Acting, Playing or Talking about the Story: An Annotation Scheme for Communication during Interactive Digital Storytelling

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Abstract. In this paper we investigate the communication of children playing with an interactive digital storytelling system. What users say during their interaction with a digital storytelling system can tell us much about how they relate to the characters and how engrossed they are in the storytelling activity. We propose a communication annotation scheme that combines ideas about framing from research on pretend play and role-playing games, and use it to analyse children's utterances gathered in a small-scale user experiment. Our results show that certain kinds of communication are prevalent among the children's interactions. We conclude that this can be attributed to the design of our system, and we envisage future use of the annotation scheme to inform the design of other interactive storytelling systems.

1 Introduction

In the field of interactive digital storytelling, evaluation has received considerably less attention than system design and development, and there is no generally accepted methodology for the empirical evaluation of interactive digital storytelling systems. Methods that have been used in user studies include questionnaires [3, 12], interviews [5, 8], analysis of system logs and created stories [11, 13], and observations of user behaviour [1, 5, 8, 11]. Aspects of the interactive narrative experience that are considered include the user's sense of presence and immersion, enjoyment, feelings of agency and control, believability of and identification with the characters, and system usability aspects.

We are not aware of any user studies that systematically analyse the communication of people interacting with a storytelling system. However, users' communication can be a rich source of information about, among other things, their level of identification with the characters, what they think of the story, and their understanding of the system's interface. Consider for example the following transcript[1] of an interaction with our digital storytelling system, in which children control the actions of some of the characters to create a story together.

[1] Translated from Dutch.

(1) System [narrating an action by Child 1]: Red skips to the beach.
System [narrating an action by Child 2]: Granny bursts out in tears.
Child 2 [in character, addressing Child 1]: *Because you are leaving me!*

In this fragment, Child 2 is role-playing as his character, Granny. He addresses the other child (Red) in character, providing a motivation for Granny's emotional outburst. He is actively taking part in the story creation process, identifying himself with the character he is playing.

Not all of the children's communication demonstrates the same level of immersion in the story being created. In the next fragment we see Child 6 taking a game-playing rather than a role-playing approach to the storytelling activity:

(2) System [narrating an action by Child 5]: Red eats the birthday cake.
System [narrating an action by Child 6]: Granny shuffles to the beach.
Child 6 [addressing Child 5]: *Then it's your turn.*
System [narrating an action by Child 5]: Red does the dishes.
Child 6: *And now Granny.* [selects an action] *That one, I think.*

In this paper, we present a study of children's communication with an interactive storytelling system. We focus on the question to what extent the children are focused on the story they are creating, and what perspective they take on it. In an effort to obtain quantitative results, not just anecdotal evidence, we designed a multi-layered scheme for annotating the children's utterances. The scheme is based on the notion of framing as used in research on role-playing games [6] and children's pretend play [9]. We have used it to annotate the transcripts of eight interaction sessions with our storytelling system, involving four pairs of 8-11 year old children. Below, we present and discuss the results.

First, we describe the interactive storytelling system in Section 2. We present our proposed annotation scheme, with a discussion of its foundations, in Section 3. We describe our analysis of children's communication in Section 4, followed by a discussion about the validity of the annotation scheme in Section 5. The paper ends with conclusions and suggestions for future work in Section 6.

2 The Interactive Storyteller

Our interactive digital storytelling system is called the Interactive Storyteller [1, 11]. It allows users to control the actions of one or more characters in a simulated story world, where they interact with other characters controlled by artificial intelligence (AI). There is no scripted storyline; stories emerge from the actions that the characters (either user-controlled or system-controlled) take in the simulated story world. This *emergent narrative* approach [3] is closely related to improvisational theatre and to children's dramatic play.

The system has a multi-touch tabletop interface, which resembles the setting of a tabletop board game. To reinforce the resemblance with board games, we use tangible playing pieces to represent the characters. Its board game interface distinguishes our system from other AI-based storytelling systems such as

FearNot! [3] and TEATRIX [8], both well-known systems specifically aimed at children. Storytelling systems that do have tabletop interfaces, such as Reactoon [2], TellTable [5] and StoryTable [13] are aimed at facilitating children's storytelling and do not incorporate intelligent agents as characters in the story.

Fig. 1. Children playing with the Interactive Storyteller (tangible version).

The story world of the Interactive Storyteller is inspired by the story of Little Red Riding Hood. It has three characters (Red, Granny, and Wolf) and five locations (Red's house, Granny's house, a forest clearing, a lake, and a beach). Possible character actions include moving between locations, talking to other characters, and baking, eating and poisoning cakes. The story world is represented visually on a multi-touch table, using a top-down map view, as shown in Figure 1. The map shows the characters, the locations (marked by light blue circles), and the paths between the locations.

