agent, together with the inheritance of the Last Name: this will be useful for telling the stories of lineages, and for personal events. We added a new attribute to each individual: the race, so they can be elves, humans, dwarfs... Thanks to the modular structure of the system it has not been a difficult task to achieve.

Other changes are related to the system structure. One problem was the involvement of non natural deaths, never considered in the old MAS. We added a random possibility of dying for each agent, allowing the possibility that we can relate this early death to the betrayal of a friend, poisoning by a wife, or even a mysterious accident.

The finishing touches arrived with the recording of the sequence of “life events” for every individual. But usual life events, like having friends, finding a couple, or the birth of children, are not interesting enough to build an exciting fantasy adventure. Because of that, we have included new types of events related to this context that will appear randomly. Thus, along his path, the agent can suffer several spells (loss of memory, fireball... or even change of sex!), kill horrible monsters (ogres, dragons), get lost in mazes or dark forests, find treasures and magic objects in dangerous dungeons... In this way we can build a really amazing (and sometimes weird) story, with several characters that evolve and interact among them.

At the end of simulation, this collection of events, together with the agents’ characteristics, is exported to an XML file. The XML-Schema pattern that rests beneath is not context-dependant, so the same format can be applied to other simulation environments. This file will be imported by a tool that will continue with the process of generating a story from the lives of some of these agents: the most interesting ones.

Here we present an explained example of the generated XML with the important information of each agent. In Figure 3 we can see the header of the file.

```
<?xml version="1.0" encoding="iso-8859-1"?>
<Story Id="fantasy">
 <Description>
   A fantasy Middle-Age world
 </Description>
```

Figure 3. XML header of a log

Now the logs of every agent are listed: the initial ones, together with the next generations that appear during the simulation. Here we show just one of these logs: the one corresponding to the individual that will be selected as star of our story.

Each log is divided in two main sections. The first one (Figure 4) corresponds to the characteristics of the agent: each attribute of the character has two parameters, expressed as XML attributes: its ID (identifier of the attribute) and its Value. The value of these keys is, of course, context-dependant: here they represent aspects like its race or how religious the character is.

```
<Log Id="i212">
  <Description>
    Log of a character of the simulation.
  </Description>
  <Attribute Id="name"
      Value="badash"/>
  <Attribute Id="last_name"
      Value="taltaur"/>
  <Attribute Id="race"
      Value="elf"/>
  <Attribute Id="sex"
      Value="female"/>
  ...
  <Attribute Id="religion"
      Value="very religious"/>
```

Figure 4. Attributes of a character

The second main section (Figure 5) is the collection of life events, associated with the time in which they took place. As in the previous sections, XML attributes are context-free, but values of these attributes depend on the context. Thus, we can read in the full log (here we only show a small fragment), that in the year 515, the elf Badash Taltaur suffered a spell that transformed her into a frog. Or, analyzing the chain of events, we can see that the impossible love of her youth was, after she grew to be an adult, her formal couple, giving her many children and living happily... at least for some years.

```
  <Events>
   ...
   <Event Id="e9" Time="515"
      Action="spelled" Param="frog"/>
   <Event Id="e10" Time="515"
      Action="impossible love"
      Param="i229"/>
   ...
   <Event Id="e14" Time="526"
      Action="couple" Param="i229"/>
   <Event Id="e15" Time="526"
      Action="child" Param="i258"/>
   <Event Id="e16" Time="526"
  </Events>
</Log>
```

Figure 5. Events of a character

3.4 A Rule-Based Story Generation System

Given appropriate configuration parameters the social simulation generates a set of results which is sufficiently complex to constitute an interesting challenge for content planning. For this purpose, we have extended the manual story generation tool with an automatic story generation system. This program accepts a thread of facts from each agent of a defined set, and analyzes the connections and relations between these threads in time.

In our current design, we have chosen to perform an iteration through the elements of the log, using a rule-based system. Our first try was to implement the rule system in Jess [3], but, although it did work, the execution was extremely slow, and it required enormous amounts of memory. In contrast, writing rules in Jess is much easier than in Java, language in which we have developed the final version.

We have defined a set of domain-dependent rules for this problem in particular. We want to keep separated the general application of story generation (the editor *Herodotus*, structures for storing the stories, the natural language text generator, etc.) from ad-hoc content specialized for the specific system or a particular game. In this way the only work needed for adapting the application to other domains is restricted to defining the rules that establish which facts are important, and how they are going to appear in the final text, presentation or animation.

We have considered these rules to be expert knowledge. In the domain we are working on we cannot ignore the semantics present in the data saved in the logs during the gameplay for story generation. The meaning of particular attributes, not measured with numerical weights, must be taken into account before narrating a log: killing a red dragon is usually more interesting than killing a little spider. Of course, we can set some numerical values, as "kill-dragon interest", that should be a higher value than "kill-spider interest", but the final discourse will be made interesting with some "hand-made" rules, established by the system administrator, or perhaps the game-master.

3.4.1 Content Determination

As commented before, the first thing to do is to determine which data is not going to be told, and remove it. There are many possible solutions for this problem. The one we have used is to give a *factor of interest* to the characters. This interest factor is only a numerical value that represents how important it is for that character to appear in the story, not necessarily the comparative importance of that character with respect to other characters in the story. The value can represent real interest, coherence, fun, or any other reason why a given element from the logs should appear in the final text. In this way, a unimportant character can have a high *factor of interest*, because it is necessary that such character appears in the story. This factor is divided in two values:

- *Base interest* ($I_b(X)$) is the value we associate with the facts of some character X, and with their attributes. In this way, the character can be easily evaluated. With the attributes we can design a heuristic function h that represents the significance of some fact in the life of that character, given the attributes. It is usual for a man to fall in love, but not for an orc. That is why falling in love is more interesting in an orc's life than in a human's life. The actual method for computing $I_b(X)$ is shown in Formula 1 below,

$$I_b(X) = \sum_{i=1}^{n} f_i \cdot h\left(X, i\right) \tag{1}$$

  where f_i is the interest that we assign by hand for the fact i, x is the character, and $h(x, i)$ is the weight for the appearance of i in the life of x. The value of h is calculated with the type of i (what kind of fact it is) and with the attributes of x (if it is an elf, or an orc).
- *Relationship interest* ($I_r(X)$) is the level of importance of a character X calculated from the interest of their relationships with other characters: friends, foes, offspring, etc. We could not build a good factor of interest by considering only the characters as individuals, so we added this additional value. As before, the attributes of a character determine the final interest. We have a new function, g, depending on the relationship and the two characters, that represents the true interest of a relation: two elfs can easily be friends, but it is very strange (and perhaps we should tell about it) a friendship between an elf and an orc. The actual value is obtained using Formula 2 below,

$$I_r(X) = \sum_{i=1}^{n} I_b(Y) \cdot g\left(X, Y, i\right) \tag{2}$$

  where $I_b(Y)$ is the *base interest* of the character who has the relation i with X, and g is the heuristic function of the relationship i between different characters X and Y. The value of g is calculated with the type of i (what kind of fact it is) and with the attributes of x and y (if they are two orcs, or an orc and an elf, for example).

The final *factor of interest* is, in our current implementation, obtained according to Formula 3:

$$I_f = I_b + I_r \tag{3}$$

Once we have this value calculated, we have a new explicit data that will determine what is going to appear in the final structure. With the "interest" and some rules, like redundancy elimination (delete symmetric data: A is friend of B, and B is friend of A, then delete A or B), omission of irrelevant characters (those that are just born at some stage of the gameplay and then die at some later stage with little intervening activity), and of course, an importance filter (remove those characters whose *factor of interest* falls below a given threshold), we can have a set of facts and characters ready to form part of the final story. With these and other rules and filters, we can determine not only which characters are going to appear, but also which of their facts are going to be shown. The particular solution applied in generating the interest factor ensures that facts that are related to important characters are always included. This is intended to avoid the risk of eliminating non-interesting elements that may be of importance in a plot.

3.4.2 Discourse Planning

In discourse planning, basically we just reorder the facts in the story, and adapt the relationships between them. This is, in terms of computing, an easy task. But the goal of discourse planning is not only organizing the facts stored in the log, but inferring the guidelines of the story, giving them priority, and making them the main structure of the narration.

Several tasks must be accomplished in order to create a meaningful, clear and interesting story. In fact, we have found that these tasks are very dependent on the domain, and on what we want to present in the final story. While, as we have verified, adjusting the *factor of interest* to appropriate values is usually good enough for *content determination*, in discourse planning this is not true. It is very difficult to write general rules that generate different stories for different domains.

What we have done is to define ad-hoc rules for the domain we are working on, to process the particular data we have; and rules to generate the stories that we think that could be interesting for the reader. This rules are based on the three sets of data that we have: *facts content*, *attributes of the characters* and the *time*.

Some of this rules are, for example, to narrate the birth and death date of the main character only, to maintain a more or less time-ordered discourse, to talk about the unusual facts only, and so on. If we wanted to generate stories of fairy tales, for example, we could have omitted the dates, and we could have ordered the facts in a different way, trying to hide data that is only important in the end of the story.

It is important the way we manage time. In [1] we can see many ways of representing time, very related to this work. At this moment we consider that facts are instantaneous, ignoring intervals and time reasoning. We generate the time nexus between facts also with rules, and we have verified that, for simple narrations, this could be sufficient.

Once we processed the initial log, and having performed *content determination* and *discourse planning*, we can generate the final result. This result can be not only text, but also a script that controls an animation, a generated comic, or a summarised reproduction of the gameplay.

3.4.3 Sentence Planning

The final generation of the story is not only a nice way of showing the results. It can make the discourse interesting or boring, even if the order of the facts resulting from *discourse planning* is bad or good, respectively. Thus, we cannot ignore this step if we want to evaluate the generated content. It is not the same to say "Elrond was an Elf. He had a daughter called Arwen. Elrond was friend of Aragorn.", as to say "Elrond the Elf, father of Arwen, was friend of Aragorn the King". The final form of sentences not only gives beauty to the text, but may also convey information not actually present in the data structure. We can infer, in the second sentence, that Elrond is somebody important, as Arwen, and Aragorn is going to play a main role in the story. This knowledge is not contained in the first sentence. To achieve computational modeling of these characteristics is currently beyond the scope of this paper, but we intend to address it in future work.

The actual examples of output text presented in this paper have been generated with the use of a simple template-based surface realizer built on purpose for this particular application, and which produces monotonous text with little inflexion and no concern for literary style. This is because the main concern of the research reported here has been the succesful completion of the content determination and discourse planning tasks. For this purpose, such output texts are sufficient, and yet considerably easier for the reader to understand than the corresponding XML output files. The final result in terms of stories to be read by humans may be considerably improved by resorting to an existing sentence planning application. In future work, we intend to address this problem by integrating the present work with the PRINCE generator [8].

3.5 An Example

Now, we show a real example of our application. The multi-agent system is capable of running parametrized simulations, changing the number of characters, probabilities of the facts, years of simulation, and all other attributes of the system. Once executed, the system generates logs in XML, like the ones we have presented in 3.3.

At this stage, the story generation application reads the resulting XML file, and outputs a text. This example is the result of a simulation of the life of 200 initial characters and their descendants over a time span of 80 years. The system has inferred who is the most important character, and it produces the following rendition of her mortal life:

The Great Story - A fantasy Middle-Age world:
Badash Taltaur the Elf was born in 504.
Badash Taltaur met Amdor Taltaur, and she was lost in a forest, then she was enchanted with the incredible spell of memory, then she found a Magic Ring.
Badash Taltaur was lost in a labyrinth, then she met Werlom Mcknight, and Werlom Mcknight was offspring of Rirbag Greatgibber, and Badash Taltaur was involved in a great battle, then she was enchanted with the incredible spell of frog.
Badash Taltaur fell in love, desesperately, with Werlom Mcknight, then she was lost in a forest, then she found a Treasure, then she married Werlom Mcknight, then she had a child: Idrin Taltaur.
Badash Taltaur had a child: Dora Taltaur, then she had a child: Dwalin Taltaur, then she had a child: Pimmam Taltaur, then she had a child: Baradadan Taltaur, then she found a Magic Sword.
Badash Taltaur found a Magic Ring, then she was lost in a forest, then she was involved in a great battle, then she was enchanted with the incredible spell of sex, then she was lost in a forest.
Badash Taltaur found a Treasure.
Badash Taltaur died in a mysterious accident in 555.
The end.

4 Discussion

There are three main points worth discussing in an analysis of the proposed story generation solution: the possibility of evaluating results by comparing with human performance over similar tasks, the possible role of the sentence planning solution employed in the perceived quality of the output, and the particular choice of implementation that has been used.

4.1 Evaluation Against Human Performance

We are not evaluating if the story is interesting or funny, yet. We are only focusing on how similar are the machine generated stories with those stories that could be written by humans from the same source. We will keep on refining, in particular, the *content determination* process, because the output of this step is where we decide the interest of the elements of the story.

It would be interesting to compare the resulting work of the application of *content determination* and *discourse planning* in a log from a gameplay presented on this paper with a manual generation of the same log. In this way, we could see if the rules that we have applied in the code (filtering, ordering, connections between events) are those which would be applied by a human narrator. This task is, of course, possible, but the cost in time and human effort is very high. To perform the previous tasks by hand, over a log of 500 characters, could mean several days of work.

This prevents us, in principle, from evaluating how correct our application is, but it is an indicator of the utility of this work. This kind of story generation is very hard to do by humans, and can be easily done by machines. However, one possible evaluation of the system could be to ask a group a people to write a text describing a small set of facts of the log. This would provide an evaluation of the discourse planning stage of the system, but only partially address the evaluation of content determination - unless an evaluator chooses to omit a fact included in the selected set. In this way, we could compare human generated texts with machine generated ones.

4.2 The Effect of Bad Sentence Planning on Perceived Quality

Relative to the final output of the present work, it is obvious that the final example of generated text that we have presented does not have

a nice form, and the narration is a little boring. The reason is that the *sentence planner* we are using is a skeleton implementation not even intended to be passably correct at its task.

This can be easily illustrated by a close analysis of the sentence planning tasks that are performed poorly in the given example, and considering how the text might have improved if those tasks were actually addressed in the implementation.

An important issue is how the sentence planner decides to represent the fact that a particular set of facts have been grouped by the discourse planner into a block of related events, to be narrated as a distinct thread within the discourse. In the current implementation this is simply solved by chunking all such facts into a single sentence, clumsily linked together with discourse markers indicating some kind of sequence. This can be seen in the example above in fragments such as:

> *Badash Taltaur met Amdor Taltaur, and she was lost in a forest, then she was enchanted with the incredible spell of memory, then she found a Magic Ring.*

This could easily be improved if, for instance, a simple sequence of sentences where used:

> *Badash Taltaur met Amdor Taltaur. She was lost in a forest. She was enchanted with the incredible spell of memory. She found a Magic Ring.*

However this obscures the fact that there are indeed chronological relations linking these particular facts with one another. A complex sentence planner would have to take this into account, and possible decide to give up the chronological information in favour of more fluid text.

Another related problem concerns sentence aggregation. The current sentence planner is incapable of detecting that a fragment such as:

> *...then she married Werlom Mcknight, then she had a child: Idrin Taltaur.*
> *Badash Taltaur had a child: Dora Taltaur, then she had a child: Dwalin Taltaur, then she had a child: Pimmam Taltaur, then she had a child: Baradadan Taltaur,*

might be considerably easier to read in a form like:

> *She married Werlom McKnight. They had five children: Idrin Taltaur, Dora Taltaur, Dwalin Taltaur, Pimmam Taltaur and Baradadan Taltaur.*

This transformation seems simple but involves at least an abstraction that is not trivial: the fact that a set of facts with the same predicate can be regrouped as a single predicate with a plural compound second argument.

This same example illustrates a different problem, that of referring expression generation. The sentence planner does indeed address this task in a clumsy manner, deciding at different places in the discourse to refer to a given character either by its full name or by a pronoun. This could be greatly improved, especially if it were considered in its interaction with elements such as additional sentence boundaries arising from a more refined realization of narrative threads. Additional issues related with this task arise from the fact that, if they are mentioned in close proximity, knowing the surname of the parents one may omit the surnames of all their children. This could lead to an even more refined version of the example above:

> *She married Werlom McKnight. They had five children: Idrin, Dora, Dwalin, Pimmam and Baradadan.*

4.3 Implementation Issues: Modularity vs. Efficiency

Relative to the implementation, it is also worth discussing the efficiency problems we have encountered using a declarative rule definition system like Jess. We first tried to build the whole rule system, and the evaluation of every fact present in the log, just using an implementation written in Jess. But it has problems of efficiency, because the algorithm behind Jess (the *Rete* algorithm), works in a way that is not optimal for our problem in particular.

We could have, then, implemented a hybrid system, and, while this is possible, the remaining content that could have been written in Jess was very reduced and easily translatable to Java. For that reason, we decided to stop using Jess, at least for this work.

As an example of rule, we present a definition of a simple filter that removes from the list of facts, those whose interest is equal to zero.

In Figure 6 we show the code as we implemented using Jess. The line "`(event (type ?type)(interest 0))`" means "that event of a defined type that has no interest". The other conditions in the rule are needed for the interface with Java (with the data structures). The resulting action of the rule is to remove, from the story, that fact.

```
(defrule remove-non-interesting
    (story (OBJECT ?story) (facts ?facts))
    (fact (type ?type)(OBJECT ?fact))
    (test (?facts contains ?fact))
    (event (type ?type)(interest 0))
    =>
    (?story remove ?fact)
    )
```

Figure 6. Rule implemented in *Jess*

The corresponding code in Java is the one we show in Figure 7. This implementation is much faster. If we add more rules to the system, and make them sequential in a Java program, it will be even more efficient than if we implement the rules in Jess.

```
ListIterator<Fact> it = facts.listIterator();
while (it.hasNext()) {
  Fact h = it.next();
  if (h.getInterest() == 0) {
    it.remove();
  }
}
```

Figure 7. Rule implemented in *Java*

5 Conclusions

We have presented a system where interactions between agents over a long period of time can be told in natural language automatically. With this work MMORPGs can generate texts describing the gameplay for different audiences and purposes. The text could be generated at the end of the game or while a player is still playing, or it could be the script for a 3D, or a generated comic.

We have shown a particular way of generating the stories, based on rules. We have explained a three-step process for performing this task, and we have verified that for *discourse planning*, the rule-system is very dependent on the domain, and the desired type of story.

Although the implementation includes an application for the manual development of narrative structures from a log of events, it has proved impossible to contrast the results generated by the application with any manually obtained equivalent due to the sheer size of the input logs that the application is currently handling. The effort involved for human evaluators is too large for voluntary participation.

The results of the system are less impressive - when rendered in a readable text format - than they might have been if the system included an elaborate sentence planning module. The current version is just a skeleton implementation that lets down an otherwise acceptably selected and planned discourse.

6 Future work

We plan to empower the multi-agent system, through several lines of evolution. The main point where improving is always required is to build a more interesting story. The introduction of random events was a huge step in this direction, and more improvements in this field can have incredible results.

We can add more characteristics to the agents, selecting the most attractive for the context. For example, including the profession or role of each agent could be a great idea for improving the story told: knight, king, princess, wizard, priest, peasant... If a peasant kills a dragon, would be much more heroic than if a knight does so. Another good characteristic to be introduced is geographical position. In our social simulation there is a graphical visualization of the agents, distributed in a space. If we parse this (x, y) positions dividing the space into countries, we would have knights that come from a far kingdom to save the princess.

Adding characteristics is now a particular field of the agents... but what about if we give "personality" to the inanimate objects? If we give an ID and a Name to the objects of the events, we would have events like: "lost in the Lorien Forest", "found the Anduril sword", or "killed by the dragon Smaug". These events can be analyzed to generate stories in which the dragon Smaug killed three knights (with their names), but the fourth one, Aragorn, at last killed him and freed the Gondor kingdom.

The relationships between agents represent another sector where we can add complexity. New type of relations could be included: hate (natural feeling between orcs and elfs), complex family relationships (like cousins), to belong to the same religious order...

The most part of the fantastic life events (like killing a dragon) are generated randomly in every agent. Thus, the events are particular for each agent. A new type of event could be generated: a common random event, which could affect to lots of agents at the same time (maybe to the whole world, maybe to just one kingdom). For example, a huge battle in the year 527 between dwarfs and orcs, killing lots of them, harming others, killing loved ones... and even it can lead to a prince that inherit the crown of his dead father.

Other improvements are planned for the story generation tool. A new objective can be to find a more efficient alternative to the one we tried with Jess only, perhaps a hybrid implementation between the speed of a procedural language, and the flexibility and power of a rule definition language, so the tool can be built in a more modular way, and also having the benefit of an easier to write system. Of course, another line of evolution is to enlarge the amount of rules that control the rule-based system, so more precise and complex knowledge can be used.

Another important objective is to apply more sophisticated time representation and reasoning concepts for fact and block nexus. It is very important to focus on how we narrate the story in terms of choosing what should be told before, and how we connect it with the rest of the discourse.

Different approaches to story generation are planned, and future comparisons between this work and them. An interesting line of research that is contemplated is to consider whether a Case-Based Reasoning solution, applying in discourse planning a set of patterns learned from the way humans have told similar sequences of events in human-generated stories, might compete with the simple rule-based solution.

ACKNOWLEDGEMENTS

This work is partially supported by the Spanish Ministry of Education and Science project TIN2006-14433-C02-01, and research group grant UCM-CAM-910494, jointly funded by Universidad Complutense de Madrid and the Comunidad Autónoma de Madrid (Dirección General de Universidades e Investigación).

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Effects of Narrative Levels on Comprehension : Theoretical Framework and Methodology

Baptiste Campion[1]

Abstract. Studying educative interactive narrative, we define the deep level as characterized by a conjunction between the storyworld and comprehension macrostructure ; we define the surface level as characterized by a disjunction between the storyworld and comprehension macrostructure. Both are often used in interactive designed for children. The goal of this contribution is to present work in progress that intend to evaluate educative effects of both levels. First, we will present the whole research and its theoretical bases ; second we will present what it is set up for empirical evaluation.

1 INTRODUCTION

Narration is often used in edutainment products. Sometimes, it seems that it's only for 'packing' (presumed) boring educative content. Narrative is supposed to be attractive despite difficulties linked to the educational content. In other cases, narration results from a scenarisation process of the hypermedia (for example an hypermedia structured around a quest). And there are another cases, when narration and educative content seem be set up together (i.e. due to structural convergences, like for historical contents). All these examples show that there are different uses of narration in educative interactive documents. And it shows also that if narration constitutes a structure for all these documents, narration can imply very different documents and, thus, different comprehension processes for a given reader/user.

For these reasons, distinguishing between all these situations is important. Distinctions must furthermore be used for setting up some reception models focusing on possibilities of different ways of using narration. These models should be useful for researchers in education, but also for designers. If we can prove there are some significant comprehension differences between different ways of using narration in educative narrative, you will not write the same story if you want to focus reader's attention on one aspects more than another one. Results should be valuable as well for 'classic' (linear) narratives as for interactive narratives or narrativised educational games.

We will present in this paper some elements of an undertaken research about educative use of narrative, especially in interactive narrative. Because this research is still a work in progress, this contribution intends focus on theoretical and methodological issues with broader interest. But this aspects will be enlighted by some empirical elements. We will focus on a single assumption but this research counts other dimensions we will not discuss here. This focused assumption concerns what we called the 'level' of narration use in educative narratives, which is illustrated by previous examples. First there will be a short presentation of research theoretical framework. Then experimental design will be presented and discussed.

2 THEORETICAL BACKGROUND

2.1 General context

The general purpose of our research is to investigate educative effects of narrative use for science pupularization. Can we learn something when explained with narratives ? 'Effects of narratives' are defined in terms of cognitive effects : how can subjects use narratives in order to understand parts of the world narratives are talking about ? Indeed, we make some distinction between understanding a story and learning somewhat from a story. Only this last case is called 'comprehension'.

First, we will describe how people understand narrative. Then, in next section, we will see how we can consider narration as an cognitive resource for readers. By this way, we will have at disposal some model describing how storytelling can be used in education.

2.2 Narrative comprehension

Following van Dijk and Kintsch [17], we define discourse comprehension as the constitution (by the receiver) of a mental representation integrating and articulating inputs. Following this theory, readers 'comprehend' a discourse (we generically call 'text') through a double process of construction of a coherent representation of discourse and construction of a model of the situation this discourse is speaking about. This process results from an automated (mental) strategie. Schema theory can be use for describing the integration/organization of picked-from-the-text elements in a coherent mental representation [2], [15], [16].

