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3D Simulated Interactive Drama for Teenagers coping with a Traumatic Brain Injury in a Parent

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Abstract. This paper describes the current state of a pedagogical immersive 3D story TBI-SIM and the changes that have been made to it. The system is a narrative simulation in a fully immersive 3D world in which the user controls a character that can interact with non-player characters (NPCs). The users achieve goals and make decisions that have an impact on the course of the story.

Keywords: Interactive Drama, Interactive Narrative, Pedagogical Interactive Drama, Pedagogical Narrative Simulations, Educational Games, IDtension, Traumatic Brain Injury.

1 Context

1.1 Traumatic brain injury

Children and adolescents undergo a dramatic change in their family life if one of their parents has a traumatic brain injury (TBI). Interactions among family members change rapidly and, often, for the worse; and new responsibilities are thrust upon the child or adolescent, who may be overwhelmed by feelings of guilt, anger or helplessness [2,6].

Our research project aims to develop and deliver educational material to youths faced with TBI of a family member. Based on testimonials we obtained through focus groups and interviews with families, we developed scenarios of everyday situations in an imaginary family in which members have to cope with the father's TBI.

1.2 Techno-pedagogical environment

The *IDtension* interactive drama engine has been used to implement the scenarios [9]. They are then displayed on the *Unity* game engine [12]. By playing a virtual character involved in short pedagogical stories (with a few goals to achieve), users experience different kinds of behavior. The experience of both usual and unusual situations in a safe simulation environment can be a good basis for further exchange in a real or a virtual focus group, or for therapeutic sessions with a psychologist. The 3D simulation that we developed provides an immersive interactive environment that readily engage users [3,4]. Engagement is reinforced by the narrative nature of the user experience, which focuses on relevant and striking situations, instead of simulating scientifically social relationships within a family.

IDtension [9] is the underlying drama engine used to generate narrative actions, which does not rely on any branching or conditional branching mechanism, but generates appropriate actions on the fly, based on narrative rules and algorithms (see [9] for a full description of the engine). As a result, the engine enables a large number of choices, which differentiates the current demonstration from most pedagogical narrative simulations (e.g. Heart Sense [7], Carmen's Bright Ideas [5], FearNot [1] or Scenejo [8]). This larger number of choice aims at providing a greater engagement to the user.

The system described in this paper is an improvement over an earlier demonstrated version [10]. Changes covered in this paper are about the scenario, the text-to-speech integration and the end-user interface.

1.3 The scenario

This demonstration presents the third version of the scenario. The user plays the role of Frank, a 16-year old teenager living with his parents, his younger sister, and his grandmother. His father Paul had an accident some years ago and now suffers from frequent mood changes, memory problems and socially inadequate reactions. At the beginning of the scenario, Frank is at home with his father, his sister Lili and his grandmother Olivia. His mother Martina is still at work. She asked him to prepare the dinner. But Paul has forgotten to buy what he was

supposed to buy earlier at the supermarket. Frank has to find a solution. During the scenario some other events like the visit of a friend, a phone call from Martina, Paul's mood changes, etc. modify the flow of the story and hinder Frank's efforts to reach his main goal: prepare dinner. These events can lead to new goals to achieve like giving his medicine to Paul.

In this version of the scenario, events pop during the experience to disturb users. In the previous version of the scenario, there was only one main goal to achieve, that is, to welcome Frank's school friend Julia and give her book back, which started always at the beginning of the game. While trying to do that we had to stop Paul from drinking alcohol, which constituted the only event. Now, with the latest version of the scenario, we have no predefined event at the beginning of the game but one main goal to achieve, to make dinner. Random events will start to run to complexify the simulation while we try to make dinner.

2   Technical implementation
2.1   Unity and IDtension

The real time 3D engine, *Unity* [12], was chosen to develop this learning game. The 3D environment and the user interface are implemented via scripts written in *C#*. *Unity* allows compiling the project on several platforms with the same code. The project is mainly compiled to the web version to allow online access without installation.