To change characters' locations in the story world, physical toys representing the characters can be moved from one location to the next. The use of these tangibles is optional; we also developed a touch-only version of the interface with graphical representations of the characters that can be moved by dragging them across the table surface. Apart from the character representations, the touch-only version of the interface is the same as the tangible version.

Users can select non-move actions for the characters through a menu. Actions are carried out in a turn-based fashion. When a character gets the turn, the system determines which actions are possible for that character given the current state of the story world, and displays them in the menu.

When a character performs an action, this action is expressed using a simple sentence and narrated using Loquendo text-to-speech. The written sentences are

added to scrolls recording the story text. One of these scrolls can be seen in the bottom left corner of the table in Figure 1 (there is another one on the other side of the table). Spoken narration of the sentences provides the users with immediate feedback about what is happening in the story.

Because character actions are selected by the users via touch, and all actions are narrated by the system through both speech and writing, spoken communication between users is not strictly necessary when they are using the system to create a story together. However, our experiments with children showed that they did frequently talk to each other while interacting with the system, as illustrated by the transcripts shown in Section 1. In fact, the multi-user tabletop interface of the system was designed to stimulate such social interaction [1].

3 User Communication Annotation Scheme

In this section we describe the annotation scheme we devised to analyse the communication between the users of our system. It combines ideas from the work of Sawyer [9] and Fine [6]. A central notion for both is that of *framing*, a term that was first introduced by Bateson [4], and greatly expanded on by Goffman [7]. Frames can be seen as the organizing principles of experience, which define how messages should be interpreted within a communicative situation. Bateson's classic example is that of play-fighting monkeys: because the monkeys' bites are framed as 'play', they do not get assigned the same meaning that they would have in a non-playful context. The playful bite is metacommunicative in the sense that the act itself communicates that it should be taken as 'play'. Similarly, human activities such as children's pretend play are metacommunicative in nature: it is the communication that defines the play frame.

3.1 Sawyer: Blending of Frames

Given that our approach to interactive storytelling is closely related to children's improvised dramatic play, we first looked to work in this field for inspiration. Sawyer [9] categorizes metacommunication in pretend play along two dimensions: *frame* and *explicitness*, distinguishing four levels within each dimension.

Explicitness only concerns children's proposals to modify the play frame (i.e., change the story world). In the Interactive Storyteller this is done via the system, so we do not discuss this dimension further here, focusing only on frame. The communication's frame can range from in-frame (in-character) to out-of-frame, with two blended levels in between, as shown in Table 1. In the blended frames, reference is made to objects or events from the other frame.

Sawyer's notion that in-frame and out-of-frame communication are not wholly separated realms, but that they can be blended, is a useful starting point. However, we feel that Sawyer's scheme is insufficient for our purpose. In the Interactive Storyteller, unlike dramatic play, the children do not only interact with each other directly but also via the system, which provides a shared visual representation of a story world and external characters that can be controlled. This means

Table 1. Sawyer's annotation scheme for the frame dimension (adapted from [9]).

Level	Frame	Example communication
1	In-frame	Imitating voices, referring only to in-frame objects or events, e.g., *Watch out for the earthquake!*
2	Blended frame (in-character)	Speaking in-character, but referring to the world outside play, e.g., in a character's voice: *I need more blocks!*
3	Blended frame (out-of-character)	Speaking out-of-character about the play itself, e.g., *Let's say my guy was killed in the earthquake.*
4	Out-of-frame	Speaking out-of-character, not about the world in the play frame, e.g., *Let's play house now.*

there is a division between the story that is created during play and the play itself. Sawyer's annotation scheme for frames cannot account for this distinction, which means that a more fine-grained annotation scheme is called for.

3.2 Fine: Three Frames, Linked to Identity

Whereas Sawyer only distinguishes two basic frames, play and non-play (with blending between them), Fine [6] distinguishes three frames in his study of fantasy role-playing games. Each of the three frames is linked to a different side of the role-player's identity:

1. The "primary framework" of reality, with participants as persons in the real world;
2. The framework of the game, with participants as players manipulating their characters within the rules and constraints of the game;
3. The framework of the fantasy, with participants 'being' the characters that they play.

Interactive storytelling with our system is similar to fantasy role-playing, in that players assume the roles of characters in an imaginary world of which the setting is given, and do so within a (non-competitive) game context with certain rules and procedures. This makes Fine's frame structure suitable for our system. The interaction fragments from the introduction illustrate two of Fine's frames: the child as character in fragment 1 and as player in fragment 2. An example of a child's utterance in the primary framework is *He's still filming us!* referring to the video recordings that were made during our user experiments (see Section 4.1).