What about comprehension of narrative ? Narrative comprehension is basically a discourse comprehension operation even if narratives are particular discourses. In narratology —with the *story schema* theory [13], [14]— 'schema' definition remains ambiguous because it can either refers to mental structure or parts of the story (semiotic structure) [3, p.381]. So, we prefer describe these mental structures with the mental models theory [9], [10] (which is not incompatible with the schema theory). According to this model, various cognitive operations result from (non propositional calculation) operations carried out on the basis of running a 'mental model'. This model of the world is far away from the syntactic structure of narrative sentences, even it's based

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on a narrative and is a model of the world narrative is speaking about. Signification cannot be reduced to a purely intra-linguistic operation [10].

If we follow Herman's cognitive narratology [8], [6], narratives suppose a double mechanism of story comprehension and construction of a situation model similar to this postulated by van Dijk and Kintsch, and which can be completed in terms of mental models. Herman considers that comprehension of a narrative passes by the constitution of a 'storyworld' [7], i.e. a mental model of situation defining some elements useful to locate, contextualize and interpret the narration. The storyworld is built from the narrative text when the reader articulates bottum-up and top-down operations in two stages. Level of the microdesign (bottom-up) for the reader consists in establishment of an inventory at the local level while concentrating on 'What's going on ?'. The macrodesign (top-down) level refers to integration of these various parameters in a higher level whose result will consist in a mental model of situation.

2.3 Can narratives be used for comprehension ?

Lots of works have shown such comprehension mechanisms. But what it is interesting is that we can use the constitution of a given mental model by the narrative reader, to present the assumption that this mental model —the storyworld— can be used for later cognitive operations based on this model. Herman, following Vygotsky's 'cognitive artifact', considers narrative as a general cognitive tool : "I argue that stories provide crucial representational tools facilitating humans' effort to organize multiple knowledge domains, each with its attendant sets of beliefs and procedures. […] My hypothesis is that stories provide, to a degree that needs to be determined by future research, *domain-general* tools for thinking" [8, pp.157-159]. This postulate enables studying the knowledge and the comprehension of the world conveyed through narration, or more exactly through the mediation of a storyworld built on the narration.

This not only happens in *educative* narrative, but potentially in all kinds of narrative. But because we wants precisely see how narrative can be used as tools for learning, specific inquiry must be set up.

There are no reasons of thinking that this is not true for interactive narrative or even some narrative games (due to narrative structure of most of them based, for example on a quest schema), even if it's possible to formulate opposite assumptions about the effective effects of interactivity and non-linearity[2].

3 THE 'LEVELS' OF NARRATION

So, readers constitute a mental model of what they have read [7], and this mental model can be used by people for later mental operations (for example : inference). The question now is : when narrative contains specific educative stuff (explanation of a scientific phenomenon, historical precisions, etc.), how is it implemented to the storyworld ? Or : has the specific educative content a different place in reader's storyworld in different narratives ? More concretely, designers will ask how to implement educative content in a narrative so that the narrative will encounter the (correct) planned educative effect.

The concept of storyworld allows to define different ways using narrative in educative interactive documents. We call these ways 'levels' even if there is no normative judgement about it. We define two opposite levels of using narration : a 'surface level' and a 'deep level'. In both cases, new knowledge must be extracted from narrative, but we assume that the way it is done differs from one case to another. Last, these two cases can be viewed as extreme poles of a continuum on which we can place most of educative narrative productions.

The surface level appears when one gives a 'narrative packing' to some educative content in order to transmit educative information to the reader. In this case, the storyworld does not relate to the field of knowledge which one wants to speak about in the narrative, but it refers to the situation of the narrative (characters, actions, etc.). In this case we assume that understanding a narrative is not sufficient to reach comprehension. Readers must integrate specific integrative information in another mental model : the storyworld doesn't help for integration.

The deep level consists in using the narration structure itself to transmit the matter. There is a stronger integration between the field of knowledge and narration ; the storyworld can be used as basis for real appropriation and integration of this knowledge. Readers can base their comprehension of educative content on the storyworld, even if abstraction/extraction work has probably to be done for total integration of new knowledge.

The main consequence of this assumption is that formal aspect of a narrative should directly influence comprehension of educational data integrated to the narrative. Effect depends on reader's focus which depends on used level. Reader's capacity of extracting and integrating new data should be greater with deep level. In surface level case, disjunction between the story itself and educative stuff should cause integration (to a coherent mental model of the explained situation) problem. But that does not mean that first case is *better* than the second one : it depends on the planned/desired effect. We test here comprehension, not memorization, for example.

4 CURRENT EXPERIMENTATIONS

4.1 Research assumption

This framework leads us to the following research assumption : deep level narrative should lead subjects to build to a relatively unified representation. On the contrary a surface level narrative should oblige subjects to work with two levels of representation : one for the story itself, and the other for the educative contents.

This assumption is currently being quasi-experimentally tested with specific educative interactive narrative explaining to children a scientific phenomenon. We speak about 'quasi'-experimentation [4] because it will be performed in schools rather than in real lab conditions.

The dependent variable is thus the coherence of the mental model/representation of the scientific phenomenon. The explicative variable is the level of narrative use (deep/surface). Other variables will be controlled as much as possible. In particular, we will neutralize the 'interactive' or non-linear variable[3] : all experimental document will be strictly linear for this quasi-experimentation. Finally, our population sample can be considered as 'equivalent' in terms of scholar skills because we will carry this out in classrooms in the same degree.

[2] These assumptions about interactivity effects are for example partially developed in [3].

[3] This quasi-experimentation is a part of a broader research for which we also test effect of linearity/non-linearity with similar interactive documents. For this specific test, we don't use any non-linear document.

4.2 Methodology

We will compare representations of a scientific phenomenon acquired by two groups of children from a deep level narrative and from a surface level narrative. We will control these results with those of two other experimental conditions : a group who read a non-narrative explanation, and a control group without any explanation about the phenomenon. (This last is set up only to control children skills about the matter.)

The comparison will focus on children ability to synthetically explain the scientific phenomenon explained in interactive document. We indeed postulate that discourses held by subjects contain 'traces' of mental model used by subjects to understand the situation they are speaking about. We need this postulate in order to consider any empirical experimentation about such phenomena. It is consistent with works about language postulating and/or highlighting linguistic traces of the subjacent cognitive activity[4].

So, our data will consist in written discourse held by subjects as they were answering a research questionnaire after reading the interactive document. This questionnaire contains four questions. One is a recall question (they have to explain what they remember about what's explained in the document). One another is a problem-solving question (subjects have to solve a problem which need a good comprehension of the scientific phenomena). Third is a 'drawing' question (subject have to make a schema of the phenomenon). The last one consist in words explanation ('what's a bacterium ?', etc.). These questions should enable us to sketch central dimensions of the subject's mental model (storyworld).

Our indicators are :

- Elements and relations between elements (spatial relations, inclusion, exclusion, superposition, motion…) in pictures ;
- Specific vocabulary used by subjects when describing the scientific phenomenon, especially action verbs, personification, names, etc. ;
- Conjunction or disjunction between answers ;
- Subjects ability to abstract and re-use gathered info (in problem-solving question).

All groups will have the same questionnaire, behalf the control group (condition without any document) where the recall question (that makes no sense) is suppressed.

4.3 Experimental material

We will work with around 100 children of Belgian 5th year elementary school (± 11 years old). They will each read one version of the experimental interactive documents built for the experience. These documents are HTML pages These documents explain a simple 'scientific' phenomenon : how do tooth decay develop in the mouth ? Three versions of the experimental document have been built[5]. They are partially derived from a former study on narration and memorization [5] because it showed they were suitable for 11 years old children.

Two versions of the explanation are defined as 'narrative', following Adam's six criteria. It's indeed difficult to characterize exactly a text as 'narrative' even if everybody know spontaneously what a narrative is. So we use Adam's criteria [1]. It's not the only way to define a narrative and each criterion could be discussed, but we assume that if each criterion is individually respected, the text can surely be considered as a narrative. For Adam, a narrative is characterized by : (1) a temporal succession of actions, (2) a thematic unity, (3) predicates transformation, (4) a process, (5) narrative causality-consecution in dramatization and (6) a final evaluation [1, pp. 92-110].

Both experimental narratives are written following all six items, but in two different ways. The first one is defined as a 'deep level narrative' : scientific content is narrowly integrated to the story (it's the story of a bacterium who tries to perforate a tooth in the mouth). We consider there is a narrow integration because characters (bacterium), processes (transformation of sugars into acids) and other agents are the same for understanding narrative *and* understanding how does a decay develop. The other one is defined as a 'surface level narrative' where we maximized disjunction between the story (it's the story of a boy who musts go to dentist before a match play) and scientific content (how does tooth decay develop). These two versions correspond to modalities of 'level use of narration' variable.

The third (and last) version is defined as a 'non-narrative' condition : that's an explanatory text where we paid attention not to follow Adam's criteria when it make sense. For example there are no characters, no predicates transformation, no dramatization.

All scientific (i.e dentistry related) information has been controlled so that it is strictly equivalent between conditions. Each condition will count around 25 pupils.

4.4 Forthcoming results

Data acquisition is currently under way. Some data were already collected in two schools. The full tests should be performed for april-may 2007.

5 CONCLUSION

The main goal of this research is to enlighten the presumed role of what we called the level of narration use in comprehension of a phenomenon. Even if we conclude with significant results, that will not mean there is a *normative* difference between levels of narration use. We hope this experimentation will provide sufficient data in order to perform additional qualitative and comprehensive interviews with other subjects. The purpose of this forthcoming phase will be enlightening elements required for a better integration of so-acquired knowledge.

If our assumptions about surface and deep level are verified, further works should focus on precise effects of these levels in terms of comprehension in relation with hypermedia elements that enable (or prevent) conscious use of one level or another. In particular, it will be useful to focus on the mechanisms of extraction of scientific information in the two configurations.

Another axis of investigation is the interaction between levels of narrative use and reader's implication, especially in interactive stories and games. We can for example presume that improving reader's 'first person' central experience increase effects of deep level because it's own experience is mobilized in defining a mental model of the matter.

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[4] See for example the cognitive grammar of Langacker [12] or the works about metaphor of Lakoff and Johnson [11]. These authors show (each one on their specific object) how the language contains traces of mental operations and structures on which would be based our knowledge of the world.

[5] These can be read for a while at following URLs (all documents are in French) : *http://www.comu.ucl.ac.be/reco/grems/batweb/expe/site2/* for deep level narrative ; *.../site4/* for surface level narrative ; and *.../site3/* for non-narrative condition.

ACKNOWLEDGEMENTS

Many thanks to Estelle Fierens who allowed me to use and transform her original experimental story [5] for this current experimentation.

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Towards a classification of Video Games

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Abstract. This paper is part of an experimental approach aimed to raise a video games classification.
Being inspired by the methodology that Propp[3] used for the classification of Russian fairy tales, we have cleared out recurrent diagrams within rules of video games, named "Game Bricks". The combinations of these different bricks will allow us to represent a classification, in accordance to their rules, of all the video games.

In this article, we will study the real link between these bricks and the rules of video games, trough realisation of an experimental "brick-only" based game.

1 INTRODUCTION

The idea of classification of video games is not a new idea of course. Le Diberder brothers[4], or Stephane Natkin[5] have already raised classifications.

But, in all these works, even though they are references, we have rapidly found absences or slants. These facts are denounced by Mattieu Letourneux[6] in his article "The question of the kind of video games": To him, any video game classification is condemned by its very nature to the obsolescence, because games technological evolution also modifies the chosen criterions.

How define what a video game is, if its classification is rapidly wrong?

Being inspired by the Propp's methodology[3], we have exposed in a previous article[1] the genesis of this project that leads to the development of "V.E.Ga.S", a tool to index and analyse video games. Influenced by Salen & Zimmerman we focused on the game rules[14].

With this tool and a list of 588 video games we have proposed a first step[2] of the development of a classification criterion: we have emphasized the "Game Bricks"(figure 1), the "fundamental elements" whose different combinations seem to correspond to different rules and aims of a video game ("Game" aims to the "game rules" notion, referring to Gilles Brougère).

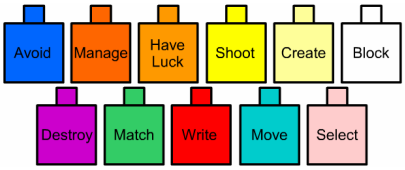

Figure 1: The Game Bricks known up today

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The number of "different combinations" thus obtained was rather high, but we have noticed that some pairs of bricks, named "Metabricks" (Figure 2) were recurrently found in a large number of combinations.

After analysis [2], we have realized that these "MetaBricks" really seemed to outline an encouraging path towards a classification of video games.

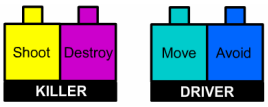


Figure 2: The two MetaBricks discovered up till today

To summarize, we have identified "Game Bricks" that represent "tasks to carry out" within the video games. Based on these bricks, we have updated a classification based on groups of video games into "families" having identical combinations of "Game Bricks", these families could be regrouped by the presence or not of some pairs of bricks named "MetaBricks".

For example, the Game Bricks featured in "Pac-man" are : "MOVE", meaning player can move an avatar, "AVOID" for the Ghosts you have to avoid, "DESTROY" for the dots you have to eat, and "POSITION" because you have to reach each dot's spatial position to destroy it.

But you can also find these Bricks in the race game like "Need for Speed": MOVE a car, AVOID opponents, and POSITION on checkpoints you have to DESTROY. When reached a checkpoint becomes "out of the game" and is not reachable anymore, so it can be considered "destroyed", just like a dot eaten by Pacman.

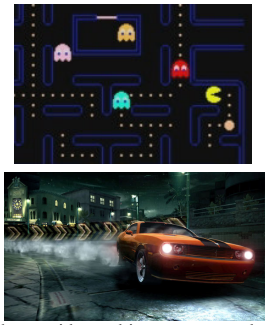


Figure 3: From the outside, nothing seems to rely Pacman (Namco 1980) and Need for Speed Carbon (E.A. 2006).

As both games feature the same bricks, they are classified in the same family, one of the game families featuring the "DRIVER" MetaBrick (MOVE+AVOID).

There are nevertheless problems left to be resolved, that we wish to solve to make an improved analysis tool.

We have to try to reduce the part of subjectivity which appears during the valuation of a video game. Two complementary approaches appear then to us:

- A quantitative approach, which notifies several entrances for each game, thanks to contributions.

- A qualitative approach, which eliminate at the most the subjective aspect of the definition of the "Game Bricks".

On the other hand, the definitions of some bricks like ANSWER are in a lack of precision. This problem is due to the fact that we are still not able to fully answer the question: "What do really the bricks represent concerning the video games?"

The aim of this article is thus to propose a formal definition of "Game Bricks".

At first we will introduce an experimental validation work about bricks, followed by thoughts about the very nature of the bricks and their relationships to the rules of video games.

These two steps will allow us to propose a positive definition of the bricks, considered as criterions among a classification of video games in accordance to their rules.

2 EXPERIMENTAL VALIDATION

2.1 Specifications

In order to test the pertinence of our bricks, we have elaborated an application and the target is to help us to see how, on a data basis, the "Game Bricks" are put together in a video game.

Ideally, it would be an application allowing us to add or remove "Game Bricks" in order to be able to observe the impact on the game. This stage implies a finite definition of the bricks, in order to be able to insert them in a program.

Being inspired by the works of Raph Koster[7] and Stéphane Bura[8] who both try to elaborate a grammar of video games in the shape of diagrams, we have thus formalised diagrams as definitions of our bricks.

With the idea to handle the rules of a video game on a data basis, we have thus thought of a game representation model in an algorithmic way.

We have been inspired by the works of Michael Thielscher [9] in "the General Game Playing", who creates programs for games being able to play games with rules that are initially unknown. His team has developed in particular a language, the GDL (Game Description Language), which allows representing a game in a logical way by describing its rules and its initial state.

We have also been very inspired by the “games creation softwares”, like those created by Clickteam [10]: "Klik n’Play", "The Games Factory" and "Multimedia Fusion". These softwares are an aid in the creation of video games: they withdraw the technical part and allow the Game Designer to focalize on the rules of the game, the graphics and the sounds, as well as the control of the interfaces. The construction of levels and game scenes (level design) is also easier by using these tools.

2.2 Conceptual representation of a game

We rely on the definition of a game according to Katie Salen and Eric Zimmerman [11]: "An activity with some rules engaged in for an outcome".

Katie Salen and Eric Zimmerman thus consider a game as an activity defined by two elements: The rules and the result, the last one according to a previous goal.

2.2.1 *The game rules: "some rules".*

If we consider that a video game takes place in a virtual universe and that it is composed by several "elements", in a large point of view, then these different elements are submitted to "rules", in accordance to the game like the elements composing our own universe which are governed by physical and behavioural rules.

For example, the universe of the game "Pong" is composed by the following elements: The racket of the player, the adverse racket and the ball. The area of the game (the size of the screen) can also be considered as an element, even though it doesn't have a graphical representation, it does "exist" within the rules of the game.

These elements are submitted to different rules like “Each frame, the ball element moves according to an (x;y) vector”, or further on ,"if the ball touches a racket, then its vector of movement (x;y) becomes (-x;y)".

Analysing this last rule, we will realise that it is composed by two parts:

- The "trigger": "if the ball touches a racket, "
- The "effect(s)": "then its vector of the movement (x;y) becomes (-x;y)".

We will call "targets", the elements to which are applied those rules.

We will notify a similitude between this conceptual representation and the algorithmic or even programming on the whole: a condition ("if") driving to the production of a succession of instructions ("then").

2.2.2 *The objective of a game: "an outcome"*

In the same logic, the aim of a game can also be described by its rules, for example by Pacman: "if all the pastilles have been eaten, then the level is "won"". It is all about a rule having an effect corresponding to "the game has been won" (moving up to the following level, end of the game...), associated to a condition formalizing a target to be obtained.

At this level, we consider that it's logic to include "the objective of the game" into "the whole of the game rules", the "Game" part of a video game.

2.2.3 *Conceptual Diagram*

We will then obtain a model permitting us to describe a game by enumerating the elements of its universe, elements applied to the whole of the rules, including the objective of the game.
These rules are composed by different triggers and effects (figure 4).

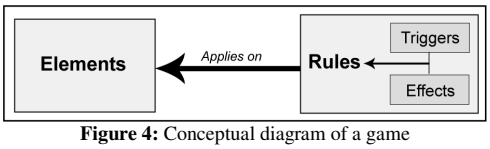


Figure 4: Conceptual diagram of a game

2.3 The modifiable game: “Gam.B.A.S.”

Starting from this design, we have programmed a whole of "elements", "triggers" and "effects". The elements position is randomly chosen, we do not include any aspect of level design in this experimental game for now.

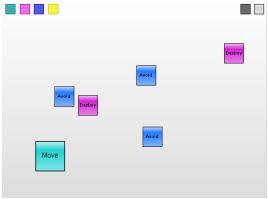


Figure 5: Gam.B.A.S. (Game Bricks As Switches)

Further on , we have programmed triggers like "Always", triggered on every frame, "MouseDown", triggered when you push the left button of the mouse, or even "Collision", when two elements collides.

These triggers are linked to one or several effects such as "CreateElement", "DestroyElement" or also "Move Element" applied when the condition of the trigger is "true".

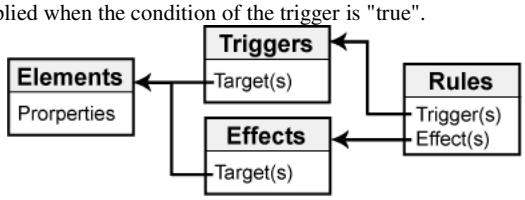


Figure 6: Simplified Class Diagram of Gam.B.A.S.

We have then been able to gather these elements, triggers and effects in order to realise basic video games: a game where you have to collect some elements and avoid others, recalling "Pacman", or even a game where you have to destroy elements that you don't have to touch, shooting on them, recalling the famous "Space Invaders".

2.4 The very nature of "Game Bricks"

At this stage, we have decided to set up in these "games" the "Game Bricks", based on the logic diagrams being defined in the "Specifications" phase *(see 2.1)*.

In order to simplify, we will not set up neither the bricks of "TIME" and "SCORE", nor the brick of "TOY" because of a lack of satisfying diagrams.

We then realized that the "POSITION" brick is composed by a "Collision" trigger between two elements with spatial coordinates. The "SHOOT" brick features a "CreateElement" effect, and the brick "DESTROY" is composed by a "DestroyElement" effect applied to every element of the scene except of those relied to the player.

We finally observe that it is possible to build our bricks by assembling elements based on the previous definitions: the triggers and the effects.

These two being "the construction elements" of the rules, we realise that the "Game Bricks" can thus be translated into "game rules".

We also notice that the bricks definition diagrams can not be translated directly into rules: actually, there are within these definitions "areas of liberty", especially about the elements that are targeted by the rules. For example the definition diagram of the "Move" brick specify its effects are applied on "element relied to the player", but it doesn't specify the number of these elements: Is it about one unique piece or a whole army of mutant orcs?

The translation of definition diagrams into rules needs to answer this kind of questions.

2.5 Statement of the experiment

For the needs of this experiment we had to:

- Define a model of the representation of a game: a universe composed by elements to which rules are applied.
- Define "elements of construction" for the game rule: they are composed by two elements, the "triggers" and the "effects".
- Establish definition diagrams for Game Bricks.

At this stage we will define the "Game Bricks" as "a canvas of rules", a diagram to follow in order to build a rule or a group of rules in a video game.

Nevertheless, if we observe the games obtained by the successive realisation of different bricks, even though they unquestionably remind us the basic principles of the classified games, we realise that we don't obtain precisely one of them.

For example, after having activated the bricks of the game of "Pacman", it seems that there still is a "lack of rules" compared to the original game: there are no "special dots" that make the "ghosts" edibles, the ghosts/elements to avoid don't move.....

We finally realise that all the rules of a game are not covered by the bricks. This "no-exhaustiveness of the video game rules" finds its answer in the objective of bricks, which intend to be a criterion to a classification, but will return to this point further on.

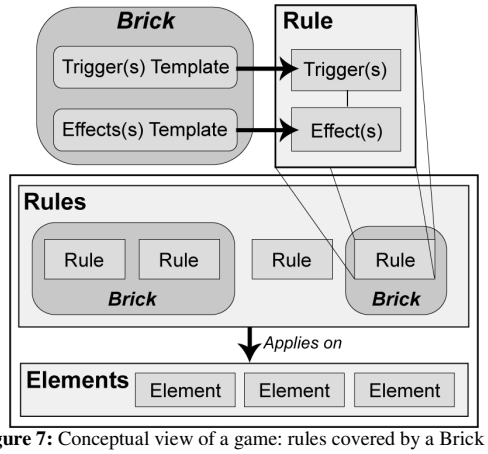


Figure 7: Conceptual view of a game: rules covered by a Brick are created from its template, unlike uncovered rules.

3 A VIDEO GAMES CLASSIFICATION ACCORDING TO THEIR RULES

The objective of the study of the "Game Bricks", according to the previous articles [1] and [2], is to achieve a definition of criterions for a classification of the Video Games. The "Game Bricks" should thus be these criterions, as their association into "Metabricks" will allow us to obtain "families" recalling those of the Russian tales classification by Propp[3].

The works on the very nature of "the Game Bricks" described previously have permitted us to achieve the following observation: the bricks represent "diagrams of game rules", translated into rules by the specification of "areas of liberty" present in their definitions.

These "areas of liberty", generally relied to the elements targeted by the rules or "feedbacks" definitions, have been included intentionally within these bricks.