IDtension [9] is the drama engine that dynamically generates all dialogs in the game. Narrative components of the scenario are written in XML files and *IDtension* translates them into different situations that make up the user's experience. *IDtension* is *Java*-based and can be deployed on several platforms.

For the Internet-accessible version, The *Unity* scripts are compiled on a *Linux* server where *IDtension* is also hosted. Both programs communicate via sockets. The project is accessible via a web page that launches an execution of *IDtension* for each user.

2.2   Text to speech

In this prototype, the characters can talk. The use of recorded human speech, as in *Façade*, would have created high quality dialogs, however, it seemed to be not feasible for our project because of the high rate of all possible dialogs. Even techniques for assembling small parts of dialogs together would have required a huge amount of recording that we could not afford within the scope of the project. Therefore, a text-to-speech technology was introduced.

We chose "Natural Voices" technology from AT&T because it was the only one that contained enough voices for all our characters for the sake of the project. Nevertheless, we are open to adopt another text-to-speech technology in the future to include emotional variations and more languages (French in particular).

Text-to-speech technology allows us to use sentences generated by IDtension and to transform them into a sound file on the fly that is loaded by Unity and that is attached to the character who speaks. Since Unity supports 3D-sound, the volume of dialogs changes according to the distance between Frank and the speaking character. The version presented in this demo is fully voiced by "Natural Voices", using male and female voices that speak in American English.

3   User experience
3.1   Navigation

The scene takes place in a specific part of a house including the kitchen, the living room and the entrance. We replaced each 3D model of *TBI-SIM* (except characters) with a low polygons model to produce better performance and to maximize compatibility with old computers.

Physical navigation can be performed in two different ways. The most common way of physical navigation consists in using arrows on the keyboard and/or mouse to move the character, as is commonly done in many videogames. The second navigation system is more immersive, as it uses a large projection-based screen and a *Wiimote*, with users standing in front of the screen.

3.2   Interaction mechanisms

When users approach a non-player character (NPC) they can see the character's portrait appear at the top center of the screen to show the current addressee (see figure 1). Then, users can interact by pressing the action

key ("Enter" on the keyboard or "A" with the *Wiimote*) or by clicking directly on the addressee's portrait. This two-step interaction avoids a possible long list of choices that may appear each time the player character walks to another character. Alternatively, users can click directly on the character. A transparent window then appears and lists all the actions the user can undertake with this character.

NPCs in the scene have an "idle activity". "Idle activities" are behaviors that characters perform when they receive no action from the narrative engine (like talking to another character for example); they help to give life to the simulation. An "Idle activity" can be someone sitting on the sofa and watching the television. While the user is interacting with a NPC (i.e. when the user is choosing among different options with him), this NPC cannot move anymore and his "idle activity" is disabled as long as the user is interacting with him. If this NPC needs to execute a behavior as part of a narrative action (sent by the narrative engine), it will start this activity, but the user will be able to launch an action with him, since the player character has priority over all behaviors (except the ones he is already involved in). It means that Frank can stop a dialog between two NPCs to start a behavior with one of these NPCs.

In early versions of TBI-SIM, interactions were possible only between two characters (between NPCs or between Frank and a NPC). For example, at the beginning of the scenario, users could talk to Olivia and ask her for a solution to prepare dinner. She might have answered that food was in the fridge for dinner. Then, the user had to interact with Olivia again to be able to open the fridge. Now direct interaction with objects is also supported, in the same way users interact with characters. This integration of interactive objects in the 3D simulation makes it possible to enrich the scenarios, generate higher levels of coherence, and better approximate real-life settings. In the current state of the scenario, the user can interact with a few objects like: the fridge, the television, a chair, Paul's medicine or the broom.

