A Challenging Design Case Study for Interactive Media Design Education: Interactive Media for Individuals with Autism

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Abstract. Since 1999, research for creativity triggering education solutions for interactive media design (IMD) undergraduate level education in Yıldız Technical University leaded to a variety of rule breaking exercises. Among many approaches, the method of designing for disabling environment, in which the students design for the users with one or more of their senses disabled, brought the challenge of working on developing interactive solutions for the individuals with autism spectrum conditions (ASC). With the aim of making their life easier, the design students were urged to find innovative yet functional interaction solutions for this focused user group, whose communicational disability activate due to the deficiencies in their senses and/or cognition. Between 2011 and 2012, this project brief supported by participatory design method motivated 26 students highly to develop design works to reflect the perfect fit of interaction design to this challenging framework involving the defective social communication cases of autism.

Keywords: Autism, Interaction, Design Education, Innovation, Affordance.

1 Introduction

Research and design studies on assistive interaction design solutions for individuals with autism have been very popular for the last 20 years [1,2,3]. Autism is a disorder, which adversely affects individuals' cognitive abilities such as changing the perception mechanism, social communication abilities, recognizing and making facial expressions. Today's interactive technologies are on the verge of changing our lives by making the devices invisible so that we interact with them seamlessly and in a more natural manner. Many of these issues fall into the interests of interaction design field that works on the interaction between people-people or people-machines. Moreover, attentive user interface (AUI) studies [4] are looking for smart systems, which watch for people's needs and serves the information whenever needed. We believe that this

A. Marcus (Ed.): DUXU 2014, Part IV, LNCS 8520, pp. 185–196, 2014.

is potentially a sign of hope for individuals with autism. If we can design interactive experiences, which help IWA to be more naturally involved in everyday life in schools, offices, nomadic spaces, then we can all learn more from these experiences as well.

From another perspective, the facts mentioned above create very constructive design and design research challenges in relation to the creativity triggering exercises [5] Being related to lateral thinking ability of the designers and design researchers, making use of rule breaking methods by putting obstacles on the designer's way and presuming the users senses as disabled as a result of an environmental factor [6,7,8] has been used as one obstruction method. From this perspective, the features of autism may also be seen as challenging, and thus, valuable obstacles for design researchers and can be evolved as a particular case study along with interaction design students in studio classes where they can ideate, sketch and prototype interaction design solutions.

This paper shares our experiences from these studies we conducted with 26 students in 2011-13 concerning this case study of designing interactive solutions for individuals with autism in order to make their daily life easier. We used participatory design approach with the collaboration of professionals who are experienced in living with individuals with autism instead of working directly on autism. The studies were naturally directed into 3 different approaches: (a) wearable/tangible mobile; (b) spatially augmented; and (c) spatially organized interaction design solutions. The insights placed forward within this paper reflects how they are affected from these three different approaches and what kind of ideas came out of these exercises. Inline with our previous claim that disabling situations contribute to IMD education [5], we also believe that after this experience, autism and interaction design will work very well together in the near future.

2 Background

In this section, we will first discuss how the technology has been involved in autism related solutions in previous studies. Then we briefly discuss findings on affordance in relation with particular users with autism. Finally, we point out the similar approaches in design education in which autism is considered as a problem space.

2.1 Design Oriented Solutions for Autism

For the last 20 years in design practice, autism awareness has gradually been increasing within the design related fields such as architecture, visual communication, industrial product, and HCI. Architects explore guidelines for building autism-friendly living, working and education spaces. Psychologists and graphic design researchers focus on visual perception and representation methods. Industrial design domain discusses the tactile abilities of IWA and develops tangible solutions. As being one of the broadest inter-disciplinary domains of today, HCI researchers have also been leaning on this subject [9, 10]. IWA may lack abilities for planning actions [11], following social or one-to-one communications [12, 1], understanding facial expressions [13], cause-effect reasoning, and eye-contact [14]. In contradiction with above negativities, most IWA are good with structural information processing [15] and focusing on specific things such as mechanical systems. It is known that technology can help education, rehabilitation and daily life process of IWA [16] because the aforementioned features make them potentially good users of machines and technology [17]. But, when considering the fact that autism has a wide range of characteristics and effects regarding perception and representation abilities, smart and attentive interactive solutions aiming particular needs of different IWA cases should be developed [18].