Actually, a precise definition for an effect like "the Pacman

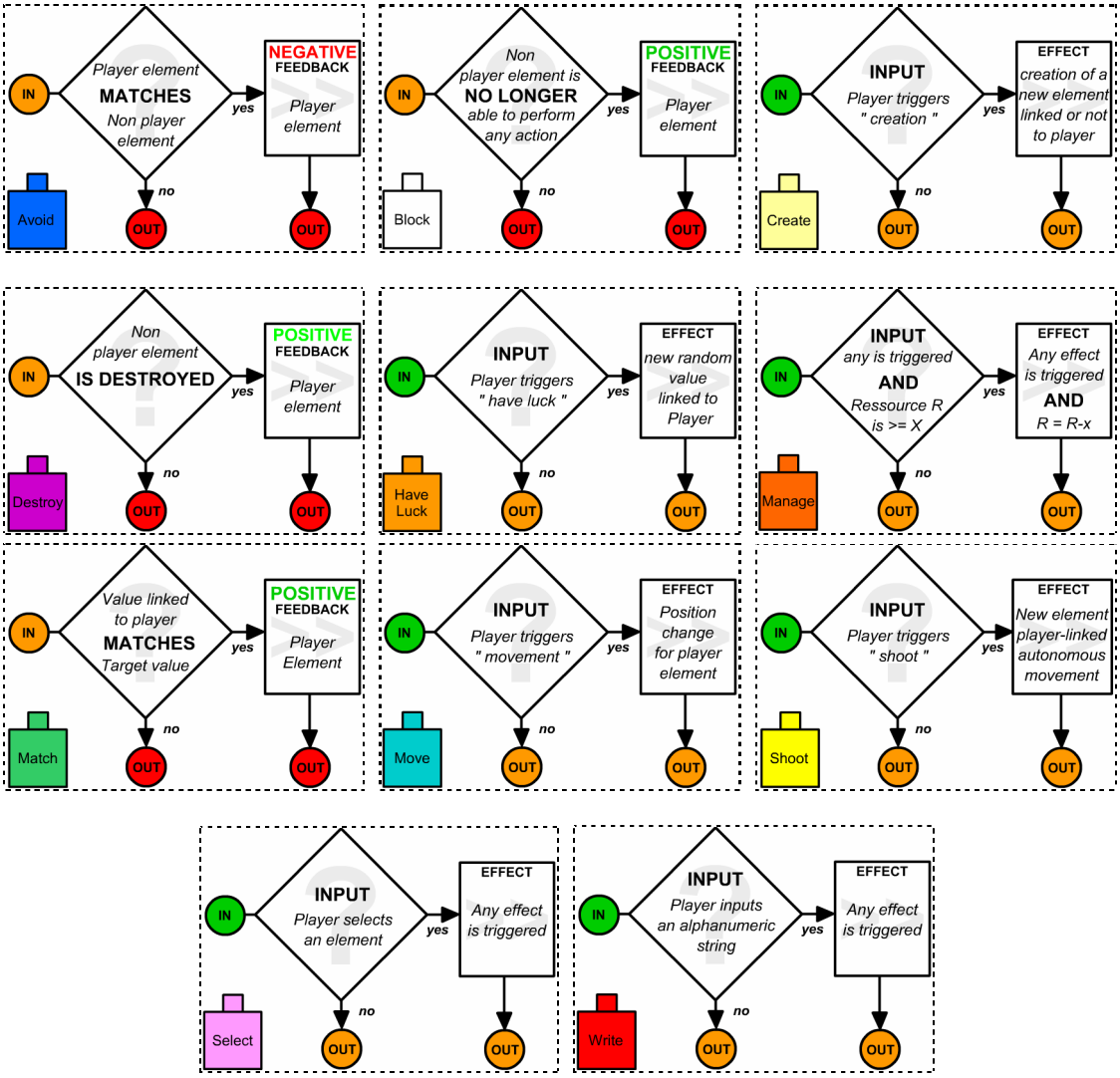
element moves 15 pixels north" or "the Pacman element moves 12 pixels east", yet matches exactly to the rules of Pacman, but would be completely unusable for a classification : the number of rules and thus of bricks would be extremely large with such precise definitions.

The combination of bricks allows us to represent the whole of the games being indexed, but it doesn't represent them in an exhaustive manner: numbers of rules are not included in the definitions of the bricks.

It's a choice made in order to limit the number of the bricks, and thus the criterions of our classification in order to enlarge the performance of it.
We therefore have concentrated our efforts on representing the rules related to the actions of the player with the "Game Bricks".

In accordance with the methodology described by Propp[3] and his classification, we have decided criterions of our classification, the "Game Bricks" form the video games : we have observed indexed games, and we have identified "recurrent rule diagrams". These different "rule diagrams" are, as it has already been said, the definition of the "Game Bricks".
The bricks we have identified at present are the issue of 588 games being indexed in a first version of V.E.Ga.S. and are the result of an iterative approach, as former versions of bricks were created from smaller corpus[1].

The differences between games featuring the same bricks, strictly concerning the rules, are coming out from these two choices of limitation of the precision of the bricks with the aim to obtain a relevant classification.



According to the former version of bricks[2] we notify the disappearance of the "ANSWER" brick, because its definition was too large, and which intend to be replace by two new bricks : "SELECT" and "WRITE".
We also notify the removal of the "SCORE", "TIME" and "TOY" bricks, which weren't directly related to rules, and an enlargement of the definition of the "POSITION" brick which becomes the "MATCH" brick.

For instance, within the limits of the game rules, we notice great resemblances with the game of "Pacman" and a racing game such as "Need for Speed Carbon": in both games you have to move an element (Pacman/car >> "MOVE" brick), and avoid others (Ghosts/Rivals >> "AVOID" brick) that it is possible to destroy

("DESTROY" brick), and finally passing by several succeeding spatial positions (Swallow dots/Pass the checkpoints >> "POSITION" brick);

Nevertheless, even within their rules, these two games are different: the movement and thus the "MOVE" brick has two dimensions in “Pacman”, but three in “Need for Speed Carbon”, the number of checkpoints to pass in the last one is much smaller than the numbers of dots that Pac-man has to swallow and the movement of the elements to avoid is different in the two games....

These differences between these two example games are the issue of different implementations of "rule diagrams" from the bricks they are sharing, but are also due to the use of rules are not covered by the bricks, as the frequency of these rules in our corpus were to weak for us to index them as a “rule diagram” in a “Game Brick”.

4 GAME BRICKS DEFINITIONS

We will here introduce the diagrams of the different "Game Bricks" that we identified up till today.
These bricks will be used as criterions of classification in a further version of V.E.Ga.S., our tool of video game indexation and analysis.

5 CONCLUSION

We hope that we have clarified by this article **the very** nature of "the Game Bricks" having been clear about the choices at the time of their construction in the target to use them as criterions of a classification of video games according to their rules;

Answering the article by Matthieu Letourneux, "The question of the kind of video games"[6] that points out the short life of the video games classifications due to the lack of “no-evolution criterions”, we consider that the game rules of the video game seem to be an interesting criterion by the fact of its obvious redundancy between different games. We also notify that this aspect of the video game doesn't seem to be submitted to an evolution as quick as the one concerning for example the control devices or the graphic aspects, which make “the rules” particularly interesting for a classification criterion.

We can nevertheless establish a relationship between the "The game rules" and the "middleware". The "middleware" corresponds to different "engines" (game, graphics, physics, sounds....) sold separately and that permit the creators not to reprogram the redundant parts of their different games.
These games engines are generally distributed with the pre-programmed rules, rules that you will find in the important lines in all games of the same "kind", according to the classifications by the specialized press (Shoot'em up, FPS, RTS,…)

We consider this as a real example of the small variation of "game rules" between the games considered as being the "same style", when these same games offers different graphics or controls.

This article helped us to reconsider what is a "Game Brick" in accordance to a game: a rule diagram, or more precisely "recurrent game rules diagrams". We realize then, that the choice of the creation or not of a brick relies on the evaluation of the pertinence of the diagram as well as the definition of its "areas of liberty".
As we previously have explained, the bricks that we have identified up till today are the result of an heuristic approach from 588 games. We pretend neither to have identified all the bricks, nor to have identified the more pertinent diagrams.

We are aware of the fact that the planned increase of our indexed games will lead to an refining of the bricks definitions, or maybe even be the discovery of new bricks or meta-bricks.
The "Game Bricks" showed in this article, along with their definitions, will be used as criterions for the classification being included in the second version of "V.EGa.S”. As we have mentioned in the introduction, we wish to decrease the part of subjectivity during the evaluation of the games, done by the human being, thanks to an approach of quality as well as a quantitative approach.

While the current paper is a part of the qualitative aspect, the quantitative aspect is related to the opening to the public of our V.E.Ga.S database. We will thus apply for a contribution concerning the inventory and the evaluation of the games, the bricks featured in a game will then be chosen according to the statistics of the different evaluations that the game received.

You may offer, evaluate or get informed about a game in the online version of our classification:

http://www.gameclassification.com

Nevertheless, it is obvious that a game is not made only of rules, it also features a graphic aspect, interfaces, and a content. Talking about content, the work presented here get a broader meaning when focused on “Serious Games”.

The current article was focused on the “Game” part of Serious Games, and need to be related with the work on the “Serious” part presented in our second paper [12]. This one started from the analysis of five Serious Games areas: Edutainement, Advergaming, Edumarket Games, Political Games and Training games.

This analysis led us to conclude that these Serious Games are composed of two main categories:

- Serious Games based on simulation which present a “world”, with its “rules” and where there is no objective imposed by the application.
- Serious Games based on video games which propose a “world”, with its “rules” and implemented objectives that the user has to reach.

We can observe both categories of Serious Games seem to take place in a “virtual world with its rules”, thus we can see the role of the “rule analysis” work presented here.
But we can also notice that some Serious Games features an “objective to reach”, whereas the first category, based on simulators, doesn’t impose any objective.

Can the “Game Bricks” be applied on the “Game” part of both Serious Games categories?
Or does the lack of objective of the first category imply its games will use a different set of bricks?

We will try to work on theses questions on our future works.

6 GREETINGS

The authors wish to thank Jean-Yves Plantec and Martial Bret from the "Iode" Society, for their point of view concerning the notion of "Brick", as well as Stéphane Bura, Art Director at 10Tacle Studios, who have let us know a great number of references.
We also wish to thanks a lot Annika Hammarberg for the translation of this paper from French to English, and Rashid Ghassempouri for his general help and thoughts in the earlier works about this game classification.

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Serious Game: just a question of posture?

Alvarez Julian[1] and Rampnoux Olivier[2] and Jessel Jean Pierre[3] and Méthel Gilles[4]

Abstract
This article explains the difference between a large variety of Serious Games and tries to propose a classification to understand this type of video games. We explore the connection between the goal of the game designer, the objective of the game and the posture of the player. Finally, we explore how we can create some serious game to make corporate communication or educative programme.

Introduction
Great numbers of Serious Games are proposed in various fields of application like health, army, education or communication...Facing this diversity, are we really in the presence of various categories of Serious Games or is it just a variety of fields of application? If this is the case, which are the elements being characterized by each of these categories and which is the part of marketing of each variety?

In the first part of this paper, we will introduce elements that characterize a Serious Game and thus index five big categories. In the second part we will estimate the relevance of these different categories and lead a reflection to see if transmitting a message by a Serious Game is just a choice of posture that the creator of the application or the mediator tries to get adopted by the user. In fact, in some special circumstances, the players, especially the children, don't have a direct access to Serious Game, but the game might be introduced by an adult, according to Vygotsky's theory. For example, at school or in a youth center, the child does joint activities or mediatized activities. (La Ville, 2005).

1 HOW TO CHARACTERIZE SERIOUS GAME?

In its article "From Visual Simulation to Virtual Reality to Games", Mike Zyda proposes the following definition for Serious game: "A mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives." (p. 26) In other words, the vocation of Serious Game is to invite the user to interact with a data-processing application whose intention is to combine at the same time teaching, training, communication, or information aspects, with ludic mechanisms based on video game. The purpose of such an association is thus to give attractive shapes or plots (Game) to didactic contents (Serious).

Zyda indexes a broad range of the applications concerned with Serious Games as David Michael and Sande Chen do also in their book "Serious Games:Games that Educate, Train, and Inform" (2005). In this enumeration, it is important to raise a major distinction between the applicability concerned with "health", law and order, or engineering and the categories of intentions such as "Communication Strategy" or "Education". The fields of application are too many and too subjective to be able to build a resistant typology contrary to the categories of intention which are simpler to identify and to formalize.

We propose 5 categories to classify the Serious Game: Edutainment, Advergaming, Edumarket game, Political games, and Training and simulation games.

1.1 Edutainment

The ambition of an edutainment is to transmit knowledge or training by a ludic approach. The game "Auto junior" from the French multimedia magazine "Mobiclic" n°6 of October 1998, (editions Milan-Presse interactive) (playable on the website www.ja-games.com), invites the user to drive a car. The objective is to reach an open air cinema while respecting the Highway Code and being careful about speed. The game thus proposes a random series of tests (avoid an elk which crosses the road, not to cross a solid white line, stop at the halt sign…) which insist on a rule to respect. Each mistake is given an explanation and punishes the player by drawing points away from his driving license. The faster the player will drive, the more he will be exposed to the traffic accidents. We are facing a game whose scenario is made to give an educational message: to drive prudently by paying attention to the speed and to respect the Highway Code. This game is classified in the category of edutainment products.

This game's production and realization constraints require to find an equilibrium between the "educative" and the "ludic" components. The game aspect can easily get the upper hand hiding all educative or informative aspect. In the same way, the too strong formative aspect brings the product closer to a quizz. The users are not taken in and they reject the product (Kellner, 2006)

Figure 1: Auto Junior (Editions Milan/Ja.Games – 1998)

In the line of this paradigm, the MIT and the University of the Wisconsin joined to develop a research program named "Education Arcade" (http://www.educationarcade.org). The two terms

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[3] IRIT, Université Toulouse III, France ; jessel@irit.fr
[4] LARA, Université Toulouse II, France ; methel@univ-tlse2.fr
[5] LARA, Université Toulouse II, France ; pierre.molinier@univ-tlse2.fr

"Education" and "Arcade" are put here together to emphasize the idea to conceive education systems built on great ludic principles.

1.2 Advergaming

"Ponkey Bong" from the website www.spirou.com, presents two characters, Parker and Badger, created by Cuadrado and published by Dupuis Editions. In this video game, the player controls Parker and has to deliver his friend Badger. This one is attached on a rocket ready to take off! An angry site foreman, who looks like a gorilla, located at the top of a metal structure, throws barrels which roll along the various scales (fig.1). The gameplay of this game parodies "Donkey Kong" imagined by Shigeru Miyamoto (Nintendo) created in 1981 (fig.2). The objective of "Ponkey Bong" is here to transform a game into a tool of communication: to make the children play with the two characters of comic strips. This type of Serious Game, called "advergaming", is based on the "ludic culture" of the players. The idea is to release them from the training of the game play so that they are focused on the peripheral elements. We are in the same situation as an add for children where peripheral elements become more important because the narrative structure is quickly taken in.

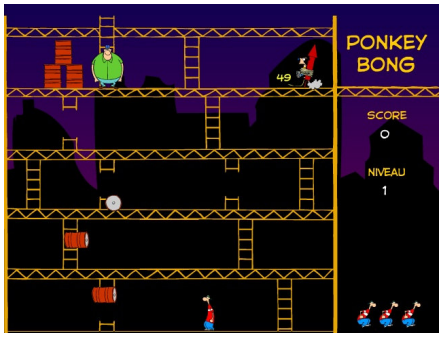

Figure 2: Ponkey Bong (Editions Dupuis/Ja.Games – 2002) and Donkey Kong (Nintendo/Miyamoto – 1981)

The video game "Sportura the game" http://www.sporturathegame.nl/public/testrit.php (Nonoche.com, 2004) plunges the user into a race car game. The goal is to be the fastest.

Brougere, in "Jouer/Apprendre" defines ludic culture as « a combination of procedures which make game possible" (p 106). He writes about a "personal ludic heritage […]: young adults remain marked, for some of them, by videogame which belongs to their culture, their story. They discovered it during childhood, but many of them kept it in their personal ludic heritage" (p 113). Brougere evokes the young adults audience but "that can be applied to all the players socialized through videogames practising and who would share perception and action habits coming from common ludic paradigms" (p 8)[1]

Figure 3: Sportura the game (Nonoche, 2004)

The required reasoning is similar to a process largely used in the cinema, "the placement of products" (Galician, 2004). This term indicates the positioning of brands, logos or even products in the scenery of a videogame. In all the phases of play thus appears a Seiko watch and the road is strewn with posters pointing out this brand. The back number plate of the car is used to display the name of an automobile magazine. Lastly, on both sides of the game are posted the whole of the partners' logos which allowed the production of this title (fig.3). The exact term used by the communication agencies to indicate the placement of products in a videogames is "in-game advertising". This marketing concept can be pushed a little further and become interactive. In the MMORPG (Massively Multiplayer Online Role Playing Game) Everquest II, there is now an option to order true pizza pies to Pizza Hut Company online!

1.3 Edumarket games

This section gathers applications with an educational purpose, or at least applications aimed to make its users (especially children) sensitive to an educative message through video games. This different way of communication allows to change children's sensitivity, in order to help them having a better understanding of social stakes. For example, these social stakes can be durable development, school orientation, labour market, humanitarian aid... Edumarket games are tools aimed to communicate on a video game

[1] Personal translation by authors

basis while integrating an educational aspect.

For example, in this section we can find the game called Food Force (www.food-force.com), released by the United Nations in 2005, freely downloadable on Internet, with country-specific translations (Italy, France, Poland, China, Japan,...), and which is intended to make children sensitive to humanitarian missions made by the United Nations in their daily fight against starvation. On the website, we can find a special area for teachers, in order to help them building teaching lessons aimed to strengthen children's knowledge by complementary activities linked to the theme of this Serious Game.

Figure 4: Food Force – Introduction

Figure 5: Food Force – Example of game

This title features six different mini-games, each representing a different aspect of the humanitarian aid, linked to a global objective: help a disaster victim area to recover. These games show the difficulties encountered by the different humanitarian workers. Each game is introduced and explained, including problems and game rules, by a 3D character seeming to come straight from a video game, such as Lara Croft.

When the mission is over, a short movie looking like a journalistic report shows real images of the tasks pictured in the game. When the global mission is over, the player can check his ranking on an online score table. The score table is of course intended to invite the player to improve his or her performance, but also helps to develop a reflexion about the community of players who devote themselves to "Food Force".

1.4 Political games

In the first level of the video game "Darfur is Dying" (http://www.darfurisdying.com), the user is a child from Darfour who must go and seek water for his family. On his way, he crosses dead animals and must avoid being captured by the militia (fig.6). The goal of this Serious Game is to denounce in a direct way the problems which currently strike Darfour. Gonzalo Frasca, a researcher at the Center for Computer Game Research of the IT University of Copenhagen, Denmark, calls this kind of video games "Political games".

Figure 6: Darfur is Dying (MTV Networks On Campus Inc)

The line followed to carry out such plays consists in mobilizing in a diverted way the ludic mechanisms of the video game within a politically engaged situation. This diversion can be done on two levels:

- ✓ By modifying the rules of the game: For instance, "Antiwar Game" (http://www.antiwargame.org) prevents the player from winning if this one adopts the tactics which lead to the victory in a traditional videogame: to develop a powerful deterrent force, or to pile up many resources... Here on the contrary, these strategies lead on to the defeat or a state of stagnation. To make progress,

military budgets will have to be replaced by social development in the end.

- ✓ By transforming the graphics and sounds of the game, following the example of advergaming. For example, the patch "Velvet-Strike" (http://www.opensorcery.net/velvet-strike) allows players to tag the walls of the Counter Strike FPS (First Personal Shoot), with pacifist graffiti.

These two aspects are not exclusive. There are patches, which not only modify the graphics or sounds of the game but also modify its rules. That's called Mods, abbreviation of Modifications. For instance "Escape from Woomera" (http://escapefromwoomera.com) is a Mod added to "Half-Life", a futuristic FPS (Sierra Studios/Valve Software), to transform it into a refugee camp called Woomera which really exists today and which is located in the south of Australia. The objective is to make the player sensitive to the problems of the asylum seekers in Australia and to take a critical look on the solutions applied by the government.

The website Sklunk which devotes a file to the diversion of the videogames (http://www.sklunk.net/Detournez-the-plays-video) indexes a whole of political games. It is striking to note that out of about fifteen games presented, eleven denounce violence or war. Knowing that many commercial titles mobilize this principle in the gameplay, it is also a militant act to want to modify the structure of it; we even think that it is a form of *reductio ad absurdum* and the provocation which encourage to act.

1.5 Training and simulation games

The most famous Games in this section are "Sim city", "The Sims" and "Flight Simulator". These applications allow the user to build and look after a virtual city, a virtual family, or to fly virtual planes based on real physical models.

The purpose here is not to win, but simply to have fun or to reach some "user-generated objectives", as Frasca explained in the second chapter of his thesis "Videogames of the oppressed: Videogames as a means for critical thinking and debate". He first reminds us that the Le Diberder Brothers define simulators as a virtual world, where attention to detail is a major feature, and with no clear objectives stated. The lack of objectives allows the user to switch as he wants from a playing purpose, called "paidea" (according to Roger Caillois's taxonomy) to a gaming purpose with precise rules, named "ludus".

Figure 7: Sim City 4 (Maxis/EA)

Frasca takes the example of "Flight Simulator" in which no precise objectives are stated. The player can enjoy "free-flight" (paidea) or decide to reach an imaginary aim such as flying under a bridge without crashing himself (ludus). Frasca concludes with the following: "The designer might suggest a set of rules, but the player has always the final decision."

Figure 8: The Sims 2 (Maxis/EA)

Figure 9: Flight Simulator 2004 (Microsoft)

2 JUST A QUESTION OF POSTURE?

2.1 Reduction of the number of Serious Games' categories

In the first part, we have identified five categories of Serious Games: Edutainment, Advertainment, Edumarket game, Political games and Training and simulation game. When we analyse the nature of the first four categories, we realise that the method used to conceive them always consists in diverting, not in an exclusive manner, either the rules or the "cosmetics" as Chris Crawford says (graphics and sounds) of the video games. We also notice that these four categories share the same purpose that consists in delivering a message. Finally, it seems that it's only the very nature of the message that makes the difference between these first 4 categories. At a formal point of view we are thus in front of the same collection and the target is to deliver a didactic message or information. Only the latest category of "Training and simulation games" seems to be distinguished by relying exclusively on simulations which are cut out to pass down a knowledge first of all, leaving the player free to choose the way he wants to proceed.

It is also important to notice that simulation games just as the other categories of Serious Games have a system of values. The psychiatrist and doctor, Director of the Marmottant Hospital in Paris, Marc Valleur denounces the Sims as having consumerist values from North America. The richer one player is, the more friends he has. Actually, being wealthy make the social activities as well as the relationships easier between the actors in the game. But, Will Wright, the author of the Sims has made a place for money like Molière in The Miser. Money is a part of our Western Society and has its own function. It makes relationship "smoother" between people (Kauffman). It thus makes the exchange easier, even though

it "decreases and simplifies" the very nature of the relationships. Starting from this analysis, the questions show that a simulation could also be a support for the distribution of a message. .

2.2 The message diffused by a simulation game

For Frasca, in Sim City, a simulation videogame, the user builds his own rules and objectives. For instance, to develop the largest, the smallest or the richest city but also to set fun challenges like deciding to make the most aesthetic city. However, we remain here exclusively within the framework of the game. For Genvo, to play is also a choice of posture that the user adopts. Indeed, by using Sim City, a trainer fixes the objectives in adequacy with a teaching progression, the player adopting a posture of learning, according to the context defined in the set objectives: for instance, to understand and to analyse the reactions of a population if the city does not have any shopping centre, or to observe the impact of road infrastructures ill adapted to the economic development of the city.

Thus, it is very simple for a user to switch from the paidea to the ludus, but also from a ludic posture to a didactic posture with a simulation. As Brougere explains to us in "Jouer/Apprendre" by using the concept of "frame" developed by Goffman (p.45), to adopt a choice of posture depends on the context within which the use is (home, school, institution...), if the user is alone or not. All of these notions are also mentioned by Katie Salen and Eric Zimmerman and regrouped in one of their three “primary schemas” named “Culture” (p.102 to 105).

If simulation can take an educational function, it also can take an advergaming function. For that the game designer just has to introduce advertising posters or commercial products into Sim City. To introduce video reports on the trades of town planner, architect, mayor to each annual balance sheet for example would make it possible to bring an Edumarket game dimension to Sim City... Lastly, for the political aspect the game designer just have to add tags or political posters on the walls or to introduce situations of play around poverty (Homelessness, impoverishment, excessive debt). The incidence of the user’s political choices makes it possible to insufflate some not disguised criticisms on the policy of urbanization and economic development currently carried out by the rich countries. Board games like “Tiers Mondopoly” (Orcades Editions) come from the same reflection.

Consequently, we can deduce that a simulation can diffuse all types of messages and objectives like video game does, according to the posture that the user chooses to adopt and to the ingredients (rules and design) which the game designer decides to introduce in the “world”.

2.3 Can the video games permit to train like simulations?

We have just seen that simulation can diffuse a message as well as the first four categories of Serious Games founded on videogames. At this step the added value of simulation would be, if compared to the video game, to offer a training to the user. This thus leads us to know if the video games can do the same.

