

## Motivating Children with Autism to Communicate and Interact Socially Through the “+me” Wearable Device

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## 1. Introduction

Autism Spectrum Disorder (henceforth ASD or simply autism) is increasingly considered a *pervasive neurodevelopmental disorder* responsible for *social impairments* (AA.VV., 2011; Al-Qabandi, Gorter, & Rosenbaum, 2011), *certain types of dysfunctional repetitive behaviors*, and *impairments of the ability to communicate* (American Psychiatric Association, 2000). Here we focus in particular on the support and development of social competence in children.

The attention on design for children with autism should be directed to make the child feel emotionally comfortable within the environment, to value the presence of others, and to develop basic communication and reciprocal interaction skills before embarking in supporting the acquisition of complex linguistic skills. New technological systems support children in working together on specific tasks and promote the acquisition of social interaction skills such as turn-taking, sharing (e.g., passing the device to a partner) and negotiation (Millen et al., 2011).

Recently, the study of ASD has also been corroborated by the emergence of new approaches using computational models and artificial agents (robots or avatars) to study sensorimotor development (Caligiore, Tommasino, Sperati, & Baldassarre, 2014) in ASD. The development of new technologies has also contributed to improve emotion recognition in ASD individuals enhancing their social skills (Pioggia et al., 2005).

Interactive products are opening up new learning and playing opportunities for children with autism. A key element of these products is the need to be able to motivate the child to use them. Indeed, the motivational desire to interact is at the core of all communication behaviors (Chevallier, Kohls, Troiani, Brodtkin, & Schultz, 2012).

Activities that children feel passionate about will be much better at motivating their learning processes (Papert, as reported in Kestenbaum (2005)). Although autistic children can be highly sensitive, or insensitive, to stimuli, they truly enjoy *sensory rewards*, such as sounds, music, vibration, and deep

pressure (Hengeveld, Voort, Balkom, Hummels, & Moor, 2007). This work presents a project whose main objective is to provide an interactive mechatronic prototype, called “+me”, that facilitates social interaction and supports the development of social skills of children with autism by leveraging highly motivating sensorial feedbacks.

## 2. The “+me” Interactive Wearable Device

The “+me” device could be used to explore new hypothesis on social behavior improvements, based on recent pioneering studies highlighting the relationship between *sensory and motor deficits and impairment in social function in autism* (Grossberg & Seidman, 2006; Haswell, Izawa, Dowell, Mostofsky, & Shadmehr, 2009).

**Motivation.** The motivation to create the “+me” device (see *Figure 1* for a first implementation of the prototype) begins with a scenario that happens many times as part of a long, sometimes heart-breaking, story of children with autism having difficulties to communicate with their family. In this scenario, the families feel compelled to remove their son or daughter from common social environments and restrain them in places where the children’s behavior can be better controlled.



*Figure 1: The “+me” prototype<sup>1</sup>*

**Main purposes.** The main purposes are to enhance the motivation of the child to communicate, to improve his/her basic interaction skills with others, and to extend the child’s ability to communicate and play with others while keeping engaged in every-day activities (“+me” has an ordinary-life “embedded” nature).

**Characteristics.** It is an interactive transitional object directed to enhance social interaction and communication between a child with autism and an adult. Transitional (or “comfort”, “security”) objects are soft objects with rough edges (e.g., blanket, pillow) that easily mold on the body to provide psychological comfort (Wilson & Robinson, 2002). “+me” is a soft (100% cotton fabric) interactive collar pillow that provides visual, auditory, and haptic sensorial feedback. “+me” has embedded pressure sensors, color changing lights, and speakers. The features can be remotely controlled to adjust the type of feedbacks the pillow returns. The feedback can thus be either directly caused by the child’s action, or it can be controlled remotely by an adult.

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<sup>1</sup> [www.bestezcan.com/plusme/](http://www.bestezcan.com/plusme/)

**Usages.** Children with autism can interact with the prototype in the ways they prefer (e.g., by hugging, squeezing, carrying or even sleeping with it).

**Interaction.** It is important that the person who is with the child is not seen by her/him as the one in control of “+me” but rather as a facilitator or mediator, allowing the child to initiate whatever will happen in the session. This approach leads both the child with autism and his/her mediator to work to find a mutually enjoyable way in which to interact. The positive sensorial feedback focuses on the interpersonal communication and on the achievement of their goals during the interaction.

### 3. Towards an Experimental Protocol to Evaluate the Wearable Utility

This section presents a preliminary hypothesis on a possible experimental protocol usable to evaluate the utility of the proposed wearable. The preliminary ideas proposed here will be refined together with specialists, such as therapists and students who work with autism, as well as together with autistic children's parents. The use of the “+me” device is expected to lead to improvements in the autistic child's social interaction and communication skills. Also, since the “+me” device is a secure/transitional object, we expect to see an increase in the child's confidence levels and communication skills after its repeated use.

The basic protocol to investigate these aspects could be as follows. The experiments could have a between-subjects design, with two groups of children with autism in the same range of ASD and age. One group would use the “+me” device and the other group (control group) would not. The experimental sessions would take place as the normal therapeutic sessions already involving the participants and would be based on the same tasks for both groups. This would allow the use of the device in already experienced therapeutic sessions and environment.

The following data could be recorded automatically by the “+me” device for later analysis: time of activation of feedback, duration of the feedback, pressure activation of sensors. The recordings by the pillow would be paralleled by a synchronized recording of the child's behavior with an external

video camera. The analysis of these data should give indications if certain correlations exist between the number/level of pressures on the pillow and the feedbacks, on one side, and the stress levels, and the variation in communication and interaction with adults, on the other side.

#### 4. Conclusions

We proposed a new interactive device, called “+me”, that leverages the natural tendency of children with autism to be rewarded by specific, predictable sensations, and to motivate social interactions with adults in familiar, reassuring environments. The device can be used both to support social interactions and to improve social and basic communication skills through its prolonged use. Future work will further develop the device properties and possibilities of interaction with external devices (e.g., PCs or tablets). It will also investigate, with structured experiments, the actual impact of the use of the device on the autistic child's social capabilities and on their long term improvement.

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