What is so special about designing for special needs?

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ABSTRACT
In this paper, we explore opportunities for the IDC community to exchange and combine knowledge about designing for children with special needs and typically developing children. To do that we describe and discuss designs developed for social interaction of autistic and typically developing children and analyze how these may be suitable and appealing for the two different groups of children. Based on that we illustrate that it may be possible to (re)use designs in multiple contexts, if not just as they are, maybe by making some adaptations to the original designs, or by changing the age group recommendations. This is possible because all the designs are platforms on which multiple games and interaction opportunities can be built.

Keywords
Special needs, design for children, autistic children, social skills, open-ended play, user centered design.

1. INTRODUCTION

In this paper we examine how to bridge between designing for children with special needs and typically developing children with the aim to address the question to what degree we can support the IDC community better in sharing knowledge and extending the applicability of the interactive designs that are being developed for different user groups.

In a design process products are developed by taking the specific requirements, needs and values of the intended user group into account. In design for children with special needs this approach is especially important, because of the specificity of their needs. Guha et al describe how the role that children play may be influenced by the type of special needs [12].

There are some existing designs that are made both for children with special needs and typically developing children. For example, Brederode et al [9] developed a tabletop game, with the intention of having these groups of children play together.

Making a bridge between design for typical and special needs is important because of the following reasons: (1) the IDC community might be missing opportunities in looking at the applicability of designs for children with different abilities and needs. Developing a novel play object is time consuming and costly, so its usability could be designed for a complementary audience at the ideation and conceptualization phase. and the knowledge and designs would be wider applicable; (2) there might be opportunities to get inspiration by examining how children with diverse needs would and could interact with a designed object. (3)Yet another benefit is to see whether children with special needs can be involved in engaging play activities with their healthy siblings and peers. A common problem for autistic children for instance is that many have typically developing sibling, so games and objects that are interesting for both user groups will make possible the satisfying interaction of these children in families. (4) It may be possible to (re)use designs in multiple contexts, if not just as they are, maybe by making some adaptations to the original designs, or by changing the age group recommendations.

We will advocate our exploration by examining how four projects that we have been supervising may exchange knowledge and resources We describe and compare how a design for autistic children may be interesting for typically developing children, and how a design supporting the practicing of social skill may be applicable for autistic children. The comparison is done according to the following criteria:

- Physical design
- Interaction affordances
- Design of the games
- Targeted skills and behaviors

As an outcome we want to describe the way and the extent to which the design object can be used by the other group of children (i.e. special vs. non special needs).

2. Method

To explore the potential of our argument we will examine two designs each for autistic children and typically developing children of comparable play objects (designed by the authors and their students) used in a comparable game setting. The play objects and the games are comparable in the following way

- They represent an interactive light objects that express different behavior when making a virtual contact.
- These objects provide affordances as follows:
  - one child may explore the interaction between the objects
  - two children may use the objects to communicate/fight/connect
  - a caregiver or teacher may suggest (methaphoric) use of the objects and try to let the children interact.
- The games are built on an open ended play concept.
- The games aim at enhancing social interaction and physical activity

There a several questions that will be answered by the both evaluators: Would the toy have general appeal for typically developing children? What kind of games might they incorporate it in? What kind of skills would be required, and would they be able to practice with the each play object, e.g. physical, social, emotional and cognitive?

We perform and an informal expert review on play objects and the potential of the games that are created with them. Both play object/game combinations are created under the supervision of one of the authors. The first author will explore how designs, called the i-blocks and the Snakes made for autistic children may be interesting for typically developing children. The second author will examine how designs of interactive play objects called the ColourFlares and the Shuffle, for typically developing children may be interesting for autistic children. The authors read a paper about the designs, made an initial analysis and finalized the analysis based on a discussion of the considerations for appeal and suitable for the various use groups.

3. Design cases for autistic children: i-blocks and Snakes

A multiagent platform of interactive blocks [2][4][11] where the blocks are embodied objects with sensors and actuators that invite interaction with users through simple and natural physical interaction metaphors (Figure 5). The blocks emit colored light and interact when positioned in each other's vicinity. Depending on the algorithm that is loaded on each block at this moment they express a different set of local interaction behaviors that cause emergent collective behaviors.

The blocks can be used to make constructions with regular forms and precise positioning, which is appealing to the autistic children. The fascination of the autistic children for patterns and regularity makes the blocks an interesting toy for them. The emergently changing behavior of the i-blocks stimulates the explorative behavior of the autistic children [4]. We have chosen blocks with cubic shape and a size the can easily be grasped by a child, but still big enough to prevent single child to "occupy" all the blocks. This may encourage children to join their efforts in building patterns together or at least make the child allow others to add to his construction, like another child or a caregiver.

