Usage guidelines

Technology-enhanced role-play for social and emotional learning context – Intercultural empathy

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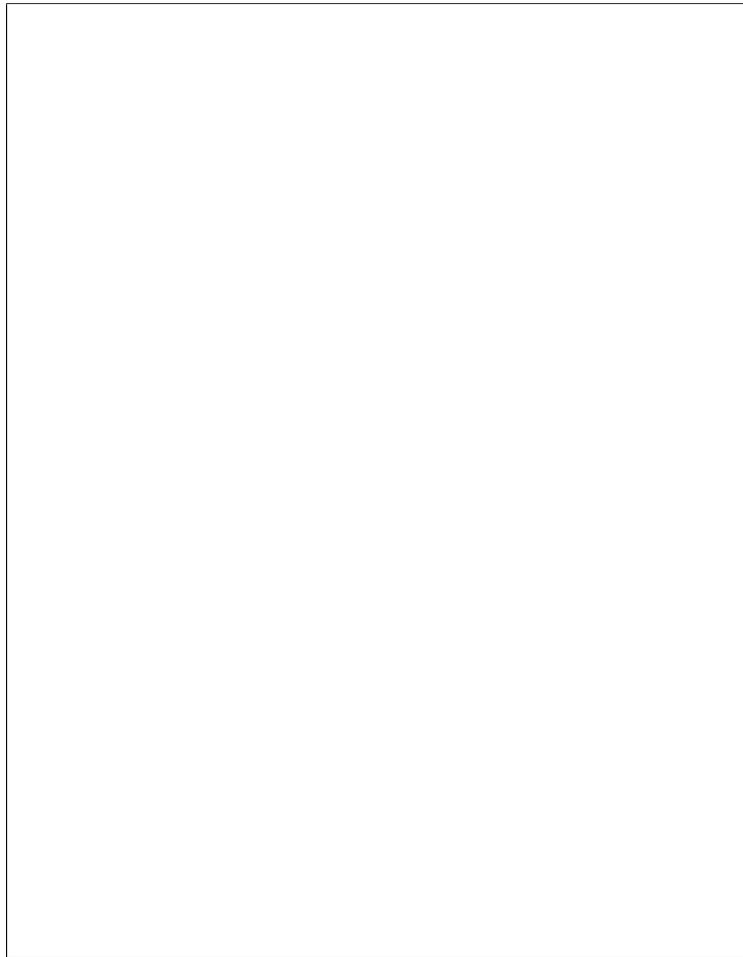[e] School of Computing and Technology, University of Sunderland, UK
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ABSTRACT

Role-play can be a powerful educational tool, especially when dealing with social or ethical issues. However, while other types of educational activity have been routinely technology-enhanced for some time, the specific problem of supporting educational role-play with technology has only begun to be tackled recently. Within the eCIRCUS project we have designed a framework for technology-enhanced role-play with the aim of educating adolescents about intercultural empathy. This work was influenced by related fields such as intelligent virtual agents, interactive narrative and pervasive games. In this paper, we will describe the different components of our role-play technology by means of a prototype implementation of this technology, the ORIENT showcase. Furthermore we will present results of our evaluation of ORIENT.

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1. Introduction

Drama and play have been used for education for a very long time [9] and have resulted in game-based educational approaches. These provide a means of overcoming real-world social restrictions, placing the player in a role that may or may not be socially acceptable in real life, such as a medical doctor or a thief. Games allow the player to escape into fantasy worlds, encourage exploration of exciting things, people, and places that are otherwise inaccessible in the real world, inducing a 'suspension of disbelief' in the player. Learning often takes place while the game is played, with immediate feedback. The subject to be learned is directly related to the game environment where constant cycles of hypothesis formulation, testing and revision are evoked as the player experiences continuous cycles of cognitive disequilibrium and resolution.

This paper explores an approach to an educational role-play (RP) game developed in the ORIENT showcase of the eCIRCUS[1] project, employing innovative technologies to foster social and emotional learning in the adolescent age group. With globalisation, dealing with cultural difference and diversity has become a widespread task and is both challenging and enriching. Several studies show a coherence between experiences of discrimination and mental stress, lower well-being and symptoms of depression [47,35]. Beside risk factors, protective factors need to be regarded and developed. Although several international preventive approaches for social integration of underage migrants already exist [45], ORIENT will add an innovative approach.

Acculturation is defined as a long-term, complex, multidimensional process with the aim of participation in the society of settlement; it is initiated when individuals and groups are in permanent contact with another culture and it leads to a change of the original cultural pattern of both groups as a consequence of persisting contact [5,6]. Determinants of integration are to be found on the societal level, on the level of subgroups in society, and on the individual level. Individual characteristics that influence acculturation (as tackled through educational software like ORIENT) are:

- *Prior to acculturation:* age, gender, education, motives for migration, cultural distance.
- *During* acculturation: language skills, attitudes, coping resources, social support/discrimination, prejudices.

