

# **PUPPET: a virtual environment for children to act and direct interactive narratives**

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This paper presents findings from an evaluation of an autonomous agent populated virtual environment called PUPPET, that allows children to play multiple roles in the creation of an interactive narrative: audience, actor, scriptwriter, and editor. The speech of children playing with the PUPPET system was analysed to determine their ability to understand the behaviour and motives of the autonomous agents, to take on the role of an avatar character, to script dialogue for the characters, and to reflect upon and edit the recorded dialogue.

The findings showed that children were able to understand the interaction between the autonomous agents in terms of goals. They were also able to express an understanding of different emotional states built into the agent architecture. Most children took on the role of the avatar, although interaction with the agents as avatar was relatively simplistic. In line with a theory of externalisation (Scaife & Rogers, 1996), recording and editing tasks were successful in eliciting discussion and reflective thought about dialogue.

## **1 Introduction**

This paper presents findings from the final evaluation of the PUPPET system. PUPPET is a European Union i<sup>3</sup> funded project exploring the potential of an autonomous agent populated virtual environment to promote playful learning (Bruner, 1979), specifically learning about drama. PUPPET allows children to play multiple roles in an interactive narrative: audience, actor, scriptwriter, and editor. Children are able to both ‘dive in’, taking on the role of a character in the drama, and to ‘step out’, reasoning about a character’s emotional states and goals, as well as reflecting upon their own character dialogue recorded while playing with the system as scriptwriter. Both perspectives have been described by Ackermann (1996) as equally important in promoting cognitive growth. PUPPET was designed to provide a permanent record of any character dialogue produced by children to be reviewed and edited ‘off-line’. It was predicted, in line with a theory of externalisation (Scaife & Rogers, 1996), that this facility would promote discussion and a sophisticated understanding of narrative and character emotional states.

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\* Tragically, Mike Scaife died as the evaluation of PUPPET was being conducted. He is greatly missed by all in COGS.

## 1.1 The scenario

The PUPPET world was designed as a virtual farmyard inhabited by two autonomous agents, a cow and a farmer, both with different personalities and conflicting goals. The cow wants to be more ‘human-like’ and is something of a free spirit. Thus, he continually attempts to escape the confines of his pen to read books on a nearby bookshelf, and to listen and dance to music on a gramophone. The farmer, in contrast, loves order so whenever he spots the cow trying to escape, he attempts to return him to his pen. Based on the conflicting goals of these two interacting characters, a perpetual narrative cycle emerges, intended to capture the attention of the children and get them to reflect upon the dissonance.

The behaviour of the agents in this interaction is determined by their position on two emotional state parameters:

1. *Status* determines how dominant (high status) or submissive (low status) an agent is, and
2. *Attitude* (positive or negative) determines the strategy used by an agent to achieve its goals: luring versus herding for the farmer and avoiding versus confronting for the cow.

Each of the four combinations of status and attitude associated with the agents are communicated to the audience via a combination of characteristic facial expressions, gait, non-verbal sounds etc. Previous work on PUPPET had emphasised the importance of the face in communicating emotional information to young children (George & McIllhigga, 2000). Figure 1 shows how the two agents appear in each combination of status and attitude.

