

# Development and Evaluation of emotional Interface Agents in Training of learning disabled Children

Yehya Mohamad  
Carlos Velasco  
Holger Tebarth

[Fraunhofer Institute for Applied Information Technology (FIT.LIFE)] Schloss Birlinghoven, D53757 Sankt Augustin  
[yehya.mohamad@fit.fraunhofer.de](mailto:yehya.mohamad@fit.fraunhofer.de) [carlos.velasco@fit.fraunhofer.de](mailto:carlos.velasco@fit.fraunhofer.de) [holgar.tebarth@web.de](mailto:holgar.tebarth@web.de)

**Abstract:** Adaptive User Interfaces are an important success factor for the development of information and communication systems and, in particular, for those subsystems where interaction with end-users is critical, like therapeutical and training systems. Current adaptive interfaces are based upon user and device profiles. The social awareness as recognition and simulation of emotions are not integrated. We present research projects trying to studying the possibilities of raising the social awareness of information systems.

*Keywords:* emotional interface agents; skin conductivity; learning disability; evaluation

## 1. INTRODUCTION

We present our work on recognition and response to user's arousal states in a therapeutical context for learning disabled children. It adds a new powerful tool for the development of such adaptive systems by analysing the arousal states of the user with non-invasive biofeedback sensors. The recognized arousal state is then used to adapt the computer interface upon it.

## 2. INTEGRATING EMOTIONS INTO TRAINING AND THERAPEUTIC SYSTEMS

Under the scope of our projects (TAPA and IPCA ), we have developed an approach to recognize user's emotions, integrating and using them together with other parameters to personalize training units. The main focus was on the development of a model to assess the recognized emotions and to combine them with other parameters to adapt the training units to the actual user's motivational level and the context of use.

We have used Interface Agents at the user interface side to complement the emotional system to convey emotional expressions to the user. Furthermore, they can play a role in increasing the motivation level of the user. The interface adaptation can be enhanced using the described emotional system. In our framework we have evaluated the following input technologies: touch-screen, speech recognition, mouse, keyboard, skin conductivity sensors, diverse virtual input options via GUI buttons, questions through the interface agents (generally from the user interface), and behavioural monitoring through a psychologist.

## 3. THERAPEUTIC SYSTEM AS A STORY IN AN ANIMATED WORLD (TAPA)

Virtual environments such as training simulators and video games do an impressive job at modelling the dynamics of the physical world, but fall short when modelling the social dynamics of anything but the most impoverished human encounters. However, the social dimension is at least as important as graphics for creating engaging games or effective training tools.

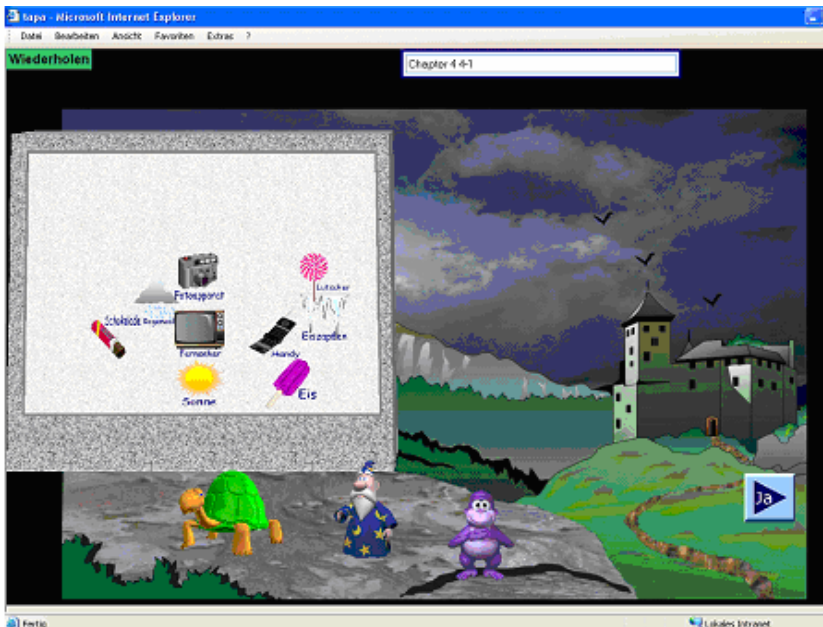
The presented framework has been implemented in a prototype, considering the aforementioned social awareness with the following components:

- Pedagogical interface agents [4];
- A story played in an animated world, where the training units are encapsulated;
- Emotional monitoring and response components.