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In looking for ways to help the process of acculturation of adolescents from immigrant backgrounds, there were a number of reasons for not focusing on them directly. Firstly, they form a heterogeneous group with a multitude of cultures and languages. It would be infeasible to try to capture all these in a computer-based system. Furthermore, acculturation is a two-way process in which both the incoming group and the host group have to negotiate a common understanding. It was therefore decided to focus on the host group, and to foster intercultural sensitivity through the development of intercultural empathy. This seems particularly necessary where the public discourse is often so hostile to incomers. By increasing the social and intercultural competence of the host adolescents, ORIENT aims at diminishing discrimination and hence lowering the mental stress of peers from a migration background.

ORIENT's role-play relies on the stages of Intercultural Learning proposed by Grosch and Leenen [16] and on the Levels of Intercultural Sensitivity proposed by Bennett [3,4]. We focus on the exploration of another (virtual) culture and on the reflection of similarities and differences between the own and the foreign culture – relate to a subset of Bennett's stages: acceptance and adaptation. ORIENT should lead the learners to understand how to explore a culture and to understand that thoughts and feelings are culturally driven.

Through role-play, new schemas representing attitudes and actions will develop within the host adolescents as they act out new roles [26]. Role-play thus supports experiential learning emphasising the importance of a direct encounter with the subject of study "rather than merely thinking about the encounter [with the subject], or only considering the possibility of doing something about it" [7]. ORIENT offers a virtual role-play environment inhabited by autonomous artificial agents that interact with and react to a group of learners. Within this artificial context, new elements of behaviour can be performed without causing conflicts with existing behavioural schemas – behaviour is not demonstrated in reality, but under "as-if" conditions in a secure environment [25]. The testing of new behavioural strategies is immediately followed by feedback from the virtual environment serving as a source of information for the learners about the appropriateness or suitability of their actions. Hence, learners can collaboratively improve their perception of and alter their emotional reactions and attitudes to members of other cultures, while interacting with the virtual environment through a set of engaging and immersive interaction devices.

The rest of this article is organised as follows: we start by reviewing related work in pervasive games. This is followed by a description of the game, ORIENT, focusing on the background story, the current prototype and the cultural element. Section 4 provides a description of the system components while Section 5 details an example scenario in the game. Next, an evaluation of ORIENT is presented in Section 6 including the methodology, aims, results and discussion. Section 7 concludes the paper.

2. Related work

Pervasive gaming takes virtual narrative elements out into the real world, focusing on introducing game elements into the everyday life of players. They exploit interaction devices such as handhelds to display virtual world elements [2] and employ technology support through which human game-masters can exercise higher amounts of control over the game experience [42]. The enhanced reality live role-playing of the IPerG project, in the area of pervasive games, has successfully carried out a number of pervasive games in real spaces [34]. These focused on the idea of linking the real world into the story world [43], through for example, using unwitting inhabitants of the real world as props for pervasive game

players. Some other groups have also produced educational pervasive games. Virus [8] is a game in which learners take on the role of a virus and transmit it via specially-designed mobile devices called Thinking Tags by getting within proximity of other users. This demonstrated a complex disease-propagation algorithm in a real world setting. In Paranoia syndrome [19], learners can take on the roles and skills of a technician, doctor or scientist. The Virtual Savannah [2] took child learners out of the classroom setting and through the use of handheld devices made it possible for them to view their school playing field as a Savannah on which they role-played lions. A more recent and more problem-oriented role-play, the Environmental Detective [27] used a whole university campus as its story-world, while artistically oriented pervasive games such as Uncle Roy All Around You and I Can See You Now [2] have used whole cities as the game environment.

The use of large-scale real-world spaces for role-play suits some applications, but others require a dedicated space, and can be thought of as stage-based role-play. This is true of many of the existing educational role-plays. A stage-based environment can be thought of as a sensor-rich pervasive computing environment including large display systems in which virtual actors and graphical worlds can play a more prominent role than is feasible when only hand-held devices are used. An early example of the stage-based approach is the Mission Rehearsal Exercise [20] in which a single human participant interacts with virtual characters in a stressful and dramatic situation (peacekeeping) using structured speech. This work has been extended into a more augmented reality environment using 'flats' – large display screens within a real world space, but has limited interaction modalities. ORIENT also takes this approach for a role-play that aims to educate students in inter-cultural empathy employing a set of innovative interaction devices.

3. The game: ORIENT

3.1. The story

ORIENT was developed for the 13–14 age group of boys and girls and our initial prototype was customised for British and German users. However, it could be easily localised to different languages. It is designed to be played by a group of three teenage users where each one of them takes on the role of a member of a spaceship crew and is responsible for a different interaction device with specific functions. Their mission takes them to a small planet called ORIENT, which is inhabited by an alien race – the nature loving Sprytes. Portraying a fictional instead of an existing culture makes our application more flexible and suitable for users from diverse backgrounds. Furthermore, it allows us to exaggerate cultural differences for dramatic and educational purposes.

The Sprytes are not aware of the danger that their planet is in: a meteorite is on destruction course and unless someone stops it, it would mean the end of life on ORIENT. It is the users' task to prevent a catastrophe. To do that the users first have to befriend the Sprytes and ultimately cooperate with them to save their planet. Through interaction with the Sprytes, ORIENT promotes cultural-awareness in the users, who have to put themselves into the shoes of guests in a strange and unknown culture. At the same time ORIENT acts as a team building exercise where users play as a single entity rather than as individuals. All users have the same goal in the game although their roles and capabilities differ.

