Are we telling the same story?
Balancing real and virtual actors in a collaborative story creation system

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Abstract

Interactive Drama applications aim at offering interactive experiences to the participants by empowering them with active participation and engagement in the development and solution of a story. However, introducing this interactivity leads to a natural conflict between the participant's freedom of interaction and the system's control, or, more precisely, the author's expectations in the development of the story. As such, favouring one over the other, leads to different experiences and perhaps even different genres. This balance has been extensively discussed amongst researchers in the community, and yet achieving such balance is still regarded not only as a challenge but also as an art itself. In this paper we discuss a system, I-Shadows that is an Interactive Drama based on Autonomous Affective Characters and Drama theory. In this system we tried to reach such balance through considering the storytelling experience as the "collaboration" that emerges from the real actors (the users) and the virtual actors (some Chinese shadow puppets). Supported by improvisation theory, our actors (shadows) act as if they are collaborating with the user in achieving the story. However, to achieve that, the virtual actors need to have an agent architecture that supports emotion reactions, goal oriented behaviour and social interactions. Aspects such as role taking, waiting for the right time to say their line, have a coherent personality, turn taking, and others, are considered in the minds of the virtual actors, allowing for this balance to be reached. Furthermore, and to complement this aspect of autonomy of the agents, the coordination problem between the actors is also helped by the presence of a specific agent (a story director) that allows for agents to appear or disappear from the scene of the story.
This approach was used in the construction of I-shadows, which, although not yet evaluated, has revealed its power.

Introduction

Improvising a story to an audience is perhaps one of the greatest challenges the actors pursue. Stand up comedy and Improvisation is regarded as a definite major test for actors. Further, when there is more than one actor, the improvisation needs to be done in cooperation, often posing other interesting difficulties. Each of the actors play at least one role and develop the story according to each character's personality and their perspective of the story development. However, how is improvisation going to result from these perspectives divergences? What happens if one of the actors does not respect the turn taking?

Interactive Drama systems that combine autonomous agents face this problem. In reality, if we see such systems as cooperation between the user and a system in the process of telling a story, this cooperation often leads to an unbalanced state between the user's expectations of the story development and the system's plans. One way of overcoming this problem is to limit the goals of each character and user according to the author's perspective of the story development. This approach has shown some good results [1][2], but it partially removes the creative influence of the user in the story development.

Approaches that allow for this intervention were made in Teatrix[3], where the user was involved in the set up phase that conditioned the rest of the story, and in the Interactive-Theatre[4][5] where agents were free to improvise their actions under the influence of the user. However, this influence was achieved at a very high level. These systems did not show enough flexibility to directly change an on-going story.

The use of autonomous characters as the one developed by M. Cavazza[6], has brought some flexibility to this research area, and the agents proposed by Aylett et.al.[7] allowed for more freedom of interaction to the users. Users interact with agents and stories emerge from this interaction.

In I-Shadows we are building a system that looks at the process as cooperation between the user and the characters, while the story is being presented to an audience. In this paper we present the foundations of this project as well as some preliminary results.

The paper is organized as follows: first we present the theories which support this work. Then, we briefly describe I-Shadows starting with a short presentation followed by some implementation details. A theoretical proposal to close the gap between the user and the characters is then presented and some details of the implementation of the

Characters and the Director agent are given. To finalize we present some preliminary results and main conclusions.