Fine observes that during the game, the players are constantly oscillating between frames, and that participants are "able to operate on several levels nearly simultaneously" [6, p. 240]. However, unlike Sawyer, he does not explicitly distinguish blended frames as separate levels.

3.3 The P×R Annotation Scheme: Perspective and Reference

In our opinion, both Sawyer's and Fine's frameworks are not fine-grained enough to capture the different types of communication that occur during interaction with our storytelling system and, presumably, other systems. However, we feel that the two can complement each other to allow for sufficiently rich annotation. Sawyer's scheme incorporates the possibility of blending, which is necessary because communication can be in one frame while referring to another frame. Fine's scheme includes a game frame, which is necessary to allow for annotation of communication about game play. Therefore, we combined Sawyer's and Fine's ideas to create a new annotation scheme that we call P×R. The new scheme includes Fine's three frames but also allows for blending between frames.

Table 2. The P×R annotation scheme, including shorthand notation for the different communication categories.

		Reference		
		Story	*Game*	*Reality*
Perspective	*Character*	*CS*: In-character utterances and imitations	*CG*: In-character references to game elements	*CR*: In-character references to events or objects outside play
	Player	*PLS*: Action suggestions and proposals referring to the story	*PLG*: Communication about game aspects	*PLR*: Including real-life events or objects in the game frame
	Person	*PES*: Observations about events that happened in the story	*PEG*: Observations about the interface, opinions about the game	*PER*: Communication about events or objects outside play

Our annotation scheme (see Table 2) is based on the notion that a user of an interactive storytelling system can take on different *perspectives* (P) toward different frames of *reference* (R). In other words, the scheme indicates which identity a speaker takes on (perspective) and what he or she speaks about (reference). We want to be able to annotate how a user relates to the story: as a character in the story, as a player controlling a character in the story, or as an observer of the story. These classes of utterances are captured by the CS, PLS and PES categories respectively. We also want to distinguish whether the user is referring to the story, the game or the reality. This is an extension of Sawyer's distinction between in-frame and out-of-frame references, with Fine's game frame as an added out-of-character level.

By combining the two dimensions of perspective and reference, we broaden the scope of Fine's categorisation, which would only allow for annotation of the classes on the diagonal of our scheme (CS, PLG and PER). A mapping of Sawyer's scheme to our own yields the following correspondences of our categories to his frame levels: (1) = CS; (2) = CG, CR; (3) = PLS, PLG, PES,

PEG; and (4) = PLR, PER. This illustrates our scheme allows for distinctions that Sawyer's cannot make.

As shown above, the P×R annotation scheme offers several refinements of Sawyer's and Fine's schemes. There are however some classes that are less intuitive, namely the CG, CR and PLR classes. A fictional example of a CG utterance would be a child speaking as Red about the game saying that *It's too bad I have to wait for Granny before I can do anything*, indicating in-character that she would have to wait for her turn in the game. Granny might also exclaim *Oh, Red, we are being filmed!*. This would be annotated as a CR utterance, as it is an in-character reference to an event taking place outside the story and game frames. Lastly, a PLR utterance (a user speaking as a player about the reality frame) would be one in which a user tries to incorporate an object or event from the reality frame (outside the game and story) into the game. For example, this would be the case when a user says that she can only go swimming at the beach when it is sunny outside (she introduces a game rule based on the reality frame).

4 Analysis of Children's Communication

In this section we describe the communication data to which we applied the P×R annotation scheme. We also describe the annotation process, and we present and discuss the results.

4.1 Data and Annotation

The communication data were collected in a small-scale experiment, in which four pairs of 8-11 year old children played with the Interactive Storyteller (see [1, 11] for details). All participants were pairs of siblings or friends. One child controlled the character Red; the other controlled Granny. Wolf was always controlled by the system. Each pair of children carried out two play sessions with the system, one with and one without tangibles (in a counterbalanced order).

At the start of each run of the experiment, the children were told that they could use the system to create a story, and the basics of the user interface were explained to them. Because we were interested in their spontaneous behaviour while interacting with the system, we did not give them a specific goal to achieve, nor did we ask them to talk or think aloud. The entire experiment was recorded on video, see Figure 1. On average, the play sessions lasted 12 minutes (min. 9, max. 14 minutes), amounting to almost two hours of play in total. All character actions (selected by either the children or the system) were logged, and the children's communication during the play sessions was transcribed.

