

The Interactive CrossTalk Installation: Meta-Theater with Animated Presentation Agents

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Abstract

This paper introduces CrossTalk, an interactive installation with animated presentation agents. CrossTalk is an attempt to spatially extend the interaction experience beyond the usual single front screen. It offers two separated agent spaces (screens), where the agents “live”, which form a triangle with the user’s control panel. In this setting, we explore the meta-theatre metaphor for a new variant of information presentation in public spaces, such as a booth at a trade fair or a product information kiosk in a department store. The meta-theater metaphor lets agents live beyond the actual presentation: “outside” the presentation, agents are professional actors. This enriches the interactive experience with unexpected out-of-role intermezzi and off-duty dialogs, including rehearsals. The name CrossTalk expresses the variety of human-agent and agent-agent interactions that emerge and work together to attract and bind the user’s attention. Technically, we rely on a fine-grained interweaving of automatically generated sales dialogs and manually scripted scenes of off-duty conversations. CrossTalk has been exposed during a one-week demo at the CeBIT convention 2002 to the general public, where we are able to gather some feedback on the installation from visitors.

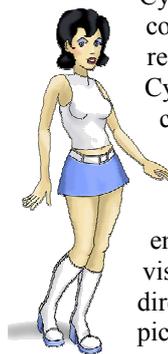
1 Introduction

Lifelike characters, or animated agents, provide a promising option for interface development as they allow us to draw on communication and interaction styles already familiar to human users (cf. Cassell et al. 2000). During the last years, animated characters have been used in a number of different application fields including educational software (cf. Johnson et al. 2000), help systems, and virtual representatives on commercial web pages that act as product presenters and sales assistants. Most of these applications assume settings in which the agent addresses the user directly like in human face-to-face conversations. This seems appropriate for a number of applications that draw on a certain agent-user relationship. For example, an agent

may serve as a personal guide or assistant in information spaces like the worldwide web.

Starting with the development of the so-called PPP Persona back in 1994, our group designed a number of animated conversational characters for a variety of different application tasks. One of them is Cyberella¹.

1.1 Cyberella



Cyberella is a female synthetic conversational character working as a receptionist. A user can engage with Cyberella in a typical receptionist conversation, for instance, by asking her about directions how to get to the office of a certain staff member.

Since Cyberella contains an affective engine she can react emotionally to a visitor's utterances (Gebhard 2001). This direct agent-user interaction model is depicted in Figure 3, part 1.

1.2 The Inhabited Marketplace (IMP)

There are situations in which direct agent-user communication is not necessarily the most effective and most convenient way to present information. Inspired by the evolution of TV commercials over the past 40 years, our group has discovered role-plays with synthetic characters as a promising format for presenting information. A typical TV commercial of the early days featured a sales person who presented a product by enumerating its positive features – quite similar to what synthetic characters do on web pages today. On TV, however, this format has been almost completely replaced by formats that draw on the concept of short, entertaining scenes. Typically, such performances embed product information into a narrative context that involves two or more human actors. Episodic formats offer a much richer basis compared to the plain enu-

¹ <http://www.dfki.de/cyberella>

meration of product features, and thus meet the commercial industry's high demand for originality. We propose a shift from single character settings towards interactive performances given by a team of characters as a new form of presentation (Figure 3, part 2).



Figure 2: Tina and Ritchie performing a car sales dialogue.

The use of presentation teams bears a number of advantages. First of all, they enrich the repertoire of possible communication strategies. For example, they allow us to convey certain rhetorical relationships, such as pros and cons, in a more canonical manner. Furthermore, they can serve as a rhetorical device that allows for a reinforcement of beliefs. For instance, they enable us to repeat the same piece of information in a less monotonous and perhaps more convincing manner simply by employing different agents to convey it. Furthermore, the single members of a presentation team can serve as indices, which help the user to organize the conveyed information. For instance, we may convey meta-information, such as the origin of information, or present information from different points of view, e.g. from the point of view of a businessman or the point of view of a traveler. Last but not least, multiple characters allow conveying social aspects, such as interpersonal relationships between emotional characters (cf. Prendinger & Ishizuka 2001, Rist & Schmitt 2002).

The Inhabited Market Place (IMP) is an example of a system that employs presentation teams to convey information about products like cars, (cf. André et al. 2000). IMP is a virtual showroom where seller agents present products to buyer agents in form of a simulated multi-party sales dialogue. Figure 2 shows Tina and Ritchie, two of our characters, in a car sales scenario.