The answer is obviously related to the posture that the user decides to adopt with his video game. If the video game is essentially an invitation with ludic, Michael Stora in his book "Guérir par le virtuel", explains to us how he uses video games as a therapeutic tool to cure a child’s behavioural troubles. It is here necessary to insist on the place that the adult occupies within the relation which is established between the child and the video game: He is engaged in order to modify the intention and the posture of the child player. In the same way, Shawn Williams tells us in his article « Learning the gaming way » (The Escapist, n° 59), how video game is used daily by his wife, who has a degenerative disease, to preserve her health. The video game thus offers the same properties as simulation.

Thus, we can conclude that Serious Games are composed of two main categories defined as follows:

- ✓ First Serious Games, based on simulation which present a “world”, with its “rules” and where there is no objective imposed by the application.
- ✓ Second, Serious Games, based on video games which propose a “world”, with its “rules” and implemented objectives that the user has to reach.

To diffuse a message and to let the user the choice to adopt ludic, didactic or training posture are possible with the two categories that we have identified, the fields of application being similar.

2.4 To implement objectives, is it an added value to spread a message?

We have just identified in 2.C. that the difference between the two main categories of Serious Games lay only in the presence or not of objectives implemented in the application. Now, the question is to know if the presence of objectives laid down within an application constitutes an added value to spread a message or not.

An experiment carried out in September 2006, in collaboration with the Vortex team of the Toulouse Institute of Computer Search (IRIT) makes it possible to lay down some orientations for future research. Within the framework of the centenary celebration of the discovery of Garges’ cave, three multimedia devices were set up. The idea was to present to the public, through this numerical process, the inaccessible places or restricted areas in order to preserve the cave.

The first device is a simulation which invites the user to locate and raise the layout of various animals on the wall of the cave. The device is composed of a multimedia table on which a video is projected representing the wall of the cave where engravings illustrating the animals are tangled up. The user, thanks to a light pen, draws the contour of some animals which he has to locate first. To accompany him, an organizer guides his browsing and gives explanations (fig.10).

The second one is a traditional computer connected to a video projector which presents a simulation in three dimensions of the hands’ sanctuary. The user can look at each recess thanks to a spherical panoramic that he can move with a mouse. Here, an organizer is present too, to explain the vocation of the numerical set and to comment on the pictures (fig. 11).

The third one is a multimedia video game whose goal is to invite the player, in less than 3 minutes, to locate and draw with a mouse one animal’s contour on the same wall of the cave that is presented in the first numerical set. The effigy of the animal is permanently presented on screen. Here there is no organizer in charge of explaining the contents and the rule of the game (fig. 12). However, when an organizer was present, the users only questioned this one about how to play.

Figure 10: Set on multimedia table

During the day, we interviewed three twelve-year old children, having used the three numerical sets, in order to collect their perceptions and their feelings. Concerning the first device, the spectacular dimension, to draw with a light pen, is arisen in an obvious way. Concerning the reception of information, the children are able to enumerate the animals that they had recalled. The children were fascinated by this imaginary and futuristic activity. The technology generated by itself a ludic and emotional dimension which resulted in a gathering around the set. Even some seniors have approached chairs. The performance of the volunteers who came to draw was a true show for them (fig. 13). The second set was mainly described by the explanations given by the organizer. The children explain the vocation of the device and the nature of the pictures displayed. The global intention and the organizer's remarks are well restored. As for the multimedia video game which represented the third set, the children described it only with the ludic challenge which it proposed: "In this game, you have to recall the animal's shape before it is too late!" The children neither evoked the name of the animals that they had to draw nor formulated questions or comments about the difficulties that the scientists had to face when they listed all the shapes on the real walls.

Figure 11: Organizer presenting the device of the "Hands 'sanctuary" displayed on traditional screen and video projector.

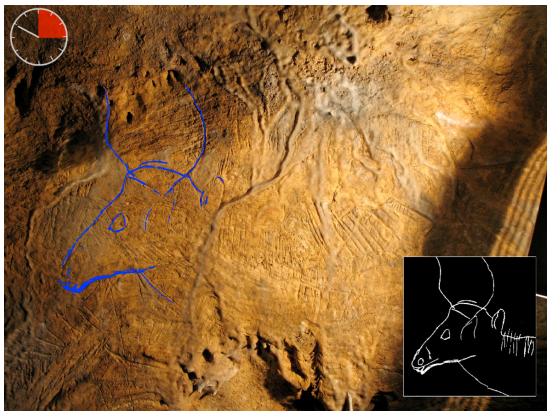

Figure 12: The video game "Gargas" cave" (Vortex/Ja.games – September 2006).
http://dreampict.free.fr/Gargas/Gargas3.swf

Figure 13: For the first computer set, the seniors sitting attend the performance of the volunteers who drew on the multimedia table as if it was a show.

These three devices highlight that the simulation accompanied by an organizer more often invites the user to adopt at first a didactic posture. Conversely the game, especially without an organizer,

naturally invites the user to adopt a ludic posture. In this context, according to the way in which an organizer or a teacher wishes to diffuse his message, it directly influences the users's posture. Thus the mediatized activity takes a different experiential dimension.

A short term memorizing is effective in the experiments one and two, which lets us think that the presence of a mediator reinforces the potential trainings around Serious Game. This assumption is under evaluation in our current search on Edumarket Games.

2.5 Beyond posture, some marketing aims to take into account

The challenge for the industrialists or the institutionalists who wish to use Serious Games as marketing strategy or communication tools, is to manage to offer products which take into account a child's educative and also playful environment. The objective is then to manage to develop products corresponding to the cultural referents of the aimed market. To reach such a goal, it is necessary to go beyond the mere integration of its brand in the existing game play. A heavy adaptation of the original concept can't be avoided because of a different sociocultural context. This process implies a complete transformation of the product by teams understanding as well the cultural stakes as the technological challenges linked to the game and to the brand. It is the only way for the industrialists to be able to settle on markets on a long-term basis and to avoid emergent resistances from consumers who are more and more aware and critical about new advertising strategies.

The implication of both the educative relation and the pleasure dimension corresponds to this wish to build a clear understandable message. This specificity reinforces the idea that the marketing action's main line lies in the experiential dimension of consumption (Hetzel, 2002) and of use (Kline, Duer-Witheford. and De Peuter, 2003). Pleasure of telling and acting, confrontation to challenges, interactivity and narrative liberty are communication lines widely mobilized and prepared in advertising campaigns using serious games.

However there are limits in this search for efficiency and result in a communication policy. The attitude towards the brand aspect takes us back in a wider way to the consumer's perception aspect. The individual mustn't be trapped in market logic at the risk of creating forms of resistances. It is then necessary to build well-balanced plurimedia strategies that respect one of the major stakes of society today: provide the consumer with the "keys" of consumption practice and help him to understand things behind offer and the consequences of his choices, that is to say educate the individual to consumption. This doesn't mean to inculcate him in unquestionable behaviour ways (such product rather than such other) but rather to help him to build a common reference of skills, that is to strengthen the resources that can be called up when he meets the product and its graphics. Thus Serious Game as a communication tool has an importance in diverting and educative principles, even if the posture choice remains unknown for the user in the end.

CONCLUSION

The reflexion in this article has allowed us to discover that there are two kinds of Serious Games: Those based on the Video Game proposing a target that the player has to obtain, and those based on simulation without a special aim. This fact leads us to consider that the different categories of Serious Games being indexed up till today don't find their foundation within a formal constitution, but are a part of a choice of position that the game tries to transmit to the player, by representing "a world" governed by rules as well as graphics and sounds in accordance; The player is always the one that decides about the position to adopt about using the Serious Game.

In order to get to know whether it is better to use an application with available aims, we consider for the moment that the player will at first appreciate to play if the targets are implemented but if they are not, he will get a didactic or training posture. The impact of the distribution of the message is probably depending on how this way is used at the beginning by the game designer or the mediator.

At last we have seen that above all the question of position has to be taken into account when you will construct a strategy of communication with Serious Games. This implies to give "keys" to the user to teach him how to apprehend a Serious Game better over time and to discover its performances.

In that way a Serious Game is a fundamental challenge within modern societies because it reveals ideological models that are hidden and it shows the ambitions of society. This dimension also asks the question about the responsibility of the creators of games because the activity is significant and has a lot of meanings.

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Educational Games: Overview of Shortcomings and Proposed Solutions

Rania Hodhod

Abstract. Educational computer-based games (*edugames*) are games that promote the acquisition of skills and knowledge in a pleasant interactive way. It is well known that not all the users share the same preferences or styles when interacting with a game and solving game-problems. This leads to the importance of adaptation in the sense that behavior of each play-instance of a game depends on the actions of an individual user/player. The major aim for an adaptive game-based learning system is to support and encourage the learner/player/user by considering his needs, strengths and weaknesses. However, the lack of a common design vocabulary has considerably slowed the progress of edugame design.

For this research proposal, we propose to develop a design/methodology for adaptive educational games and to evaluate it empirically by implementing an edugame prototype to practice prolog programming. Evaluation that addresses the new and main aspects in the developed design/methodology will be prominent at the end of the research.

1 INTRODUCTION

With rapid technology development in graphics, sound, and real-time video; electronic games have become increasingly more entertaining and enjoyable for kids as well as adults. Among the various kinds of games, there is a special category, educational games (*edugames*), which have one goal beyond solely entertainment and that is education.

Research in edugames has over time progressed via three separate stages. The first stage perceived the use of computer games as a direct way to change the behaviour of a user through repeated actions. The second stage put the spotlight on the relation between the computer game and the player. The latest stage now includes the context of computer games and how they facilitate learning environments.

Since the 1970's various educational games have emerged and some of them claimed to have educational effectiveness. However, very few formal evaluations [1] have been conducted to evaluate the actual pedagogical values of these games.

Taking into account that different personal interests, different knowledge status, and learning abilities will often lead to different playing patterns implies a factor that must be taken into account in any evaluation of a game. This leads to the importance of a design/methodology on adaptation in edugames, as will be shown below.

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The paper is organized as follows: The next section presents the various aspects and educational needs of games. Following this is a discussion on problems encountered in edugames and some solutions. After which the paper presents a brief introduction to different learning theories and an overview of existing edugames. The paper finally finishes with a research proposal and the conclusions so far reached.

2 GAME ASPECTS AND EDUCATIONAL NEEDS

Games are enticing problem solving environments which the player can explore at will, creating his own ideas of its underlying structure and synthesizing strategies which reflect his understanding of this structure. They are competitive interactions bounded by rules to achieve specified goals that depend on skill, and often involve chance and an imaginary setting [2].

Games have challenges, fantasy, abstract concepts and curiosity that engage the player's attention [6, 7, 8, 14]. To this is added other powerful characteristics such as virtual worlds. These virtual worlds are not just about facts and isolated skills, but embody particular social practices such as developing situated understanding, and experimenting with new and powerful identities [4, 5]. Moreover, games have the potential for motivating drill and practice by providing environments in which students actually enjoy repetition.

Noting the highly motivating nature of games and all the other constructive aspects games can provide, researchers have started to investigate whether these games could be utilized to assist learning [3].

Many (if not most) of the present edugames have not been designed based on any of the existing learning theories [8, 16, 18, 19, 21, 22, 23, 24, 25] but have been designed in an ad-hoc way. Only few designers claim that their games are really effective in education, and even fewer support these claims with results from formal empirical studies [1]. Some researchers such as Klawe [9] consider edugames effective only if the interaction is monitored and directed by teachers, or if the games are integrated with other more traditional activities like pencil-and-paper exercises. Other

researchers believe that effectiveness of edugames is related to the features, preferences and behaviour of a particular user [3]. We argue that a design bearing the "individualized instruction" feature can be an efficient way to deal with personal differences.

3 PROBLEMS ENCOUNTERED IN EDUGAMES

Empirical studies have shown that one major problem is that while edugames are highly engaging, they often do not trigger the constructive reasoning necessary for learning. Two researchers [10, 8] have argued that students can be successful game players by learning superficial heuristics rather than by reasoning about the underlying domain knowledge; but the lack of a common design vocabulary presents problems in evaluation these claims. (In addition to which is the observation that the evaluation phase has not been a serious factor in present designs of edugames.)

In adaptive edugames more problems are presented such as the real-time adjustment of the background story (dependent on the user interaction), and the expansion of the user model which itself is a key element in the adaptation process as it includes not only the level of student knowledge but also his intentions. These issues (and others) are often missing due to the lack of awareness of existing learning theories; theories which themselves can serve as a template in the design process of edugames. Such awareness in a design of an edugame can lead to achieving higher learning levels implying better educational outcomes.

4 EDUGAMES AND LEARNING THEORIES

Many learning theories exist that edugames research area can utilize to achieve desired educational needs. According to research [11] those of Gagne's events of instruction [13], Keller's ARCS Motivational model [11], and Bloom's taxonomy [15] are the most appealing templates to be used in game design principles, while Reigeluth's Elaboration Theory can be also be optionally included [12].

• Gagne [13] has developed what is called "events of instruction" which serve as a guide for developing and delivering a unit or units of instruction. His described nine events are: Attention gaining, Objective setting, Invoking of prior learning, Presentation of new material, Created scaffolding, Provision of practice, Feedback, Assessment, and Retention-and-transfer of new knowledge to a real-life situation.

• According to Keller [11], motivation is a necessary but not sufficient condition needed to ensure that learners actually learn something. His ARCS model is represented using the four following classes: Attention, Confidence/challenge, Relevance and Satisfaction/success. In deeper detail, gaining attention is a learning prerequisite while relevance is about what is taught and how it is taught. Confidence is expectancy for success, and finally satisfaction is about how people feel about their accomplishments. Keller's model is intended to be incorporated in accordance with instructional models like Gagne.

• Bloom [15] has identified six levels within the cognitive domain, from the simple recall or recognition of facts, at the lowest levels, through increasingly more complex and abstract mental levels to the highest orders which are classified as synthesis and evaluation. His theory is further discussed below.

• Reigeluth's Elaboration Theory [12] proposes several major strategy components: An Elaborative Sequence where good games follow a well-paced sequence progressing from simple (and easy) to complex (and hard). Learning rote sequences is the involving of simplified problems as well as providing suggestions. Summary is something that almost all games provide in the some form of statistics/percentages (e.g., score, health, strength, maps, assets, etc.). Synthesis is building on knowledge gained from previous knowledge. In Analogies players very quickly learn to look for approaches or tactics that are similar to some other game they have played, and will try to apply these in any new context that looks like it might favour this approach. The idea of Cognitive Strategies is the ability to force the player to use strategies invented by the designers in order to achieve goals. Learner Control is the idea that a player/learner is always in control is an obvious requirement for all games since without it a game becomes a non-interactive computer program.

In common to all the above approaches is the need to measure the learning outcomes of edugames. The higher the learning level achieved, the better the edugame learning outcome. As seen in the above mentioned theories, the various components and attributes are shared like: attention gaining, feedback, motivation, relevance, success, summary, cognitive strategies, etc. These concepts should be kept in mind throughout the design and implementation of any edugame.

However, Bloom's classification of the learning levels can serve as a measurement of the learning outcomes of edugames. The next section introduces the existing edugames briefly and in a way that points out the most important aspects and weak points found. In addition a measurement will be assigned to their learning outcomes according to Bloom's taxonomy.

5 EXISTING EDUGAMES

Mapping the learning outcomes to Bloom's learning levels requires first to identify exactly what each level in the taxonomy means, so that a gauge can be calibrated guided by these definitions. Bloom's taxonomy of learning levels can be defined as follows:

- Knowledge is defined as the remembering of previously learned material.
- Comprehension is defined as the ability to grasp the meaning of material.
- Application refers to the ability to use learned material in new and concrete situations.
- Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood.
- Synthesis refers to the ability to put parts together to form a new whole.

- Evaluation is concerned with the ability to judge the value of material for a given purpose.

An early educational game, such as *How the West Was Won* [16] was developed in 1976 to teach mathematical expressions. It has an embedded user model that leads the student through the game while identifying the student's weak points. Another edugame developed at this time (1977) to teach logic and probability is the *Wumpus* game [17]. Wumpus has an embedded user model to identify the player's logical problems. Both edugames reach the Application Level.

The embedding of agent technique with user modelling can be seen in the edugame *Easy Math* [18] (developed in 2000). This embedded user model helps in identifying the misconceptions of individual students. Although this edugame has a puzzle game as one of its exercises, it lacks many of the game features which affect its success as an edugame. This edugames reaches the Knowledge Level.

The *Aqua Moose* edugame [19] (developed in 2002) to teach mathematical functions through visualization. This edugame proves that a fantasy story line or a good interpreted background story can have priority over graphical issues in the edugame environment. However lack of a user model prevents the edugame from tracking the player performance. This game reaches the Comprehension Level.

Prime climb edugame [10] (also developed in 2002) to teach number factorization. This edugame also shows the importance of having a well structured story line to engage the student. If such a story line is absent, the player will be distracted from the main purpose of the game by trying to find other joyful objects in the playing environment in front of him. This edugame reaches the Application Level.

In a problem solving environment like *Betty's Brain* [20] (developed in 2005), researchers believe in the learning-by-teaching paradigm. This game tries to reach the higher levels in Bloom's taxonomy (Analysis and Synthesis), but it fails in helping the players to attain this.

JVM edugame [21] (developed in 2004) to teach the compilation process of Java language with the help of an agent embedded in the game environment. Players are immersed in micro-worlds, not learning any particular domain but becoming part of the environment. This game illustrates that long, traditionally tedious, and difficult tasks can be engaging and fun when they are part of a good story. This game reaches the Analysis Level.

The *Lincoln* edugame [22] (developed in 2006) proves the effectiveness of taking over the role of the virtual character in a game as a good way of involving and engaging the student. Although this game can be considered one of the good games to teach history, it lacks the presence of a user model that targets individual preferences. This edugame reaches the Analysis Level.

Some attempts to teach computer programming concepts include *RoboCode* [23], *ToonTalk* [24] and *CeeBot-4* [25]. *RoboCode* is a Java-based virtual robot game intended to teach Java programming techniques. The programmers implement their robots in the Java programming language, and test their creations either: using a graphical environment in which battles are held, or by submitting them to a central web site where online tournaments regularly take place. *ToonTalk* is a game to teach programming concepts but without the writing of source code. *CeeBot-4* is a game to learn programming, or to teach programming at middle school, high school and university. It uses a language close to Java and C# to program robots that will solve various tasks ranging from finding the way out of a labyrinth over car racing to playing soccer.

RoboCode and *CeeBot-4* lack a pedagogical agent while *ToonTalk* uses agents to provide hints and help but without making use of any user model. These games are examples of using entertaining goals to motivate students to practice perceived dreary activities like programming. *ToonTalk* reaches the Synthesis Level, while *RoboCode* and *Ceebot-4* reach the Application Level.

During a recent literature survey/review many issues were noticed. Among these issues, adaptation has not been achieved through adapting the game environment itself to be contingent with the educational needs of the player as dictated by the user model and its state in the game environment. For example in the edugame [8] the objects and obstacles on the same level were fixed for all users unless changed by externally by someone (say, the teacher); otherwise the ability to adaptive in this edugame is only through the style of help and hints provided to the user by the pedagogical agent. Likewise, in the edugame [11] adaptation is acquired through the idea of the presence of various sub-games that are assigned to different users according to their profile.

Another issue noted was that none of the existing edugames that contains a user model has dealt with the *mental state bandwidth* where bandwidth is a parameter for categorizing student models. User input gives an indication of both the knowledge and intentions underlying a user action. Making use of these indicators can help in the adaptation process. Lastly, it was noted that that the highest learning levels in Bloom's taxonomy have not yet been reached any of these edugames surveyed.

6 PROPOSED RESEARCH

6.1 The proposed model

As mentioned above the idea of adapting the edugame environment according to the users needs in a dynamical fashion during the playing of a game not been investigated. Therefore, we argue that tackling this issue can be achieved through our proposed research. Figure 1 shows the proposed model where the interactions between the story engine, the educational material and the user model are identified.

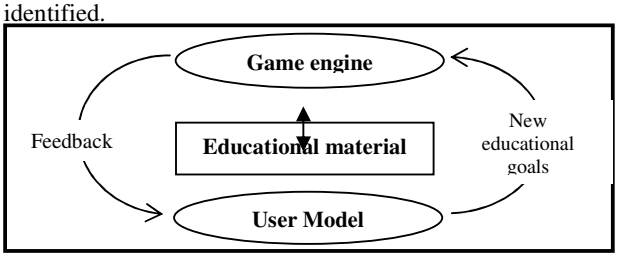

Figure1. The proposed model

By understanding the relationship between the educational needs and the game elements can allow development of edugames to include visualization and problem solving skills [7]. This idea can be extended using the model presented in figure 1 to incorporate the dynamic generation of the game elements that are associated with educational goals.

The proposed model incorporates the notion of direct interaction between the story engine and the educational material; while the game engine provides feedback to the user model which in turn provides new educational goals to the engine. The task of the game engine is to generate game objects associated with specific educational task dynamically during the playing of the game. Such generation is in accordance to the information dictated from the user model and the educational material, and it was not specified by the edugame designer beforehand but it is achieved according to some generally coded association rules. The representation of such rules is an area that itself be independently researched.

The proposed model considers two important issues: the first issue is the contraction/expansion of the user knowledge over time and the second issue is the perseverance of engagement and fun during play time (or learning time). The first issue is considered important since game objects are always generated according to constantly updating user model. This means that if a contraction/improvement is noticed in the level of the player's (student) knowledge then the appropriate object associated with the appropriate educational material will be presented or retracted. In this way the level of difficulty of the game is adjusted to the player preventing him from being frustrated by finding the game too difficult or getting bored by finding it too easy.

The second issue is also considered important due to the fact that the educational material is integrated as a part of the game story itself and the success of learning this material leads ultimately to the success completion of the game. In turn this helps in maintaining a fairly constant level of engagement with the edugame. We believe that the outcome of this research is a model that can lead to a deeper understanding of the adaptation process which then in turn leads a better design of edugames with higher educational outcomes.

6.2 Proposed design methodology

The previous subsection discussed some of the shortcomings in the field and proposed ideas to rectify them. In this section a design methodology that incorporates these ideas is presented.

This design methodology has the following characteristics:

- The design must be based on a learning theory.
- The educational aim must be considered within the game design from the very beginning and in every step through the design process.
- The educational material has to be integrated with the story line and be part of the edugame environment.
- Enrich the learning opportunities for users by offering intellectual exploration through individualized user guidance and support to resolve the user's misconceptions within the learning environment.
- Reaching the higher learning levels of Bloom's taxonomy must be achieved as an outcome.
- Educational material, student and tutoring models should be incorporated in the game. The student model should incorporate student goals as well maintaining an idea of the student's knowledge.

The proposed methodology gives the user/player/student the chance to be exposed to higher learning levels. While this can be achieved through the drill and practice puzzles embedded in the edugame environment, pace of game play can be reduced/increase through dynamically varying the difficulty of puzzles, reducing the number of tasks to be performed if the concept has already been mastered; de/increasing the number of interactive characters, or even simply changing the player/characters inventory [26]. In addition, the proposed design recommends dealing with the mental state bandwidth in the student model, where the student model has to incorporate the student goals along with his educational knowledge. We believe this can also help in guiding the adaptation process so leading to better educational outcomes. Finally, a battery of hints and feedback should be designed within the edugame environment as necessary components of tutoring [27, 28].

6.3 Proposed scenario

The proposed methodology/design will be demonstrated through the implementation of an edugame to practice Prolog language programming. Given this short scenario it can be seen how the proposed model can work in an edugame environment.

Assume that the player/student is situated in the hallway of a house and is presented with a problem to solve. The system can capture the level of knowledge and the student intentions from the answer(s) he will give. The student feedback provides information about his knowledge level and how he provides his answer provides information about his intentions. For example, if the system now believes that the student executes certain rules, *rule1* and *rule2*, in a certain order to entail the goal *g*. This can be added to the student model as an indicator of what the student believes and what are his intentions are during the solving this kind of problem.

Now assume that the next task presented to the player is to write a program to deduce a secret number. It is now the job of the game story engine to decide what is the next appropriate object to present to the user. A method to reason about this can be as follows: As the user is indoors, it will not be suitable to present a tree object to introduce the new task, while as the task is to deduce a secret number, an object like a safe is more suitable than a ball. Hence reasoning about the environment together with the educational material plus the user knowledge state is main task of the edugame engine. The engine also has to consider all these issues in order to present the player with the

suitable object that better serves the educational task and keeps the fun and engagement in the edugame.

7 EVALUATION OF PROPOSED WORK

The evaluation of the prolog programming edugame prototype that demonstrates the proposed design /methodology will be done in two stages. The first stage will assess the design methodology through an internal evaluation whereby a clear picture of the architecture of the intelligent tutoring facility and how this kind architecture provides the edugame environment is shown.