3.3   Action selection and execution

To design a user interface (UI) for an interactive drama is challenging. The UI needs to offer many possible choices (e.g. 10-15), while remaining unobtrusive, in order to favor immersion. Furthermore, the user risks being overwhelmed by parallel dialogs intervening between non-player characters.

Figure 1: The user interface when interacting with a NPC

While usability issues have not been entirely solved, several changes have been made to improve the demonstrations' usability and immersive quality.

First, the portrait of the current addressee ,is only shown during direct interactions with another character instead of a blank portrait being displayed when there is no addressee, which reduces visual clutter. At the same time, the number of possible actions is now displayed inside the portrait (see Figure 1) in order not only to highlight the specificity of such a learning game (number of choices) but also to allow users to anticipate the possible length of the list of choices that they might be faced with when clicking a portrait icon.

Second, in the list of choices displayed to the user when interacting with a NPC, the choice have been made easier by changing the order of actions. On the top are displayed actions that the narrative engine considers as more relevant at the time of interaction, leaving less relevant actions at the bottom. Relevance is a criterion that is calculated by the narrative engine to score and rank actions for both NPCs and the player character. It measures the fact that an action is more or less relevant in the context of the previous actions, for example, a question is relevant if it follows the corresponding question (see [9] for details). This type of ordering is based on the ergonomic principles of guidance: we estimated that the user would select preferably the most relevant actions, so we put them at the top . If not satisfied with the top choices, the user can browse other actions and choose another option. Other ordering could be experimented, too. Further research would be needed to assess the pedagogical and ergonomic value of such different ordering options.

Third, the dialogs in which Frank, the main character is involved, are now clearly distinguished from the dialogs between non-player characters (see Figure 2). In the previous version of TBI-SIM, all dialogs were shown in the same way, including those that didn't involve Frank. In the current scenario, it was observed that NPCs dialogs were of lesser importance than Frank's dialogs and they created some confusion in parallel dialogs. Consequently, they were made smaller to be distinguished. By this method, users focus on Frank's dialogs when both occur at the same time. Moreover, when Frank turns his back to NPCs who are talking with each other, their dialogs are hidden (But can still be heard in the voiced version). Dialogs involving Frank take the whole width of the screen and are always displayed at the bottom (Contrary to NPCs dialogs which can be hidden).
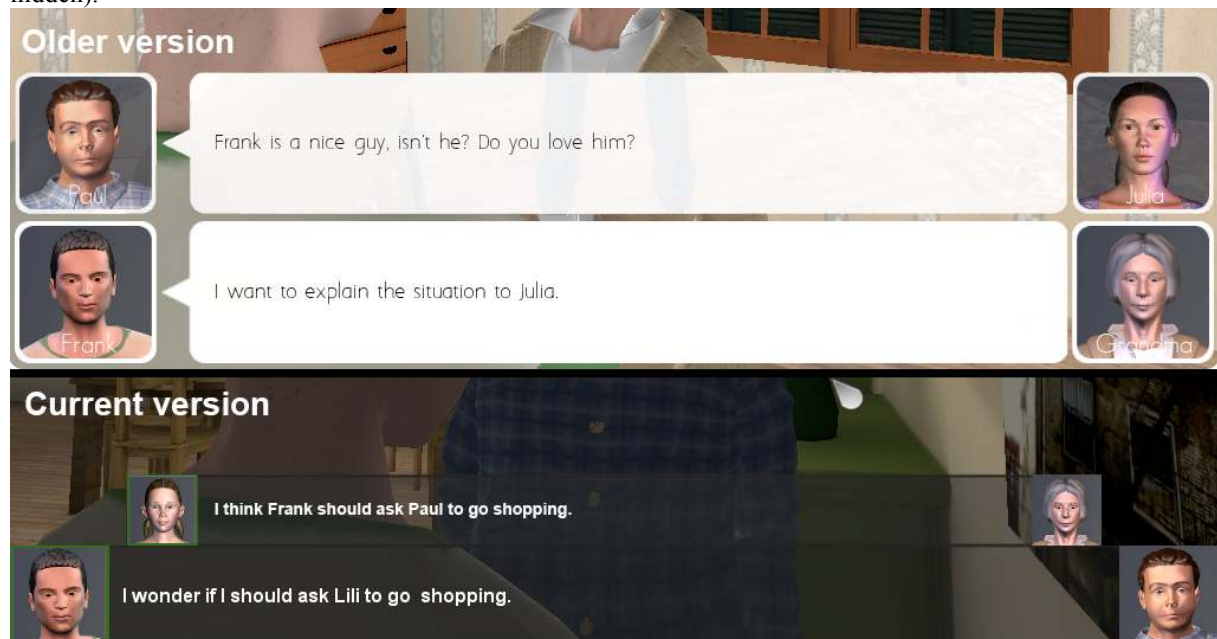