The overall system's presentation goal is to provide the user with facts about a certain car. However, the presentation is neither just a mere enumeration of facts about the car, nor does it have a fixed course of dialogue between the agents. Rather, IMP allows the user to specify prior to a presentation (a) the agents' roles, (b) their attitude towards the product, (c) their personality profile and (d) their interests. Based on

ality profile and (d) their interests. Based on these settings, a variety of different sales dialogues can be generated for the same product.

1.3 CrossTalk and meta-theater

Both Cyberella as well as the IMP system have limitations. IMP suffers from a lack of user interaction, whereas Cyberella lacks the subtle yet entertaining presentation power of multiple agent performances.

CrossTalk combines both systems and thus, both interaction models in what we call the *meta-theater metaphor*. Cyberella acts as fair hostess, and the IMP is something like a stage where actors (Tina and Ritchie) give presentations. Thus, we make explicit the fact that Tina and Ritchie only "act" and add another layer of role-play where Tina and Ritchie appear to be professional actors (their meta-roles). This opens up possibilities for both actors to "step out" of their roles during presentation and to explicitly interact with Cyberella, who gives instructions, calls rehearsals and initiates presentations. Cyberella is the direct interaction partner for the user, although the user can give limited feedback to the IMP actors which causes "spontaneous" responses from both Cyberella as well as the actors. Figure 3, part 3 shows the resulting interaction model.

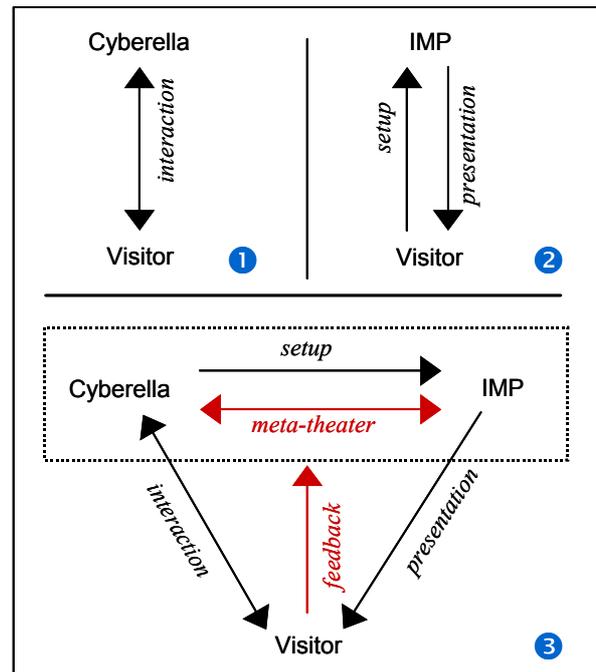


Figure 3: Interaction models of the Cyberella (1), IMP (2), and CrossTalk (3) systems.

Note that the cross-talk between Cyberella and IMP system gives room for nontrivial "off-duty" activities when no user is directly interacting (but watching from a distance or passing by). The extension of characters' lives beyond the time of presentation makes the system's role-play more complex and thus, more life-like. It allows for unexpected interrelations between off-

duty and presentation modes that can continually refresh the user's attention. In this paper we explore some of the implications of this new model.

2 CrossTalk Installation

A visitor enters the CrossTalk installation by stepping in front of the user console. The visitor can then see two angled screens before him/her (see Figure 4). The three components are spatially arranged in the form of a triangle:

- 1) Cyberella screen
- 2) IMP screen
- 3) Console with touch screen and camera

The positions of the screens nicely support the impression of cross-screen conversations between Cyberella and the IMP "actors" Tina and Ritchie.

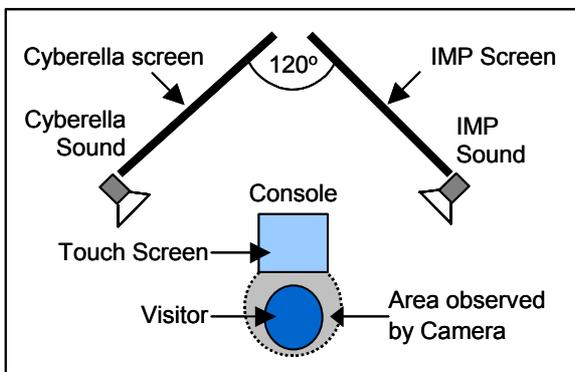


Figure 4: Main components and spatial layout of the CrossTalk installation.