Augmentative Alternative Communication (AAC) technology [19], is one leading method which uses visual or auditory messages to augment and regulate the intended communication. The emerging technologies in wearables, robotics and ubiquitous computing engage high potential for AAC studies. Furthermore, today we have the technological abilities to process the emotional states of people with motion and facial expression sensing technologies and help individuals understand emotions [3, 20] which can take the AAC subject to a next level. In one promising project, Kaliouby & Robinson [21] suggests a prosthetic solution; the "Emotional Hearing Aid", a system, which watches facial expressions of encountering persons and gives the information to the ASC individual providing feedback about facial expressions. However, it is also known that, ASC individuals don't like attachments in most cases. So we need further research on seamless technologies [22]. Another core focus for social involvement of IWA is about proximity information about socially challenged individuals. FeilSeifer & Mataric [9] used proximity information gathered through the observation of IWAs and robots to explore its effects on IWA. One of reasons why proximity is this important is that studies have shown that social involvement of IWA can be enhanced by the help of multi-user interfaces [14]. While some studied virtual reality (VR) solutions [23, 24, 2], some focused on and found positive effects of co-located collaboration using multi-user tangible tabletops [25]. Others also reached positive clues while exploring interaction with remote users through tangible interfaces [26]. Tangible interaction benefits affordance and hand-eye coordination abilities of IWA [22]. Moreover, most high functioning IWA can use tangible interfaces when written instructions, direct manipulation control devices, and keyboards are provided [27]. Based on the fact that Autism has an increasing worldwide prevalence [28], and HCI field is constantly developing more natural, intuitive, seamless and smart technologies every day, we believe that designing smart interactive user experience solutions for IWA is a promising topic within the area of IMD.

2.2 Affordance for Individuals with Autism

With above perspective, we've gone deeper into the subject of autism-specific affordance issues. One of the most important issues while designing a product that IWA are expected to use or interact in any way is the subject of affordance. In the physical world, objects communicate with the users. Healthy individuals, ones that are not suffering from ASD are supposed to predict how to use an object they encounter. Such clues that an object is giving out are called 'affordances'. Norman [29] implies that the idea of perceived affordances is that, when the designers expect the users to interact with an object -be it in real world or on a computer screen-, they have to make sure the users can easily comprehend, solve and understand what they can do with the object.

Yet, the designer has to be aware that the planned object and interaction scenarios might differ when a product is designed for IWA. Studies show that IWA may have a difficult time without the use of assistive equipment, when interacting with design objects and systems that are organized with metaphorical symbols, such as traffic systems, which healthy people may be familiar with [1]. This shows that metaphorical signs that are supposed to raise affordance may not work for IWA. On the other hand, many studies have shown that virtual environments that do not offer visual overload may be very well used by high-functioning IWA and may be used for reasons such as education or gaining various useful practices [23, 10]. Additionally, virtual reality is found to prove a safer environment for IWA, compared to physical educational spaces [1, 2]. As we mentioned above, IWA that experience communication difficulties with people because of their abnormalities in voice and face recognition [13], may easily embrace and adapt to control virtual avatars and puppet characters. They can get into interactions, which they may find difficult in real world, in virtual environments due to the high affordance that their visual resemblance to such avatars provides them.

IWA are known to have more success in using minimalistic interfaces that provide orderly and regular procedures, rather than multimodal interfaces that create cognitive overload [12]. IWA can also learn rules and restrictions of interfaces very well, as long as these are put clearly and not through metaphorical signs or speech [12, 1]. Also reward systems have proved to be useful in enhancing the educational level on IWA in such virtual systems [20]. Such reward systems also allow the IWA learn how to use more complicated interfaces. Another way to raise the affordance level for IWA is to design tangible interfaces and control devices that resemble real life objects [22]. While tangible interfaces are proven to be usable by IWA, the extents of what assistive designs can be made through such interfaces, is not researched adequately.

2.3 Autism as Problem Space for Design Education

Despite the presence of above summarized growing attention on autism among the whole design community and high relevance of autism's features for IMD education curriculum, we could not find any well-structured and rationalized attempt in the literature. At first sight, it is not hard to encounter examples in the architectural design education. Heylighen et. al. [30] proposes design expertise on disability as complemental for architects' multi-sensory qualities in architectural design and claim that they are focusing on autism as a case study in this sense. Tang and Hsaio [26] explains their experience about briefing interaction design graduate students on autism and collected insights from the students attended the studies, where they involved actual users for exploring user requirements. While they base their main objective on user involvement in a teamwork oriented studio, the influence on the autism case study is weakly considered in the paper. Island of ideas [24] is a collaborative virtual reality environment, which brings together students with autism; design students and researchers in order to develop user-centered design solutions with a participatory design approach. This ongoing study still questions if the creative and productive design research method called participatory design study, can also be used in studies with children with autism.