The overall behavior of the system of blocks depends on the local interactions, and therefore it forms an embodied multiagent system [2]. The complexity of the emerging behaviors depends on the complexity of the individual behaviors of the blocks. The technical details of the first stage of the development of this platform are described in [2].

The blocks were specially designed to fit the play habits and the patterns of thinking of the autistic children. Initial user tests as reported in [4][11] have shown that children find them very engaging and pleasurable. In general, the advantage of these blocks is as follows: (1) Direct manipulations of tangible objects can exactly be registered; multi-modal feedback can be provided. (2) i-blocks are suitable for training goal directed actions such as grasping and object manipulation. (3) i-blocks are relatively simple and reliable technological tools and can easily be connected to computers, robots and other media.

A variety of games was created with the i-blocks in which the children were enthusiastic and creative about playing with the blocks despite they normally do not show variation in play. The proposed method shows a potential in supporting autistic children in learning imitation and turn taking behaviors at a very early age, as summarized in the following observations. (1) Most of the children managed to imitate the play scenarios with the i-blocks and with the mobile robots. The children took part in turn taking by sharing the active block with the caregiver. (2) The video modeling showed to be a suitable way to teach the children understand and imitate the target behavior. (3) The stress levels of the children stayed lower than in actual social contact with new person, as observed by the coordinator and they could get well prepared for the upcoming scenario.

An open-ended play objects called Snakes that detect pressure and bending provoking colored feedback which can be communicated between the different Snakes were created. During different sessions children interacted with the Snakes in various ways, corresponding to their level of intellectual and social development. The opportunities for open-ended play that Snakes create were shown to mediate interaction between caregiver and child, so the caregivers could teach the children different social behaviors.

Figure 1: A child and caregiver playing with Snakes.

3.1 Toys for autistic children used for typically developing children

The design of the i-blocks and the Snakes have open-ended play opportunities. The Snake changes colour depending on which parts of the Snake is bending and how much it is bending. Furthermore, a special effect occurs when two i-blocks or Snakes come in close proximity of each other, such as changing a color. One block may color its neighbor and the colour may depend on the number of neighbors.

I expect that young children, of the age of 3 and upwards would have fun exploring the interaction opportunities by themselves, and use them in fantasy play. They could also use them in fantasy play with their parent. When they become better at collaborative play, around the age of 4 or 5 years old multiple children could play together in creating a variety of games, including fantasy games, or games like tag and hide and seek.

The functionality can be compared to a certain extend with that of the ColourFlare, in that the Snake can send the colour to another Snake. Children (aged 7-11) created tag and hide-and-seek games when playing with the ColourFlares as well [7]. The open-endedness of the Snakes and the i-blocks would support the negotiation process of what games to play and how to interpret the interactive behavior of the play objects.

Depending on the look and feel, the Snake may be seen as being too childish when children reach the age of seven or eight. A more colorful snake would be more appropriate for young children who still have a more magical and fantasy approach to thinking. A more realistic and possibly scary look and feel might be more appropriate for children of 7 years and above [1].

Involving typically developing children in the further evaluation and design process of the i-blocks and the Snakes, might provide inspiration for different functionality, and more detailed ideas for the look and feel of the Snake, such as material properties and visual features of the Snake. Other variations to the Snake and the i-blocks can be made by exploring feedback with different modalities, such as vibration and sound. We examined how different feedback modalities influenced the games that children create in a variation of the design of the ColourFlare called the Multi-modal-mixer. Previous research showed that different feedback modalities provide different opportunities for creating games [5]. This may enable both autistic and typically developing children with a wider opportunity for creating games.

4. Design cases: ColourFlare and Shuffle

The ColourFlare is an object that can detect whether it shaken or rolled. It provides feedback by changing its colored feedback. Children can explore how the ColourFlare responds to their own movements. Furthermore, children can allocate meaning to the different types of feedback, thus creating their own game rules and goals. The ColuorFlare was designed following a user-centred design approach where children provided input at various design phases [5,6,7].

The ColourFlare emits one of six colors at a time, chosen in random order. When it (see Figure 1) is rolled, its colored light changes to a different color. When it is shaken, the light starts blinking for five seconds. While the ColourFlare is blinking, it is able to transmit its color to another ColourFlare using infrared technology. The other ColourFlare then takes on the same color. The shape of the ColourFlare supports two purposes: it supports the sending and receiving function of the prototype and it causes the ColourFlare to move in a circle around the player, instead of in a straight line, which emphasizes the fact that it is intended to be a personal object.