2.1 Scenario

The visitor is welcomed by Cyberella (left screen) whose primary task is to play the fair hostess. She offers the user a demo of an automatically generated car sales dialogue by the "actors" Tina and Ritchie (IMP, right screen). She also asks the user to decide on some settings such as personality profiles and interests of the coming demo, which she uses to instruct her actors across screens. After some introductory remarks the demo starts.

Now the visitor's attention is drawn to the "stage" of IMP space (right screen). The actors Tina and Ritchie change their body postures to "ready" by straightening up and perform a car sales situation. They discuss the features of a certain car in an automatically generated dialogue. Clearly notable variations in the dialogues are due to the specific settings of the agents' personalities and interest profiles. During this performance the user can give feedback by pushing one of three buttons ("applause", "boo" and "help"). Such feedback may cause unexpected (meta-theatrical) behavior. For instance, if a visitor submits a "boo", the actors getting nervous and may forget their lines. In contrast, "ap-

plause" makes them proudly smiling/bowing to the user. When "help" is requested, Cyberella stopping the demo for short explanations. Note that changing the body posture helps signaling to the user whether an actor is "in character" or steps out of his/her role.

After the demo Cyberella takes over again, asking whether the user wants to see the demo again, possibly with new settings. If not, the visitor leaves the installation and the actors go to "off-duty" posture. But instead of switching off or just idling around the agents display their off-duty behavior by chatting with each other across screens or Cyberella calling a rehearsal for the next demo. The visitor is so encouraged to stay for another while watching the "personal lives" of the agents and, more important, new potential visitors are allured from the crowds of passers-by.

2.2 Presentation vs. off-duty mode

Human staff members at a convention stand usually switch back and forth between presentation activities when visitors are present and private conversations when they are "off-duty". Presentation can be considered as a performance for the visitor, as "theater". The off-duty activities, on the other hand, are natural actions for humans. But when we let artificial actors emulate these off-duty actions, it becomes yet another performance or "meta-theater".

Using meta-theater we give the agents the authenticity of professional actors and convey the impression that they are permanently alive. This has an impact on the user's attention and interactive experience. Talking characters are likely to attract new visitors to approach the installation and be detected. Also, visitors may leave the control panel but still observe the installation from afar. The ensuing switch to off-duty mode can raise the leaving visitor's interest again since they are now curious what else the characters can talk about.

In off-duty mode, the characters wait, start chatting or begin rehearsing for the next performance. When a visitor approaches the console (Figure 4), s/he is detected by a camera mounted underneath the touch screen and the system enters presentation mode. Cyberella welcomes the visitor and offers a presentation of the IMP system. This presentation is given by Tina and Ritchie. During the performance, the visitor is provided with a feedback panel on the touch screen (Section 3.5). The actors Tina and Ritchie have especially designed postures to clearly signify the mode they are in. In presentation mode their posture is upright and alert, whereas in off-duty mode their posture is relaxed.

Each mode is modeled as a state diagram of sub modes. For instance, in off-duty mode the system switches between the idle, chat and rehearsal sub modes using transition probabilities.

2.3 Technical set-up

Technically, we had to integrate three systems: Cyberella, IMP, and the user interface (touch screen). Each system runs on its own PC. An information router based on TCP/IP sockets was created as the backbone. Special hardware is not required. As sketched in Figure 4, a spatial separation of the display screens for Cyberella on the one hand and Tina and Ritchie on the other hand is essential to convey the impression of cross-screen conversations.

Most software components of CrossTalk are implemented in Java. The implementation of the dialogue planner is based on the *Jam Agent Architecture*². The outcome of the planning process is commands to be executed by the agents. We use the Microsoft Agent Toolkit³ for the animation of the characters and the L&H TTS3000 text-to-speech (TTS) engine for speech synthesis.

3 Dialog and Interaction

The Cyberella system comprises a natural language dialogue component that analyses textual input from the user, performs a domain-specific semantic interpretation of input sentences, and generates appropriate responses which are either verbal, gestural or by facial expression. Technical details about the Cyberella system are provided by Gebhard (2001) and André et al. (2000).