Autism research takes a very large share of worldwide research funding. Many universities all over the world have Autism related research groups and a significant amount of HCI research on Autism is being run. In 2011, Core77 and Autism Speaks Foundation have organized a worldwide design contest among undergraduate level design students. In contradiction with above facts, the results of focusing on autism as a case study in interaction design education had not been explored before.

3 Objectives

Our main objective in the study has been to draw upon the particular specifications of autism within the studio courses of IMD. Based on the previous findings in the literature, we believe that the specifications of autism listed above create very productive design challenges for interaction designers. We have been exploring "obstructive case studies" for triggering creativity in IMD education, and autism is promising to become the stage for yet another sophisticated case in the same manner.

With such goals in mind, we have been briefing IMD students with design challenges about autism. One of the priorities of our approach was to keep students from attempting to control or restrict the users' actions with their designs; but rather help others understand and interact with them, better. While we encourage the students to try to ease the life of individuals with autism, we also think this shouldn't be by trying to 'normalize' them from any point of view. This is not only because that the students don't study in a medical branch, but also we believe a designer should respect and try to enhance any individuals' features rather than limit them. Another criteria that we had advised the students to be sensible about was designing naturally usable interfaces (NUI), i.e. with high affordance, in order to stay away from trying to give detailed instructions to the users. This resulted in mobile, wearable, tangible or spatial solutions instead of graphical user interfaces (GUI) based applications.

As students began ideating on natural user interfaces (NUI), we wanted to take one step further to make them understand the variety of human interactions based on the performative skills of human body with respect to time and physical space. Originating from research, we have found out that visuospatial capabilities as well as spatial perception have not dramatically changed in IWA [1]. With reference to real objects and functions, the possibility to benefit from the use of solid and tangible user interfaces, was proved to be an effective way of helping with particular sensory features of IWA where the visual reference increases the affordance through the hand-eye coordination of IWA [22].

As the literature suggested, IWA may tend to suffer when they have to plan actions or make decisions and think for alternative solutions where these conditions trigger unexpected or inappropriate responses [11]. So we advised the students to base the spatial experience on a linear story with no alternative routes for navigation and no visual obstructions to provide informative and entertaining environments for IWA, especially for children, as the effects of this disorder begins in early childhood and persists throughout adulthood [14].

4 Method

The study mentioned above was conducted between 2010-2013 in the Department of Interactive Media Design of Yildiz Technical University with a total of 26 undergraduate students under design studio courses that focus on developing interaction design solutions for a variety of technological platforms, tools and user scenarios. Studio courses have been running with 4 hours studio sessions, 2 times a week, for a month. Although the outputs of each studio design course were different, general tendency to proceed could be defined from the steps given below:

Background Research: The students were advised to examine and investigate the information provided by movies, documentaries, interviews, the mission/vision and principles of associations concerned with IWA and autism disorder.

Disabling Environment Review: With the participation of experts on autism, the specific qualities and different behavioral aspects of IWA were discussed in order to understand the reactions they give to certain environmental factors, basic motor, emotional and cognitive tendencies and perceptual capabilities.

Assessing the Case Study Group: With reference to the investigation on different types of autism disorder, the students selected specific groups in terms of age and type, as their pilot group to work on.

Identifying the Problem: The problem was defined concerning the needs of IWA pilot group that does not refer to any prior psychiatric knowledge and existing tools, scenarios and technologies, which would not limit or prove disadvantageous for the individuals were discussed. Besides, the students were grouped to work on different technological platforms.

General Tendency for Design: The designed tool, service or application must be developed to ease the 2-way communication of the IWA with the outer world. While creating the automation in the design was favored, perceiving the designed tool as an exercise or a game is supposed to ease the use and increase the efficiency.

Preliminary Sketching: The students were guided to discover the different modes of interaction that would be beneficial for their projects. This process was important in order to discuss and dwell on the balance between the qualities of cognitive, emotive and motor skills that will be made use of. Meanwhile, they were also advised to take notice of the technological platforms. This process ends with developing alternative sketches for the combinations of the interface, interaction and technology.

Developing the Idea: Within this phase of the design studio, interaction scenarios were developed in parallel with the alternative forms in terms of activities, actions and operations [31]. This phase includes the detailed design and planning of interaction scenario together with maintaining the controls, movements and end results.

The interplay of action, interaction and controls were expected to be realized through the mapping correlations of the designs.

Evaluation: Experts from the area of autism studies and associations were invited for the assessment of the design works. In parallel with their experiences, the advantages and disadvantages of each design were discussed in parallel with the achievements of the design group.