Foundations

A significant part of the research on interactive drama is strongly focused on the user interaction problem. The dominance of this problem is not without a reason. Users mess up the well grounded linear story, and interactive drama becomes to some extent a user interaction challenge. As a consequence the user is a critical element of the evaluation of such systems. The principles for evaluating the users' role in an Interactive Drama system are presented in Murray's three aesthetic categories [8]: Immersion, Agency and Transformation. Immersion is achieved when the user totally accepts the logic of the environment. Furthermore, and according to Mateas [9] this acceptance can be noticed when a player assumes the role of a first-person character in a dramatic story. Differently, Agency is defined as the influence that the user's actions might have on the unfolding of the story. Transformation is achieved when the combination of Immersion and Agency provide a unique users' experience each time he or she uses the system. [9][10]
One should note that there is a conflict between Agency and the other two categories. This conflict can be related to the conflict between the author's need to guarantee a safe story development, thus following a drama structure, and the Characters' and users' need to act autonomously.
The approaches taken to combine these categories always end up with a dilemma of choosing between reinforcing user's autonomy versus reinforcing characters' autonomy.
In our approach we are not interested in solving the problem or in taking any side in this dilemma. Instead, we are aiming at improving the communication between characters (that act autonomously in an interactive drama application) and the user, by combining them in a form of a collaborative task. A way to think about the combination of these two approaches would be to try to pass some of the structural knowledge of the play from the Author to the Characters.
As such, we seek inspiration in the work of improv theatre companies where the actors try to develop plays from an initial scene based only on pre-defined relations and their own creativity. The first major reference to his theatrical method goes back to Europe's Renaissance period when Comedia Dell'Arte troops travelled around Europe presenting plays based upon open narratives with well defined characters, and narrative structure. More recently theatre teachers such as Viola Spolin and Keith Johnston created new techniques that launched the growth of several Improvisational Theatre companies, such as Compass. Most Improv directors agree on the following basic principles for an improve actor's actions on stage:

- Always accept information given by others.
    - Otherwise we say the actor is "Blocking" the scene
- Always add history to the scene
- Scene Beginnings should be short and objective
- Enter, stay and exit scene with purpose
- Maintain character's point of view

According to Spolin "Improvisational theatre requires very close group relationships because it is from group agreement and group playing that material evolves from scenes to plays". This suggests that in order to achieve a successful interactive drama, the user must take part in this group relation.[11] [12]
Our research on interactive drama was inspired by this seminal works on trying to integrate the user in an affective environment, where he or she can interact with emotional characters that act like real actors adapting the play to what is happening. Relations are established between the user and the characters according to their roles in the story and a consistent emotional behaviour. It is from the richness of these interactions, where the user is immersed, that we expect to bring real interactive drama to life, with surprising but structured story developments.

I-Shadows

Description

The I-Shadows' installation was inspired by one of the oldest forms of theatre: Chinese Shadows Theatre. There are however some important differences: (1) in I-shadows a user is a puppeteer in the play (thus manipulating physically his/her shadow puppets), and (2) some of the characters in the play are automatically controlled by a computer system. The play emerges as a collaborative process between the user (puppeteer) and the system (I-Shadows). The system monitors the action on the screen using a vision component, and participates in it by projecting characters onto the screen. The drama emerges from the interaction between the projected characters and the users, that physically manipulate other characters' puppets.

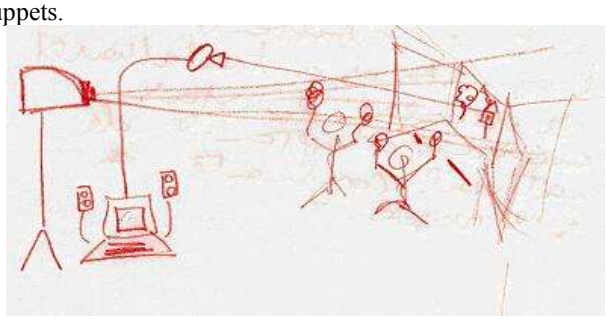

Figure 1 – I-Shadows installation

One of the goals of I-shadows is to provide an environment where children can learn how to create stories and act them

out in character, in front of an audience. So, we expect that the audience will be able to watch a play improvised by a child (or group of children) in cooperation with autonomous characters.
To contextualize I-Shadows in children's fantasy world, we found inspiration in the most common infant stories: Fairy Tales. The set of characters developed were based on typical fairy tales stories, thus including fairies, goodies, a boy, a girl, a witch, a dragon (among other characters), but with modern elements added to it (like cookies, houses, and others).
The challenges imposed by this project are numerous. Going back to the fundamentals of interactive drama, and in terms of Agency there are no severe restrictions on the actions of the user (a child's actions have direct impact on the story) as long as he or she uses his/her puppet. Immersion will depend on the level of cooperation achieved between the user and the system. Transformation is achieved if the user feels that this cooperation does not monopolize his own decisions.

