Making it up as you go along - improvising stories for pedagogical purposes

Ruth Aylett[1], Rui Figueiredo[2], Sandy Louchart[1], João Dias[2] and Ana Paiva[2]
ruth@macs.hw.ac.uk, rui.figueiredo@tagus.ist.utl.pt,
sandy@macs.hw.ac.uk, joao.assis@tagus.ist.utl.pt,
ana.paiva@inesc-id.pt

[1] Heriot-Watt University, Edinburgh EH14 4AS, UK
[2] INESC-ID, Avenida Prof. Cavaco Silva - Taguspark, 2780-990 Porto Salvo, Portugal

Abstract. We consider the issues involved in taking educational role-play into a virtual environment with intelligent graphical characters, who implement a cognitive appraisal system and autonomous action selection. Issues in organizing emergent narratives are discussed as well as the impact on the authoring process.

1 Introduction

A constructivist view of education argues that people are not passive recipients of their experience but active constructors of their own reality through mental activity [18]. In order for this process of active sense-making to take place and transfer outside of the classroom it is also argued [4] that learning must be situated in a rich context, reflective of the real world. Story is a specific mechanism through which the real world can be created in the imagination of learners so as to take on a virtual existence in the classroom.

Educational role-play is one specific use of story in education where social interaction is used as the stimulus for challenging and changing existing beliefs [18] and can result in significant behavioral changes [12] making it highly relevant for social and emotional learning [5, 9]. The basic premise of educational role-play is that it is easier to empathise with how another person might feel under certain circumstances if one has experienced something similar, even symbolically as part of a role-play [20].

However role-play is not necessarily an easy option in the classroom - difficult to organize, and sometimes difficult also to sustain given that school students are not experienced actors and through embarrassment or lack of technique may shatter the willing suspension of disbelief required to make it a success. It is for this reason that a number of research groups [8] [13] [14] have explored the use of intelligent synthetic characters as virtual actors in a 3D graphical environment - sometimes an immersive one - with the intention that the sense of presence in the virtual environment, and, much more important, the believability of the characters, will sustain the engagement with the story and thus meet the pedagogical objectives embedded in the experience.

An important characteristic of role-play is that it is improvised rather than scripted, and that the story created through role-play emerges from interaction between the characters involved. Typically role-play is organized around a scenario: the characters are specified in terms of their background, often through past events they are said to have taken part in (their *back-story*), their role, their personality, and their goals. It is not possible to specify a linear plot in the same way as film or standard theatrical drama: educational role-play is often developed as a succession of scenes, in which external events and consequences of actions within scenes may be controlled by the facilitator of the role-play between scenes, and the new back-story and character goals communicated to role-players at the start of each new scene. In some cases the facilitator will themselves play a character with the specific intention of shaping the emerging story in particular ways. It is through these methods that the inevitable tension between the somewhat unpredictable outcomes of role-play and the desired pedagogical objectives is resolved, and the high-level dramatic trajectory of the experience is shaped.

These aspects of role-play have so far had little impact on virtual dramas, which have instead often adopted branching narrative structures, in which a finite number of pre-scripted paths result from a choice made at a specific decision point [8] [14]. In other cases work has tried to cover the whole space of possible options [15], with a correspondingly combinatorial authoring problem. The work discussed in this paper has tried instead to incorporate the role-play approach by developing an emergent narrative [2] in which the story is indeed generated by interaction between autonomous intelligent characters.

This raises a number of interesting challenges. Characters must have a rich repertoire of actions and corresponding graphical animations, and it must be possible to combine these dynamically, both through a character-based action selection mechanism and graphical morphing between animations. Characters must also possess an adequate repertoire of expressive behaviours, since otherwise their motivations and responses may remain opaque. Finally, some at least of the functionality of the facilitator of educational role-play - or the gamemaster of live and table-top role-play - must be incorporated in order to give the experience the desired pedagogic shape.