The prototype has the following characteristics:

- Task/goal oriented: e.g., if the agent wants to give a reward to the user, it would not be very helpful to display sadness but to display happiness.
- Environment influence: e.g., if something happens suddenly it would be suitable to be surprised and to show an appropriate behaviour reaction.
- Personality: every agent has its own character, so the emotions should follow an individual personality concept.
- Time: synchronization is a very important issue, since we are dealing with many agents simultaneously; the behavior of each agent must be adequate to the behaviour of all others at that moment [6].

### 3. EVALUATION



**Figure 1:** TAPA GUI screenshot

The developed software Training with Animated Pedagogical Agents (TAPA) [5] presents a special training environment for children with cognitive impairments see [figure 1].

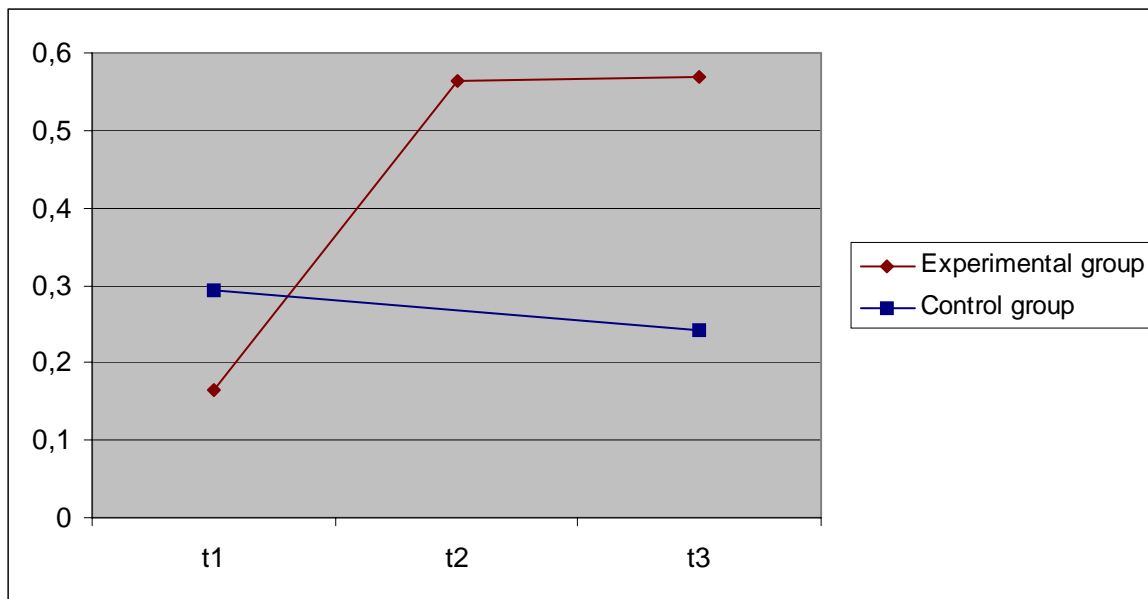
We involved in this study 71 students between 9 and 14 years at a school for learning disabled children, comparing a TAPA-treated group with a non-treated control group. The intention was to examine the effectiveness of the training as well as the functionality of the bi-directional communication process between the agent and the user. The main aspect of the cognitive training is to impart a special meta-memory strategy which is called "categorical organisation". It is known that this memory strategy as one of many is spontaneously shown in the age between 9-11 years in "normal" cognitive development. If world-knowledge and ability to think in abstract terms increases, then children begin to recognize the possibility of categorization of objects. This ability belongs to the so-called meta-cognitive performance and is used instinctively in different learning situations. Children with learning disabilities do not develop these strategies in time and that is one reason why they are often affected by memory impairment.