Installation

The I-Shadows' installation merges the real world with the virtual world in the sense that the user, the real shadows and the screen exist in the real world (see Figures 2 and 5), but what is projected is a result of a virtual world, where the characters' shadows are controlled by agents' minds and decide upon the events of the story. In this paper we will mainly focus on the aspects of mind in the virtual world although some aspects of the user interaction in the real world are essential for the whole system.
The *virtual world* is modelled symbolically (using a tool-ION developed in GAIPS for that purpose) and has two main components: the Virtual Set which is a virtual representation of the real set that compounds all the active characters (all the characters in the scene, including an image of the real characters), and the Cast which aggregates all the inactive characters (characters that are ready to be used but are not on the scene). In the Virtual Set, the user (controlling one or more characters) decides on the actions to do, and those actions are captured through the vision system and transformed into symbolic representations, which are then symbolically represented. All the other agents acting in that virtual set perceive the actions of the others and act accordingly. To manage the transfers of characters between these two components there is also a Director Agent, that perceives the emotional parameters of the scene and decides which characters could or should enter the scene, thus moving characters from the cast to the virtual set, or the opposite, forcing characters to leave the scene, moving from the virtual set to the cast.

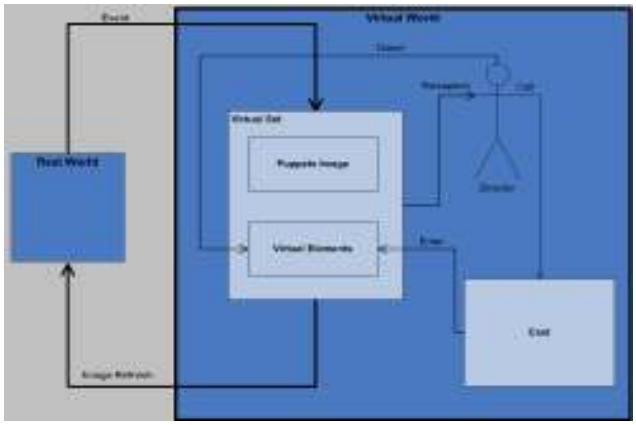

Figure 2 - High level architecture for I-Shadows

Closing the gap between user and characters

As mentioned earlier, our approach to Interactive Drama intends to achieve surprising and partially structured story developments. At a first glance, surprise and structure may seem hard to conciliate. One should note that there can be a big gap between the surprise added by the user's actions and the plans of the virtual characters. To try to close this gap we found inspiration in Freytag's Drama Theory.[13]

In 1863, Freytag defined the Freytag Pyramid and stated that drama (based on what he had studied) in general followed the same pattern of development along a variable that he called tension.[14]

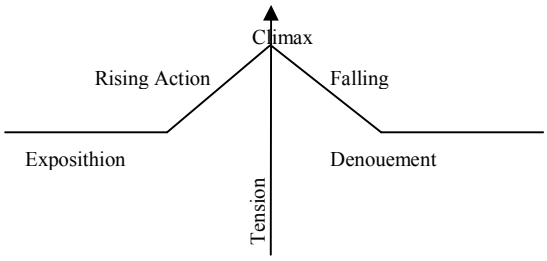

Figure 3 - Freytag Pyramid

Following the storyline from left to right, there are 5 acts. The Exposition provides the information about the environment, the characters and their relations. The Rising Action is the reaction to some negative events that are preventing the protagonist from reaching his or her goals. The Climax is a turning point, usually leading to a positive solution. The Falling Action brings everything back to normal. Finally, the Denouement is the conclusion of the story. From an emotional point of view we can somehow associate the story start with a positive mood, which then suffers a negative impact and ends with a positive conclusion. We call this process a Valence Loop, and it is this valence loop that we will try to create in the I-shadow episodes.
Note that tension is a direct consequence of the emotional mood of the play. Emotions with a high arousal such as

anger or surprise, will contribute positively to the increase of the tension. Using arousal and valence, we propose an emotional reaction model as a form of monitoring an Interactive Drama emotional state, which will somehow be the application of Freytag's storyline onto an emotional Valence vs. Arousal system (see Figure 4).