This paper discusses how the FearNot! demonstrator, initially developed as part of the EU-funded project VICTEC (Virtual ICT with Empathic Characters) and now being further developed in the follow-on project eCIRCUS (Education through Characters with emotional-Intelligence and Role-playing Capabilities that Understand Social interaction), tries to meet these challenges.

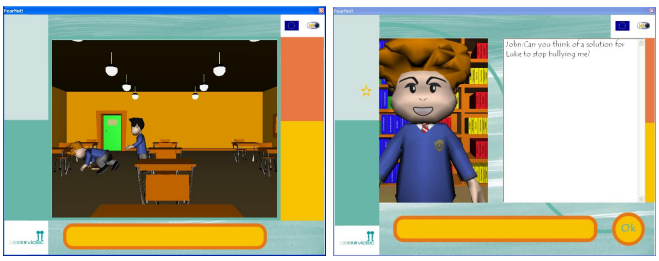
2 FearNot!

FearNot! is an Interactive Virtual Environment (IVE) developed to tackle and help to reduce bullying problems in schools. Bullying behaviour is characterized as "a repeated action that occurs regularly over time, and usually involves an imbalance in strength, either real or perceived" [17]. This may involve hitting,

kicking or punching, in the case of direct bullying, or, in relational bullying, social exclusion or malicious rumour spreading. FearNot! offers a safe environment for children where they can witness individually (from a third-person perspective) bullying situations in virtual 3D scenarios. Each child then acts as an *invisible friend* to the victimised character, discussing the problems that arise and proposing coping strategies. This advice influences the actions of the victim in the next episode.

The requirement that the child must influence the victimized character underlines the need for an emergent approach. A scripted system would limit the child's interaction and pose serious scaling problems in authoring. The concept of emergent narrative is based on the idea that a story can emerge directly from the interactions between different characters and the causal relationship between its different elements. Thus episodes are unscripted and result from the actions, interactions and reactions of autonomous agents.

In order to make such autonomous agents believable and empathic, we focus on two characteristics raised at an early stage by traditional animators and often explored by researchers working in synthetic characters: emotional expressivity and personality. Personality and the character goals associated with it are crucial in achieving pedagogical objectives in emergent narrative because of their role in producing agent behaviour, allowing the facilitator to build an overall narrative by choosing the right set of characters and situations. Mechanisms must be developed supporting models of agent emotions and personality, that can be used within characters to influence their reasoning and actions.



(a) Luke pushes John

(b) The user interacts with John

Fig. 1. FearNot! application

We have developed such agent architecture and applied it successfully to a short physical bullying scenario of two scenes. The first presents an initial bullying situation where Luke (the bully) pushes John's (the victim) books off the table(Fig. 1-a). Afterwards, the child interacts with the victim via free-text keyboard entry, and gives him suggestions on what to do. The *Story Facilitator* (SF) then chooses the next episode in relation to the child's advice (Fig. 1-b).

For instance, if the advice is to fighting back, the SF confronts John with Luke once more, while if the advice is to tell someone, it puts John and one of his friends together. Due to the number of possible suggestions and the fact that the outcome of an episode is not certain (e.g the victim may succeed or fail in fighting back), this small number of scenes corresponds to a much larger number of distinct plays. It is easy to see the combinatorial explosion if we were to script and foresee each possibility. Fortunately, the scale up of scenes just requires the definition of much smaller number of additional goals and generic rules in the character's definition.

3 Generating story through character interaction

The architecture of the characters in FearNot! is of crucial importance given that it through their autonomous action-selection mechanisms that the dramatic content of episodes is generated. Figure 2 shows the main functions of this architecture. The agent mind takes percepts from the virtual world and uses a cognitive appraisal system based on the work of Ortony, Clore and Collins (OCC) [16] discussed in more length in [19] to generate an emotional status. This then affects the agents drives, motivations, priorities and relationships, and produces coping behaviour [11]. FearNot! incorporates two distinct levels in both appraisal and coping mechanisms. The reactive level provides a fast mechanism to appraise and react to a given event, and generates behaviours such as crying, which cannot be considered as planned. The deliberative level takes longer to react but allows a more sequentially complex and rich behaviour, for example a plan by the bully to push the books of a victim off his desk.