In the IMP system, dialogue contributions of all agents participating in a car-sales talk are determined by a centralized action planner. The task of this component can be compared with the task of a scriptwriter who acts out all parts and dialogue contributions for the actors in a theater play.

In order to obtain a believable result, a scriptwriter, as well as our automated planning component, has to consider the knowledge and personalities of all characters and must be able to anticipate a reasonable unfolding of the scene. Since the car sales domain is a relatively closed domain, a broad variation of car sales dialogues can be automatically generated using only a relatively small number of dialogue patterns. The current IMP system comprises approximately 30 dialogue plans to represent typical dialogue moves in this domain. For a description of the underlying planning approach we refer to André et al. (2000) and André/Rist (2001).

Through the metaphor of meta-theater CrossTalk achieves a smooth coupling of pre-scripted sub dialogues with automatically generated car-sales dialogues.

² Developed by Marcus Huber at Intelligent Reasoning Systems, visit <http://www.marcush.net>

³ <http://www.microsoft.com/msagent>

3.1 Authoring scenes

While a broad variation of car sales dialogues can be automatically generated by means of a relatively small number of dialogue patterns, an approach for the automated generation of small talk dialogues (which would be interesting enough for a visitor to listen to) appears much more challenging. We therefore decided to rely on a pre-scripted repertoire of small talk situations, so-called *scenes*, from which the system would randomly choose one in off-duty mode.

A total of 180 different scenes were composed by one of the authors with experience in theater acting and directing. Some scenes cover themes related to everyday belongings, such as what to do in the evening, how to get home, or where to get cigarettes. Other scenes refer to the world of the theater or movies. So the agents may reflect on their stagecraft, or what to do professionally after the CeBIT convention.

The specification of such pre-scripted dialogues include special tags to control the agent's non-verbal behavior, such as gaze, gesturing, and body postures, as well as console commands (Section 3.4).

The gestures come from a repertoire based on empirical studies by Kipp (2001), modeled and rendered by a professional animator as a library of animation clips. To realize the two different postures (ready and off-duty) of the actors we had to produce two complete sets of animations for each character plus posture transitional actions.

3.2 Scene compilation

Authoring pre-scripted scenes is similar to writing a screenplay. A compiler has been developed that takes a written dialogue script (Figure 5) and converts it to a plan specification that can be processed by our dialogue planner. Scenes are represented as dialogue plans. When selected in the planning phase, the planner adds the corresponding scene to the overall script.

```
Scene: OFF-Chat stage-direction
... ..
Ritchie: [TINA AS_LookLeft] Ok, if you are
interested leave me your number.
[V_LookToCy]
Tina: Well, <Pau=300> ok.
[RITCHIE V_LookToActor]
Sounds ... great. [AS_Glasses]
I'll think about it.
Cyberella: [GS_Chide] My agent will contact you.
Ritchie: Yeah. Sure. [GS_DoubtShrug] All right.
```

Figure 5: An authored scene.

To define a pre-scripted scene, the writer has to specify the mode (presentation vs. off-duty, plus sub modes) and the name of the scene. During runtime, each time the system enters a particular mode; suitable scenes are

selected and executed. A scene is a sequence of dialogue turns of the three characters. Each dialogue turn specifies an agent's verbal and nonverbal behavior as a sequence of utterances with added tags for gestures, pauses, and TTS-commands like emphasis, speed- and pitch-control. In a turn, the author can also specify actions for the two listening agents (e.g. for realizing backchanneling, laughter etc.). The scriptwriter can indicate whether gestures should be performed simultaneously or if one agent should wait until another's action is finished. Furthermore, the scriptwriter can integrate system control commands (Section 3.4).

The dialogue compiler translates each scene into a dialogue plan. It also produces HTML/JavaScript-files, which allow the scriptwriter to preview the authored scenes. An example scene is shown in Figure 5. Every dialogue turn is converted to sub plans for performing actions (*play_anim*) or speech (*speak*). Actions are denoted by square brackets. If the first word is the name of an actor, the animation refers to him/her (*[RITCHIE V_LookToActor]*). By default, it is executed by the agent who holds the turn. Commands for the speech-engine are set in "*<...>*" brackets, e.g. a pause of 300ms as "*<Pau=300>*".