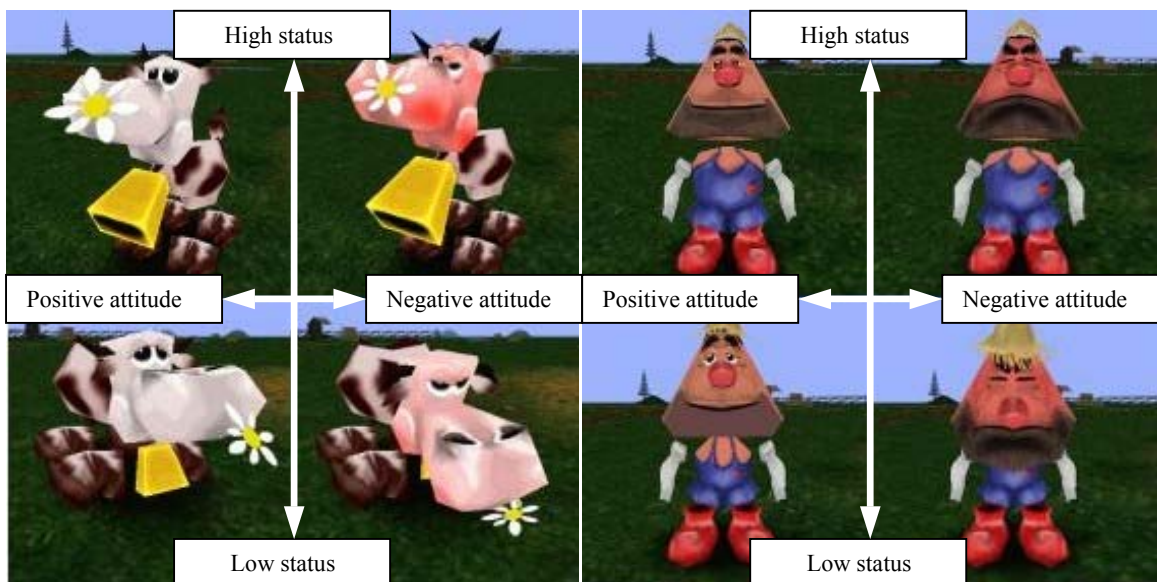


Figure 1: The cow and farmer agents in all 4 combinations of attitude and status

A third character, the sheep, can be selected as an avatar, the child’s representation in the PUPPET world. The sheep can be in one of three mood states: positive, negative, or neutral. The sheep can be used to make sounds and actions towards the other characters. An agent will respond in a way appropriate to the sheep’s mood state and with repeated interaction will change its status and attitude. As the type of interaction

between the two agents is a function of these parameters, the sheep can be used to change the course of the narrative cycle. For example, the sheep in negative mood could be used to chase the cow back into its pen. The cow, having failed to reach its goal would then change to low status. The farmer having seen his goal of returning the cow to its pen met, would then change to high status.

## 1.2 Roles

Four styles of interaction with the PUPPET system are possible. These are:

1. *The child as audience.* Children watch the interaction between the two agents, reflecting upon their emotional states and goals.
2. *The child as actor.* Children use the sheep avatar to explore the PUPPET world and to interact with the autonomous agents.
3. *The child as scriptwriter.* Children record dialogue for the two agents and the avatar. Each piece of dialogue corresponds to a combination of status and attitude, and the character to whom it is directed.
4. *The child as editor.* Children review the dialogue they recorded while viewing screenshots depicting the scenario at the time the recording was made. The children can then re-record any sounds they want to.

## 1.3 Evaluation study

The aims of the evaluation study were fourfold. These were to investigate young children's ability to:

1. Read characters and interpret their behaviour and motives
2. Take on the role of the avatar, and engage in and understand interaction between characters
3. Use recording facilities to script dialogue for the characters
4. Reflect upon and edit recorded dialogue.

Particular attention was paid to the children's meta-level understanding of the narrative underlying the drama. It was predicted that by externalising character dialogue during the recording session, children might be able to use sophisticated evaluative procedures while editing (Scaife & Rogers, 1996).

## 2 Methodology

To examine our objectives, we decided to place the PUPPET system in an educational setting, where children would come for repeated sessions. This would allow them to play with the system in each of the different roles. The PUPPET system was therefore set up in the library of a school local to the University of Sussex. Children were taken from their classroom in pairs to play with the system for between 15 and 30 minutes. Each pair had four sessions with the system in the afternoon over the course of approximately two weeks. Each session introduced to the children one of the styles of interaction listed above.

During the *audience* session, the experimenter controlled the viewpoint, focussing on the interaction between the two agents. As *actor*, the children played as the sheep

avatar. Initially, one child controlled navigation with a mouse, while the other child controlled behaviour and mood with a Universal Concept Keyboard<sup>1</sup>. After children were able use the controls adequately, they took it in turns to use both the mouse and the concept keyboard. As *scriptwriter*, the children watched the PUPPET world with the experimenter controlling the viewpoint. When the system was about to play a novel sound file, the action stopped and the children were invited to record new dialogue for the two agents and the avatar. In the final session as *editor*, children reviewed their previously recorded dialogue while viewing screenshots taken at the time of recording. They decided whether to keep or to re-record each recording. Once children had finished editing their recordings, they re-entered the PUPPET world as avatar to hear their sounds in context.