3.2. The ORIENT prototype

A prototype of ORIENT has been implemented consisting of the main components shown in Fig. 1. Each component will be

described separately in the next section. In this prototype a group of three users explores four different locations of the Sprytes' world. All users share a single first person perspective of the same 3D virtual world. Each user is equipped with a different interaction device (Section 4.3), all three of which are necessary to interact with the virtual Spryte characters. A Spryte character is implemented as an autonomous agent based on the FAtiMA [11] agent mind architecture (Section 4.1). Dialogues are treated by the agent mind as symbolic speech acts. When a Spryte speaks, a language engine transforms the speech act into natural language subtitles while a speech engine simultaneously generates the respective audio in an artificial incomprehensible gibberish language. Special words such as character names are maintained in the gibberish language so that it can be used as input by the users to address the Sprytes during interaction. As in artificial languages designed for science fiction movies, this gibberish language aimed to increase the believability of the Sprytes.

While the application is running, both the ORACLE (Section 4.2) and the Story Facilitator modules are constantly monitoring all events in the game world. The ORACLE uses this information to provide context-sensitive help and advice to the users. The Story Facilitator on the other hand, monitors the events in order to ensure an interesting story develops. This is achieved by directly influencing the game world, for example by introducing a new character in certain situations.

3.3. Culture in ORIENT

According to Kluckhohn [28], culture is that part of behaviour which is learned by people as the result of belonging to some particular group. "It is the main factor which permits us to live together in a society, giving us ready made solutions to our problems, helping us to predict the behaviour of others, and permitting others to know what to expect of us" (p. 25). Culture has an effect on human cognition, affect and behaviour. To define cultural differences in artificial agents, variables which describe the cultural personality of an agent have to be defined. While communication is unique within each culture, there are systematic similarities and differences across cultures that can be explained and predicted theoretically using dimensions of cultural variability. Hall [17] and Hofstede [22] provide some classifications of cultures and dimensions of cultural variability.

Fig. 1. ORIENT system components.

The dimensions of cultural variability according to Hofstede [22] exist in all cultures at the cultural and individual level and one characteristic within each dimension tends to predominate. The following dimensions of cultural variability were defined:

- *Individualism–collectivism* – Individualism pertains to societies in which the ties between individuals are loose while collectivism pertains to societies in which people are integrated into strong cohesive groups.
- *Uncertainty avoidance* – This dimension deals with the degree to which members of a culture try to avoid uncertainty. High uncertainty avoidance cultures tend to have a lower tolerance for ambiguity than members of low uncertainty avoidance cultures.
- *Power distance* – This dimension refers to the extent unequal distribution of power is accepted by less powerful members of institutions. Members of high power distance cultures tend to see and accept power as part of the society whereas members of low power distance culture assume that power should only be used when legitimate.
- *Masculinity–femininity* – In traditional-gender-oriented masculine cultures, distinct social gender roles can be identified. In contrast, gender roles overlap in feminine cultures.

These dimensions have been used to define the Sprytes' culture. The Sprytes are a tribal culture with a hierarchical organisation of its society members (power distance), depending highly on respect and age. This is reinforced by the fact that Sprytes are militarily active and believe in using force and power to influence others and to protect their habitat. They are a collectivistic (individualism–collectivism) culture, which makes them compassionate with each other, and live in groups where the majority holds power. They are highly traditional in their ways and view uncertainty as a threat (uncertainty avoidance) but exceptions do exist in younger Sprytes. Gender (masculinity–femininity) is absent from the Sprytes and the graphical representation of the Sprytes is intended to be ambiguous from this point of view as can be observed in Fig. 2a–c.

The Sprytes are thin and tall creatures, resembling tree frogs. While not technologically deficient by any means, they choose to rely on more traditional processes to sustain themselves. The are naturalists, eating only seedpods that fell onto the ground. Families in a traditional sense do not exist. Young Sprytes are born from small plants and dead Sprytes are recycled to produce dark liquid that is believed to be good for health, and soil that is used for the birth of new Sprytes.