3.3 Interweaving scenes and generated dialogue

The dialogue compilation process leads to a uniform representation within the action planner. Both the dialogue strategies of the IMP system and the pre-scripted scenes are encoded as dialogue plans in the CrossTalk domain. This allows a smooth interweaving of pre-fabricated material with the car sales dialogues generated at runtime. We have used this feature in both off-duty and presentation mode.

3.3.1 Rehearsals in off-duty mode

In off-duty mode, the agents usually perform a random sequence of pre-scripted scenes (small talk). But they can also practice for their next performance. In such a "rehearsal", Tina and Ritchie start performing an arbitrary part of the car sales dialogue which is at some point interrupted by a *rehearsal crisis*: for instance, the actors start arguing about pronunciation or the correct version of a text passage. Afterwards, the rehearsal continues. Technically, a rehearsal consists of a chunk of generated car sales dialogue where a pre-scripted scene, the rehearsal crisis, is inserted (Figure 6 shows one sample rehearsal).

Rehearsal crises can be inserted into rehearsals in a *fixed* or a *generic* manner. Fixed rehearsal crises require a specific context, e.g. the "Slang" scene starts with Ritchie saying "How much horsepower has this heap?" which leads to a dispute with Cyberella who insists on using the non-colloquial word "car" instead. To be applicable in the planning process, the system has to provide the proper context for this scene, namely

that Ritchie is the buyer and not the seller, that he is impolite, and that the attribute "horsepower" has not been mentioned before. This is done by setting the relevant parameters (role and politeness) for each agent before starting the dialogue planner. Figure 6 shows an excerpt of a generated dialogue plan in which the dialogue strategies of the IMP system are displayed as white boxes. The highlighted box is the plan for the rehearsal crisis, a pre-scripted scene called "Slang" transformed by the dialogue compiler.

Generic rehearsal crises depend solely on the identity of the last speaker (Tina or Ritchie) and can be inserted any time into the rehearsal. In the crisis "Cut", for example, Tina interrupts the performance because she thinks that Ritchie's last text passage has been cut, and in the "Honey- Scene" Ritchie finishes his last sentence with "Honey" to tease her.

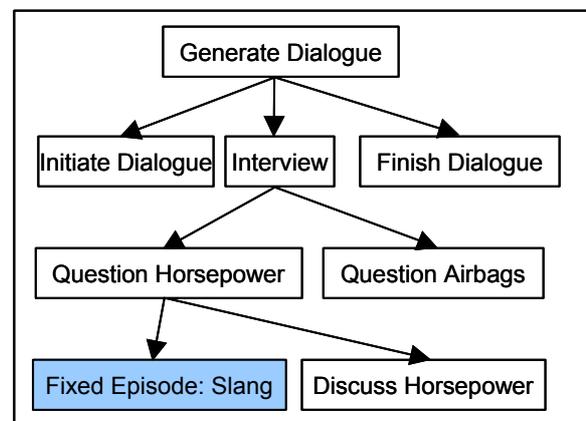


Figure 6: Excerpt of a generated dialogue plan with rehearsal crisis (highlighted).

The underlying control mechanism is quite simple. The system randomly chooses the number of turns after which the generic rehearsal crisis should be played. If, during dialogue generation, this number is exceeded, the respective dialogue plan is invoked.

3.3.2 Intermezzi in presentation mode

In presentation mode, performances are occasionally interrupted by intermezzi. For instance, the two actors may forget their lines, the lights may fail (screen turns black) etc. The purpose of these intermezzi is to underline the meta-theatrical flavor of the installation. The intermezzo takes the human visitor by surprise as Tina and Ritchie step out of their designated roles and reflect upon it. This is supposed to raise the attention of the visitor and to increase the believability of our characters. Also, it is funny to see how Cyberella deals with these situations. After all, she is the stand hostess and thus responsible for the presentation, so we expect to see an emotional reaction (e.g. blushing) from her when something goes wrong. Technically, intermezzi are treated by the planning component in the same way as generic scenes in off-duty mode, i.e. they are played after a randomly chosen number of turns.

3.4 Scripting the user interface

During presentation mode visitors can interact with the CrossTalk characters via guided menus on a touch screen. Depending on the state of the presentation, an appropriate menu is displayed, i.e. during the car sales performance the user can give positive (“Applaus”), or negative (“Buhh!”) feedback, or may request additional information (“?”) of what is going on (Figure 7).



