Supporting Autism Therapists: Co-designing Interventions

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Abstract
In this paper we report on the design of a support system for autism therapists. The system was co-designed with a team of therapists working with autistic children and supports session management and data collection and analysis. It is integrated with a storytelling interactive environment in the context of improving the social skills of children with Autistic Spectrum Disorder. Preliminary results show the potential advantages of such a system for the therapists' work.

Author Keywords
Austim therapy; Interactive stories; Participatory design

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K.4.2 [Computers and society]: Social issues.

General Terms
Design, Human Factors

Introduction
Autism therapy is usually a very comprehensive undertaking, involving a child's family and a team of professionals. Each autistic child has different needs and strengths. A range of different therapies have been employed targeting specific conditions, and, typically, autistic children receive treatment to more than one

condition. Each case being truly specific, translates to different treatments that need to be tailored by the therapists involved.

The range of variables involved make this a very complex process for the therapists. Their activities comprise preparing interventions, following the child's evolution, collecting and analyzing data, communicating with the parents, coordinating with educators, discussing with fellow therapists, etc. Yet, most of these activities are still mainly supported by pen and paper [3]. While technology has been used in the autism context for some years, it has focused almost exclusively in helping the autistic children, mainly through games [2]. The therapists themselves could also benefit greatly from the support technology can offer, in their information acquisition, searching, retrieval, archiving and sharing tasks.

While there are general tools (e.g. note taking applications, communication tools, etc.) that can support individual needs, and some therapists do use them, there is no support for the complete therapy workflow. Moreover, there is an absence of tools to support the therapy sessions – their preparation, running, and analysis.

For the past year, we have been working with a team of autism therapists towards understanding their requirements with the ultimate goal of designing a system that supports their work processes, and by supporting or freeing them from some of their current tasks, allowing them to devote more time to the children. The approach we adopted consisted in jointly designing a system for social skill development, that would be used in the context of therapy sessions. In this paper we report on the design efforts and results from a preliminary evaluation where the system has been used in seven therapy sessions.

Related work

Technology is no stranger to autism therapy and to therapy sessions [5, 4]. Different technologies have been used in different autism interventions: video, virtual reality, mobile devices, interactive tables, robots, avatars, social networks, etc. Some of these have seen more usage in the context of therapy sessions, while others have been explored outside of the sessions' context. Video has been the technology most used [4] because of its ability to address a large range of interventions, and the relative ease with which therapists are able to work with it. Other technologies require development or configuration skills that therapists hardly possess.

However, technology use has focused almost exclusively on the children. Therapists have to manage large amounts of data relative to the children and the interventions they have administered [3], making them a target user group that could reap real benefits from supportive technology. Albeit systems exist that collect data from interventions [6], therapists are still missing a system that could help them manage the complete workflow of preparing and managing sessions, and collecting, processing, analyzing and sharing data.

Supporting autism therapy sessions

To design a system that addresses the needs of therapists, we opted for a participatory design approach. A total of seven therapists collaborated with us, with different levels of involvement. Two of the therapists had frequent meetings with our team, and contributed heavily to the design. The remaining therapists participated less frequently, being involved in early focus group meetings, specific control points throughout the project's life cycle, and the preliminary evaluation activities. Almost all meetings took place at the therapists' institution, which

allowed us to gauge the physical space and understand the mobility requirements. The early meetings focused on requirements collection. We then begun an iterative process, with each iteration focusing on improving current features or incrementally adding new features. Therapists contributed heavily to feature design and assessment during this process. In the following we describe the concept behind the system and how it was implemented.

The concept
Following the therapists' lead, we opted to focus on supporting social skills development. From the range of possible activities to address (e.g. establishing eye contact, choosing the correct stance, etc.) we initially focused on teaching social interactions that require gestures (e.g. waving goodbye, shaking hands, etc.) and later added additional mechanisms for evaluating knowledge about social interactions.

Figure 1: The session manager interface.

Figure 2: Editing one scene from a story.

One of the techniques used in therapy sessions is storytelling [1]. We also based our system design on the concept of interactive storytelling. An interactive story consists of one or more scenes. We have partitioned each scene in 3 parts. The first is the *introduction part* where the social skill being taught is introduced. This will be based on a video or an animation showing a story leading to a point where the social skill is to be exercised.