4. System components

4.1. Virtual actors

The use of virtual actors is one of the most important ways of shaping the narrative experience in RP games. Virtual actors both reduce the expense and complication of organising role-play where real actors might otherwise have to have been used, and help to reinforce 'in-role' behaviour in learners by supporting the believability of the role-play world. The state-of-the-art in computer games, whether single person, or online multi-player such as World of Warcraft[2] or Second Life,[3] is for very simple non-player characters (NPCs) that are either completely pre-scripted or driven by very simple state-transition networks. These lack responsiveness to user actions, making their behaviour very predictable, and have
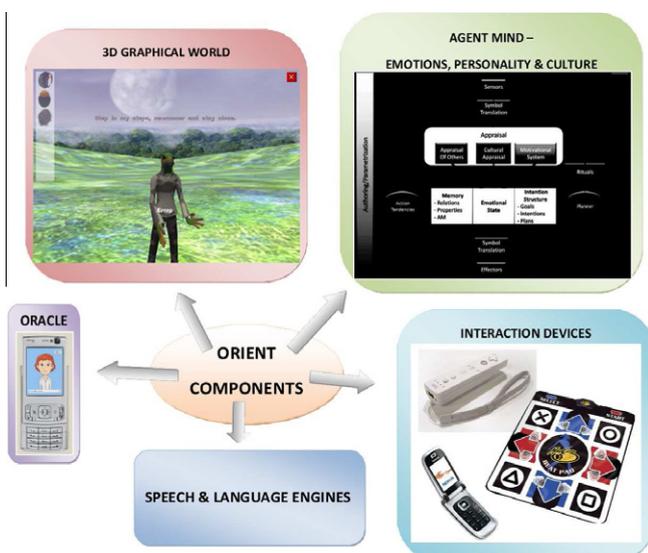
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[2] http://www.worldofwarcraft.com/index.xml.
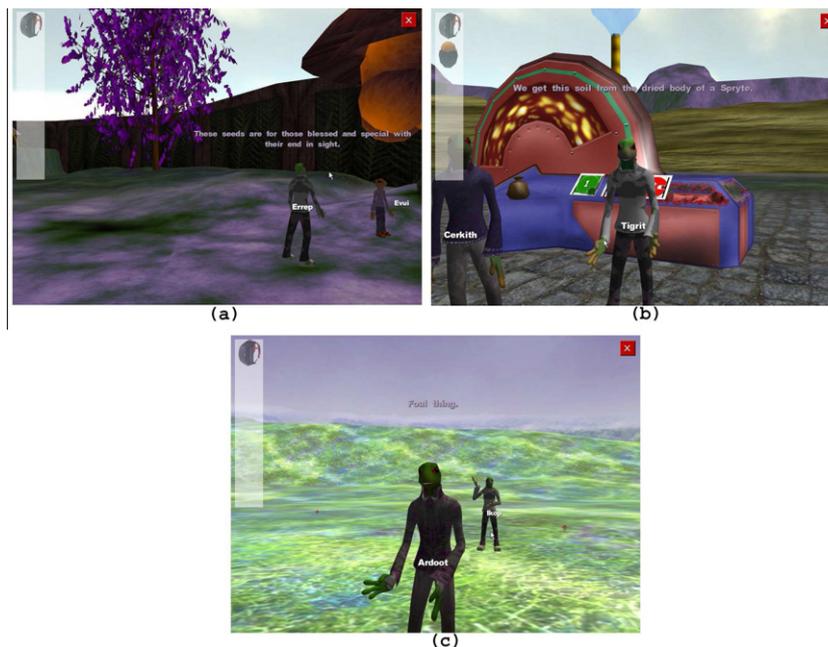[3] http://secondlife.com/?v=1.1.

Fig. 2. (a) Educating a child Spryte for picking seedpod from the tree which is against the Spryte's culture; (b) a Spryte explaining their life cycle; (c) angry gesture to the user for stepping on a little tree.

forced many computer games to use pre-videoed 'cut-scenes' to create narrative content.

In order to produce competent and responsive virtual actors, ORIENT draws upon previous work in AI from the fields of affective–cognitive models, intelligent synthetic characters and embodied conversational agents (ECAs), and interactive narrative. Affective models are seen here as a key component of virtual actors given the need to affectively engage participants and spectators in the dramatic environment. These were absent from early work in virtual actors, as in IMPROV [39] and the Virtual Theater project [41] in which virtual actors operated purely within graphics environments and were at most semi-autonomous.

The ORIENT software is being built upon FAtiMA [11], an agent architecture with an emotional continuous planner. We have extended FAtiMA with concepts from the PSI [12,13] model, which bases all actions on the fulfilment of basic physiological needs. Here, we take the body–mind [10] view of emotion where emotions do not rely purely on reasons but there exists an interaction between physiological processes and the cognitive processes in a human action regulation system.

Employing FAtiMA, the agent's decision making processes are influenced by the OCC [37] cognitive appraisal. OCC is a widely used taxonomy for categorising and explaining emotional occurrences. The advantage of using the OCC model for ORIENT characters is that empathy can be modelled easily because it directly relates to the appraisal of events as they impact on others. It is – as far as we know – the only model that provides a formal description of non-parallel affective empathic outcomes. Additionally, the OCC model includes emotions that concern behavioural standards and social relationships based on like/dislike, praiseworthiness and desirability for others, allowing appraisal processes that take into consideration cultural and social aspects, important for the believability of ORIENT characters. Characters are entirely 'in-role' in that they select actions according to their immediate goals and environment, portraying affective engagement with their own situation and each other. This lays the basis for affective engagement of the learners with the characters.

The PSI model extends the empathic modelling to more emotional outcomes than those described by the OCC model. Emotions

within the PSI model are conceptualised as specific modulations of cognitive and motivational processes. The motivational system serves as a quick adaptation mechanism of the agent to a specific situation and may lead to a change of belief about another agent [31], important for conflict resolution among ORIENT characters. Utilising PSI, processes in ORIENT characters become self-regulatory and parallel, driven by needs that emerge from activities in the environment or grow over time. Each character will continuously perceive the environment and create intentions that may satisfy its needs at a particular instance of time. One of these intentions is then selected for execution based on the degree it satisfies the character's needs and its probability of success. Through trial and error by executing different goals, ORIENT characters learn about the best solutions to different circumstances. The Sprytes learn in the sense of adjusting their goals based on previous experiences. For instance, if a Spryte was successful in inviting the user for a meal, in future interaction it is more likely for it to invite the user again. There is no learning of new behaviour per se as this would lead to unpredictable outcomes that might jeopardise the educational aims of the application. The character's experiences are stored in an autobiographic memory [21] for future reference, thus, permitting adaptive and flexible behaviour in the dynamic RP environment so that the RP is open-ended rather than pre-scripted. For more information on the ORIENT agent mind architecture, please refer to Lim et al. [32,33].