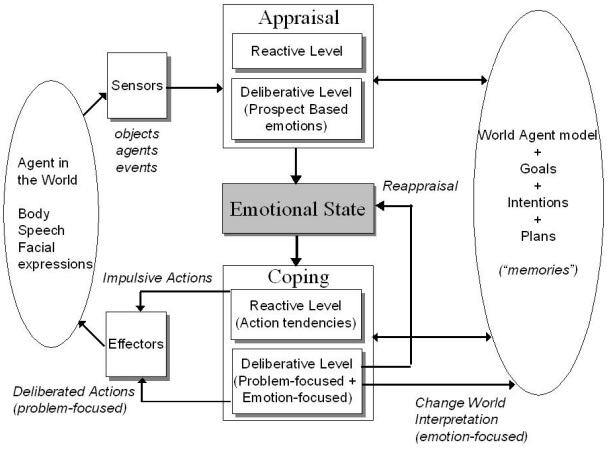


Fig. 2. Architecture Diagram

The reactive layer appraisal is handled by a set of emotional reaction rules, based on Elliot's Construal Theory [6]. A reaction rule consists of an event that triggers the rule and values for OCC appraisal variables affected by the event (desirability, desirability-for-other, praiseworthiness etc). Reactive coping behaviour is defined by action rules: each contains a set of preconditions that must be true in order to execute the action together with the eliciting emotion that triggers this particular action. The action set is matched against all the emotions present in the character emotional state 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 (i.e. triggered by the same emotion), the most specific one is preferred.

The deliberative layer is responsible for appraising events according to the characters goals, thus generating prospect-based emotions like hope and fear. The character's goals result in the generation of plans, using a STRIPS-based partial-order continuous planner, and assessment of both the probability P of success of a given plan and its importance to the character as in [7] generates hope and fear:

$HopePotential = P(Plan) * ImportanceOfSucess$

$FearPotential = (1 - P(Plan)) * ImportanceOfFailure$

Deliberative appraisal updates all existing plans accordingly to the event being appraised as well as the probability of action effects succeeding. If an action was successfully executed but an expected effect did not occur, the planner updates effect probability accordingly. This process will change the agents' internal plans (and plan probabilities) leading to different emotional appraisals of Hope and Fear. In addition, when an event is appraised, the deliberative level checks if any goal has become active, and if so, an intention to achieve the goals' success conditions is created generating initial hope and fear emotions. The deliberative layer must then choose between existing intentions/goals to continue deliberation (and planning). The idea is that we can use emotions to determine the most relevant intention: the goals 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.

Since the agents in FearNot! are emotionally driven, any significant interaction with a child user or another agent will result in the alteration of the agents' emotional state. Since the agent makes decisions based on that emotional state, this potentially affects its perception of actions and alters the probability of plan success and the resulting feelings of hope and fear. This, in turn, influences the actions selected for execution by the agent and allows for the unfolding of narratives different in form and content (i.e. according to their context) without the need for scripting them.

In role-play, the outcome of physical actions in the world is often decided by facilitator or gamemaster since the real physical world is not usually that of the role-play. Likewise, the outcome of physical actions in FearNot! is decided within the visualized graphical world in which they take place, so that a character who is pushed may or may not fall. The actual outcome of an action like this also has

a substantial emotional effect on characters: if the victim pushes the bully and the bully falls, then the victim's level of hope rises and the bully's level of fear rises, impacting their plans. If it fails, the impact runs the other way, and an angry bully may in turn push the victim with a much greater chance of success. These probabilities are taken from analysis of real bullying in which the coping behaviour 'hitting back' is observed to be relatively unsuccessful for real victims.