Transcripts were segmented into utterances based on speaker turns, bounded by silence or speech by the other child or the system. When a speaker turn consisted of multiple utterances that should each be assigned a different label, the turn was split. This was done in only four instances; all other speaker turns were treated as one utterance.

All utterances were annotated by the first two authors, using the coding scheme from Table 2. First we carried out two practice rounds, annotating one and two play sessions respectively, and comparing and discussing the results to come to a shared understanding of the annotation scheme. The remaining five sessions were annotated independently (Cohen's κ: 0.74). As a final step, all differences between the annotators were resolved by discussion.

In total, 640 utterances were annotated. This number excludes those cases where we could not make out what a child was saying.

4.2 Results and Discussion

In Table 3 we show the annotation results. They are separated by session, because the children's first and second interaction sessions had different utterance type distributions.

We found some individual differences in communication between the pairs of children: Pair 1 talked more in character, Pair 2 talked more from a 'person' perspective, and Pair 4 communicated more in general than the other pairs. However, the overall image was similar for all pairs.

In their first sessions with the system, the children communicated more about the game, while in their second sessions they communicated more about the story. In both cases, they were mostly speaking from a player perspective. These findings may be explained by the fact that in the second sessions, the children were more familiar with the system's interface and its rules and constraints. This led to fewer discussions about, for example, turn taking or which locations were accessible to the characters (both annotated as PLG) and fewer comments on the quirks of the interface (annotated as PEG). In addition, by the second session they had discovered more of the things the characters could do in the story world, resulting in more mutual action suggestions and discussing plans for their characters (annotated as PLS). An example is the following exchange:

(3)
System [narrating action by Wolf]: Hello, says Wolf to Red.
Child 7: *You have to give him the cake!*
Child 8: *It has to be poisoned first.*
Child 7: *(...) I will do that, alright?*

That such PLS exchanges occurred more often in session 2 is in line with our findings in a previous study, in which we investigated the coherence of the stories created by the children [11]. In that study, we found that the stories created in the second sessions contained longer causal chains of events, thus showing more coherence. Another, very noticeable, difference between the first and second sessions is that the children generally talked more in session 2. This is probably because by the second session, the children had become more at ease with the experimental setting and thus talked more freely.

We also compared the utterance type distributions of interactions with the tangible or the touch-only version of the system. Here, the only remarkable difference in the children's communication was that the children more often

Table 3. The annotation results of the children's communication in their first and second sessions with the interactive storytelling system.

	Session 1 (230 utterances)					**Session 2 (410 utterances)**			
	Story	*Game*	*Reality*	Total		*Story*	*Game*	*Reality*	Total
Char.	6%	0%	0%	6%	*Char.*	7%	0%	0%	7%
Player	25%	32%	0%	57%	*Player*	36%	22%	0%	58%
Person	13%	23%	1%	37%	*Person*	15%	16%	4%	35%
Total	44%	55%	1%	100%	Total	58%	38%	4%	100%

took on a 'person' perspective with the tangible version than with the touch-only version. A possible explanation for this is that when the characters were personified as tangible objects, the children were more likely to see them as separate entities, and therefore identified less with them. On the other hand, exchanges such as the following (coded as PEG) show that the children did see the tangibles as representations of themselves:

(4) Child 1: *Oh, you are so fat as Granny! Granny is fat.*
Child 2: *[...] In reality, I'm really thin!*

As can be seen in Table 3, relatively little of the communication was carried out in character (CS; 6% on average). This is not surprising, because the design of the system did not particularly encourage it. As mentioned in Section 2, all character actions are narrated through speech by the system, in principle making it unnecessary for the children to add their own dialogue. Nevertheless, the children did speak in character to express story elements that were not available in the system, such as certain character emotions (*Oooh, I'm scared!*) and goals (*Especially for you, Red!* when baking a cake). In-character communication also frequently involved miming character actions such as shuffling, diving and eating, and expressing the characters' emotions through sounds and facial expressions.

We noted that in most PES utterances the children talked about their characters in the third person, while in most PLS utterances they used first person pronouns (*I am going to bake the apple pie*). Pronoun use is an interesting aspect to investigate further, as the users' choice of pronouns indicates how strongly they identify with their character, and, in general, to what extent they are engrossed in the activity [10].

5 Validity of the Annotation Scheme

In the previous section we showed that applying the P×R scheme to the children's communication data provided us with several useful insights. In this section, we discuss the scheme's reliability and examine its validity by viewing the results through the lens of the other frameworks. We also mention some points for improvement of the annotation scheme.