4.2. The ORACLE

The ORACLE (Onboard Resource Agent for Cultural and Liaison Engagements) shown in Fig. 3 is an embodied computer character that aims at enhancing user's learning in the game. It runs on a Nokia N95 phone and plays the role of a human facilitator in fostering users' motivation and keeping them engaged, stimulating group collaboration, keeping the users' focus on the task and providing help during the mission. Its advice focuses mainly on facilitating and stimulating the intercultural learning processes but also includes more pragmatic help with the technology. For instance, it provides hints about how to proceed in the game when it notices that the team is not making any progress.

Fig. 3. Left: the ORACLE in idle state with the "Help!" button on the top right corner, middle: a set of disambiguation questions, right: the ORACLE talking, with the "Stop" button on the top left corner.

Technically, the ORACLE is made up of a Java socket server that connects three modules: ORIENT; Drools,[4] a Java-based forward-chaining production system; and a Flash client, installed on a mobile phone. Visually, the ORACLE is a 2D Adobe Flash character that can display emotional expressions. The production system makes up the ORACLE's mind which contains two types of rules: "reactive" and "proactive".

"Reactive" rules fire when the user asks for help by pressing the "Help" button (left picture in Fig. 3). When this happens, a set of context-sensitive disambiguation questions is displayed (middle picture in Fig. 3). After the users have selected one of these questions, the ORACLE responds by playing a pre-recorded audio clip synchronised with the head and torso movements using a pat-ent-pending software developed by Interagens.[5] On the other hand, "proactive" rules fire according to the occurrence of specific events in ORIENT. These rules have been prepared by preemptively identifying possible events in the environment that could be diffi-cult to understand for the users, or that would enable them to learn important knowledge about the Spryte culture. For example, when a child Spryte picks a seedpod from the tree and is being educated, the ORACLE may prompt the users by saying "The Sprytes are talk-ing. Pay attention to what they say." Thus, the ORACLE stimulates reflection on events and outcomes of ORIENT by asking the users appropriate questions and commenting on their actions when necessary.

4.3. Interaction modalities

It is a challenging task to determine interaction modalities for a system such as ORIENT. First of all, the modalities have to harmoni-ously enhance the story of the application. Since ORIENT's scenarios aim at a multi-user setting, the interaction devices assigned to the users should support their roles in a story. Research has shown that by increasing integration of the user's physical environment, inter-action can be rendered more intuitive and engaging [15,14]. Inno-vative interaction devices that provide more intuitive interfaces to express affect have also been shown to enhance empathic engagement [38]. Thus, in order to increase the user's engagement we considered physical and embodied interactions. Finally, the interaction techniques supported by the devices should be easy to understand and apply, at the same time innovative and fun to use.

During the entire design process of ORIENT's interaction modal-ities, the Sprytes' fictional culture was given careful consideration to ensure that the final application evokes feelings of unfamiliarity in the users so that the pedagogical goal to raise cultural awareness can be achieved. In particular, ORIENT's communication tech-niques, such as the language were made different from the users'. The unknown language complicates the users' mission because it forces them to find alternative ways of communication. Therefore, we had to identify appropriate devices and interaction techniques which would support other verbal and non-verbal interaction channels rather than natural speech.

Since the users of ORIENT are on a space command mission, we based our design on concepts that were applied in well-known sci-ence fiction movies for verbal and non-verbal communication with unknown residents of alien worlds. Mobile devices convey the metaphor of a "tricorder device" similar to those used in Star Trek.[6] The users can use this "tricorder device" to address a Spryte by pronouncing its name. From the technical point of view, we used keyword spotting to recognise the spoken name. Users utilise the "tricorder device" and its microphone to verbally input the name of the Spryte that they would like to interact with. After the speech input, the recorded audio file was transmitted to a server that holds a speech recogniser with training material of all Sprytes' names. After the recognition, the name of the respective Spryte was sent to the mobile phone as well as to the virtual world.

Using this "tricorder" metaphor, mobile devices can also be used to select objects in the story. In this case, keyword spotting would not work: the users do not know the Sprytes' terms for dif-ferent objects. They only know the names of the Sprytes. Thus, to manipulate objects, the users employ the "tricorder device" to scan the intended object in the real world and transmit their identifica-tion to the Sprytes. For instance, we used the RFID scanner on the mobile phone to transmit objects such as *soil, seed* and *green drink* that were required at certain points of the ORIENT story. We chose the Nokia 6131 NFC phone (Fig. 4a) as the "tricorder device", since it supports a built-in microphone for keyword spotting, a built-in NFC-reader for scanning RFID-tagged real world objects and a Bluetooth interface for the transmission of the speech and scanned object to the ORIENT world.