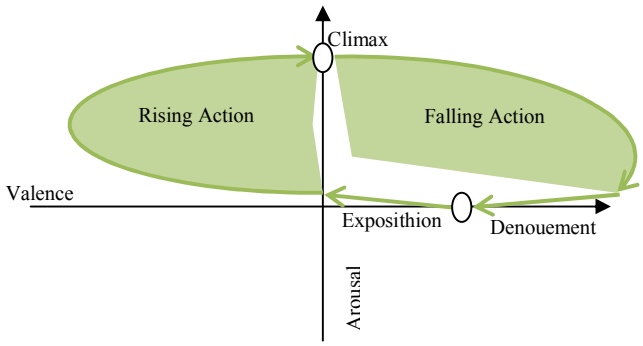

Figure 4 - Emotional Model for Interactive Drama

As such, the storyline would start with a positive mood when all the characters live peacefully, in neutral arousal. As the story develops someone or something subtly disturbs the peace (similar to the villainy function of Propp[14]). Once that happens, and the good and evil are identified, the villain will express his or her evil again but this time with enough impact to change the mood of the action into negative values. A hero will react to this (similar to the hero response function of Propp[14]), rising the arousal until the decisive moment of climax, when the valence of the story changes definitively and the villain's defeat seems inevitable. Then we will achieve the falling action, and there will be a return to normality, ending with the denouement.
Using this model, while capturing the emotional state of the scene, our system should be able to identify at which moment of a storyline the interactive drama is, and decide how to intervene in order to guarantee a story development around the proposed storyline. At the same time, the system guarantees that the pace goes in a way that promotes the collaboration between the story intervenients (users and autonomous characters). Since our goal is to let the story emerge from the relations between characters, the intervention in the action will include telling characters to enter or leave the scene, as well as sounds, and indications to the actors of what direction to take. To sum up, the proposed model adapts to the user's actions, not only through the interpretation of some patterns of behaviour but also through the adjustment of the storyline as the emotional state of the story progresses.

The Characters in I-Shadows

Based on the preference demonstrated by our users in Fairy Tales stories, both the behaviour and the body of our characters are inspired by this type of stories. The next three sections present the implementation of two kinds of characters: Real Characters manipulated by the user and Virtual Autonomous Characters implemented in our system. The Director aims at conciliating both the Real and the Virtual Characters' perspective in the story development.

Real Characters

Real Characters are puppets manipulated by the user that are detected by the system using a vision component. The algorithm that interprets the movements of these characters including their emotional expressions was developed in close collaboration with children from a local school (the training of the component was done with stories created by the children).

Figure 5 - Real Characters (Puppet)

The design of these characters was also influenced by them. In early acceptance tests, users were invited to express their opinions upon each puppet's shape, colour, size and personality. The results of these tests were several puppets accepted by the users in their imagination and in their stories. More information about this work can be found in [16].

Creating Autonomous Virtual Actors

Based on the proposed model, I-Shadows implements a very rich cast of characters, with appropriate actions and an emotional behaviour. To achieve this emotional behaviour we are using an OCC based architecture (FAtiMA)[15] developed at GAIPS, for the minds of the characters and director (Agents).
Each agent in the world (the character) perceives the environment through a set of sensors (allowing the perception of events, objects, etc. in the world) and acts within the environment through its effectors.
In order to achieve believable and expressive agents, their behaviour is influenced by their emotional state and personality. FAtiMA models emotions based on the OCC cognitive appraisal theory of emotions, where emotions are

defined as valanced (good or bad) reactions to events. Whenever the agent receives a perception, the agent appraises its significance and triggers the appropriate emotions. Additionally, if a goal becomes active, it will add a new intention to achieve the active goal in the agent's mind.