Fig. 2. Comparison between the older and the new dialog system

3.4   Resulting experience

The interactive drama starts with an introduction to the story and various help screens that the users can consult or skip. Then the users navigate in the room and interact with the present characters to make the story move in one direction or the other, as illustrated in Fig. 3. Playing an entire story lasts about 15-20 minutes.

On a preliminary test with 38 users, on average, 22.6 distinct options were available whenever the user was making a choice. This largely exceeds what the authors could have reasonably written. This was achieved with a scenario containing 35 goals (but note that the number of choices does not solely depend on the mere size of the scenario, but also on its structure).
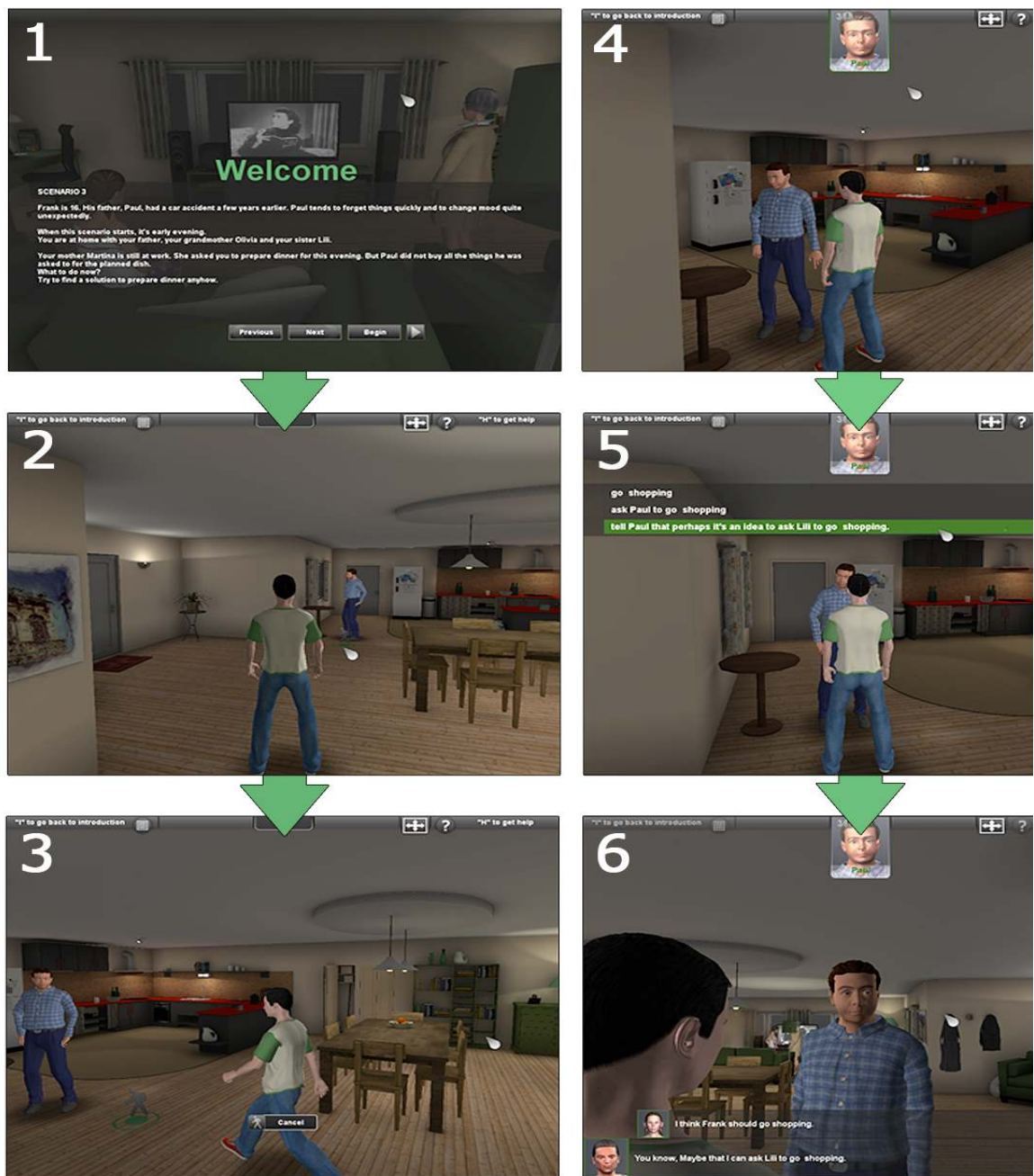
Fig. 3. Series of screenshots illustrating the user experience. 1) The game introduction explaining the starting situation and the main goal. 2) The user controls Frank with keyboard arrows or clicking on the ground or on a character. 3) Following a click, Frank moves to the desired location. These movements can be cancelled at any time. 4) Paul's portrait appears, Frank can interact with him because he is within distance. 5) By clicking on Paul's portrait, a list of actions appears. 6) A dialog between Frank and Paul has started. At the same time, two NPCs are discussing together, because the engine has launched two actions in parallel.