In the second stage, an external evaluation will take place in which the educational impact of the edugame on the player and how the edugame helps the player to improve his knowledge and skills will be measured. The measurement suggested is a cognitive walkthrough and a heuristic evaluation of what has been learnt. The first stage gives the chance for researchers to take on the role of the users and so identifies potential usability problems. The second stage evaluates the user interface and indicates potential problems that violate the general principles of good design interface. Further to this is the logging of game play which is helpful in understanding how the edugame is played. Finally evaluation through focus groups and pre/post tests will give a measurement of what has/has-not be learnt.

8 CONCLUSIONS

Educational games must be at least as effective as the teaching methods they replace. Therefore the fundamental goal of educational games must be: the player must master the content of the educational material in order to master the game. In other words, success in the game must be dependent on learning skills and/or concepts. In addition there is natural tension in game design between the complexity of rules and the simplicity of interfaces. Player choices and feedback from these choices should be transparent enough to foster freedom, immersion, and flow of movement in virtual worlds without overwhelming the player with information and/or commands. To this we argue that it is important to consider the learning theories during the edugame design and evaluation.

Further, we believe that the proposed ideas in this paper can help in overcoming some of the shortcomings and drawbacks that currently exists in the edugames research field, by noting that the proposed methodology /design/model offers a kind of equilibrium between achieving the desired educational needs and a constant level of fun and engagement during the learning process associated with game play. In addition the capability of the proposed edugame manages not only the player/student knowledge but also his intentions leading to a deeper understanding of the adaptation process which we argue leads to better educational outcomes.

ACKNOWLEDGEMENTS

I would like to thank the AISB'07 Symposium: AI and Narrative Games for Education reviewers for their comments, which helped improving this paper. Also, I am gratefully acknowledges Nim Shah's and Lillian Clark's comments that helped in improving the language of this paper.

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Intelligent Mobile Tour Guide

MeiYii Lim and **Ruth Aylett** [1]

Abstract. 'Agents' research has been going on for more than two decades now. The idea of improving assistance by agents capable of responding to the needs and emotional states of the users is not new, yet not much has been achieved so far. The main aim of this paper is to describe an intelligent context-aware mobile tour guide, having a biologically inspired architecture of emotion that allows the guide to adapt to the user's needs and feelings. The resulting agent guides visitors touring an outdoor attraction as well as personalises the story presentation. A review of related work is presented, followed by a technical description of the system focusing on the core element - the guide's emotional architecture and concluded with the current state of the project.

1 Introduction

Many research projects have explored the new possibilies of context-aware tour guide systems (eg. [1, 34, 24, 26, 14, 20, 4, 2, 33]) for augmenting the environment to provide guidance to users during a tour visit. This is part of the effort of ubiquitous computing to integrate computation into environment to enable people to interact with information in an inherently social manner. However, in interaction with current virtual guides, users tend to lose interest rapidly due to lack of 'life' and unmet expectations. This problem should be solved in order to prolong and produce a more engaging and natural interaction between the guide and user, also, to increase appreciation of a heritage site.

The better computational agents can meet our human cognitive and social needs, the more familiar and natural they are and the more effectively they can be used as tools [8]. Hence, intelligence and emotions are necessary for an effective computer system. Picard argues that "a machine, even limited to text communication, will be a more effective communicator if given the ability to perceive and express emotions" [27].

Supporting these arguments, the Intelligent Mobile Tour Guide is a guide with personality and beliefs, to provide guidance and engaging interaction during a tour visit. It addresses the frustration that usually occurs in the interaction with an emotionless computerised system that does not react sensitively to user's feelings. The guide applies its beliefs, interests, user's interests and its current memory activation to narrate stories. Decisions on story generation and updating of beliefs about user's interests are affected by its internal processing controlled by an emotional model which receives input from the user.

The guide not only tells stories based on its own experiences and point of view, but attempts to evoke empathy in the user [19]. It attempts to persuade the user to think in the way it thinks, that is, to put the user in its own shoes. By seeing things from the guide's perspective coupled with his/her own knowledge and understanding, a user will be able to analyse, enquire, reflect, evaluate and use the source of information critically to reach and support conclusions. In short, it makes the user envisage an event in a deeper sense and fosters learning, the attainment target of the UK National History Curiculum [23].

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2 Technical description

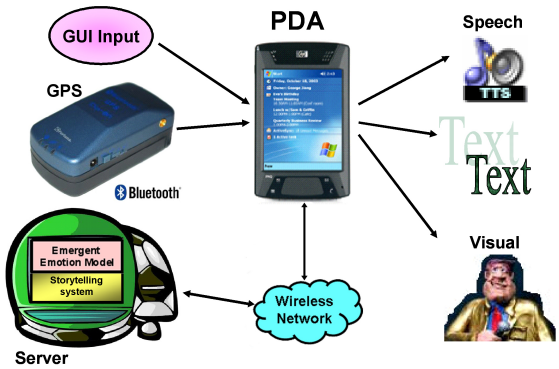

Figure 1. System Architecture

The Affective Guide is implemented on a PDA, taking advantage of the expanding mobile technologies such as Wi-Fi wireless hotspots and bluetooth access points. Multiple modalities are used to complement each other and focus the user's attention on the information presentation. User's position is determined by a Global Positioning System while user's orientation is calculated based on previous and current location information.

Prior to a tour, there is an ice-breaking session where the guide extracts information about the user's name and interests. It then chooses attractions that match the user's interests and plans a route to the destinations in such a way that it is the shortest route possible. It then navigates the user to the chosen locations by giving directional instructions as well as presenting the user with an animated directional arrow. The guide will notify the user upon arrival at a destination and start the storytelling process. Since tourist information is location-dependent by nature, the system links electronic data to actual physical locations, thereby augmenting the real world with an additional layer of virtual information. A server performs the processing and holds the guide's memories, both long-term and current, and sends the results of processing to the PDA on demand.

A 'Head up' approach is adopted where stories are presented using speech allowing the user to have full appreciation of the attraction visited. The text is also displayed on the screen allowing the user to read any information missed in the speech. After each storytelling cycle, the user can choose to have 'More' stories about the current

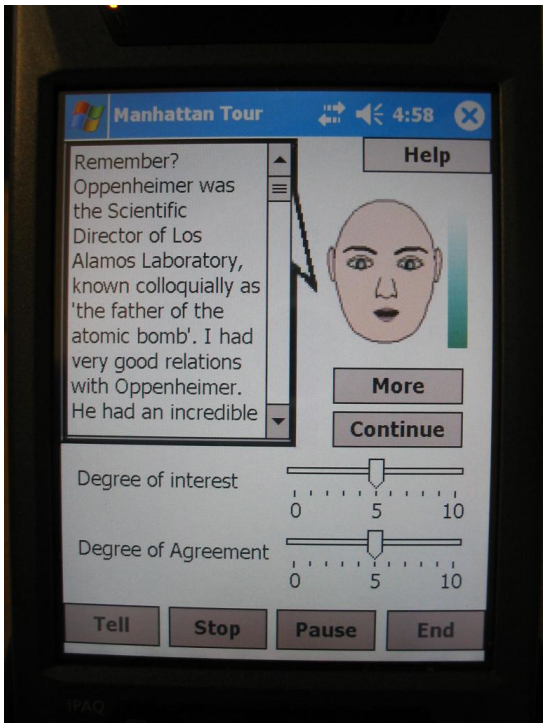

Figure 2. The Graphical User Interface

location or 'Continue' to the next location. This is the only time the user is required to look at the screen to provide feedback on the degree of interest of the story and his/her degree of agreement to the guide's argument. The user inputs reflect his/her current feeling and opinion about the story content, useful for personalising further stories.

As can be seen in Figure 2, a simple graphical user interface has been designed due to the limited space on the PDA and to reduce cognitive load for the user. The user is given the flexibility to stop the speech if they are not interested in the currently presented story. User can also ask the guide to pause, resume or repeat the current story. Furthermore, acknowledgement and notification using both speech and message boxes are provided periodically to reduce long idle states and as an assurance to the user that the system is operating as intended. If the user is attracted to a site which is not in the preplanned route, they can activate the storytelling process manually by clicking the 'Tell Story' button. If information is available, the guide will start the narration, else the user will be notified about the unavailability of information. At any time, the user can activate the 'Help' menu if he/she is unsure about the function of a particular button on the interface.

3 Body-Mind Architecture

3.1 Related Work

As mention in the Introduction, emotional systems are essential part of an intelligent computer agent. Thus, researchers on character development are paying attention to the design of motivational structures, emotional and personality traits and behavior controls systems for characters to perform in context-specific environments with well-defined goals and social tasks [10, 16]. They have long wished to build creatures with whom you'd want to share some of your life whether as a companion or a social pet.

Cañamero [5] proposed an architecture that relies on both motivations and emotions to perform behavior selection. Under normal circumstances, behavior selection is driven by the motivational state of the robot. Emotions constitute a 'second order' control mechanism running in parallel with the motivational control system to continuously monitor the external and internal environment for significant events. However, the main problem with this architecture is that it was totally hand-coded.

On the other hand, Velásquez's work [36] is inspired by findings in neuropsychology that relies on the use of computational frameworks for Emotion-Based Control. The model integrates perception, motivation, behavior and motor control with particular emphasis on emotions as building blocks for the acquisition of emotional memories. Velásquez's robot, *Yuppy*, utilized feed backward operation of emotion where previous emotional experiences are fed back to the behavior system forming an emotional memory, which affects action selection strategy when it re-encounters similar situations. However, *Yuppy* capabilities are prespecified and it does not show emotional responses to a novel object or situation.

Next, the OCC model [25] is one of the most used appraisal models in current emotion synthesis systems although the theory was not intended to be used for emotion synthesis by the authors. OCC model works at the level of emotional clusters, called emotion types, where the emotions within each cluster share similar causes. This model proposes that emotions are the results of three types of subjective appraisals: the appraisal of the pleasingness of events with respect to the agents goal, the appraisal of the approval of the actions of the agent or another agent with respect to a set of standard for behavior and the appraisal of the liking of objects with respect to the attitudes of the agent. Numerous implementations of this model were seen, for example, the Affective Reasoner architecture [11] and the Em component of the Hap archtecture [3].

Klaus Scherer [32] explicitly proposes treating emotion as a psychological construct consisting of five components: cognition appraisal, physiological activation, motivation tendencies, motor expression and subjective feeling state. He proposed the 'component process model of emotion' and suggested that emotion can be defined as an episode of temporary synchronization of all major subsystems of organismic functioning represented by these components. Furthermore, he suggest that there may be as many emotions as there are different appraisal outcomes.

The Oz project [3, 21] attempted to build a small simulated world, containing several real-time, interactive, self-animating creatures. It aimed at producing agents with a broad set of capabilities, including goal-directed and reactive behavior, emotional state, social knowledge and some natural language abilities where individual *Woggles* had specific habits and interests which were shown as different personalities. Social relations between the agents directly influenced their emotional system and vice versa. Oz focused on building specific, unique believable characters, where the goal is an artistic abstraction of reality, not biologically plausible behavior.

AlphaWolf's [35] emotional model is based on the Pleasure-Arousal-Dominance model presented by Mehrabian and Russell [22]. It captures a subset of the social behavior of wild wolves, involving models of learning, emotion and development. The wolves' emotions lead to formation of context-specific emotional memories based on the "somatic marker hypothesis" presented by Damasio [7], which affects how they will interact in the future. This research emphasises social learning and offers initial steps toward a computa-

tional system with social abilities.

All the above projects involves explicit labelling of emotions and focus either on the neurophysiological aspect of emotion, or on the cognitive aspect, adopting the notion of appraisal. Very few attempts have been carried out to bridge the gap between these two aspects where models such as perception, motivation, learning, action-selection, planning and memory access are integrated. Two effort in this direction are [9], the emotional model adopted by the Intelligent Mobile Tour Guide described further in Section 3.2 and [28].

[28] aims to investigate improved realism in generating complex human-like behavior by integrating behavior moderators with higher cognitive processes. It integrates a connectionist cognitive model of emotional processing called SESAME [6] with a synthetic force model, SOF-Soar architecture [13] for training in a battlefield simulation. The response system accepts information from, while appraisal system provides information to, the connectionist emotions model. Emotional states can be viewed as arising from a combination of pleasure/pain, arousal, clarity/confusion components and by changing these connection strengths, different personalities result.

3.2 Emergent Emotion Model

The emotional architecture of the guide is based on the 'PSI' model [9]. It is biologically inspired where the interest lies in modelling the conditions to the emergence of emotions to avoid rigidness in behavior and provide more colors to the resulting emotions. In this architecture, emotions emerge from the modulation of information processing, action selection, planning and memory access. The guide continuously forms memories, expectations and immediate evaluations, resulting in behavior that can be termed emotional.

The guide has two built-in motivators to maintain. It needs to preserve its level of competence and adjust its behavior appropriately to the level of uncertainty. The level of competence refers to its capability to cope with differing perspectives about an issue or event whereas the level of uncertaintly is the degree of predictability of the environment and the user interests. For example, if user disagrees with the guide's opinion, its level of competence decreases. Furthermore, if the user finds the stories uninteresting, its level of uncertainty increases as its prediction about user's interests is incorrect.

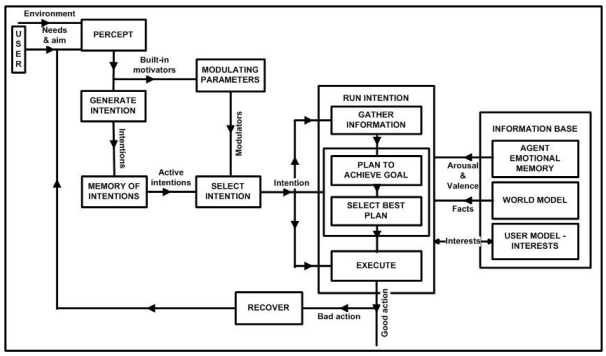

Figure 3. The Emergent Emotion Model

Functionally, the guide reads the user inputs, system feedback and the GPS information continuously, then, generates an intention, let's say to tell a story. The intention together with its built-in motivators are stored in a memory of intentions. The guide makes assumption about the user's interest based on the initial information extracted through the ice-breaking session. Basically, the guide has three possible intentions that it can select - update its belief about the user's interests, adjust the story topic and presentation or perform storytelling.

More than one intention can be active at the same time. Depending on the importance of the need and the urgency for its realization, one of the active intentions is selected. For intention execution, the guide decides autonomously whether to explore for more information, to design a plan using the available information or to run an existing plan. The decision on how to perform the intention is made based on the value of its built-in motivators and modulators such as arousal level, resolution level and selection threshold, or in in other words, the agent's current emotional state. Arousal level refers to the speed of processing or the agent's readiness to act. Resolution level determines the carefulness and attentiveness of the guide's behavior. Lastly, selection threshold is the limit competing motives have to cross in order to take over.

Besides emotions, personality plays an important role in the guide. Results from our survey of human tour guides show that factors like role, interest, experience, guide's belief, guide's personality, type of tour and visitor group affect the information presentation. Different guides have different styles and most guides tend to incorporate belief and past experiences whether his/her own or others while narrating a story. Similarly, the intelligent mobile guide's personality is reflected through its perspective about a particular historical event. Furthermore, in our model, personality emerges from varying the weight of each modulator as discussed in [18]. Like emotions, personality is not defined explicitly but results from overall activity of the guide and by its patterns of interaction.

3.3 The Guide's Memory

The guide possesses a long-term memory that is made up of declarative memories, both semantic and emotional memories [18]. Semantic memory is its memory for facts, including location-related information, definition of concepts, the user's profile, etc. Each piece of the guide's semantic memory contains the following features:

name	:	as an identification of the memory piece
type	:	the type of event
subjects	:	the subjects involved in the event
objects	:	the objects involved in the event
effects	:	the effects of the event
concepts	:	basic elements in the piece of memories that has a more detailed definition
attributes	:	describes the nature of the story element, for example, science, military, social
location	:	the associated physical location where the event occur
text	:	the text encoding the event

While the semantic memory contain facts, emotional memory is a memory for events that have emotional impact on the guide. The emotional memory is tagged with 'arousal' and 'valence' [17] tags analogous to the *Emotional Tagging* concept [30], which recorded the guide's emotional states for an event. The guide's emotional memory holds a certain ideology, defined simply as beliefs held by the guide, that reflects its perspective about an issue or event. It is a manifestation of the guide's past experiences. The guide's emotional memory pieces have a similar structure to the semantic memory pieces with the addition of the following:

arousal	:	the arousal value when an event took place
valence	:	the emotional valence value an the event took place

3.4 Storytelling System

When interacting with the visitor, the guide will be engaged in meaningful reconstruction of its own past, at the same time presenting facts about the site of attraction. The guide adopts the storytelling technique proposed by [15], however, with some modifications.

In every step, the guide decides what to tell dynamically. It constructs stories by improvising taking into account factors such as the already told story at the current moment and the affinity between story element and the guide's interests as well as the user's profile. Three scores corresponding to these factors are calculated each time, which are then combined to calculated an overall score for each candidate pair of story element and location. It selects a memory spot, that is a memory element with the highest overall score. This spot will lead to further extension of facts as well as emotional memory elements depending on its current resolution level. The retrieval of memory pieces continues until the combined memory pieces is large enough to generate a story as illustrated in Figure 4. All these extension processes are performed by Jess [2], a Java-based rule engine.

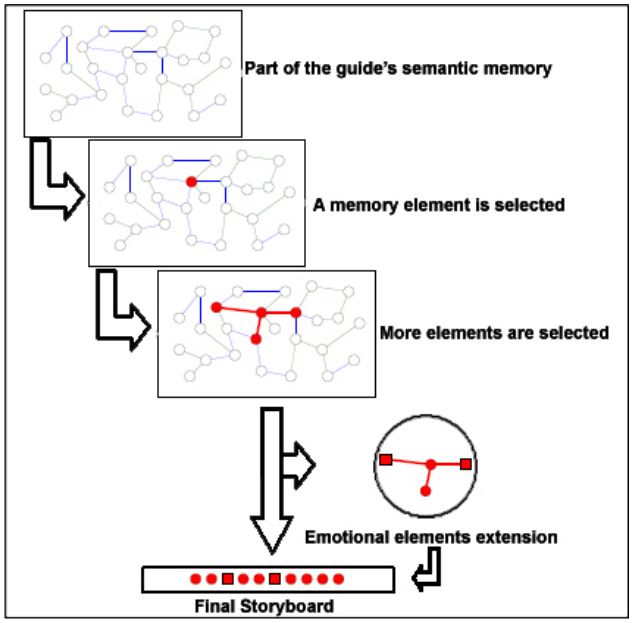

Figure 4. The Story Extension Process

After each story presentation, the guide will update its current memory so that the next retrieval will be based on the current active memory elements resulting in a reminding process. Reminding is a crucial aspect of human memory and it can take place across situations. The memory elements of the guide are retrieved based on reminding methods: processing-based reminding and dictionary-based reminding as discussed by [31].

Processing-based reminding occurs during the normal course of understanding or processing of new information. A *scene or location*

[2] http://herzberg.ca.sandia.gov/jess/

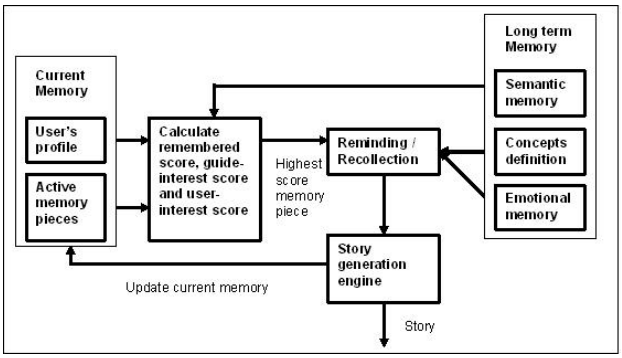

Figure 5. The Storytelling Process

is a kind of structure that provides a physical setting serving as the basis for reconstruction. Besides that, the guide's memory elements are activated based on *subject-object* links as one person can remind us of another, one object can remind us of another object or one event can remind us of another. *Cause-effect* links also act as a reminding criterion where a particular event leads to the activation of another element of memory which is the cause or the effect of the current memory element.

The changeability of dynamic memory makes people's memory acts differently in apparently similar situations. We are usually being reminded of similar events or the closes previously experienced phenomenon. In this sense, *attributes* are use to link and retrieve the guide's memories on similar events or circumstances. On the other hand, dictionary-based reminding occurs when the guide searches for the definition of an infrequent word, concept or object. It uses the *concept* element of the memory piece to further elaborate the stories by retrieving the definition when a concept occurs for the first time. Analogous to human memory, a concept strength in the guide's memory increases when it is activated frequently and will be forgotten if not used after a few iterations.

3.5 Overall Process

The recollective experience of the guide is related to the evocation of previously experienced emotions through the activation of the emotion tags. These values combine with the built-in motivators values to trigger the resolution level and selection threshold, resulting in re-experiencing of emotions, though there might be a slight variation due to the input from the user. The user's response, contributes to the guide's certainty level by confirming or disconfirming the guide's prediction. On the other hand, the degree to which he or she agrees with the guide's argument, contributes to the guide's level of competence.

Let's take a look at some examples. If the guide's prediction about the user's interests is correct (high level of certainty) and the user perspective is consistent with that of the guide (high level of competence), the guide may experience low to medium level of arousal and selection threshold with a medium resolution level. In this case, the guide may be said to experience pride because it could master the situation. It is not so easy for another goal to take over. The agent will perform some planning and provide a more elaborated story on the current subject based on its active ideology. The guide's belief about the user's interests is srengthened. This is consistent with the

argument of Fiedler and Bless [12] in which agent experiencing positive affective states fosters assimilation that supports reliance and the elaboration of its existing belief system.

However, if the guide's prediction about the user's interests is right (high level of certainty) but the user's perspective is in conflict with the guide's ideology (lower level of competence), then the arousal level of the guide may be higher than the previous case. The resolution level decreases while the selection threshold increases. In this case, the guide may have some difficulties coping with the differing perspective, but since it has anticipated the situation, it is motivated to concentrate on the specific goal and adjusts the presentation of story appropriately by giving a more general view on the issues instead of presenting them from its own ideological standpoint.

Next, in the case that the guide's prediction about the user's interests is wrong (low level of certainty) but the user's perspective is consistent with the guide's ideology (high level of competence), the arousal level of the guide may be equal to or lower than the second case. The guide is still in control of the situation making the uncertain environment look less threatening. Nevertheless, the guide may be disappointed or sad in relation to its wrong prediction. The selection threshold decreases and the resolution level increases. Now, the guide will perform more detailed and substantive processing to elaborate its perspective and overcome the discrepancy by changing its beliefs about the user's viewpoint. This is again supported by the discussion of Fiedler and Bless that negative states trigger accommodation processes, allowing beliefs to be updated.

On the other hand, if the guide's prediction about the user's interests is wrong (low level of certainty) and the user's perspective is in conflict with the guide's ideology (low competence level), the arousal level of the guide will be very high. It is reasonable to react quickly, concentrate on the respective task and refrain from time consuming memory search. Therefore, the selection threshold should be high while its resolution level should be low in which case, we may diagnose that the guide is experiencing anxiety. In this situation, a biasing effect occurs and the guide tends to give a more general story of the current site without details. The current situation will be fedback to the system so that the guide can adjust its beliefs appropriately to better cope with the situation in future.

By doing so, it adapts its behavior according to its internal states and the environmental circumstances. Each execution of intention will produce a feedback into the system and recovery or the guide's belief is updated as necessary.

3.6 Example Stories

The 'Los Alamos' site of the Manhattan Project [3] has been choosen for the prototype implementation of the Intelligent Mobile Guide System, where the buildings are mapped onto Heriot-Watt Edinburgh campus buildings. Hence, all the stories are related to the 'Making of the atomic bomb' [29]. Below is an extract of a story from the non-emotional and emotional guide presentation.

Non-emotional guide's presentation:

The first Japanese bombing target, Hiroshima was of such size that the damage would be confined within it, so that definite power of the bomb could be determined. Little Boy exploded at 8:16:02, August 6, 1945, Hiroshima time, one thousand nine hundreds feet above the courtyard of Shima Hospital, with a yield equivalent to twelve thousands five hundred tons of TNT. Trinitrotoleune or TNT is a pale yellow crytalline aromatic hydrocarbon compound that melts at eighty one degree Celcius. It is an explosive chemical used on its own or in many explosive mixtures such as Torpex, Tritonal, Composition B or Amatol. It is difficult to dissolve TNT in water; it is more soluble in ether, acetone, benzene and pyridine. The explosive yield of TNT is considered the standard measure of strength of bombs and other explosives.