Communication with the Sprytes is not only carried out ver-bally, hence, we also considered a metaphor for non-verbal input. We chose a set of gestures that the Sprytes use to communicate ac-tions, such as *greet, ask, give* and *apologize*. The users can execute these actions by using the "magic stick": the WiiMote (Fig. 4b). Three-dimensional gesture recognition is performed based on mo-tion data from the Wiimote's accelerometer sensors using the Wii-gle library [40]. Combining the "tricorder device" and the "magic stick", the users build phrases to communicate with the Sprytes. Every phrase consists of a Subject (a Spryte's name given by speech), an Action (a gesture performed using the Wiimote) and an Object (scanned RFID tag). In this way, the phrases represent an utterance which is addressed to a particular Spryte, e.g. a ques-tion about an object available in the Spryte's world – *Abbuk ask recycling*.

For navigation in the virtual world, a Dance Mat (Fig. 4c) was utilised. This interface has two advantages: first it bears a resem-blance to real-world navigation in the sense that the user has to take actual steps and second since it only occupies the users feet, it allows this user to operate the ORACLE at the same time.

After having defined different interaction modalities for com-munication with the Sprytes, we took into account the right assign-ment of the modalities to the different users in order to increase their engagement as well as collaboration. There is empirical evi-dence that a more positive effect on collaboration can be achieved when using a computer with multiple input devices and cursors

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[4] http://www.jboss.org/drools.
[5] http://www.interagens.com/.

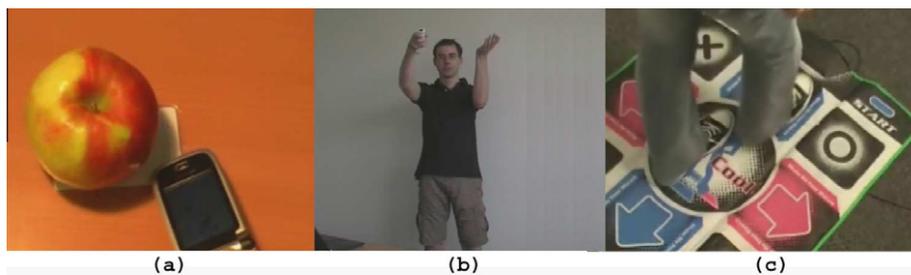[6] http://www.startrek.com/startrek/view/index.html.

Fig. 4. Interaction modalities employed in ORIENT: (a) RFID tag scanning, (b) performing a gesture using the WiiMote, (c) navigating using the Dance Mat.

than when using one without these interaction facilities [23,36,29,30]. For instance, in one study different multi-user settings for pervasive games were explored [30]. This study showed that a setting where each user is assigned a role via an interaction device with a dedicated function helps organise interactions within a group, fairly distributes the levels of interactivity and avoids dominant users. This setting promotes collaboration among users in a better way than a setting where just one interaction device was given to the whole group or a setting where each group member was equipped with an identical device.

Based on these findings, we defined roles for the three users in the story by the interaction devices assigned to them. The first role, called Communication Officer, makes use of the mobile phone for keyword spotting and RFID scanning of real world objects. The second role, Intelligence Officer, employs the Wiimote for performing the gestures. The third role, Organization Officer, operates the dance pad for navigation and the ORACLE that was introduced earlier. Each of the three interaction devices has a unique function, necessary to achieve the goal of the story.

5. Interaction scenario

During the mission, the users have the chance to witness the Sprytes eating habits – eating only seedpods that have dropped onto the ground (Fig. 2a), life cycles – recycling the dead (Fig. 2b), educational styles, family formation and value system – trees are sacred (Fig. 2c). An example scenario that is related to the Sprytes' eating habit is described below:

The interaction starts with the users greeting the Sprytes (performing the greeting gesture using the WiiMote). Then, the users witness a Spryte picking a seedpod from the ground and eating it. On the other hand, there will be a child Spryte who picks a seedpod from the tree. Once the child picked a seedpod from the tree, an adult Spryte will start the education process (because picking or eating seedpods from trees is forbidden in the Spryte culture) from which the users can learn about the Sprytes' culture. If the users approach a tree (stepping forward on the Dance Mat in the direction of a tree), they will be warned by one of the Sprytes about their inappropriate behaviour. If the warning is ignored and the users pick a seedpod from the tree (perform the pick gesture using the Wii-Mote and scan a RFID-embedded seedpod), the Sprytes will be angry with the users. A friendly Spryte might put in a good word for the users with his angry mate in this case. At this point, the Story Facilitator might interrupt by creating an external event, for example, a meteor hitting one of the Sprytes. The users can then act with the help of the ORACLE to cure the dying Spryte and by doing so, achieve redemption. If the users pick a seedpod from the ground, they will be invited for a meal together with the Sprytes. The users can choose to accept or reject the invitation (performing accept or reject gesture using the WiiMote) and their response affects future relationship with the Sprytes.

Fig. 5. A group of users interacting with ORIENT.