During all sessions, either one or two experimenters sat with the children. Children were encouraged throughout to talk about the system and the characters. Experimenters guided the children's interaction with the system by, for example asking questions about salient features of the scenario such as agents' mental state. All sessions were videotaped. All discussion between the children and experimenters was transcribed for analysis.

## **2.1 Participants**

In total, sixteen children took part in the study – 6 girls and 10 boys. The median age was 7 years 9 months (range 7;5 – 8;3).

## **3 Results**

Transcripts of all sessions were produced. The children's dialogue was then analysed to produce an impression of their understanding of, and engagement with, the PUPPET system. Findings are summarised by session below:

### **3.1 Session 1: Child as Audience**

Children were able to reason accurately about the goals of the agents embodied in the agent architecture. Statements about goals were operationalised in the analysis as ones about what the agents might "want". Most goal statements about the cow were that it wanted to "read" or to "listen to music". Most goal statements about the farmer were that he wanted to put or keep the cow in its pen. The children were also able to understand most of the action in the PUPPET world. For example, one child said of the farmer, "He tries to make him [the cow] follow him, but he keeps reading the book".

Children understood the emotional states of the agents at least partially. They seemed to be able to read what was meant by *attitude* in the agent architecture, describing both agents in synonyms of "happy" in positive attitude, and "angry" in negative attitude. Understanding of the *status* parameter expressed by the children was less clear-cut, although they frequently described the cow as "unhappy" when in low status.

### 3.2 Session 2: Child as actor

The ability of the children to take on the role of the avatar was explored in the analysis by examining the tense used to talk about the sheep. Nearly all of the children produced some 1<sup>st</sup> person speech and character dialogue as the sheep, thus to some extent took on its role in the virtual world. This ability to become the sheep was related, unsurprisingly, to how well the children were able to control the character with the mouse.

1<sup>st</sup> person speech, and dialogue as the sheep was in both the singular and plural tense. For example, upon discovering a river near the farmyard, one child exclaimed, “I don’t want to fall into the water. I’m not a sheep that’s wet”. Another child, watching the cow being herded back into its pen by the stick-wielding farmer, shouted, “How dare you hurt our friend”. Thus, some children seemed able to take on avatar’s role as a pair. This ability was unrelated to whether both or only one child was in control of the avatar and shows a high level of flexibility in the children’s ability to take on a role in the drama.

1<sup>st</sup> person speech *as* the avatar was most frequently about navigation (e.g. “Let’s go away from the barn”) and direct engagement with characters and objects (e.g. “I’m going to smash the fence over”). Dialogue *about* the avatar in the third person was varied, but frequently more reflective than speech *as* the avatar. For example, one child changed the mood of the sheep, explaining, “I like it when it’s angry because it looks like it’s going faster...though it’s actually going slower, because it looks like it’s going in slow motion”.

Most of the children’s time as avatar was spent exploring the virtual environment. Attempts to engage with the characters were generally directly physical, rather than indirect by making sounds and actions via the concept keyboard. One boy, for example, explained his actions as, “I’m trying to head-butt the farmer to help poor Daisy”. This was despite physical interaction having very little effect on the agents. Three out of the eight pairs of children adopted the goal of the cow, trying to escape from the farmer. This demonstrates that some of the children at least, were able to improvise on their understanding of the narrative.

### 3.3 Session 3: Child as Scriptwriter

Children found the task of recording character dialogue to be particularly engaging, spending much time recording and re-recording speech for the farmer, cow and sheep. Much of the dialogue was very inventive. One pair of children for example, made up songs for the characters to sing, such as the following piece of dialogue recorded for the farmer:

It’s a lovely day today,  
And the sheep and the cow,  
Are not having rows,  
Over the bread and milk today.

The recording task was also effective at promoting discussion between the children. The topics of discussion were very varied, but included previously recorded sounds, action, the quality of the recording and the appearance of the characters in relation to

their emotional state. The terms used by the children to describe the emotional states of the agents were similar to those used by the children in the first session, and did not map perfectly onto the agent architecture as it had been designed. In particular, children made little reference to anything resembling the *status* parameter. It is possible that this was because *status* is a more sophisticated concept than *attitude*. Whether children were unable to understand *status*, or whether they were unable to verbalise an understanding is unclear.