Emotional guide's presentation (medium level of resolution):

The first Japanese bombing target, Hiroshima was of such size that the damage would be confined within it, so that definite power of the bomb could be determined. Little Boy exploded at 8:16:02, August 6, 1945, Hiroshima time, one thousand nine hundreds feet above the courtyard of Shima Hospital, with a yield equivalent to twelve thousands five hundred tons of TNT. Trinitrotoleune or TNT is a pale yellow crytalline aromatic hydrocarbon compound. Its explosive yield is considered the standard measure of strength of bombs and other explosives. The important result of Hiroshima bombing and the one that we sought, was that it brought home to the Japanese leaders the utter hopelessness of their position. When this fact was reemphasized by the Nagasaki bombing, they were convinced that they must surrender at once. The Air Force is operating primarily to laying waste all the main Japanese cities. Their procedure had been to bomb the hell out of Tokyo, bomb the manufacturing and assembly plants, and in general paralyze the aircraft industry so as to eliminate opposition to its operations.

Emotional guide's presentation (high level of resolution):

The first Japanese bombing target, Hiroshima was of such size that the damage would be confined within it, so that definite power of the bomb could be determined. Little Boy exploded at 8:16:02, August 6, 1945, Hiroshima time, one thousand nine hundreds feet above the courtyard of Shima Hospital, with a yield equivalent to twelve thousands five hundred tons of TNT. Trinitrotoleune or TNT is a pale yellow crytalline aromatic hydrocarbon compound. Its explosive yield is considered the standard measure of strength of bombs and other explosives. The important result of Hiroshima bombing and the one that we sought, was that it brought home to the Japanese leaders the utter hopelessness of their position. When this fact was reemphasized by the Nagasaki bombing, they were convinced that they must surrender at once. The Air Force is operating primarily to laying waste all the main Japanese cities. Their procedure had been to bomb the hell out of Tokyo, bomb the manufacturing and assembly plants, and in general paralyze the aircraft industry so as to eliminate opposition to its operations. With the success of the Hiroshima weapon, the pressure to be ready with the much more complex implosion device became excruciating. We felt that the sooner we could get off another mission, the more likely it was that the Japanese would feel that we had large quantities of the devices and would surrender sooner.

4 CONCLUSION

The focus of this research is the development of the body-mind model for the guide. A prototype of the system has been completed and is currently being evaluated. It is hoped that the evaluation will finish in a few weeks time and a detailed analysis can be performed to

[3] http://www.lanl.gov/

verify the usefulness and adaptive capability of the system. In future, it will be desirable if morphing technique can be utilised to reflect the guides emotional states, providing an infinite range of expressions.

ACKNOWLEDGEMENTS

Work supported by the European Union's Sixth Framework Programme, in the IST (Information Society Technologies) Thematic Priotity IST-2002-2.3.1.6 Multimodal Interfaces, HUMAINE (Human-Machine Interaction Network on Emotion) [4] (Contract no. 507422). The authors are solely responsible for the content of this publication. It does not represent the opinion of the European Community and the European Community is not responsible for any use that might be made of data appearing therein.

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Evaluating synthetic Actors

Sandy Louchart and **Ruth Aylett**[1]

Abstract

We discuss the extension of an emotionally-driven agent architecture already applied to the creation of emergent narratives. Synthetic characters are enhanced to perform as actors by carrying out a second cognitive appraisal, based on the OCC model, of the emotional impact of their projected actions before execution. We present the evaluation of this approach and some initial results on whether it produces more 'interesting' narratives.

1 INTRODUCTION

Narrative has become a topic of great interest in video and computer games development as a way of drawing the player into the game play [16], and is seen as a focus for the development of mobile and Augmented Reality-based gaming [21]. Much active research addresses the generic use of interactive graphical environments and intelligent synthetic characters to extend the power of narrative in new ways [16]. Specifically it has played a central role in a number of interactive graphics-based e-learning systems both for adults [24] and children [9, 18]. Narrative is also used as a generic method for adding intelligence to virtual environments, for example, through the development of virtual guides [4].

The key characteristic of all these environments is interactivity: users expect to move freely and interact at will with objects and synthetic characters. Yet this interactional freedom clashes badly with the conventional narrative requirement for a definite structure, creating a narrative paradox [13]. A plot-based narrative structure supposes the right actions at the right places and times but these may not be those the user chooses to carry out [19]. More generally, an authorial plot-based view of narrative where particular actions must execute in a particular order conflicts with a character-based view where characters autonomously select their actions in response to their sensing of the state of the virtual world – strong autonomy [15].

Merging the roles of spectator and author evades rather than reconciles the contradiction since authoring merely allows a plot-based approach to be maintained; this approach has been exploited in a number of systems [9, 18, 20]. The God-like perspective of games such as 'The Sims' gives the privileged user overall responsibility for the activity within the virtual world in a similar fashion. Creating a branching narrative is another solution [24, 14], though either the user is constrained into a few key choices, breaking their immersion in the narrative world, or characters must be supplied with "universal plans" [23] covering every possible response to whatever the user does. Façade [15] is an impressive example of the result of doing this, using the concept of 'beats', based on an adaptation of Aristotelian theory, but required substantial authoring effort for a short (20 minute) narrative, with clear implications for scalability. Limiting the interactive stance of the user is a third solution: one may apply concepts such as Boal's [3] spect-actors, in which participation and spectating are episodically interleaved [2]. In [5] characters have universal plans expressed as AND/OR trees but the role of the user is confined to manipulation of key objects, forcing character re-planning.

Strong autonomy for characters offers a potential solution to the problem of interactivity since if synthetic characters are allowed to autonomously select actions, then a participating user can also be allowed to do so on the same terms. Given that in general, structure can emerge from interaction between simpler elements, it seems possible that interaction between strongly autonomous characters could under specific circumstances produce narrative structure, or an emergent narrative (EN) [1].

The main objection to character-based narrative based on strong autonomy is that there is no guarantee that interesting narrative structure will result precisely because characters are responding to their internal state and individual goals in choosing actions and not to the overall story structure. However, an existential proof of the EN approach can be found in interactive forms such as improvisational drama and human RPGs: in the former actors start from a well-defined initial state and strong roles and select 'dramatically-interesting' actions, while in the second, a game-master dynamically manages the experience of the autonomous participants [13]. In this work we discuss the application of both these ideas within the additional framework of affective appraisal theory.

The hypothesis being explored is that an autonomous agent that explicitly assesses the emotional impact of its actions on other agents around it, much as an actor would, will produce a more engaging emergent narrative than one that only uses its own 'in-role' emotional state to select its next action. Other virtual actors [22] have not tried to assess the differential emotional impact of a set of possible 'in-role' actions, making this a novel approach. Because it uses emotional impact, it is also different from assessing the goals or plans of other agents [11].

2 NARRATIVE AND EMOTION

If narrative is to emerge from interaction between characters, then the character architecture is fundamentally important. It is the contextual relevance and richness of the actions selected by each character that will or will not produce sequences with the post-hoc structure of a story: that is a coherent compound of external interest and surprise (causal chains of actions) with internal perceived intentionality and emotional impact (motivation and expressive behaviour). Displaying role-specific emotional reactions to the actions of other characters and the emotion behind their own actions is an important component of successful human acting.

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For this reason a number of researchers in synthetic characters, starting with Elliot's Affective Reasoner [7] have integrated affect into their agent architectures [8, 2], usually drawing on cognitive appraisal theory. Appraisal is the human perceptual process through which objects, other characters and events are related to the needs and goals of an individual, generating a resulting emotional response and thus linking emotion to cognition. The most widely implemented system is the taxonomy of Ortony, Clore and Collins (OCC) [17], used by the FatiMA agent architecture which formed the basis for the work described here. The OCC model is an approach based on a valenced (good or bad) reaction to an event and the structure of emotions it defines can be seen as a hierarchical taxonomy organising 22 emotion types.

3 AFFECTIVE AGENT ARCHITECTURE

The FatiMA (Fearnot Affective Mind Architecture) [6] agent architecture is shown in **[Figure 1]** (with the additions of the work reported here added in red) and is that used in FearNot!, an application that generates episodes of emergent virtual drama relating to bullying for educational purposes [2]. In this architecture, an agent's emotional status affects its drives, motivations, priorities and relationships, with an OCC-based appraisal system and resulting coping behaviour [12] - those internal emotional adjustments made or external actions taken in order to deal with negative emotions. Characters may also have different thresholds and decay rates for each of the 22 OCC emotions, implicitly defining a large set of different personalities.

As shown in *Figure 1*, the appraisal mechanism consists of both a reactive and deliberative layer [2,6]. The former is handled by a set of emotional reaction rules consisting of an event that triggers the rule and values for the OCC appraisal variables affected by the event (desirability, desirability-for-other, praiseworthiness etc).

The deliberative layer is responsible for appraising events according to the character's goals, thus generating prospect-based emotions like hope and fear. These emotions relate to future events: those congruent with the IVA's goals (hope) or those threatening them (fear). They thus connect the affective system to the planning component of coping behaviour [8].

The action selection process is also composed of reactive and deliberative levels. Reactions consist of a set of action rules: each contains a set of preconditions that must be true in order to execute the action and an eliciting emotion that triggers this particular action, for example sadness may trigger weeping. The action set is matched against all the emotions present in the character's emotional state (arising from appraisal) and the set of rules with positive matches is activated. The action rule triggered by the most intense emotion is selected for execution. If more than one action rule is selected, the most specific one is preferred.

The deliberative coping process - deeply connected to the deliberative appraisal process - is more complex. More than one goal can be active at the same time, so the first stage of the deliberative reasoning process is to determine which goal to attend to. In the original architecture, the intentions generating the strongest emotions are the ones that require the most attention from the agent, and thus are the ones selected by the planner to continue deliberation.

The next step is to choose the most appropriate existing plan to execute or to continue planning. An evaluation metric is used that: weights plans that achieve the same conditions but use fewer steps more highly; weights plans with more instantiated pre-conditions more highly; and plans with fewer inter-goal threats more highly. For example, within the bullying scenarios to which FatiMA has so far been applied, a plan by a victim to hit the bully threatens the victim's own goal of not getting hurt. At this point, the best plan is brought into focus for reasoning, as if in the forefront of the agent mind, and at this point it generates/updates the corresponding emotions [6]. It is here that there is an opportunity to have the agent consider what the emotional impact of plans on other characters might be.

The planner removes only one flaw or starts to execute one action in each cycle of coping, so that an agent does not 'freeze' in prolonged thought. Building up a plan takes several coping cycles, so that an appraisal may change from an initially strong hope to a strong fear as the character realizes that no feasible plan exists. This type of appraisal is called *Reappraisal* since it is not based on external events or stimuli, but is driven by the agent's internal processing. However it is an entirely self-centred reappraisal which does not in the original architecture take into account the impact of plans on other agents.

3.1 Double appraisal

The design of an agent action-selection mechanism that selects dramatically interesting actions is a technical and conceptual challenge. In particular, the subjective nature of drama and its perception makes the development of a reliable and quantifiable assessment measure very difficult. The idea explored here is to take emotional impact (EI) as a surrogate for dramatic interest, hypothesising that the EI of a specific action relates to its dramatic impact and could thus substitute for dramatic value. A character would therefore take an action not solely on the basis of its emotions, goals and motivations but also on the EI of these actions for both itself and other characters. This approach would allow the characters to conjointly assume in a distributive manner the dramatic weight of an unfolding story without relying on a pre-determined plot.

3.2 Architectures

We argue that the implementation of such a concept requires a novel agent action-selection mechanism whose function is not only to make action decisions but also to project the possible impact of these decisions. The mechanism described in this section features a double appraisal cycle as opposed to the single approach discussed above. This allows the agent to appraise events as in any conventional appraisal-based system but then carry out conflict resolution over a set of possible actions by running another appraisal cycle (in parallel), assessing each member of the feasible in-role action set according to its potential emotional impact. Thus the selection of an action is made not just on the inherent value of a particular action but on its ability to generate EI. The mechanism has been implemented within the already existing FAtiMA architecture, at the coping level, and features two related approaches for evaluation purposes.

In the first implementation, [Double Appraisal (DA)], the agent generates a set of possible actions using its emotions and goals and then assesses the emotional impact each action would have *if directed at itself*. An extra loop is added into the appraisal process by recasting each possible action into an event and feeding it back into the agent's own appraisal system. This corresponds to a "Theory of Mind" approach [25] in which the agent assumes that everyone else would react as they would: "how would I feel if someone did this action to me?" In order not to affect the actual current emotional state of the agent, this re-appraisal cycle is executed in parallel with the agent "appraisal-coping" cycle and takes place within an instance of the agent's mind that is not connected to its running emotional state.

The second application [Double Appraisal with Modelling (DAM)] [Figure 1] draws on the same principles but conducts the re-appraisal with respect to the emotional reactions sets of all the agents present in the scenario. It aims at selecting the action that

would have the highest emotional impact of that on all the characters within a scenario. This corresponds to "how would the most-affected of the people around me feel if I did this action?" A significant parameter in either approach is the size of the set of possible actions. Each of the implementations DA and DAM has been evaluated with a low value for the number of actions in the possible set (3) and with a higher number (9). The aim here is to establish whether the number of actions presented to the re-appraisal cycle significantly impacts the decisions made by the agent.

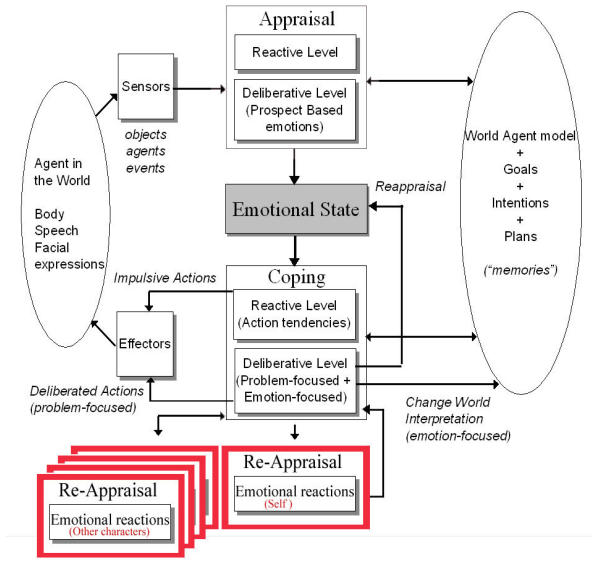

Figure 1. DAM architecture

4 – EVALUATING DOUBLE APPRAISAL

Evaluation of generative narrative is known to be very difficult and there is no agreed approach to doing so [20]. The subjective nature of storytelling is a major issue for the design of efficient and reliable evaluation procedures. Evaluating applications based on satisfaction and user experience is very different from the usual task oriented evaluation designs and is therefore still very much an open research question [10].

Another issue arises from the emergent nature of the storytelling form. Depending on the agents' minds, moods and emotions, a story might not unfold in the same way twice making a direct comparative analysis difficult. The EN approach is character-based and is aimed at participation rather than spectating. It is therefore necessary to devise an evaluation framework that focuses on the characters' decisions and behaviour, rather than 'the' story displayed. However combining a participant/spectator perspective in evaluation supports a direct comparison of data from both participant and spectator users.

4.1 Evaluation set

In this evaluation, the original FearNot! agent framework without any double appraisal has been used as a benchmark against which the implementations DA (DA.1/DA.2[1]) and DAM (DAM.1/DAM.2*) have been compared. The scenarios are composed of interacting agents who act a role and have their own personalities and goals and a Game-Master (GM) whose aim is to provide narrative events and make decisions about the world environment (outcome of physical actions, entry of new characters, removal of characters etc). In this implementation, the role of the Game-Master is played by a disembodied agent dedicated to story management. Like the actors, the Game-Master agent has been extended by DA and then by DAM. The combinations of different types of agents and Game-Masters resulted in 25 simulations. These simulations were all run with identical configuration setups and resulted in 5 different story-variations of the same scenario with identical configuration set ups.

The simulation plan [Table 1] reflects the narrative elements necessary for the development of an EN scenario (i.e. characters and game-master) and shows the appearance of story variations across the different simulations. It also includes different versions of the GM. For the purpose of this evaluation, different versions of the GM (i.e. DA, DAM) were also implemented, just as for characters, in order to test the validity of both DA and DAM for an agent playing the GM role.

	GM v1.0	**GM DA.1**	**GM DA.2[1]**	**GM DAM.1**	**GM DAM.2[1]**
FAtiMA v1.0	S1	S2 **Story 1**	S3	S4 **Story 2**	S5
FAtiMA DA.1	S6	S7	S8	S9	S10
FAtiMA DA.2	S11	S12 **Story 3**	S13	S14 **Story 4**	S15
FAtiMA DAM.1	S16	S17	S18	S19	S20
FAtiMA DAM.2	S21	S22	S23	S24 **Story 5**	S25

[Table 1] Simulation plan and story repartition

4.2 Evaluation methodology

For this evaluation, we reduced the output of the stories created by the software to a text form (actions and speech actions) to avoid graphic quality or specific user interaction modalities influencing the outcome. Stories record the interactions between characters and were generated by the software itself. **[Table 2]** shows an example. The stories were presented to a test-audience whose reactions, dramatic perceptions and judgment of dramatic intensity were documented with respect to character-based actions and plot events.

The evaluation plan designed for this application was composed of 5 different tests that aimed at assessing the dramatic values of the stories generated by the system. The first two tests (T1, T2) assess stories from a spectator perspective by presenting the user with a set of stories and asking them to mark and rank them by order of preference. Although T1 and T2 display the same stories to their test audience, these are slightly modified in T2 so all are of the same length. This is to establish whether the length of stories plays a role in the marking or ranking by the user. The final three tests (T3, T4 and T5) aimed at assessing stories from a participative perspective and presented the users with the possible game-master (T3) and character (T4, T5) decisions at every cycle allowing them to choose for themselves what would happen. These stories, like their counterparts in T1 and T2 are then marked by the user. When the marking/ranking has been executed, the users are

[1] Note that both implementations have two entries in [Table 1] since they present two slightly different versions (i.e. small and high ranges of pre-selected eligible actions (cf. section 3.2.1)). The same versioning design applies to the different implementations of the game-master (i.e. GM v1.0, GM DA.1/DA.2, GM DAM.1/DAM.2).

given further indications on the character's motivations and are asked about their decisions. This part of the evaluation could be related to the de-briefing session common to Role-Playing Games (RPGs).

Agent	Action
Colonel	Let's be clear about what we are all about to do! No one has ever been down there! Our intelligence reported this site has a potential threat to our land security! We all know why we are here today! The technology possibly hidden in there is all that matters to us. In the unlikely event of an encounter of any type, we are to wipe this place down and make sure no one or nothing ever come out of this temple! Dead or alive!
Colonel	God bless you all. Military personnel in formation, others behind me, keep an eye for traps, and loose sight of each other. All right, let's go!
The party	Following your order Sir!
Sergeant	Colonel! Here! Here come here. I have something odd here; it looks like a metal door with strange writings on top of it!
Colonel	Professor! Are these hieroglyphs there above the door say anything of what might be behind it?
Professor	Hum Yes Colonel!, Well, this is strange, these do not appear to be conventional hieroglyphs! There are actually two sets of text there. One that can be interpreted as a death threat to any mortal disturbing the lizard gods, no idea whose these can be! The other one although looks like Egyptian hieroglyphs contains many symbols I have never encountered and does not make any sense to me I am afraid!
Colonel	Ok, Everybody step back! We are going to blow this one up and see what it is hiding. Bellini, MCLean hold assault position!
Professor	Colonel, this temple is thousands of years old, this door is magnificent and such artefact has never been discovered before! Surely we can't just blow it up, we need to find a way to open it or leave it as it is. This is an archaeological wonder!
Colonel	I am not sure you are getting the whole picture there Professor! Right here and right now I am in charge! You do what I tell you to do when I tell you to do it!
Colonel	Destroys the door and the door opens

Table 2 An example of story generated (Story 1)

The evaluation methodology has been designed in order to achieve the aims summarized in **[Table 3]**.

Aim	Description
1	Determine which story is judged most interesting by the test audience (spectators)
2	Determine if the length of the story is a factor in determining its dramatic factor and general level of interest
3	Rate the meaningfulness/interest of agents and game-master actions/decisions from a spectator perspective
4	Determine whether a better understanding of the characters and roles would influence the ranking and marking of stories
5	Determine which story would be generated by the user if given authorial powers
6	Determine which story is judged most interesting by the test audience (interactive users)

Table 3 Evaluation aims and objectives

5 RESULTS AND CONCLUSIONS

In so far, the evaluation has been carried out on a total of 47 subjects with a 68 – 32 ratio between males (68.1%) and females (31.9%). The results presented herein should be interpreted as early results as the full data analysis for the entire scope of the evaluation was not yet available at the time of this article's submission. The results have however all been subjected to an analysis of variance (ANOVA) and are statistically significant within the evaluation test batches. The probability of insignificance (p) and degree of significance (%R) are indicated for each result.

5.1 Evaluation pointers

As with every evaluation process, it is essential to identify pointers that would indicate whether or not a given hypothesis possesses some tangible truth. In the case of this evaluation, we have identified a series of questions [Table 4] that require to be answered positively in order to demonstrate the validity of our approach. This list is not exhaustive by all means and focuses on the main aspects of the double appraisal theory (i.e. Dramatic efficiency, and comparison of the two implementations). It covers the basis for a more complete data analysis.

Evaluation question	Analysis pointer
(Q1) Does a double appraisal mechanism contribute in generating stories dramatically more interesting than if generated by a simple appraisal mechanism?	**(P1)** Story 1 (original FearNot!) should ranked and score lower than stories 2,3,4,5 (generated via double appraisal)
(Q2) Does an implementation considering the Emotions of all characters better at generating interesting stories than one only considering one character (self)?	**(P2)** Based on our assumption that DAM is potentially more complete than DA, Story 4 should score lower than Story 5.
(Q3) Is the consideration of all characters in a double appraisal contributes in generating overall more interesting stories?	**(P3)** Story 5 should score high on dramatic marking since it incorporate a double appraisal mechanism that takes into consideration all the characters of the scenario for both agents and game-master.

Table 4. Evaluation pointers and questions

5.2 Results

Q1

The overall story ranking (before debriefing) shown below in [Figure 2] provides elements of answers to Q1. The results have been provided by the test T1 and T2 and reflect a spectator's perspective on the ranking of our 5 stories. Whilst it shows a high ranking for story 3 (to be acknowledged in section 5.2.3), it also shows a poor ranking for Story 1.

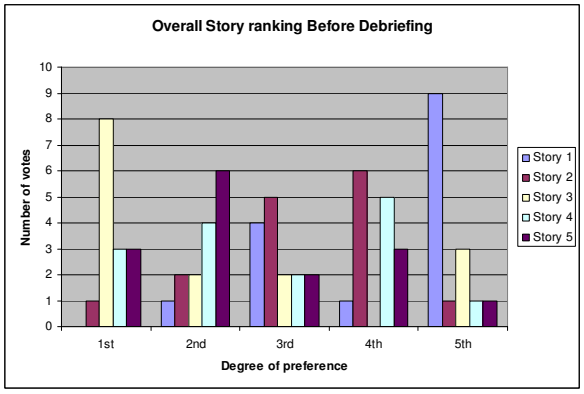

Figure 2. Overall Story ranking before debriefing

The story generated by FAtiMA did not perform well in the spectator ranking and has been perceived as the worst story of the test batch. This trend is also confirmed in [Figure 3] (p = 0.00061/ 99.39 %R) where individual story rankings have been translated into values in order to get a clearer picture of a story performance (averaging). This diagram shows to which extent Story 1 has been negatively perceived by spectator/reader users.

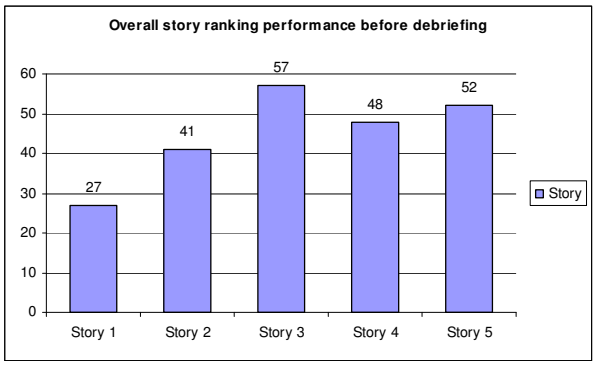

Figure 3. Overall Story ranking (points table)

Note that there are no significant differences in performance for story 1 between pre and post debriefing markings by users.