The scene follows with the *activity part*. In this part the child is expected to conduct or reflect upon a social activity. The therapists' aim in this part is to be able to assess the child while performing the activity. The system needs to collect performance data and the therapist's assessment of the activity, to enable progress monitoring and other evaluation reports. During the activity, the system should continue to accompany the child either through instructions (e.g. a video of a gesture being executed) or context information to enable the child to answer questions about social situations.

The scene ends with the *feedback part*. The aim of this part is for the therapist to provide feedback to the child based on what has been done in the activity. The therapist should have the possibility to configure the feedback given. The feedback should act as reinforcement, positively prompting the child to perform better. For instance, a child might not perform a gesture correctly, but it might still be an improvement over what the child was able to do before. In that instance, the therapist might give positive feedback to encourage the child, even if the gesture was not performed correctly. Technically, the feedback can consist of another video or animation.

System design
In order to put the interactive story concept into practice, we needed to support two main activities: story creation and story presentation. This lead to a system with the following modules: story and scene creation; story presentation; therapy session manager; and a backend storing all the information and connecting all modules.

The session manager (figure 1), besides allowing session scheduling, allows the therapist to assign a story to a therapy session. If the story does not exist yet, or the therapist wants to change a story, the *story creation* module (figure 2) can be launched from the session manager. To create stories we had to consider several requirements: every part of the scene might include videos or animations; the process of composing scenes and stories should be simple, because therapists do not have knowledge of video processing or animation creation; even though every child will have interventions designed specifically for him, scenes and stories should be easily reusable and easily modified.

We have designed and explored several interfaces for story and scene creation. All that involved any type of video or animation manipulation proved to be too complex for the therapists. Still, we learned that therapists knew clearly what they were looking for, and were often capable of finding the needed content in different sources (e.g. youtube for videos). Consequently, the scene editor loads video or animation files that are already stored on the therapists' computer drive or makes use of the ones that have been previously uploaded to the backend.

When a session is about to start, the therapist can launch the *session presentation* module from the session manager. This module supports two views, coordinated in two different browsers (that might run on two different devices). One is the child view, where the multimedia contents are presented. The other is the controller view, where the therapist controls the flow of the story.

When designing the story presentation interface the main challenge was to provide the control needed by the therapists in a way that does not disrupt the flow of the therapy session. Given that most contents to display are multimedia contents, we followed a multimedia controller approach, with standard play and pause commands. While this provided some level of control, there were additional requirements. Because some children will be distracted during the session, and others may not understand with a single viewing what is requested from them, the control panel includes a replay command. Additionally, because the child's performance during the session cannot be foreseen, and it might lead to blocking situations or delays, the control panel also includes a command to stop a story at the end of any scene and not just at the final scene.

The two different activities supported required different designs for the activity part of the scene. For the gesture recognition activity we initially considered using an automatic gesture recognition system. However, the therapists expressed reservations regarding having an automated system assessing the gestures performed during the sessions. There were two main reasons. First, some scenarios present difficulties for automatic recognition. The therapists had strong reservations with the possibility of having both false positives and false negatives, as they could severely hinder the experience children had with the system. Second, even gestures that are not correctly performed can be judged to be positive evolutions regarding what the child was able to previously perform. This kind of evolution is important knowledge for the therapist, but difficult to collect with an automatic recognition system. As a result, the presentation interface is capable of operating with and without the recognition system. Even when present, the therapist always has the power to override the recognition system decision.

The second type of activity involves assessing the child's social skills in different situations. This is usually assessed through a series of questions and challenges. The story presentation interface, for this type of activity, allows the therapist to register the performance of the child in each question. Furthermore, the therapists requested flexibility to add new questions to the questionnaire during the intervention. This means that the functionality to add questions is present not only during story creation but also during story presentation.

The final part of the scene presentation is responsible for providing feedback to the child, which offered us the possibility to explore gamification concepts. The goal is to increase the children motivation to correctly employ socially relevant skills, by encouraging them to improve on their prior performance. According to the therapists, this

Figure 3: An individual session with the child's view on the monitor and the therapist controlling the session with a tablet.