3.1 Defining a Character

The final intensity of emotions is biased by personality, supporting a greater differentiation of behaviour between different characters. For example, a fearful character has a low threshold and experiences Fear more easily, making this the dominant emotion more often. The character therefore considers goals that seem unachievable (generating stronger Fear emotions) earlier, and gives up goals that threaten other interest goals much more easily. A less fearful character is usually driven by Hope, producing in general a more optimistic and bold behaviour. Characters are defined by their Personality (Fig. 3), also strongly based on OCC and containing: a set of goals; a set of emotional reaction rules; action tendencies; emotional thresholds and decay rates for each of the OCC 22 emotion types.

Emotional reaction rules represent the character's standards and attitudes and are very dependent on personality. Action tendencies represent character impulsive actions or reactions: when the victim is very sad it will tend to cry while the bully expresses his sadness in a completely different way. OCC specifies for each emotion type an emotional threshold and decay rate. An emotional threshold specifies a character's resistance towards an emotion type, and the decay rate, the emotion decay over time. A peaceful character will have a high threshold and a strong decay for the emotion type of Anger, thus its anger emotions will be short and low.

The results obtained from a small evaluation [3], in which the emergent version is compared with a scripted version, suggest that the use of autonomous synthetic characters can lead to believable situations that do evoke empathy in users. However just as in human role-play, the whole burden of the overall narrative cannot be left on the characters especially as their internal complexity is scaled up for multiple episodes and scenarios. Although they possess mechanisms that allow them to select between competing goals, and to perform different coping strategies, these mechanisms are influenced by their always shifting emotional state. There are myriads of small things that can change their internal emotional state, ranging from a small event to a bad or good mood. Thus, as the number of goals and character complexity increases, so does their unpredictability and scope of possible behavior. As such, the need for the SF arises once more in order to put forth a macro control over the character's range of behaviours by communicating them their goals at the start of each episode.

```
- <Character role="Victim">
  - <EmotionalThresholds>
      ...
      <EmotionalThreshold emotion="Hope" threshold="7" decay="8" />
      <EmotionalThreshold emotion="Fear" threshold="1" decay="2" />
      ...
    </EmotionalThresholds>
  - <Goals>
      ...
      <Goal name="AvoidGettingHarmed" importanceOfSucess="7" importanceOfFailure="10" />
      <Goal name="PickFromFloor([target])" importanceOfSucess="4" importanceOfFailure="4" />
      <Goal name="AskForHelp(user)" importanceOfSucess="10" importanceOfFailure="10" />
      ...
    </Goals>
  - <EventReactions>
      ...
    - <EmotionalReaction desirability="-8" praiseworthiness="-9">
        <Event subject="SELF" action="cry" />
      </EmotionalReaction>
    - <EmotionalReaction desirability="-6" praiseworthiness="-8">
        <Event action="push" target="SELF" />
      </EmotionalReaction>
      ...
    </EventReactions>
  - <ActionTendencies>
      ...
    - <ActionTendency action="cry">
        <Preconditions />
      - <ElicitingEmotion type="Distress" minIntensity="4">
          <CauseEvent action="fall-back" subject="SELF" />
        </ElicitingEmotion>
      </ActionTendency>
      ...
    </ActionTendencies>
  </Character>
```

Fig. 3. XMl file for the Victim's Personality

4 Scaling up

As discussed above, an initial version of FearNot! demonstrated that it was feasible to generate a small number of short narrative episodes by interaction between two characters, the bully and the victim. However in order to produce an application that is usable in the school curriculum, many characters and episodes are required, covering various types of bullying. In addition, as in human role-play, the nature of an episode depends heavily on which characters are involved, what has already happened to them, their goals at the start of the episode and the location and objects around them. Making these initialization choices about an episode should also relate to the advice a child user has given to a victim so that the child feels the story is responding to their intervention.

For all these reasons, a structure that represents an episode was defined, this structure was inspired by the fact that Bullying has an episodic and repetitive nature, moreover role-play is developed as a succession of scenes. An episode represents a part of the story that can be combined with other episodes, with each combination creating a different story. It contains information that allows contextualization of the part of the story it represents, together with information that allows the system to know when each episode should end. The actual definition of an episode is an XML file, a quick description of the several sections contained in it is given in table 1.