### 3.4 Session 4: Child as editor

Again, the children found the editing session highly engaging. Replaying previously recorded dialogue provoked much laughter as well as reflective discussion about the recordings. Many children iteratively recorded and then re-recorded new character dialogue. The types of changes and the explanations given by the children were very varied. Examples included changes to prosody: "...so that it flows more", grammar: "I think change to 'had'. It's meant to go 'had', but not 'hadn't'" (recorded sound had been "You are the best sheep I have ever hadn't"), and sound quality: "I'll do that again because I don't understand".

Playing as avatar after editing character dialogue, the pattern of activity was broadly in line with that described in the first avatar session. Ability to take on the avatar's role was again related to ability to control the character with the mouse. Children spent a greater proportion of time than in the previous session interacting with the agents. The style of interaction was again largely physical, and lacked any overall goal or coherence.

## 4 Summary of findings and discussion

The evaluation of the PUPPET system showed that children were able to develop a quite sophisticated level of understanding of the drama and to reflect upon this. In particular, they could understand the underlying narrative cycle in the system in terms of the differing agent goals. This was despite all communication between the agents in the first session being non-verbal. Children also seemed capable of understanding the *attitude* of the agents, while having some difficulty talking about their *status*. This may have been because *attitude* mapped well onto the basic emotion *anger* (e.g. Ortony & Turner, 1990) whereas *status* is a more sophisticated concept. However, it may simply have been that children lacked the vocabulary to express any conception of *status* they may have had. Indeed, in a preliminary evaluation of the recording module of the PUPPET system<sup>2</sup> with two slightly older children, the type of dialogue recorded was appropriate to the *status* of the agents. This was despite the children making no explicit reference to anything resembling *status* while talking about the agents.

While playing as avatar, children switched between taking on the role of the sheep and standing back from the action to make more reflective comments. Comments were very varied, but included comments about the capabilities of the avatar. Ability to take on the role of the avatar was hampered for some children by problems navigating with the mouse. It is suggested a more intuitive device should be used in future work with this age group.

The children's interaction with the agents as avatar was very direct. Children often tried to 'attack' one or other agent with the avatar. Unfortunately, there was no provision for this kind of interaction in this version of the PUPPET system- the avatar simply went through the agents. It is suggested that direct physical interactions might be one way to lead children into more elaborate interactions with characters. Furthermore, the children's interactions with the agents were rarely prolonged. It is suggested that to fully engage the children in the creation of narrative, initially at least, there should be more structure to their interaction, with the children being led through a number of steps towards a goal, before being allowed to play freely. When explicitly given a goal by the experimenter, the children were able to come up with some imaginative solutions. For example, when asked to help the farmer by stopping the cow getting to the bookshelf, one girl changed the sheep's mood to negative and manoeuvred it to face the cow, explaining, "I'm trying to guard the bookshelf".

The recording session was successful in eliciting discussion about the agents, their interactions, and goals. Children found the task highly engaging and came up with some wonderfully inventive dialogue.

As predicted by a theory of externalisation (Scaife & Rogers, 1996) being able to record their dialogue allowed children to stand back from the process of production while editing, promoting reflective thought and discussion about recordings. This highlights an advantage of using such a tool over more conventional role-play or play with glove puppets in so far as it allows the children to step back from the action and to observe their actions rather than only experience them. In conventional forms of story creation, the dialogue and action produced is transient. It therefore takes great mental effort to recall dialogue to reflect and improve upon it. The recording and editing facilities in the PUPPET system, in contrast, allow the child to iteratively improve upon any dialogue they create.

## Notes

1. A concept keyboard is a touch-sensitive pad that allows the use of paper, card, plastic, and laminated overlays (see <http://www.conceptkey.co.uk/> for details). A simple iconic overlay was produced to allow the children to control the avatar mood and actions.
2. A short report of this evaluation can be found at <http://www.cogs.susx.ac.uk/users/paulma/puppet/WP2WP3.html>

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