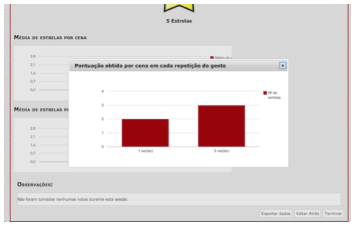

Figure 4: Graphical visualization of a child's performance data.

concept can be valuable to motivate autistic children, but only for older children. Younger children are not able to grasp the concepts associated with scores and performances. We incorporated gamification concepts optionally, with the therapist deciding to use them for specific children. Given the target audience we incorporated very simple mechanisms. The more basic variation just presents a score between one and five stars for each scene. More complex variations include presenting a score for the whole story (adding each scene's score), and presenting scores across sessions.

Data collection and presentation
The system collects all session data. This includes: the number of times the therapist *paused* the session, and when each pause occurred; the number of times content was *repeated*, and when each request for repeating occurred; and the child's performance as classified by the therapist (and the gesture recognition system if being used). All information is tagged with the time it was generated. Additionally, the therapist can create annotations at any time during the session. These annotations can store whatever information the therapist deems necessary and that might be important to interpret some of the data collected (e.g. the reason why the therapist needed to repeat some content).

The collected information is available for the therapist to consult during and after the session. This allows the therapist to assess the evolution of the child across several sessions. Graphical visualizations of the child's performance allow the therapist to check on the evolution of the child (figure 4), and to compare the evolution of different children, which might help assessing the efficiency of different interventions.

Preliminary evaluation results

Before starting a more extended trial we performed a preliminary evaluation of the system. During this evaluation, the system was used in 7 sessions, with a total of 7 children. Two of the sessions were group sessions, with three children. The remaining five sessions were individual (figure 3), two with the same child, and the other 3 sessions with different children. The children's age ranged from 3 to 10 years old. They were six boys and one girl. The participating children were selected by the therapists. Their parents were informed about the objectives of the project, and signed a consent form. Two of the sessions were based on the gesture recognition activity, while the remaining were based on the social behavior rules questionnaire. In six sessions the controller device was an Android tablet. In the other, it was a PC.

We tried to assess the adequacy of the system for use in the context of a therapy session and its impact on the levels of interest of the children. One of our team members was authorized to attend two sessions, and could collect in-situ data from observation of the use of the system by the therapist, as well as the child's reaction to the interactive story presentation. After the sessions we conducted a post session walkthrough with the therapist, and a short interview with the child (conducted by the therapist).

All therapists were able to use the available features without any problems. The single exception was the annotations feature, used by only one therapist. The justification for this was that writing the annotations on the tablet keyboard was considered too cumbersome, and it would break the flow of the session. Therapists did mention that if they were able to input the annotations with their fingers or a stylus they might have made use of

the feature. The tablet's mobility, allowing the therapist to move freely inside the session's room, was also appointed as an added benefit.

Regarding the impact on the sessions flow, the therapists expressed a very positive opinion. They reported higher levels of interest, motivation and attention from the children, because of the introduction of a new technological apparatus in their work practice. Children became more interactive with the technology, not in a way that isolates them, but in a way that made them more communicative (with the therapist or other children in the group sessions). The children did not show any signs of stress caused by the introduction of this system. They all reported to enjoy the new tool.

We found that therapists would now like the system to offer an even greater level of flexibility, supporting different endings to a story, customizable by the children.

Conclusions and future work

Autism therapists manage large amounts of information while running sessions and interventions. Mostly they do this without support from any IT tool. In this paper, we report on the period of one year, where we worked with autism therapists to design a system that could help them manage therapy sessions. Currently we are preparing a longitudinal study, where the system will be used for several months in therapy sessions, which will allow us to evaluate its effects both on the therapists work and the intervention results on the children. The work so far has opened additional intervention possibilities. One that is being considered is to employ automatic gesture recognition to support children exercises in contexts without the presence of a therapist (e.g. at home) based on remote sessions configured by the therapist.

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