Name	A unique name that identifies the episode
Set	The set is the location on the virtual environment where the events of this episode will take place.
Characters	The characters of the story that will participate in this episode and a set of properties about them such as their position on the set.
Preconditions	The preconditions are a set of conditions that specify when is the episode eligible for selection.
Goals	Character goals that are communicated to the agents in this particular episode.
Triggers	A trigger is a condition that when satisfied will cause the execution of a set of *narrative actions*.
Finish Conditions	The finish conditions are a set of conditions similar to the preconditions that when satisfied indicate that the episode is finished.
Introduction	This section of the definition of the episode is composed by a set of *narrative actions*.

Table 1. The several elements that the author defines in each episode

The responsibility of sequencing the episodes belongs to a special agent, the already mentioned Story Facilitator, which acts in a similar way to the human facilitator in educational role-play. This agent has special privileges that allow it to keep track of all the events that happen in the virtual environment. An event in this context describes an action from an agent (or the user) and how and when it was performed. This information allows the story facilitator to have contextual information about the development of the story, and is used to select

the most appropriate episode to be played next. For an episode to be selected by the SF, it must have at least one of it's preconditions satisfied. A precondition represents a set of tests on events, that when true indicate that this episode fits into the developing story.

Each time a new episode is selected the Narrative Actions contained in its *Introduction* are executed. These actions are inspired by some of the actions a human gamemaster (or facilitator) performs. Table 2 gives the complete list of available narrative actions. During the execution of the narrative actions contained in the introduction section, the minds of the characters are stopped. When all the actions finish the minds continue their normal execution. This section is used to place the characters and objects on the set, and to write some introductory text to the interface.

Insert Character	This action inserts a character in the current episode.
Insert Object	Similar to the *Insert Character Action* but applied to objects.
Change Camera	Changes the perspective of the camera.
Narrate	Writes text to the interface
Change Story Mode	Changes the interface.
Remove Object	Removes an object from the set.
Remove Character	Removes a character from the set.

Table 2. Narrative actions available to the author

Following the execution of the narrative actions contained in the introduction, the character goals are communicated to the corresponding agents. The story facilitator then monitors execution in order to update its memory with all the events that happen in the story. Each time a new event is generated the SF checks the conditions of all triggers contained in the episode. A trigger condition can test the properties of the characters and events that were generated within the current episode. Any trigger that has its condition satisfied is considered for execution, with selection of the one in this set that has the highest priority. The trigger's priority is defined via the authoring of the episode's XML.

Execution of a trigger carries out all the narrative actions contained within it and the minds of the agents are stopped so that there is no interference between agent actions and narrative actions. Triggers can be used to place additional objects and characters in the virtual environment, thus producing events exogenous to the characters, as well as to write narrative text to the visualization interface. The SF also tests for the finish conditions of the current episode. When one of the finish conditions is satisfied the episode ends and another is selected. When there are no more episodes that are eligible for selection the story finishes.

5 Authoring for emergent narrative

Authoring emergent narrative may sound paradoxical - if the story is to be generated by interaction between characters, then in what sense is it authored? However emergent narrative is not magic, and just as in human role-play must be carefully organized if it is to reach particular pedagogical objectives. Authoring is not abolished, but it is different from the approach of film and standard theater or written narrative in that it does not involve the design of a linear plot. Rather than working on one particular story and developing the characters for the unfolding of this storyline, the author needs to fully develop characters with respect to a potential 'narrative boundary' or narrative zone. In FearNot! this is currently expressed in the construction of the episodes the SF can dynamically invoke.