The results presented in this section indicate clearly that the single appraisal-based implementation (SA) scored lower than its double appraisal-based counterparts (DA/DAM).

On another hand, whilst the DAM.2 implementation of the game-master generated a different story (Story 2) than the original SA-based approach (Story 1), its counterpart in DA did not make any difference on the outcome of the scenario and still resulted in Story 1. The two stories using the SA-based agents (Story 1 and Story 2) score also sensitively lower than agents fitted with either DA (Story 3, Story 4) or DAM (Story 3, Story 4 and Story 5).

Q2

The results presented in this paper also show that agents or game-masters conforming to DAM tend to score higher than the ones conforming to DA. [Figure 3] demonstrates this by showing that Story 2 (game-master DAM) scores better than Story 1 (game-master DA). On another hand, the results detailed in [Table 1] indicate that they are no major changes in the actions of the agents unless they are interacting with a game-master of type DAM. The distinction between the two implementations discussed herein can however still be highlighted by the performances of stories 4 and 5. Both stories whilst, they feature the same version of the game-master DAM, present agents of the two different implementation types (DA = Story 4 and DAM = Story 5]).

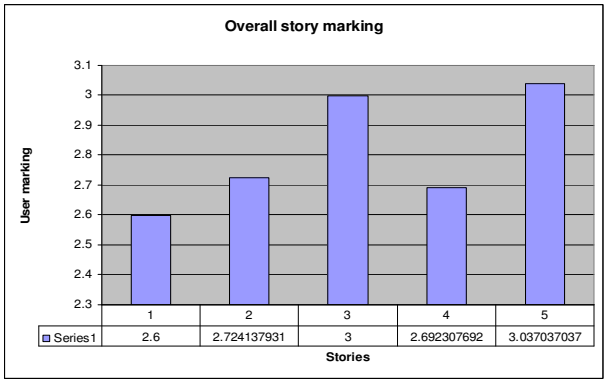

Figure 4. Overall Story marking

Both [Figure 2] and [Figure 3] show that overall, Story 5 outperformed Story 4 in the spectator/reader user ranking. This is further confirmed in [Figure 4] (p = 0.0917/ 90.83 %R) where the overall marking by all users (i.e. spectator/reader and interactive user) shows a net difference of appreciation between Story 4 and 5 in favor of the latter.

Q3

The results calculated for Q3 are interesting in the sense that two opposing claims could be regarded as significant in answering this particular question.

> Claim 1: [Figure 3] seems to indicate a better performance and appreciation of Story 3 over Story 5.
> Claim 2: [Figure 4] shows that Story 5 is the preferred story from a marking perspective.

The interpretation of these results alone is not sufficient for us to claim that the consideration of all characters in a double appraisal contributes in generating overall more interesting stories (Q3). It is necessary at this point of our analysis to focus on the nature of the tests performed in order to get a clearer idea of the validity of each claim. Claim 1 is based on spectator/reader user types whilst Claim 2 relies on interactive users. It is important to regard the marking for both perspectives (i.e. spectator/reader and interactive user) in order to make an educated decision on the validity of each claim.

[Figure 5] (p = 0.0068/ 99.32 %R) shows the overall story marking for non-participant users (Spectator/reader). It confirms, to a certain extent the results observed in [Figure 3] (Story 3 ranked better than Story 5) and shows that Story 5 is not the story

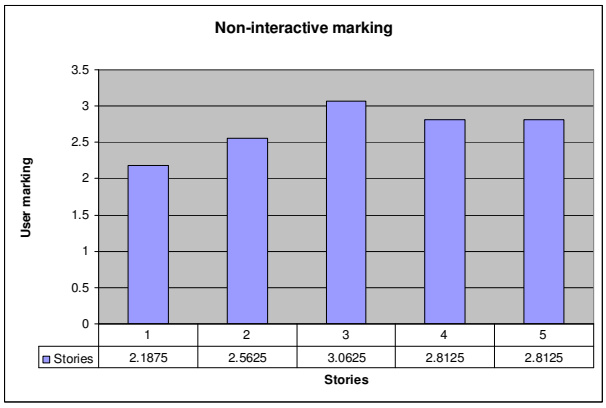

Figure 5. Non-interactive story marking

receiving the better marks. It therefore contributes negatively to the hypothesis developed in this paper that a double-appraisal mechanism considering all the characters of a given scenario performs better than both its self-centered counterpart and a single appraisal mechanism.

On another hand, [Figure 6] ($p = 0.0185$/ 98.15 %R) presents another picture by showing a net marking advantage for Story 5 over the rest of the stories by interactive users.

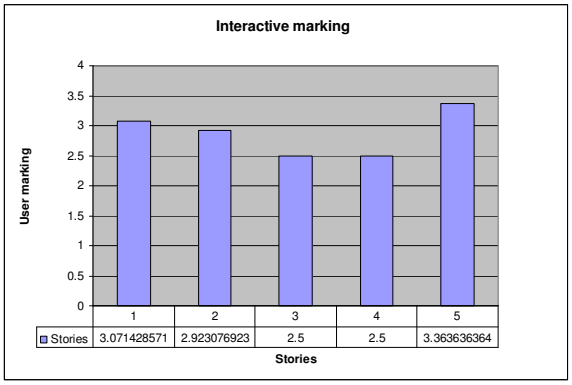

Figure 6. Interactive story marking

It is also interesting to notice in **[Figure 6]** the high marking performance of Story 1. This reinforce some of the claims made in [1] that an emergent narrative might not be perceived as interesting from a spectator/reader perspective as it would be from an interactive perspective.

In consideration to Q3, since the aim of this work is to produce interactive emergent narrative, we could understandably consider Claim 2 rather than Claim 1 as being the most significant for our results in the scope of this evaluation.

6 CONCLUSION

In this paper, we have demonstrated that synthetic characters can be enhanced to perform as actors by carrying out a second appraisal of their projected actions. The results presented herein show that the implementations proposed to extend an emotionally-driven agent architecture applied to the creation of emergent narratives (FearNot!) have positive impacts on the perceived dramatic values of the generated stories. Whilst these implementations were not equally as good in generating dramatic interest for the user (i.e. both spectator/reader and interactive user), they still produced simulations that scored higher than the original single appraisal-based architecture. On the basis of a direct comparison between the two different implementations carried out, DAM which considered the emotions of all of other characters in a scenario in order to make dramatic choices scored consistently higher than the more self-focused DA. This leads us to consider that DAM possesses a stronger dramatic potential than DA.

Finally, when comparing user marking for all stories, Story 5, which features DAM in both its agents and game-master architectures, scored the highest overall mark and was considered as the most interesting story to experience by interactive users. The results presented in the previous section show the validity of our approach and establish firmly our belief that narrative control can be exercised at character level in a distributive manner with satisfying results as long as the agents (i.e. characters) are provided with a mechanism that allows them to assess the emotional consequences of their actions on others.

This work is part of a larger theoretical work that has been investigating the emergent narrative concept for several years. Whilst significant, the results presented in this paper should be regarded as an early insight of what the overall evaluation process should come to deliver once the analysis of the data collected completed. Further work will consist in measuring the reactions, decisions and motivations of the participants in both marking and ranking the stories (spectator/readers and interactive users). Data will also be analyzed with regard to the dramatic weight associated to particular actions of the scenario and their potential impact on the user rating/marking. Finally, further theoretical work will investigate the areas of real-time narrative control, character-based narrative authoring and emergent narrative user interaction interfacing.

This work could also be extended to look at emotional trajectories rather than one-shot double-appraisal by considering sequences of planned actions rather than the goal-achieving action as at present. This would allow actors to explicitly consider the issue of dramatic climaxes.

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FearNot! An Anti-Bullying Intervention: Evaluation of an Interactive Virtual Learning Environment

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Abstract. The eCIRCUS (Education through Characters with Interactive Role-playing Capabilities that Understand Social interaction) project aims to develop an anti-bullying software, FearNot!, and evaluate its effectiveness in the classroom. This paper presents findings from two evaluations conducted during the 2006 National I-Power-I Anti-bullying Conference for Young People. Participants interacted with FearNot! v.1 (*scripted* version) and then either completed a short questionnaire (in Study 1) or took part in focus groups (in Study 2) evaluating the difference between two versions of FearNot! (*scripted* versus *unscripted*). Overall the results suggest that perfect graphics are not necessary for users to engage empathically with autonomous agents, and that the virtual characters did evoke emotional reactions. It is concluded that development of the FearNot! demonstrator is progressing well and that FearNot! will be a useful and engaging intervention against bullying in primary schools.

1 INTRODUCTION

1.1 Bullying in Primary Schools

Defining bullying and victimisation behaviour is difficult due to its complicated nature. However, a common definition states that "a student is being bullied or victimised when he or she is exposed repeatedly and over time to negative action on the part of one or more other students" [1]. Furthermore, most bullying behaviour can be grouped into one of three categories [2]:

- direct physical bullying - e.g. pushing, hitting, kicking, and stealing belongings.
- direct verbal bullying - e.g. name calling, teasing, and threatening.
- indirect (or relational) bullying - e.g. social exclusion, rumour spreading, withdrawal of friendships.

In the same way that bullying styles can be categorised, the roles taken on by children involved in acts of victimisation can also be categorised. The most significant roles are: the 'pure' bully, the 'pure' victim, the bully-victim (someone who bullies others and is bullied themselves), the bully-assistant, the bystander/neutral, and the defender (of the victim) [3], [4].

While studies report varying prevalence rates, bullying is acknowledged as a cross-cultural problem which can affect between 8% to 46% of primary age school children [5]. Bullying is a serious issue as victims can continue to show psychological problems (e.g. anxiety, depression) even after the bullying has ceased. In extreme cases victimisation can lead to psychiatric referral [6] or even suicide [7].

1.2 Current Bullying Interventions

Having examined the extent of bullying, many studies have attempted to demonstrate effective interventions against victimisation. Due to the complex interaction between bullying styles, coupled with the different roles that children may take, there is a large number of interventions that have been proposed. These include approaches which emphasise the role of the bully individually, the role of bully and victim together, and even whole schools [3].

Smith & Madsen (1997)[8] found that one third of schools in the UK have a specific anti-bullying policy, but Woods & Wolke (2003)[9] have shown that these measures are often ineffective against direct bullying, and can even lead to an increase in relational victimisation. As a result, Woods & Wolke (2003)[9] suggest that "individualised strategies may help to take the differential needs of bullying roles into account". Unfortunately, there currently appears to be few or no interventions which provide such individual education about anti-bullying coping strategies directly to children involved.

1.3 FearNot! as an Innovative Intervention

One potential medium for providing cheap, safe, and individual advice on coping with bullying could be a Virtual Learning Environment (VLE) which is populated by Intelligent Virtual Agents (IVAs).

FearNot! (Fun with Empathic Agents Reaching Novel Outcomes in Teaching) is such an application. FearNot! provides 8-11 year old children with the opportunity to visit a virtual school environment complete with characters representing the most significant roles in bullying (bullies, victims, assistants, bystanders, and defenders), locales (playground, classroom, library, and local streets), and scenarios (direct and indirect victimisation) that are commonplace in real-life bullying incidences. Characters in FearNot! are autonomous agents capable of making their own decisions and acting out their

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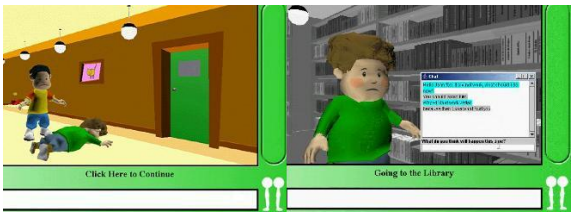

Figure 1. FearNot! v.1 Bullying and Interaction Episodes

own behaviours, thus leading to an emergent narrative as the storyline progresses [10]. Children interact with FearNot! on an individual basis by witnessing an emergent bullying episode, and then 'talking to' the victim character in order to advise them how best to cope in the following episode. The fundamental idea behind the FearNot! application is to allow children to try out various coping strategies without being directly involved themselves - the usefulness of a coping strategy can be learned safely and vicariously through the victim character's experiences. In this way the user takes on the role of an invisible 'peer buddy', or friend, to the victim character. Support for this kind of approach - learning through activity and play in virtual environments is privided by Roussou (2004) [11].

The eventual aim is for FearNot! to be voluntarily adopted by primary schools as an addition to the UK's existing Key Stage 2 Personal and Social Health Education (PSHE) curriculum. A German language version of FearNot! is also in development. The FearNot! prototype designed and evaluated during a preceeding EU Framework 5 project, VICTEC (Virtual ICT with Empathic Characters), was well accepted and reported e.g. [12]. Under the eCIRCUS project, though, FearNot! continues to be developed further - with an updated version made available for initial testing in 2006.

1.4 FearNot! Versions and Specifications

1.4.1 FearNot! v.1

FearNot! v.1 is an applet which runs within a webpage with the WildTangent(WT) Plugin(R). As a showcase demonstration, this version comprises three consecutive, *scripted* male bullying episodes with an interaction episode between each. During interaction, coping strategies can only be suggested to the victim character by means of a drop down menu. Follow-up questions are answered through free text (typed) input. The suggested coping strategy has no impact on events in a following episode. Once the three male episodes are completed three female episodes are also available.

1.4.2 FearNot! v.1.5

FearNot! v.1.5 is an intermediary version of FearNot! which improves on v.1, but is still in final development. This version is also an applet which runs within a webpage with the WildTangent(WT) Plugin(R), but boasts a number of improvements including new graphical and language specifications. The graphical design of the characters was changed so that they all wear the same school uniform instead of their own clothes, which improves validity for the UK where most primary schools require their students to wear a uniform. The language was also updated to include more colloquialisms and more valid dialect that is used by children within the target age group. A drop-down menu has been replaced by free text input during interactions, which now allows children to input their own ideas instead of forcing them to select from pre-set options. Open dialogue is a valuable research tool for understanding what children know about how to cope with bullying. Finally, the virtual characters are now able to act upon advice given by the user during an interaction episode, giving rise to an *unscripted* and *emergent* nature for the bullying episode. This version allows for a greater range of different user experiences. Only male episodes are available in this version.

1.5 The Current Study

While FearNot! v.1 was extensively investigated during the VICTEC project, the development to v.1.5 has not yet been evaluated. With the eCIRCUS project aiming to place FearNot! into schools for longitudinal investigation in 2007, it is imperative to ensure that the final version is ecologically valid - that the characters are believable and engaging, that the episode storylines are understandable and true-to-life, and that the overall user experience is fun and educational. This study aims to seek initial feedback about improvements to FearNot! made since the VICTEC project, and serves to demonstrate that FearNot! is still an innovative approach to a continuing problem.

In this paper we present findings from two studies conducted during the National I-Power-I Anti-bullying Conference for Young People held during November 2006 in Weston-Super-Mare, UK. While this setting may seem uncontrolled at first, one advantage of this approach is that it yields greater ecological validity since FearNot! is designed to be used in an unconstrained classroom environment. It also allows for an excellent cross-section of participants from schools across the UK which can differ in terms of achievement and socio-economic status. Study 1 evaluates user's perception of FearNot! v.1, while Study 2 investigates user's preference of the similarities and differences between FearNot! v.1 and v.1.5. Sections 2 and 3 of this paper present the methods and results of these studies respectively, while Section 4 provides an overall discussion of both studies and describes future directions for FearNot! and the eCIRCUS project.

2 Study 1

2.1 Method

In total 54 participants returned questionnaires. Of these 35 were male, and 18 were female (1 missing data point) with 14 respondents in primary school, 33 in secondary school, and 5 adults (2 data points missing). While the majority of participants stated that they were in secondary school, the investigators observed that these children were young enough to be comparable to FearNot!'s target age group.

Throughout the conference, laptops were used to simultaneously run four different instances of FearNot! v.1 at a stand accessible to all conference delegates. Respondents interacted freely and individually with FearNot!, but investigators were on-hand to answer questions and offer advice if necessary. Each interaction lasted approximately 15 minutes - long enough for participants to play fully through 3 related episodes. Once their interaction had ended, participants were asked to complete a short questionnaire and return it to one of the investigators.

The questionnaire used was adapted from the VICTEC project's Character Evaluation Questionnaire (CEQ). This questionnaire asked about six items of interest:

- Most likeable character

- Least likeable character
- Character graphic design (5-point Likert scale from ‘Strange’ to ‘Good’)
- Which character looked best/which character looked strangest
- Storyline believability (5-point Likert scale from ‘Unbelievable’ to ‘Believable’)
- Estimated usefulness of FearNot! in Primary Schools (5-point Likert scale from ‘Not Useful’ to ‘Useful’)

2.2 Results

2.2.1 Likeability of FearNot! Characters

The most likeable character was John - the male victim, while the least likeable character was Luke - the male bully. This pattern is also repeated for the female characters where Frances (the victim) is the most likeable character, and Sarah and Janet (the bullies) are liked the least (Figures 2 and 3). This suggests that the characters are evoking the kind of empathic reactions that they were designed to evoke.

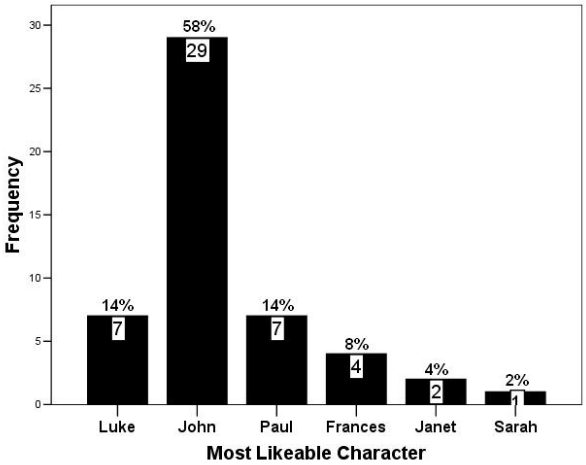

Figure 2. Most Liked FearNot! v.1 Characters (n=50)

Although it appears that the male characters are generally more well liked than the female characters this may be due to the simple explanation that more participants interacted with, and therefore gave more ratings of, the male episodes than female episodes. This explanation is upheld by the fact that the male characters receive more ratings on both the most likeable *and* least likeable scales.

2.2.2 Graphical Design of FearNot! Characters

With regards to the graphical presentation of the characters, Luke and John were jointly rated as the best looking designs, while John was also rated as the strangest character in appearance. From the female characters Frances and Janet were rated as the best looking designs, with Frances also rated as the strangest (Figures 4 and 5). This pattern (that the same characters were chosen as demonstrating both the best and strangest design) could be explained by the fact that these characters are the main protagonists in the story, and so have the greatest on-screen time. Another cause, however, could be due to the phraseology of the questionnaire which asked participants to nominate the ‘best looking’ and ‘strangest looking’ characters. It

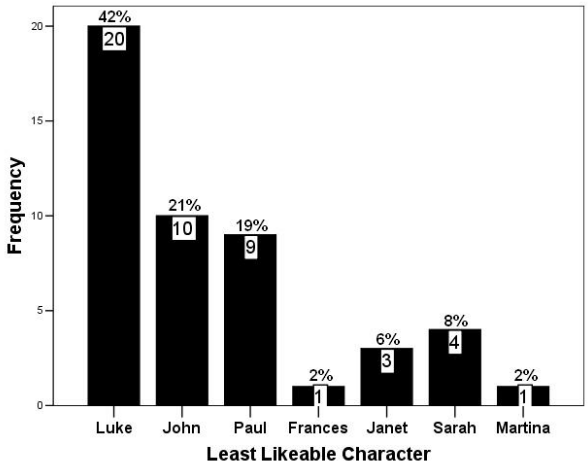

Figure 3. Least Liked FearNot! v.1 Characters (n=48)

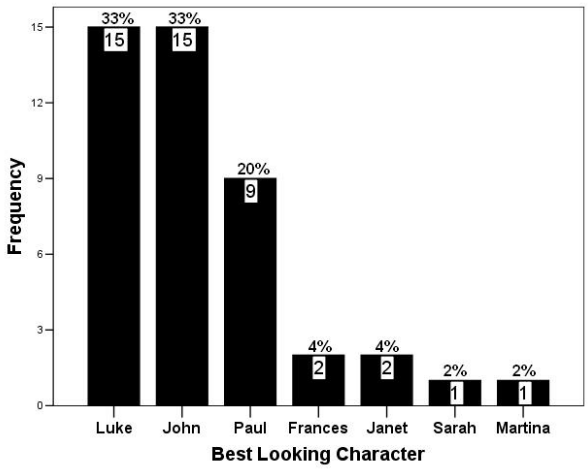

Figure 4. Best Looking FearNot! v.1 Characters (n=45)

is possible that characters which ranked highly on both questions were thought to have been drawn well, but that the actual design was disliked - e.g. John is portrayed as slighly over-weight, and Frances wears glasses; both of which can be used to tease victims of bullying.

2.2.3 Overall Impressions of FearNot!

While it is necessary to look at the characters in isolation, it is also of the utmost importance to evaluate the user’s general impression of FearNot! The current sample rated the overall graphical presentation as above average, with high ratings for storyline believability and usefulness in primary schools (Figure 6). Taken together, these findings are positively in favour of the validity and realism of the FearNot! episodes, and also show that the application has great educational potential . Given that the target age group comprised only a small proportion of the overall sample, the final analysis was re-run using data from just the primary school age participants. The results from this sub-set are quite similar to those of the whole sample. The

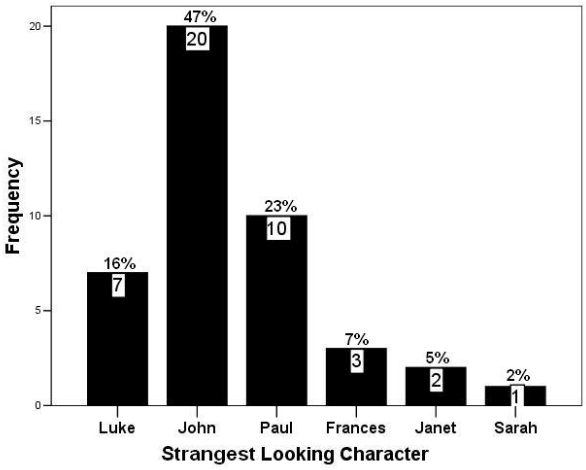

Figure 5. Strangest Looking FearNot! v.1 Characters (n=43)

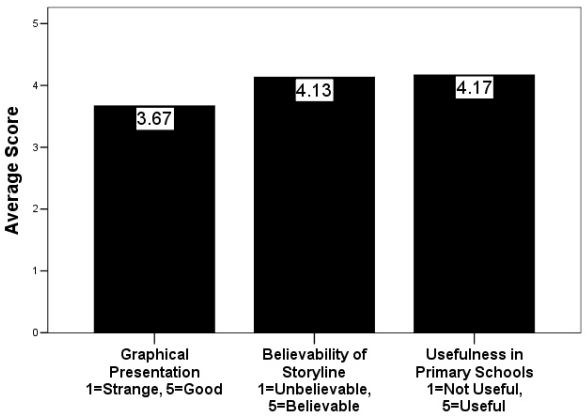

Figure 6. Overall Impression of FearNot! v.1 (n=54)

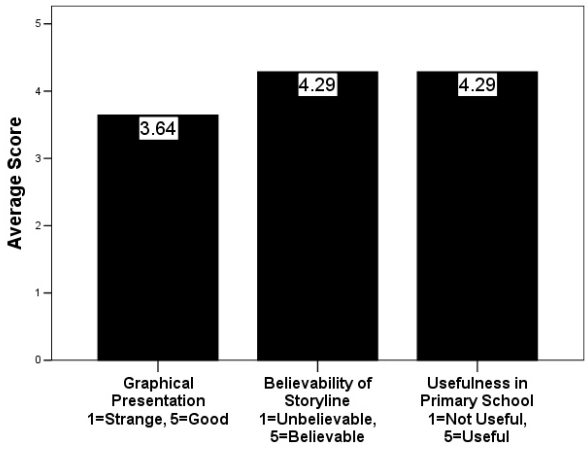

Figure 7. Primary School Children's Overall Impression of FearNot! v.1 (n=14)

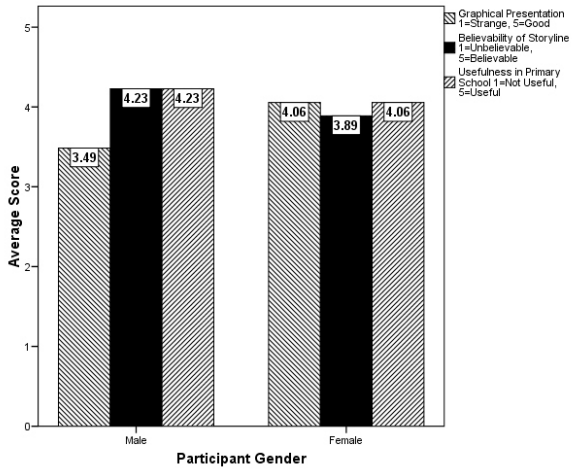

Figure 8. Gender-Split Overall Impression of FearNot! v.1 (n=54)

graphics were again rated as above average in quality, with storyline believability and usefulness in primary schools both scoring highly (Figure 7). These findings are especially useful as they provide great support for the FearNot! application directly from the user group it is aimed at.