4   Conclusion and future work

The *TBI-SIM* demonstration constitutes an example of a fully implemented interactive drama that can be accessed online. Carried out by a plural-disciplinary team (Artificial Intelligence, computing, graphical design,

writing, clinical psychology), the project has produced a succession of prototypes aiming at delivering a novel, engaging and pedagogically relevant experience to the user.

The benefit of the product is currently under investigation. An evaluation of the user experience based on the IRIS evaluation scales [11] will be conducted with approximately 30 users,. Furthermore, the participants will fill a specific questionnaire regarding the perceived relevance and usefulness of the experience.

An early version of this demonstration was presented to a general public audience in May 2012 in the 100th anniversary celebration of the faculty of psychology of the University of Geneva. About 40 people played the game in its immersive version without voices. Children and young adults where particularly attracted by the simulation and expressed curiosity and interest.

Beyond evaluation, possibilities of improvements over the current version are numerous. First, we plan to improve the communication from the game engine (Unity) to the narrative engine (IDtension) so that an obstacle (a key narrative element in IDtension [9]) could be triggered by the physical environment. Second, we plan to integrate a behavior engine to facilitate the authoring of characters' behaviors. Third, the dialog engine can be improved. In the current version, generic sentences are used for some narrative action types (e.g. Encourage, Congratulate), which is powerful. However, in some cases, the use of specific formulations would be more appropriate to provide a well-written dialog. Fourth, we plan to add the functionality of *scenes*: A scenario unfolds through several scenes that occur possibly at different locations, with ellipses between them. The challenge is to generate and trigger these scenes dynamically. Fifth, we will investigate multi-party interaction and the computation of the visibility of actions between characters as well (e.g. the computation of what characters learn at the narrative level from what they perceive at the physical level). Sixth, in order to facilitate authoring, we plan to add the possibility to access and modify authoring files on the fly during the execution of a scenario.

Acknowledgments

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