In FearNot! an author must initially decide, for pedagogical reasons, on the type of bullying that should feature and the number and type of characters that should be involved. Physical bullying involves hitting and pushing, and is much more often carried out by boys; relational bullying involves social exclusion - for example making sure nobody will sit next to the victim in activities - and is much more frequently carried out by girls, especially in the target 8-12 age group of FearNot! The settings required for these types of bullying may be different, and relational bullying usually requires an assistant to the bully, as well as bully and victim, for a plausible story to emerge. Showing the potential role of bystanders and the impact of the victim making a new friend also require relevant settings and characters on stage. The author need not define any rigid sequence for such episodes, but if it is considered important that such types of episodes can be staged by the SF, then the author must specify them at this abstract level along with their conditions and associated narrative events.

A consequence of allowing the characters to select the actions to be played out in a specific episode is that the level of abstraction of authoring is raised [2], and becomes much more declarative in nature, compared to the lower-level procedural requirements of linear story authoring.

The XML character definitions must be considered so that relevant emotional reaction rules and action tenancies are defined for the episodes in which the character may feature. The author must think in terms of interactions between characters and the likely occurrence of actions, interactions and goal conflicts in the episodes being created. This is simple for two characters but more complex as the number of characters in an episode grows. This bottom-up approach can be a relatively complex exercise in finding the right balance between delimiting the boundaries of the episodes with their associated character definitions, and allowing the characters to take charge within episodes. Each character should be thought of as having its own story space, with the existence of multiple narrative threads acting as the boundary of the overall narrative experience. This ability to see multiple stories depending on the character perspective taken is potentially very educationally powerful, and though in FearNot! it is the perspective of the victim that is currently taken, one should not rule out the educational value of

seeing the story from the perspective of a bystander, a friend of the victim, or even an assistant to the bully.

The author is required to give up low-level control of the story and instead to develop much more detailed character specifications: the outcome of this process cannot be wholly assessed by inspection but requires simulation runs in order to develop adequate actions and goals or respond to specific needs for a scenario. If characters have been written well enough, then their reactions and decisions should match the role they are asked to play in unfolding the drama within episodes. It may be quite difficult for an author to give up the conventional plot-based approach to story derived from a whole experience of childhood stories, comic strips, TV cartoons, lullabies, folklore and moral tales etc. However the success of role-play and improvisational drama in generating engaging story experiences in our view offers an existence proof for this approach.

This approach to authoring is in fact very similar to that that taken for interactive theater plays [10]. Here, an event, containing its own sequence of events or sections, is unfolded while characters that would fit the event theme are introduced within the audience and carry out their roles, occasionally reacting or interacting, according to their roles and personalities. This approach still relies on authoring a high-level story, but is very different from creating a plot to which every single character must perfectly relate to in order to generate meaning and sense.

Since this type of interactive storytelling does not conform easily to the classic narrative model of 'beginning, middle and end' [1], it is quite possible that the overall experience ends without all of the character stories having reached a dramatic climax. The existence of multiple stories at various stages of development, over which the author has only a limited amount of control,raises the issue of how to 'wrap up' the overall experience. As an example, it would be very difficult indeed to engineer an end to a performance such as the ones observed in movies like Bleu, Blanc, Rouge, Traffic or Crash.

Human Role-Playing-Games (RPGs) that share the same issue have addressed the problem by running debriefing sessions where the players can discuss their actions, interventions and motivations for doing so with other involved players. In this way, the players gain a better understanding of the overall picture and can relate to their position within the story world. Often this exercise generates discussion on what could have happened or would have been likely to happen, thus bringing more interaction between participants. FearNot! is aimed at giving each child in a class a somewhat different experience, and rather than funelling the emergent narrative into a contrived generic ending, happy or otherwise, the pedagogical objectives seem much better served by adopting this approach and locating the software within a broader educational process.

6 Conclusions

In this paper we have discussed how the FearNot! demonstrator applies ideas from educational role-play to the development of an emergent narrative. We

have described the SF mechanism as a way both of shaping the high-level narrative and as a support to a different approach to authoring in which high-level structure, in the form of episode definitions, is fleshed out by the improvisatory abilities of affectively-driven characters alongside the indeterminacy of physical events. Current work is going on to produce a robust and scaled-up version of FeraNot! that can be trialled in schools over a period of months in 2007.

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