Figure 7: Feedback menu during the presentation, displayed on the console's touch screen.

To enable an author to script complex user interaction scenarios, the scripting language was extended by a set of system control commands. The set contains commands for displaying CrossTalk backgrounds on the different screens. These backgrounds can contain multimedia content like menus, images, and animations. HTML/Flash5 is used for programming the CrossTalk backgrounds. For display, we use MS Internet Explorer 6. In addition, action/reaction templates are defined for processing the user feedback. Each action/reaction template is defined as a sequence of *active elements* (buttons, clickable images,...) and associated dialogue plans. Figure 8 gives an overview about the system control commands.

```
[SET-Screen <screen> <html-file>]
<screen> := {IMP, Cyberella, Console}

[A-R-Template <screen>]
{<active element> := <plan>}+
<timeout>:= <default plan>]
<screen> := {IMP, Cyberella, Console}
<active element> := button, clickable image
```

Figure 8: System control commands.

For example, authors can have Cyberella ask the visitor a yes/no question, and specify which scene should be played in case he/her presses the respective buttons. He can also specify a default scene, which is played, if there is no response within a certain period of time. This gives the visitor the impression that Cyberella takes back the initiative on her own.

The system control commands extend the author's creative possibilities and support the illusion that the

characters have full control over their electronic environment.

4 First Impressions

CrossTalk was presented at the CeBIT convention and at Girls' Day⁴ where we were able to observe some interesting reactions of the visitors:

- Most visitors found the installation entertaining, some of them spending more than 15 minutes to watch the characters.
- Visitors observing the characters in both off-duty and presentation mode reported that watching the characters doing small talk was more interesting instead of listening to car sales dialogues. This was not really a surprise, since the off-duty scenes contain jokes and personal comments.
- The cross-screen conversation between Cyberella and the actors Tina and Ritchie achieved a high level of believability. Consequently many users assumed that they could give verbal responses, when prompted by Cyberella. This situation even occurred in cases, when visitors were explicitly told that feedback could be given via the touch screen only.
- Designed as an installation for a public space, CrossTalk did not only attract faire visitors to interact with the system but also stimulated conversations among the stand visitors. From this perspective CrossTalk served a similar purpose as the AgentSalon system developed by Sumi & Mase (2001).

Though, no formal evaluation of the system has been carried out yet, the above-mentioned observations are encouraging. The interweavement of the two modes obviously increased the entertaining value of the system and served its original purpose to attract visitors to the DFKI booth at the CeBIT convention.

5 Conclusions

In this paper we have introduced a meta-theater metaphor, taking forward the “computers-as-theatre” paradigm that has been introduced by Brenda Laurel (1993) and since been applied by others too, e.g., by Hayes-Roth & van Gent (1997) and Klesen et al. (2001). We rely on the meta-theater metaphor as a means to raise the visitor's attention and to enhance his/her interactive experience with animated presentation agents. We applied the metaphor for the realization of a novel presentation system by combining two existing systems with animated characters. The characters constantly switch back-and-forth between off-duty and presenta-

⁴ An initiative by the German Ministry for Education and Research for girls, age 10-18 years, to learn more about technical careers, visit <http://www.girlsday.de>

tion mode. Within the scenes in off-duty mode, the characters discuss and reflect upon their own performances in presentation mode. We consider this a natural way for combining theater and meta-theater.

CrossTalk was originally developed for the CeBIT convention featuring a German audience. Therefore all pre-scripted dialogues and text templates are written in German. A preparation of an English version is currently under development. Further extensions of the system address the user interaction. The next version of CrossTalk will enable users to change parameter settings for the characters at any time. This challenges the characters to smoothly adapt to the new settings within a performance. In addition, we aim at a more sophisticated exploitation of the meta-theater metaphor. One approach is to collect context knowledge during the interactions. The observed interaction patterns can then be classified by the system and used to trigger sub dialogues during small talk, e.g. sub dialogues that reflect upon the user's interaction behavior.

To prepare the ground for formal evaluations we plan to integrate internal logging of potentially interesting indicators such as interaction duration, frequency, and distribution. Another line of thought is to let Cyberella question the user with regard to various aspects of the system (a guided questionnaire). The evaluation hypotheses will concern the effects of the off-duty mode on believability and user attention.

Acknowledgements

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