5 Results

In parallel with the objectives and method proposed above, a variety of design problems were detected and design works with originality and versatility were obtained. It was interesting to see how each student perceived the disabling environment and disabling features of autism as an alien data set and reacted to find relevant solutions. As the students were used to solve interaction problems with complex information architecture, it was not easy for IMD students to understand how this user profile acts at the beginning of the design process. While some of the students focused on creating interactive solutions to transmit the physical conditions of the user profile, others tried to enhance the communicative skills of IWA using various tools and technologies. It became possible to separate them into 3 groups in terms of their physical specifications: (a) wearable and tangible mobile interactive (b) spatially augmented tangible interactive (c) spatially organized interaction solutions. Below we present some interesting student works based on this classification.

5.1 Wearable and Tangible Mobile Interactive Solutions

The project "Play Dough" by Yasemin Yıldırım (Fig. 1) addresses the mood changes of the children with ASC by a tactile sensor shaped as an ordinary looking play-dough. The dough senses changes in body temperature, sweat and hand vibration and reflects their mood by changing colors and shape, thus communicating with others. The dough also addresses tactile tendencies and changes in density according to the mood of the child to calm them when stressed or make them playful when happy.

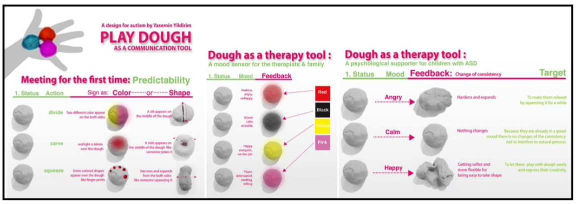

Fig. 1. Playdough (Yasemin Yıldırım, 2011)

The "Interactive Bracelet" project by Ozan Daniel Özışık (Fig. 2) consists of a wearable 2-way communication device for 3-6 year old children with autism. Firstly, the bracelet attracts the child by shining and vibrating whenever the child is called. Secondly it memorizes the child's specific movements before and during certain emergency conditions such as seizures, and contacts with the parents or nurse whenever these movements occur. In a third use, two children that are using the bracelet for a long time can communicate with each other by playing with their bracelets and changing colors of their companions.

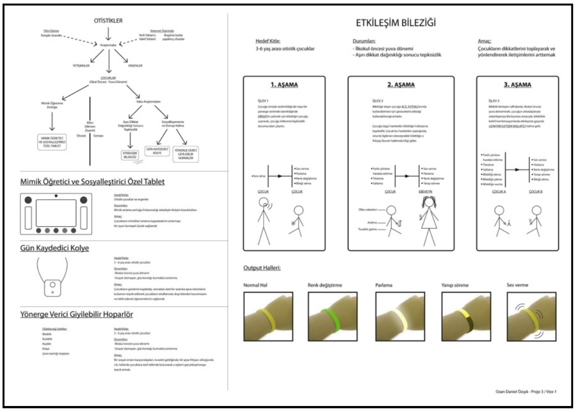

Fig. 2. Interactive Bracelet (Ozan Daniel Özışık, 2011)

5.2 Spatially Augmented Interactive Solutions

In her project (Fig. 3), Doğa Çorlu prefers to augment the proximity related information by mapping projected images on all surfaces. The objective here is to reflect the emotional states of each individual with and without autism within a room. Compared to previous suggestions, she explored different solutions where individuals might see or not see the projected visual messages with a different approach. For instance, when in a situation where the image should not distract IWA, image is projected at the back like a shadow or at the surfaces of the desk, which cannot be seen by the user, may be used to reflect emotional states.

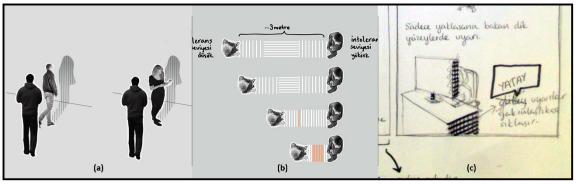

Fig. 3. Augmented Proximity (Doğa Çorlu, 2012)

In another spatially augmented interactive solution (Fig. 4), Gökalp Gönen projects abstract visual animation clues on surfaces or objects that visually inform the IWA about irregularities, warnings, and constructive clues. The main objective of the idea is to augment the environment according to the needs of the IWA in a natural way without putting physical obstructions in the space. This experimental idea explores if different visual representations can positively communicate with an IWA.