Figure 2: Two children playing a collecting game with the Shuffle.

Another play object is called “Shuffle”, which supports trading games based on the collecting of a set of colored lights. All players carry a handheld device that contains 5 ‘slots’ that can provide different colored light feedback. The game is open-ended in the sense that only the interaction behavior of the devices is defined, it is up to the players to decide what goals they want to pursue. Examples of goals could be collecting one type of color in all five slots, or creating a specific color pattern on the Shuffle. If two players decided to trade (see Figure 2), they put the ends of their devices together; the colors start to blink after which they all move one place either clockwise or counter-clockwise. This means that after each turn players have received one color from the other player at one end of their device and have given away one color to the other player. Since the shape of the devices is symmetrical, the devices can be put together in two ways. Although the players don’t know in what direction the colors will move beforehand, they do know that they will lose one of the colors and the end of their devices and they can anticipate on this.

The game can only be played when players come together and decide to trade. Because of this constraint, we expect the participants to discuss their needs and ask each other for help often during the game. The multiple ways to position the devices can lead to negotiating between players. The buttons that hide and reveal the lights that can be traded to lead to situations where players will bluff about the colors they were hiding and start to negotiate about putting lights on or off.

Since the change from individual- to a group-oriented perspective just started around the age of 7 and lasts till about their 12th year, older children will have developed their use of social skills in groups much further. Therefore, negotiating is likely to be much more visible in play sessions with older children than in the ones with younger children.

User tests with children 16 children of 7 and 8 years old, and 8 children of 11 and 12 years old. The tests showed that children enjoyed negotiating about how to use the Shuffles, and to create a variety of goals for playing with them [7].

5. Difference in the gameplay behavior between autistic and typically developing children

With respect to the physical design the i-blocks and the Color Flare have similarities with respect to the Physical design and the Interaction opportunities. Alike similarities can be found between the Snakes and the Shuffle.

The design of the games for autistic and typically developing children differs with respect to:

1. The way the children play – while the autistic children tend to explore the collective behavior of the blocks and make effort to combine the play objects, the typically developing children perform much wilder activities and willingly choose to interact more through the objects. For the autistic children there are rules of the game that provoke the moments of social interaction. The typical children were less involved in deliberate exploration, but made easily use of the newly discovered (by chance) interactive feature.
2. Autistic children will stimulate the explorative behaviors of the children. The individual object as well as the collective behaviors of the blocks will be an object of exploration, judging from the behavior of the children as reported in [9].

3. The autistic children will probably not make a self-initiation in combining the play objects if this is not their task, but this is just an assumption, because all the tests we could perform with autistic children are based on a single child or at most two children playing with the interactive objects. The caregivers did not recommended a situation in which many children will play in the same room with the new toys.
4. While engaged in open ended play activity (i.e. no rules of the game were defined), the autistic children were more concentrated in the interaction possibilities with the objects and the moment of discovery of a new feature triggered experimenting with the object. The children were eager to share these discovery moments with the caregiver. In addition they were very eager to adopt new methaphors or the meaning of the play object within the new play scenario, thought out by a caregiver.

Overall we can conclude that the **e**xtent to which the design object can be used by the other group of children depends rather on the game than on the design of the object. The game has to be matched to the mental age and IQ of the children. By low functioning autistic children the games for younger typical children can be used. Highly intelligent autistic children can make use of more complex interaction patterns than the average typically developing child. In general the games for typical children that target social interaction can be used for autistic children with higher biological age.

6. DISCUSSION

This paper aims to start a discussion about sharing knowledge and sources of inspiration by examining possible bridges between requirements and needs of user groups within the special needs and of typical children.

We found that the **e**xtent to which the design object can be used by the other group of children depends rather on the game than on the design of the object. The game has to be matched to the mental age and IQ of the children. By low functioning autistic children the games for younger typical children can be used. Highly intelligent autistic children can make use of more complex interaction patterns.

Our examples indicate the wider applicability of the examined designs. It would be interesting to explore whether other designs of the IDC community have a wider applicability than originally intended.

What can we do to uncover this potential?

- In the design process incorporate an (in)formal evaluation with a different user group to examine opportunities for broader applicability of a design.
- Incorporate expert input for what (little) changes to the designs would increase the applicability.

We discussed example designs that focus on children practicing and applying social skills in the interaction with other children and or adults. We found a bridge between designing for autistic children and designing products that incorporate social interaction processes. We can imagine other 'bridges' between for examples, designing products for children with physical disabilities and the design of physical games for typically developing children.

In the workshop we would like to discuss the feasibility of the idea for autistic and other types of special need categories.

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