Psychological research has shown that it is basically possible to coach these children effectively and to give them a chance to improve their learning situation. But to be successful, it is especially important for disabled children to give them an individual motivational support.

Considering these requirements, we combined measurement of skin conductance with self-report-tools and learning performance of the user to define several algorithms expressing the child's motivational situation and deriving TAPA's reaction. Measurement of the skin conductance shows the user's psycho-physiological arousal status, and allows concluding indirectly the effectiveness of the learning process. It can be postulated that a status of relatively medium arousal is ideal for learning situations. Over and under medium arousal should be avoided. Self-report-tools ask the child for the fun or pleasure it has felt while fulfilling the tasks and allow starting a 'repair'-communication in the case of variant input data.

The TAPA system's reaction is basically in two different directions: 1. tasks difficulty decrease or increase in three ways (number of objects and categories, clearness of categories) and 2. the agent's behaviour. Following the individual algorithm the agent intervention is used to influence the child, regarding psycho-physiological arousal and motivational situation. For this purpose the little life-like characters are equipped with several emotions expressing behaviour sequences and natural speech engines. The memory performance of the group which has

trained with TAPA shown a significant improvement in comparison to the memory performance of the control group see [figure 2].



**Figure 2: Memory performance results of the training**

Results of the study give as a whole an interesting idea of the possibilities of animated agents as special pedagogical support. Next to the successful teaching of a meta-memory strategy to teach disabled children, it could be shown that it is possible to influence the user's motivation status via agent's behaviour. The study results allow concluding that animated pedagogical agents can play a valuable job in future assistive technology.

## Conclusion

Although these results seem to be very promising for the developed approach, further and more complex evaluations are planned to strengthen the technical integration of physiological emotion measuring. We are planning to conduct more evaluation rounds with an enhanced system. Further examination appears necessary to clear the precise role of agent's motivational support in the learning process.

## References

- [1] Ball, G. and Breese, J. (2000). Emotion and Personality in a Conversational Agent, pages 189–217.
- [2] D. Goleman, Emotional Intelligence, (1995). Bantam Books, New York
3. McCrae, R. and John, O. (1992). An introduction to the five-factor model and its implication. Journal of Personality, pages 175–215.
4. Microsoft Agent Software Development Kit (1999). USA, Redmond Washington.
5. Mohamad Y., Tebarth H. (2001). Evaluation in the Development of a tele-medical Training System. Universal Access in HCI: Towards an Information Society for All. Volume 3 of the Proceedings of HCI International 2001. New Orleans: Lawrence Erlbaum Associates
6. Mohamad Y., Hammer S., Haverkamp F., Nöker M., Tebarth H. 2002. Evaluational Study: Training with Animated Pedagogical Agents. ICCHP 2002: 117-124
7. Ortony A, Clore GL, Collins A (1988). The Cognitive Structure of Emotions. Cambridge: Cambridge University Press.
8. PERLETH, C. (1992). Strategienutzung, Metagedächtnis und intellektuelle Begabung (Dissertationschrift). München: LMU
9. Picard R. (1997). Affective computing. The MIT Press.
10. Picard R. (2000). IBM Systems Journal, Volume 39, Numbers 3 & 4, MIT Media Laboratory
11. Prendinger H., Ishizuka M. (2002). Evolving social relationships with animate characters. Symposium of the AISB-2 Convention on "Animating Expressive
12. SHAW E, GANESHAN R, JOHNSON WL et al. (1999). Building a Case for Agent-Assisted Learning as a Catalyst for Curriculum Reform in Medical Education. In: Proceedings of the International Conference on Artificial Intelligence in Education. Marina del Rey (California/USA): University of Southern California, Center for Advanced Research in Technology for Education (CARTE)