Gender differences show that females liked the graphical presentation more than males, while males found the storyline more believable and rated FearNot!'s classroom usefulness as higher than females (Figure 8). These results can be explained by the observation that males are more likely to interact with video games in everyday life, and so will expect higher standards for graphical presentation and will be more open to using such an application at school. That girls found the storyline less believable could be due to the fact that most participants interacted with the male episodes as opposed to the female episodes - naturally these episodes are less relevant to females. Unfortunately the small size of invidual groups did not allow for deeper inferential analysis.

3 Study 2

3.1 Method

45 participants attended a FearNot! workshop run as part of the anti-bullying conference. This sample's demographics were similar to those from Study 1. Participants interacted with FearNot! v.1 in groups of around 6 people to each laptop. This interaction lasted long enough to allow each group to experience both male and female episodes. After this interaction, participants were shown a prerecorded video of FearNot! v.1.5 which lasted approximately 5 minutes. Participants were then organised into four small focus groups, each led by an investigator, to discuss the two different versions of FearNot!. Topics of discussion were similar to those from Study 1's questionnaire, but preferences of the different versions of FearNot! were also drawn out.

3.2 Results

The results from the workshop's four focus groups are descriptive/qualitative in nature and give a first impression of FearNot! v.1.5 as well as serving to expand on the quantitative data obtained in Study 1.

The most liked characters were John and Paul (the male victim and defender) with Luke (the male bully) liked the least. John's and Frances' (the female victim) graphic design were considered to need the most improvement. The characters were able to elicit the kind of empathic engagement that they had been designed for - participants reported that they felt sorry for John and were angry at Luke, Janet and Sarah (the bully characters).

The storylines were generally well accepted with Frances' situation considered to be worse than that of John - presumably because of the relational nature of the bullying that Frances suffers, compared to the direct physical aggression that John is subjected to. This finding could be due to the sample. Because the participants were mostly of senior school age (12 years old and above), and slightly older than the target age group, it is possible that their more advanced cognitive development meant they were able to understand the relational bullying more easily than the target age group. In addition to this, the relational episodes were also considered more believable and realistic (when speaking to secondary school age girls) than the physical scenarios.

While the storylines were enjoyable and believable there was concern that the pacing was too slow and most participants agreed that longer, quicker-paced episodes would be more enjoyable. In keeping with the findings from Study 1, there was consensus that imperfect graphical design did not affect engagement.

FearNot! v.1.5 was greatly preferred to FearNot! v.1 in terms of graphic design (especially that characters now wore a school uniform which is appropriate for a UK setting), language used by the characters (though even more colloquialism/slang would be preferred by the target age group), storyline enjoyability, and interaction style. However, most participants reported that they would like even more interaction - specifically the ability to control their own personal avatar within the virtual environment. Many of the younger participants thought that FearNot! would be "better than normal" curriculum, that children "could learn from it" and that FearNot! "will make people think".

4 Discussion

In Study 1, victim characters were generally the best liked and the bully characters were liked the least. This shows that not only are human users willing to engage with virtual agents, but that the FearNot! characters are successful in eliciting the right kind of empathic and emotional reactions that are necessary for the user to experience a meaningful and educational interaction. While some of the graphical designs were considered to be strange, the overall quality of the graphical presentation was consistently rated as above average. In addition to this, the storylines presented were considered believable by both the whole sample, and the target age group in particular. The FearNot! application was thought to have great potential if included as part of existing primary school curriculum.

Interestingly, the graphical design of the characters seemed to have little impact on the user's rating of their believability or on the elicitation of empathy. For example, while the male victim was rated more often as the strangest looking character than the best looking character, he was also rated as the most likeable character. Taken with Study 2's findings that refined graphic design is preferred, this pattern of results suggests that excellent graphical design is not necessary to create an engaging experience as long as characters act in a believeable manner. However, graphical presentation can provide the 'icing on the cake' for an engaging VLE.

Study 2 corroborated these findings and provided further depth. Participants felt sorry for the victim character, and were angry at the bully characters. The relational episodes were seen as more serious than the physical episodes. This was thought to be due to the cognitive development of the sample, which would be in keeping with the suggestion that the understanding and use of relational bullying requires more advanced social cognition [3]. It would be interesting to investigate this further with specific reference to age differences in understanding of different bullying styles. The most positive finding to emerge from Study 2 was the consensus that FearNot! v.1.5 was preferred over v.1. This shows that the changes made to graphics, character language, and interaction style all affect the user's experience in a positive manner and improve engagement and enjoyability.

This study's methodology could be criticised for being too informal in nature. However, it is argued that the informal methodology of this study does show a number of advantages. While FearNot! is not designed to be used in the conference environment that this study took place in, the method does not lack ecological validity entirely. FearNot! is to be used in primary school classrooms with little teacher input. In this sense, the current study closely fitted this setting in terms of amount of adult supervision, background noise, and equipment (many primary schools in the UK prefer the flexibility that laptops offer over a rigid suite of desktop machines).

Given that the setting was not fully controlled, the results are strong and robust enough to demonstrate that FearNot! is successful in creating engagement and eliciting empathy even in less-than-ideal settings - this can only be a positive sign given that FearNot! will eventually be used in a quieter and more controlled school environment.

In addition to this, while there were many exhibitors at the conference, the FearNot! stand was consistently among the busiest and most popular with primary aged children and generated a great deal of interest in children and their guardians alike. Many children returned to the stand a number of times over and again - demonstrating that children actively *choose* to play FearNot! It must be acknowledged, however, that such positive outcomes could be due to a social desirability effect. Since the participants were all delegates of an anti-bullying conference it is safe to assume that they will already have a vested interest in this area, and will react positively to any potential intervention.

While mainly positive comments have come out of these studies, it was also shown that certain areas would benefit from some improvement. Most notably among these are the graphic design and language used by the characters. While the graphics have improved from FearNot! v.1 to v.1.5 there is thought to be still more room for improvement, especially when compared to commercial video games.

The findings taken from studies which utilise an informal and qualitative methodology are especially useful in the design of VLEs and IVAs as they allow developers to gain a more detailed understanding of their user's attitudes and needs than statistical approaches allow for. A number of recommendations about the development of FearNot! are also of relevance to the development of virtual environments in general.

Firstly, agent and environment believability can be improved by ensuring cultural similarity with target users. Study 2 also shows

that, with regards to language issues, local and temporally relevant phraseology/colloquialisms can improve believability, as can accents for any audio output.

For virtual environments that also include a cohesive storyline, the issue of pacing must be taken into consideration. While it is beyond the scope of this study to demonstrate the effect of pacing on engagement, it is suggested that quicker paced but longer lasting episodes are more engaging than shorter and slower episodes - at least for a younger audience.

Many respondents stated that they would like to have 'more control' over a character within FearNot! It is thought that such interaction could lead to deeper immersion within a virtual environment, and even superficial interaction - such as selecting physcial characteristics of an otherwise unplayable agent - could lead to users identifying more with a given character. Some support for this claim could be found in the popularity of commercially available role-playing computer games. Because one of the fundamental ideas behind the FearNot! application is to allow children to try out various coping strategies without being directly involved themselves (the usefulness of a coping strategy can be learned safely and vicariously through the victim character's experiences), the inclusion of personal avatars is not possible in FearNot! However, it is an interesting issue which should be taken into consideration when designing a VLE, and is currently being investigated as part of the eCIRCUS project in the development of ORIENT - a VLE aimed at aiding refugee/immigrant integration into the host nation's school system.

A central aspect of the eCIRCUS ethos is 'user-centered design', in which target users are consulted iteratively on all aspects of a VLE's design. A further advantage of using an open methodology similar to that employed in this study is that it allows for a more varied sample to participate and become involved in the design of a VLE. While the VICTEC project allowed children to become involved in the design of FearNot! this study has now also given teachers and adults the opportunity to contribute toward FearNot!'s implementation. Furthermore, teachers and educational experts will play a larger future role with regards to the development of educational materials which will support the use of FearNot! as a classroom tool.

The final version of FearNot! is currently undergoing technical development. This version runs under the .net framework, and makes use of the Ogre3D graphical environment. Some major developments will include improved graphical design (such as fully motion-captured animation) [13], and more natural speech/audio output between characters (voices will be recorded by professional voice-artists, and the language and grammar will be generated and checked by a team including native English speakers who are familiar with the accents and linguistic nuances in the geographical areas in which FearNot! will be evaluated). A sophisticated text-recognition engine will be trained for use with younger users to allow full-text (typed) interactions. More characters, locations, and bullying incidences will be included to ensure a more believable and engaging experience. Finally, the characters will be much more responsive to the user's input.

The characters themselves are also undergoing development: More believable character actions and behaviour will be achieved by integrating an affective appraisal system which includes flexible management of goals [14]. This system will be further bolstered by a simplified version of the model of autobiographic memory devised by Ho and Watson (2006)[15].

This version of FearNot! will be piloted in schools during early 2007, along with a number of psychological evaluations. These include measurements of participant roles, children's knowledge about bullying and coping strategies, their empathic abilities, and moral disengagement. Once any necessary changes are made to either FearNot!, the psychological measurements, or the accompanying curriculum, a large-scale (900 children) longitudinal (6 week) intervention will be evaluated in primary schools in the UK and Germany to assess the impact of FearNot! on incidences of bullying and the children involved.

5 Conclusion

The final conclusions that can be taken from the current studies are positive for FearNot!. Although certain aspects, such as graphical design, still require further refinement, this does not interfere with storyline believability or the user's ability to empathise with the characters. The FearNot! application is well received by children and adults alike as an innovative, engaging and educational intervention against bullying. This conclusion will be fully investigated during 2007, when the final version of FearNot! is placed into primary schools in the UK and Germany for a large-scale longitudinal evaluation. Recommendations for the success of other VLEs include ensuring cultural relevance, appropriate pacing of a storyline, and allowing users greater control in the environment. Finally, agents who behave in a believable manner are more engaging than attractive graphical presentation.

ACKNOWLEDGEMENTS

The work described in this paper was condcuted within the EU Framework 6 project eCIRCUS ("Education through Characters with Interactive Role-playing Capabilities that Understand Social interaction") (www.e-circus.org) and was funded by the European Commission under contract number IST-4-027656-STP.

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A Mixed Initiative Authoring Environment For Emergent Narrative Planning Domains

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Abstract. In this paper we present a novel interactive method of authoring planning domains for emergent narrative applications. We explain how the emergent narrative concept focuses on the interaction between autonomous agents and point out that one of the main tasks of an emergent narrative author is to design a planning domain for those agents. By reviewing existing authoring tools for interactive storytelling, we show that so far none of them has been applied to this particular task. We then describe the design of an authoring software that might be suitable to support a non technical minded author in creating planning domains in an intuitive manner. In the authoring process the author is stepping through a hypothetical storyline that is created both by the planner and by the author. The software extends and grows the planning domain by taking into account the way the author shapes the storyline and more importantly, the reasons the author gives for shaping it that way.

Introduction

Digital interactive narrative is a research field that has received growing attention during recent years. Various storytelling systems have been created that use a variety of approaches to create electronic narrative environments, in which the user can influence the unfolding of the story. However, there is clearly a perceivable mismatch between the great amount of academic, theoretical ideas and the very small amount of actual full-scale implementations of the interactive narrative concept that go beyond a small proof of concept. To put it in other words, there are lots of good ideas of how to build systems to tell interactive stories but almost no stories that are actually told. The problem, however, is that any interactive storytelling system can only be put into good use with a lot of story content. Facade[6], at the current date is the only implementation of interactive narratives, that has really striven to break through this content barrier. One reason for this lack of stories of course is that the interactive narrative community to this date consists mainly of computer science academics and resources for the implementation of complex stories are just not available in academia. This, however, is only an issue, because the content development for interactive narrative systems is both time consuming and complex, often requiring some programming skills. This complexity prevents traditional story authors with a non-technical background from creating interactive story content. Those problems might be tackled with authoring software to support the story content creation process. Ideally an authoring software is both accessible (i.e. easy to use) and productive (i.e. even speeds up the authoring process for expert users). In this paper we will introduce the emergent narrative approach to interactive storytelling and describe the tasks of an author in the emergent narrative framework. We will make an argument for the need of intelligent authoring tools and review existing authoring systems for interactive storytelling. Finally an intelligent authoring environment for emergent narratives will be suggested, in which simulation and authoring are intervened.

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Authoring Emergent Narrative

As pointed out by [9], amongst the existing theories of how interactive storytelling should be approached, a distinction can be made between two main approaches: character-centered and plot-centered. While the former approach provides strong character believability, the latter one can guarantee more plot coherence. The holy grail of interactive storytelling seems to be a solution that guarantees both character believability and plot coherence. Emergent Narrative[5] can be assigned to the class of character-centered approaches. The idea behind it is that a story emerges from the interaction of believable autonomous virtual characters. Unlike plot-centered top-down approaches, where the course of a story is planned according to a narrative model of plot and where characters are merely puppets whose actions contribute to plot-level goals, in emergent narrative there is a planner for each character that plans the actions that the character is taking. This way, character believability is maximised, because characters are never forced to act out of character in order to achieve a plot goal. Thus, the authors main task is to configure the planners that drive the characters. Stories are created in bottom-up fashion by specifying the character's behavior.

The specific details of how the planner inside the characters artificial minds work can vary. We have implemented the emergent narrative concept in the educational interactive Drama FearNot, so we will assume an agent architecture similar to that of FearNot[1]. Configuring a planner means specifying a planning domain. A basic planning domain consists of actions and goals. Actions have preconditions and effects, both of which are logical descriptions of a world state. It is the planner's main task to assemble a sequence of actions that reaches a certain goal. Goals have preconditions that need to be fulfilled before the character can try to achieve that goal and success-conditions that indicate the world state, in which the goals is considered to be fulfilled. In FearNot the planner is also coupled with a simulated emotional system that helps the planner to prioritize goals and plans, depending on how the character feels about certain events, characters or objects.

While creating content for FearNot we noticed that it requires a long rethinking for people to specify story content in this way. It seems inevitable that authors think about interactive stories in terms

of a variety of possible linear stories, instead of concentrating only on the characters. Being able to let go of the control of the story as an author is one of the key concepts that emergent narrative authors need to learn. We will investigate how authoring software can facilitate this process.

Related Work

Many researchers working on interactive storytelling have identified the need for authoring software and several tools have been developed usually specifically for a certain storytelling engine. A good overview of the tools available can be found in [8]. All authoring tools have in common that they ease data entry significantly for the designer/author compared to hand-coding. Regarding their appearance and user interface many interactive storytelling authoring tools [8, 14, 10] are similar to the editors of video games (e.g. Unreal Tournament, Neverwinter Nights or Warcraft 3) or storyboarding tools like Kar2ouche or Mediastage[4]: The author uses those tools mainly to create the 3d-environment and to place objects and characters in the environment. Additionally to just arranging the environment, most of these tools also include some storytelling features to allow the creation of branching story lines, triggers, plot segments, etc. While those functions are both helpful and necessary if the interactive narrative is visualised graphically, they do not facilitate the configuration of intelligent characters, which is the main task of an author of emergent narrative. However a smaller number of tools are a bit more unconventional and contain some ideas that an emergent narrative authoring tool might benefit from:
DraMachina [3] supports authors in annotating a linear story with meta-information to identify important story elements (entities like characters, scenes or objects, actions, etc.). In Thespian [11], a character based storytelling system, authoring can also be done by feeding linear stories into the system, but here the system automatically extracts information from those stories, whereas in DraMachina, the author has to participate in the process of extracting data from the linear input stories. Thespian uses a fitting algorithm to adjust parameters that define a character's behavior. The target function of this fitting algorithm is the degree of similarity between the simulated stories and the linear stories that are fed into the system as training data. In other words, the author provides the system with examples of how characters behave in certain situations (stories), and the system tries to generalize the character's behavior from those examples. Unfortunately this approach cannot be directly applied to solve the emergent narrative authoring task, because although it helps to create a cast of characters with distinct personalities it does not help in creating the planning domain that is necessary for those characters to act at all. Jim Thomas and Michael Young[13] describe another interesting approach to authoring interactive stories. In their idea of an *author in the loop*, the author participates in the planning process (mixed initiative planning). With this system, while the author is testing and adjusting the story world, they would have a number of sliders at their disposal to modify their story preferences while the planner is constructing a story. This is similar to a sound engineer mixing several sound sources in real time. Unfortunately also this method requires a complete planning domain and does not facilitate the construction of a planning domain in the first place. Finally, it is worth noting that since we are essentially talking about authoring planning domains, a lot of relevant work has been carried out by the planning and knowledge engineering research community, although not necessarily with a narrative background in mind. GIPO[12] is a knowledge engineering tool that allows the creation of planning domains through a graphical user interface. An authoring tool for emergent narratives will have very similar design requirements as a tool like GIPO. The same group that designed GIPO has also worked on the induction of operator descriptions from examples[7], which is a very similar concept to the Thespian approach, only that in this case the deduced information is used to grow the planning domain.

A suggested authoring environment

The emergent narrative authoring environment that we are going to suggest in the following differs from the tools introduced in the last section in one main aspect: Simulation is directly integrated with the authoring process. This idea is remotely similar to that of a debugger as it can be found in some authoring tools like Scribe[8] or Storytron[2]. However, in those tools just like in traditional programming environments, debugging and development are seen as different stages, whereas in our proposed architecture both processes are inseparable. DraMachina[3] and Thespian[11] prove that it is possible to author interactive stories by specifying linear stories, if an authoring tool extracts information from those stories. The kind of information we want to deduce is planning domain data, so there are some parallels with the work described in [7]. Finally, the idea of mixed-initiative planning as suggested by [13] is also part of our suggested authoring system design.

Story Worlds and Planning Domains

As we pointed out earlier, an authors main task in authoring emergent narrative, is to configure the planners that drive the characters. In contrast to other plot-centered interactive storytelling systems, in emergent narratives there is not only one planner that plans the course of a story, but one planner for each character that plans only the actions of that character. We ultimately want the author to construct a planning domain for those characters[2], without being an expert in planning. The elements of this planning domain (actions and goals) are the main driving force behind the events that will occur in the story. Since the user's actions also contribute to the story line, one single emergent narrative application can tell many different stories, depending on the users choices. We thus do not refer to one such application as a story but as a story world. For the use of the suggested authoring environment, we assume the following situation: The author has the intention of creating a certain story world. They might use an already existing story world as a starting point or start with a completely new one. If the planning domain is empty (i.e. the author started a new story world) the characters will do nothing in a test run of the system and if it is not empty some action might emerge but the story is probably not leading into the anticipated direction. With the help of the authoring tool the author can now incrementally shape the planning domain and as a result the story world toward their vision.

Authoring Method

In our suggested authoring method, the main interaction with the authoring tool will take place in a mixed initiative planning / debug

[2] All characters can share one planning domain, a personlisation of those domains and thus individual behavior can be reached by referring to character properties. For example an action fly can have the precondition that the character needs to have wings and thus will not be available for characters without wings resulting in different beahviour for the same planning domain.

mode. Before entering that mode, the author takes some characters and objects and places them in an environment. They also assign goals to the characters. Starting from this initial situation, a story will develop that is both created by the planner and the author. The main purpose of running through that story however is not the story itself but the development of the participating characters by adding data to the characters planning domain. The author can control the time line, pause or rewind at any time and will usually go through the story step by step. Initially none of the characters might perform any action, because their planning domain is empty or incomplete. In this case the author can control the characters and direct them to perform certain actions. The author is acting out a story like a puppeteer. However, they have to justify every action they are suggesting by specifying the reason for this action. For example a certain action A might be a necessary step before being able to carry out an action B. If the author provides this information the software can create a causal link between the two actions and add it to the planning domain, by adding preconditions and effects to the actions. In a similar way the software can also automatically generate new subgoals or specific instantiations of actions. Once the planning domain is not empty anymore the characters might start making decisions on their own. In this case the author can just step through the story until a point is reached where the author either wants to order a character to do something or a character performs an action on their own that the author does not approve. In this case the author can discard the action but just like specifying a reason for performing an action they will also have to specify the reason for not performing the action. This again will result in a more elaborated planning domain, because those restrictions lead to more detailed pre-conditions or effects. The authoring method is illustrated in figure 1.

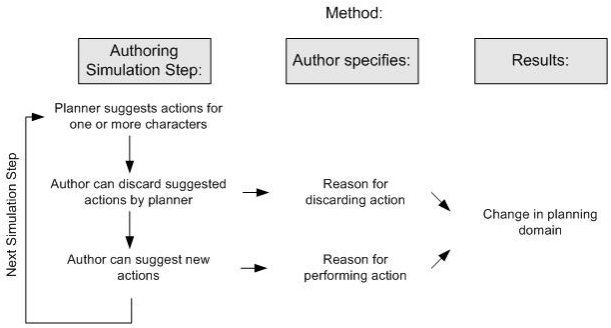

Figure 1. main authoring method

Example

To clarify the authoring method we will describe a very simplified example that illustrates a common situation within the authoring process. A lot more research has to be conducted in order to specify how exactly the author will communicate their reasons for performing or discarding an action. The challenge here is to allow the user/author to be very specific in communicating their intentions but at the same time to provide a very simple user interface for doing that. For the following example we will assume that the author specifies their motivations via a natural language interface in a pseudo-dialogue with the respective agent.

Imagine a story situation with two agents A and B. Agent A is a pedestrian in the street, Agent B is the bartender in a pub in that street. In that situation both agents are idle and the planner does not generate any action sequences for them to carry out. Even if the author fast forwards in the time line the characters will still stand there and do nothing. In order to change that situation the author has to intervene and take control of one of the characters. We assume, the author orders Agent A to enter the Pub. Now before the simulation can go on from there, the author has to specify their reasons for ordering this action. The following pseudo dialogue between Agent and Author represents the authors specification of their intent:

Agent A: Why do I enter the Pub?
Author: Because you want to buy a drink.
Agent A: Why do I want to buy a drink?
Author: Because you're thirsty.

From this dialogue, the software can deduce at least two facts and add them to the planning domain: The knowledge that you can buy drinks in Pubs (could be expressed as a pre-condition of the buy drink action) and the knowledge that the goal of getting a drink gets activated when the agent is thirsty (precondition of a goal). Now the author can step further through the simulation. After agent A has entered the Pub he will order a drink on his own, without the author having to order that action. If this is the storyline the author anticipates, they can just step forward in the story. In the next step Agent B is selling a drink to Agent A. In this example the author wants to create some conflict and cancels the bartender's action. Again this decision will have to be justified by the author:

Agent B: Why don't I give him a drink?
Author: Because he looks too young.

This time the software can deduces a new pre-condition for the sell drink action. The story could now go on with the bartender asking for an ID, agent A becoming aggressive or whatever the author anticipates. We have to point out that those stories that the author plays through during the authoring process are not necessarily replicable when an end-user is experiencing the story world, because the behavior of the software is determined by the planning domain, which is constantly reshaped by the author. However, ideally the planning domain will incrementally improve and the more stories the author plays through during authoring, the more elaborated the characters will be.

Conclusion

We envision a lot of advantages in using an authoring tool as described in this paper. First of all it forces an author to think about the effects and pre-conditions of actions and thus helps him understand the philosophy of emergent narrative. By allowing the authors to act out linear example stories, the software would facilitate the transition from traditional writing. We also believe that authoring in this environment will be intuitive and also accessible to storytellers without a strong technical background. Because debugging is integrated directly in the authoring process, the author is less likely to produce long time errors. The options of canceling actions and rewinding time make it easy for the author to correct mistakes or wrong conclusions that the software might have drawn.

We will have to refine the suggested authoring method by reviewing work on knowledge engineering and plan authoring. Especially the way the author communicates their intent to the software still requires a lot of attention. Another question that we have not focused on in this paper yet is concerned with the integration of character's individual simulated emotions into the authoring process. Ultimately our long term goal is the implementation of such an authoring tool within our Emergent Narrative Storytelling System.

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