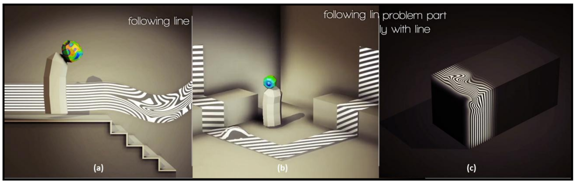

Fig. 4. Projected Assistance (Gökalp Gönen, 2012)

5.3 Spatially Organized Interaction Solutions

The design brief was based on the planning and design of a conceptual exhibition in a three-story building. This specific physical space was chosen as the working site so as to avoid linear configurations and storytelling and push the creative boundaries of students to find alternative combinations for the spatial configuration, interaction, navigational, storytelling and interface design solutions.

The interactive exhibition design project for children with autism (Fig. 5), by Mustafa Ahmet Kara named "Discrete Orchestra" focused on creating sounds by bodily interactions with tools and forming an overall orchestral music within the physical space. The tangible user interfaces of the tools were shaped with reference to the affordance design of original musical instruments. The information access tools on these tangible user interfaces were designed in an elaborated scale, so as to emphasize the affordance. Each instrument placed on different platforms connected by large stairs, the space was designed to be relaxing, distressful and transparent so as to prevent confusion, getting lost and becoming a challenge for IWA.

Fig. 5. An interactive exhibition for children with autism (Mustafa Ahmet Kara, 2011)

In his project named "Perceive" (Fig. 6), Berkin Nalbantli focused on the Gestalt principles of visual understanding and communication for the audience group of IWA with Asperger syndrome. Basic forms were used to explain how human buildings develop perception from childhood to adulthood, with matching interactions for IWA. One-way communication was favored with the touchscreens. In order to maintain the navigational and spatial unity, 3 floors were connected horizontally with ramps and vertically with a spiral that rotated in parallel with the action around it.

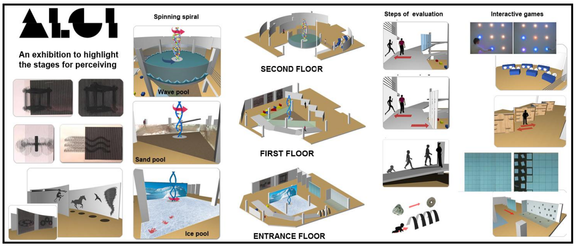

Fig. 6. An interactive exhibition for children with autism (Berkin Nalbantlı, 2011)

As a result, it is possible to say that, as the spatial connections and functional flowing of the interactions were supported by the storytelling, the navigational aspects of the designs were naturally solved within the physical space and was found to be successful in providing suitable physical conditions for IWA.

6 Discussions and Conclusion

In this paper, we share our insights from the experiences we had by briefing the IMD students with autism case study in their studio courses. This study has been a follow-up to our ongoing studies on teaching affordance so as to widen the students' creative limits while staying within the borders of accessibility. With this perspective, we wanted the students to explore the problem space relevant to interactive solutions for IWA where the features of the persona provides very valuable challenges and obstructions for the designer candidate in terms of the perceptual and mental models In order to adapt and understand the specific conditions of IWA, the students concentrated on specific problems for which they searched for attentive, smart, natural, and invisible real-life interventions using interactive media. The studies resulted in 3 different conceptual approaches in the end; (a) Mobile and wearable, (b) spatially augmented, (c) spatially organized solid solutions.

Solutions that can be categorized as "mobile and wearable" were less demanding, location-independent and partially seamless. Students tried to develop these devices as human-human communicators with the aim of avoiding the need for extra attention within the daily life of users, in addition to one other critical fact of bringing functionality to these devices to take-turn whenever needed, such as emergency situations. Consequently these designs didn't involve any form of screen. In a different approach, "spatially augmented" studies leaned on using the surfaces of the environment surrounding IWA and augmenting the environment by projecting interactive information on these surfaces. These smart systems watch for the needs and assist the communication between the co-located individuals. From the "spatially organized" interaction exercises, it was our experience to discover the potential of the solid user interface to give reference to predict the results of actions in terms of how things work. The students were able to create efficient conceptual models for the affordance design of information access elements with the appropriate use of form, sound and image. Moreover, based on the topological relationships structured in the 3rd dimension, students learned to consider the importance of the physical space to be an advantageous design element in order to shape the interactions naturally.

In summary, this has been a challenging and enlightening experience for both parties and the students with its rule-breaking results. We have seen that with the help of domain expert participation to the studios, students were very easily adapted to this challenging case study even though they were not familiar with autism beforehand. We also believe that they have learned a lot about affordance and accessibility due to many particular restrictions and special needs the autism case brings. However, it is too early to speak about the constructive results of our experiences for the student's education. We plan to run studies that question the effects for competence of students in design in order to further develop the structure of the case study.

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