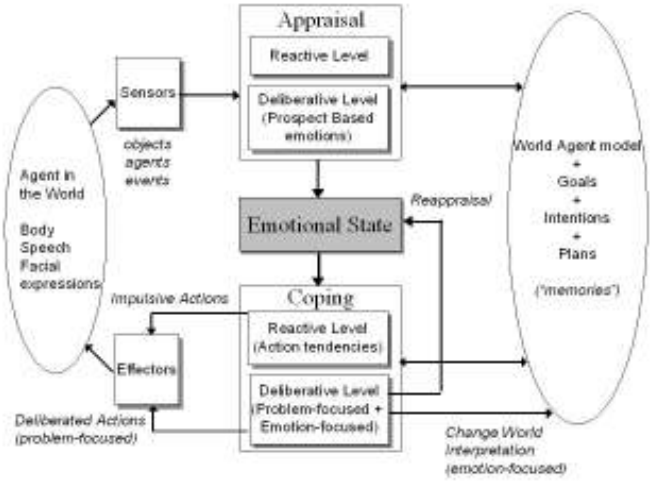

Figure 6 - Goals Implementation

The agent's mind architecture is shown in Figure 6 (taken from [15]). Given the several components that constitute such minds, for each agent built (thus, for each autonomous actor in our cast), the author needs to define a set of elements that includes among other things their goals and action tendencies that can be triggered by a particular emotional state of the agent. These action tendencies represent the character's impulsive and hardwired actions which he performs without thinking (reactive actions), and are implemented according to each character's personality.
Using this architecture we were able to create different types of characters for each "physical shadow". The FAtiMA architecture provides a framework to start authoring these characters using emotional behaviours, because it guarantees its consistency with the character's emotional state and personality. Furthermore, the relations between characters can develop dynamically along the story development and influence their behaviour. Using FAtiMA, the implementation of reactive behaviours and emotionally influenced behaviour is quite straightforward. The authoring process of these characters consists in four steps: Identifying the Characters and their Domain Actions, Defining their initial Relations, Defining their Action Tendencies (emotionally triggered actions) and Defining "Personality". This last step includes defining each character's goals and emotional reactions to external events. In addition to this, in order to allow for an even more emergent behaviour we created two new concepts at the implementation level, Meta Goals and Activation Actions.

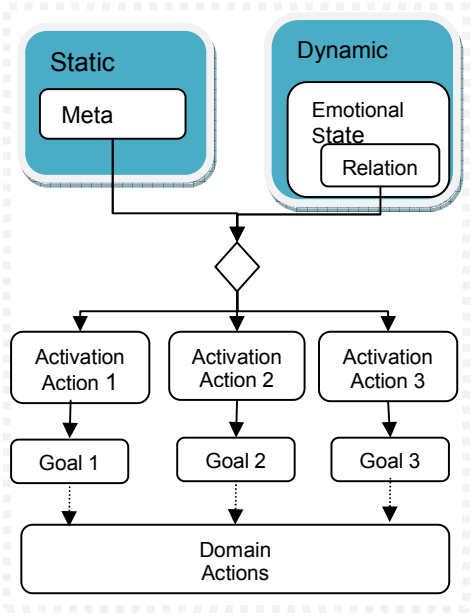

Figure 7 - Goals Implementation

This implementation allowed us to separate two kinds of goals for our cast: the "meta goals" that represent intentions at a high level such as "Show Love" or "Show Hate", and the dynamic ones, which, combined with the emotional state of the character (including interpersonal relations), use Activation Actions to activate the respective Goal using the common domain Actions.
The relations between the characters are established according to their roles in the story. The following example shows the initial relations of a Princess with the other characters. Each relation can be quantified dynamically in a [-10, 10] range, where "-10" represents a very negative dislike relation, and 10 represents a strong like relation.

For example, let's consider that Mary (a girl shadow) is a princess and victim. The example below shows that the princess starts acting with a small love relation towards the Hero, but as this relation is not static, it will evolve according to her emotional reactions to the actions of the Hero.
To sum up, we considered that, although our agents should act autonomously, to achieve different personalities and guarantee a rich cast of actors for the same role we needed to manage the emotional "parameters" (and thus the personality) of each character. By manipulating the values of activation and decay of emotions, it was possible to build for example, a hero that easily falls in love, or a hero that likes to be a lone ranger.

```
<Relation target="Donor" like="-2"/>
<Relation target="Hero" like="2"/>
<Relation target="Helper" like="-2"/>
<Relation target="Villain" like="-0.5"/>
<Relation target="Candy" like="2"/>
```

Figure 8 - Princess Relation

Director

As said before, the emergence of a story with several autonomous entities, our cast and our users should result if the process of acting and reacting is collaborative in essence. For example, an agent waits for another agent to perform its actions before it says its own line. This is guaranteed by the agent's minds. However, there are other elements in this collaborative process that are beyond the autonomous behaviours of the actors: for example, when a character from the cast is brought into scene. To control such type of emergence we have developed a "director agent" that controls the whole interactive process to keep the tension values proposed previously. Although it is still being implemented, this component is responsible for collecting all the affective information produced by the characters, specially focusing on the emotions of the hero and the victim. Based on this information and on its knowledge about the characters' relations, it chooses between: sending a message to a character in the cast telling it to enter; sending a message to a character on the scene to leave; or not performing any action for the moment. The entrance and exit of characters will have an emotional impact on the characters' relations, thus influencing the drama development. With studies performed with children collaborating in this story construction, this type of action (managing the appearance and disappearance of the characters) was very regularly used. In the future we expect to augment the repertoire of narrative actions done by the Director.