In the above scenario, the users have possibilities of making "right" or "wrong" choices thus highlighting the conflict management aspects of multi-cultural integration. Through direct feedback from the interaction, the users can analyse the appropriateness or suitability of their action. This coupled with post-role-play reflection or debriefing will help the users to transfer their experiences to real-world settings, hence, learn to adapt and accept differences among cultural groups. Fig. 5 illustrates a group of users interacting with ORIENT.

6. Evaluation

6.1. Methodology and aims

The ORIENT prototype has been evaluated in a lab-based, small-scale study in the UK and Germany with a total of 12 adolescents respectively. In the German sample, the participants' background was mainly German; only two participants had a non-German background. They were recruited from a student organization supporting honorary services of students. Within the groups, the student knew each other, some of them were friends. Participants indicated their social economic status, experiences with other cultures and foreign languages, and their cultural intelligence (CIS) [1]. The UK sample ($M = 12.7$; $SD = .05$) was significantly younger than the German sample ($M = 13.4$; $SD = .51$) ($t = -3.34$, $p = .003$). The German sample consists of significantly more females than in the UK sample ($p = .001$). The difference in the overall CIS score of both countries (UK $M = 4.28$; $SD = .56$ versus Germany $M = 3.84$, $SD = .46$) was not significant ($t = 1.87$; $p = .078$).

Each evaluation session took approximately 2 h (including device training, actual ORIENT interaction and filling out the
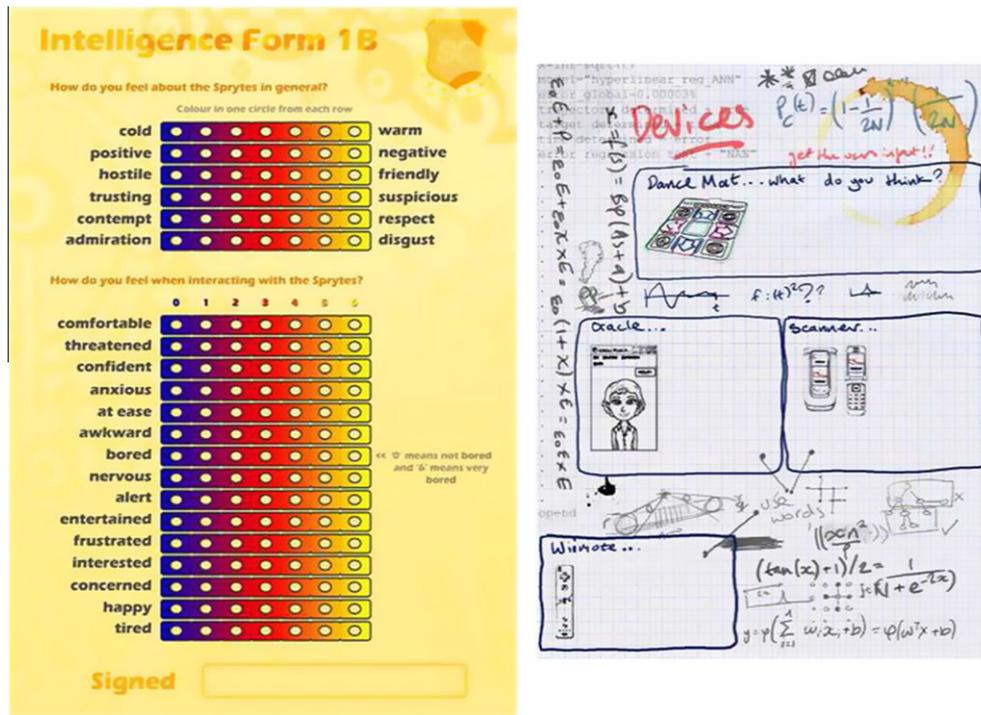
Fig. 6. Left: cultural activities questionnaire, right: usability evaluation questionnaire.

Table 1
Constructs and corresponding instruments.

Construct	Instrument/measurement approach
Demographic characteristics & cultural profile	Participant questionnaire
Cultural intelligence	Cultural intelligence scale [1]
Perception & expectations of game play	Qualitative/open instrument to assess pre-interaction views
Knowledge about the Sprytes/ORIENT	Story/task comprehension exercise
Outgroup/cultural view (with regards to the outgroup "Sprytes")	Cultural activities questionnaire (amalgamating the intergroup anxiety scale [44] & the general evaluation scale [46])
Device use	Usability evaluation questionnaire with closed questions/discussion
Response to ORIENT & Sprytes	Based on the character evaluation questionnaire [18] and by interaction observation
Feedback on interactions with ORIENT (e.g. graphics, speech, storyline, agent believability, etc.)	Questionnaires, discussion groups, creation of diaries/storybooks

questionnaires). The evaluation framework is placed within the RP scenario itself, making the evaluation part of the interaction rather than a separate experience. The users operated as members of "Space Command" throughout the evaluation. To support this in-role approach, questionnaires and training videos were designed in a "Space Command" style (Fig. 6) and our evaluation team members were acting according to predefined roles.

The key aim of the evaluation is to test the suitability of ORIENT as a tool for: (a) fostering cooperation/collaboration; and (b) fostering reflection on intercultural problems through appreciation of similarities and differences between cultures. In addition to the psychological and pedagogical aims, our aim was also to evaluate the technology, focusing on intelligent computer assisted role-play and our approach to accessing it using unusual interaction devices. The technical evaluation focused on the experience of interacting with ORIENT, the usability of the ORACLE, and on the usability of the interaction devices. Different instruments were employed to measure the different constructs as detailed in Table 1.