For the five sessions that were annotated independently (see Section 4.1), we computed an inter-annotator agreement of 0.74 (Cohen's κ), which indicates good agreement and thus reliability of the coding scheme. The only main disagreements between the annotators concerned utterances in which the players commented on the actions of Wolf, the computer-controlled character. One annotator coded all of these utterances as PES, seeing them as person-perspective observations on the story (specifically, Wolf's actions within the story). The other annotator coded several of these utterances as PLS, because they referred to Wolf as a fellow player of the game rather than as a character in the story. This is illustrated by the following conversation fragment:

(5)
Child 4: *Doesn't Wolf have any ideas anymore?*
Child 3: *Wolf is trying to think of a plan.*
Child 4: *Yes, but he can't do that because the cake has already been eaten.*

This disagreement was solved by coding all utterances of this kind as PLS.

With our scheme, we were able to pinpoint which perspective a user assumed and which frame he or she referred to. In contrast, as we argued in Section 3, both Sawyer's and Fine's annotation schemes only allow for limited annotation of communication in the context of interactive storytelling systems.

Sawyer's approach to in-frame and out-of-frame communication does not distinguish between player and person perspectives. With Sawyer's scheme, all utterances in our PLS, PLG, PES and PEG categories would have been annotated as level 3, as they are all out-of-character observations about the play (taken to include both story and game elements). Table 2 shows that in that case, 91% of all utterances would have been classified as level 3. This makes it clear that when using Sawyer's approach, we would not have been able to distinguish between the majority of utterances.

Fine's framework does not include blending between frames, which means that certain nuances would be lost when applying it to our communication data. This can be explicated by fragments 2 (coded as PLG) and 3 (coded as PLS). In Fine's scheme, the communication in these fragments would be classified as being in the context of the game and therefore as communication from a player perspective. Both fragments indeed show a player-perspective, but fragment 2 refers to rules of the game, while fragment 3 is about taking action in the fantasy world. In Fine's classification, the latter fragment's reference to the story frame could not be made explicit.

Compared to the frameworks of Sawyer and Fine, P×R gives a more fine-grained view of the users' communication by giving insight into both the perspective of the user and the frame that is referred to. However, with respect to certain classification categories the scheme could be said to be overly fine-grained. Of the categories for CR, CG and PR communication, only one instance was found in our data: a child's tangible prop was insulted out of character by the other child, and she reacted with being 'angry' in character. This instance, labelled

as CR, occurred in session 2 as only one of the 410 annotated utterances.[2] Although theoretically possible, we found no instances of either the CG or the PR categories in our data. Note that CR and CG correspond to Sawyer's frame level 2; it is unknown how often this category occurred in his pretend play data [9].

There are also some distinctions the P×R scheme cannot make. We observed that references to the story made from a 'person' perspective (PES) included utterances that were explicitly addressed to one of the characters, for example *Now, now Granny!* and *Bad Wolf!* These were coded as PES, because they were neither spoken in character nor from a player perspective. However, such utterances did show great involvement in the story: the children addressed the characters as if they were 'real'. This distinguished these utterances from other PES utterances that showed a higher degree of detachment from the story world, such as comments on the events in the story (*Now it's getting scary*) and on the characters (*Wolf is not very smart*), and cases where the children read aloud parts of the story text from the scrolls. The P×R scheme still seems not sufficiently fine-grained to capture these nuances. This, together with the finding that CR, CG and PR communication was lacking in the play sessions, encourages further research on our annotation scheme.

6 Conclusions and Future Work

The P×R annotation scheme proposed in this paper combines ideas from Sawyer [9] and Fine [6], leading to a relatively fine-grained coding framework that distinguishes two communication dimensions (*perspective* and *reference*) with three levels each, resulting in nine annotation categories. Applying the scheme to our communication data of children playing with an interactive storytelling system showed how the children's focus of attention shifted between the game and the story over time, and at what level they related to the story being created. Some of the categories specified by the P×R scheme turned out not to be used in the annotation, whereas other categories might still have been overly broad. This suggests that the scheme could possibly be further refined.

We believe that, with further refinement, the P×R scheme can be used to inform the design of interactive storytelling systems. It yields insight into the type of experience the users are involved in, revealing among other things whether users are mainly concerned with the story, game or reality frame. Future work could then look into how certain design decisions influence users' experiences. For example, the results could indicate which factors in an interactive storytelling system incite in-character behaviour (CS) (desirable for systems aimed at entertainment) and which factors incite more reflective behaviour from an out-of-character perspective (PES, PLG or PER) (useful for interactive storytelling systems with an educational purpose). In short, we expect that the knowledge gained by coding user communication in terms of our proposed P×R scheme could enhance the utility of interactive storytelling systems.

[2] As such, it made up only 0.24% of the total number of utterances in session 2 and was rounded to 0 in Table 3.

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