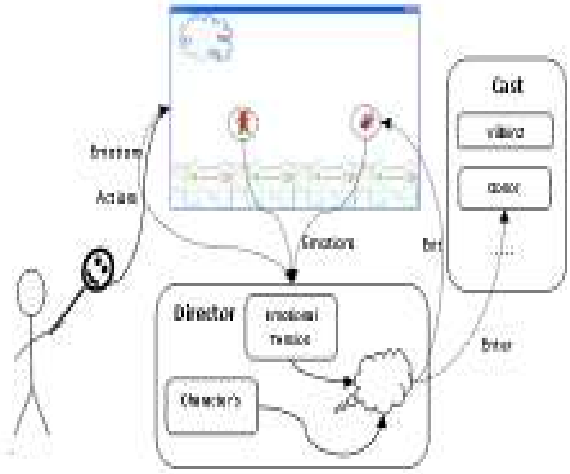

Figure 9- The director influencing the cast

Preliminary Results

So far, we have shown how we approached the construction of a narrative drama application, where stories emerge as a collaboration process between the users and the agents. To achieve that, we gave the agents a rich set of behaviours supported by an agent architecture that allows for affective and social behaviour.

The authoring process of I-Shadows combined elements of acting and fairy tales (by creating heroes, victims, or villains) and of acting itself. As the system was designed as a close collaboration between children and teachers, some good results in terms of expression detection and emotion expression were achieved.

The following example illustrates some elements of this process, with an interaction between a Princess and a Hero. Consider that the Princess loves the Hero with an intensity corresponding to the initial value shown above. When she sees the Hero, a Show Love intention is activated by the Show Love meta goal (built into its mind).

According to her emotional state, the Princess decides that the way of Showing Love for the hero is to offer him a Candy. This action generates a Joy emotion in the Hero that triggers a Smile.

Figure 10 – Princess feels Hope of Showing Love

The Hero's smile is appraised by the Princess as a positive action. This appraisal has a positive impact on the relation with the Hero. As a consequence, the next time the princess intends to show love she will consider a more intense relation with the Hero that will activate a kiss intention.

Figure 11 – Change in the Princess's relation

Figure 12 – Hero's emotional state

Figure 12 shows the actual hero's emotional state after failing to defend a Victim. The hero was in a very positive mood because of the joy he felt when the victim expressed her love for him. Suddenly the villain hits the victim. The hero appraised this event as a very negative action, and felt disappointed, this appraisal generated resentment and reproach towards the action and towards his subject (Villain). As a consequence of these events, his "Like" relation will decrease towards the villain and will increase towards the victim. And because of this he will try to protect the victim the next time. Figure 12 shows the hero's emotional state after defending the victim. This time the hero succeeded in defending the victim and had a positive feeling of satisfaction.

Conclusions

This paper argues that, to achieve interactivity in interactive narrative systems, we can regard the story construction as a collaborative process between users and characters. However, for that to be possible, the characters need to have a role and be autonomous enough to decide what to do at a certain instant. In the paper, we have described the construction of such type of autonomous agents using an emotional architecture based on FATiMa. This development was done in the context of the I-Shadows system, an interactive drama where the user is free to act in the physical world by manipulating shadow puppets.

The stories created are a result of the actions of the user and the actions of autonomous characters. Furthermore, supported by theoretical groundings in interactive drama and the role that the proposed emotional model has in achieving interactivity, we have built a Director agent that somehow coordinates parts of this process (based on that emotional model).

Authoring characters using FATiMa is not easy due to the lack of a real methodical authoring approach for building agents for interactive narrative. A character-centred approach needs to be followed, and that is often difficult to do. Characters are acting according to their roles and have dynamic relations, and it is these roles and relations that need to be captured in the agents' minds. Although the results are so far positive, we believe however that, to really obtain a good play, the characters need to be further improved. Moreover, we expect to start evaluating the system with children very soon and evaluate the degree of collaboration achieved between the children and the system.

Acknowledgements

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