During the evaluation, interaction behaviour within the group of participants was observed in real-time. The interaction was also videotaped by two cameras and microphones placed in two corners of the room, directed towards the participants. The interaction of the group was assessed on-line by two psychologists in the eval-

uation team using an observation manual that was developed to assess qualitative dimensions of cooperative learning. The observers indicated on a manual whenever they observed one of the following processes: (1) *Solution–orientation:* asking questions which serve the information seeking process and the analysis of the problem. (2) *Empathy:* interest in each others mental states, their needs, wishes, and goals. (3) *Egocentrism:* focusing on self, destructive criticism, cutting off other group members. (4) *Small-talk:* role-game related versus private. (5) *Integration:* integration of different positions and propositions and to achieve arrangements. (6) *Interaction:* consciously perceiving and communicating with one another. (7) *Group mood:* based on the "self-report circumplex model of mood" [24]. (8) *Cooperation:* shared goals and interests, e.g. to come to an important decision or to save the planet ORIENT.

6.2. Results and discussion

On the whole, teams were rated by the psychologists as showing a high degree of solution orientation in their activities and a high degree of communication related to the content of the application, interaction, and cooperation. For both samples, an agreement was recorded in 75% of the cases between the two psychologists' ratings which lead to a moderate inter-rater-reliability (kappa 0.500). In

sum, the results indicate that the prototype of the ORIENT software and the use of the different interaction devices have rudimentarily the potential to foster cooperation among the user group. It is clearly not statistically profitable to draw conclusions from such a small sample; the results are only indicative and need to be further investigated.

In post-interaction discussions, the groups reported positive feedback regarding their interaction. One group expressed that they had the feeling "... they had played very well together as a team" – we can conclude that the software enabled them to interact with the system as a group and that the devices provided and the roles attached to these devices supported the feeling of being a group and sharing a common goal in the virtual world. The participants were capable to point out similarities and differences between their own and the culture of the Sprytes and expressed rather positive feeling towards the Sprytes. The Sprytes' culture were considered to be engaging and the differences appeared to be believable and credible. The participants also expressed readiness and interest to participate in Sprytes' activities. However, differences were recorded between German and UK samples. UK teenagers (felt that the Sprytes perceived them to be enemies) have more negative reaction towards the Sprytes than German teenagers (felt that the Sprytes perceived them as friends). This may have been caused by gender difference rather than culture as only the UK groups contained boys.

In terms of interaction modalities, the participants found it interesting to handle the different devices, and that all devices were needed to accomplish the interaction with the Sprytes despite the fact that it took them quite a while to be able to control the devices. They found the ORACLE helpful although sometimes bossy.

Some issues were discovered during the evaluation including the Sprytes' personality, the story content and interaction devices. It was found that believability as well as the emotional impact of the drama on the users could be fostered by giving the individual Sprytes more distinctive personalities as they currently appear as cultural stereotypes. Furthermore, the software needs to be enhanced content-wise in order to make the encounter with the Spryte culture a pedagogically meaningful experience, for example, adding content that may lead to some kind of conflict with the Sprytes, either a vicariously experienced conflict located within the Spryte culture, or a "real" conflict between the culture of the Sprytes and the user group.

In order to enable the users to explore, understand, and flexibly react to the cultural encounter with and the specific problems of the Spryte culture, the interaction with the virtual world should be even more intuitive and seamless. As the participants found it challenging to learn Wiimote gestures to communicate with the Sprytes, the number of gestures should be reduced. Most users could not remember all of the nine gestures and often asked for help. The gestures were based on German emblematic gestures which are normally unknown to users and thus unfamiliar to conduct. These gestures seemed to be appropriate for ORIENT since gestures of the Sprytes are also considered as unknown. The problem, however, was that some of the nine gestures were not very intuitive and hard to learn. Other sources of confusion were failures of the gesture recognition system as the recognition relies highly on the orientation of the WiiMote which is dependent on the way it is held by the users. Thus, it is crucial to consider the users' cognitive and physical load in order to avoid frustration during interaction while still preserving the challenge of the game-like setting.

In terms of engagement we found that the use of popular input devices, such as the Wiimote, made the interaction for the participants more enjoyable and contributed significantly to their engagement. Furthermore, the distribution of input devices based on the findings of the study mentioned earlier [30] helped to involve all participants actively in the story. Every user have to make use of his or her input device to enable communication with the characters. The effect was enhanced by bodily activity and manipulation of physical objects.

7. Conclusion

The ORIENT software provides a novel role-play and story-framework for virtual social actors to interact with users in a number of different ways so as to create inter-cultural empathy. It employs tangible interaction modalities to increase users' motivation to learn about the Sprytes' culture and their engagement in the interaction, at the same time to enhance collaboration among themselves. It exhibits the potential of technology-enhanced role-play to support social and emotional learning in complex social situations without the risks that the learner faces in a real social situation due to the secure settings for experimentation with new behavioural strategies.

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