# D4.1 State of the art on treatment solutions and the employment of ICT technologies in ASD

## **Michelangelo Project -** "Patient-centric model for remote management, treatment and rehabilitation of autistic children"

*Version 1*

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# Executive Summary


This report evaluates the current literature on non-pharmacological interventions (behavioural, developmental and educational approaches), including ICT technologies, for children with autism spectrum disorders. Although there is significant heterogeneity across the included studies, the present report stresses the importance of considering the wide range of interventions through behavioural (behavioural or developmental interventions) and educational continuum according to the suggestions of the recent literature on this field. Furthermore, the present report:

1) outlines the issues about the scientific validity of the treatment outcome studies;
2) describes the findings of different parent-mediated interventions;
3) highlights the importance to use the same outcome measures through the studies to compare findings of different literature contributes; and
4) focuses on the importance to consider pre-treatment variables to identify children who will have better outcomes.

We also summarize and outline here some evidence-based guidelines about clinical management and treatment. Finally, we give practical recommendations to clinicians working in the field suggesting both the presence of a specialized team and of an active collaboration of the family to treatment as core milestones for the clinical management.

This deliverable has a close link with the deliverable D1.3 : State-of-the art of the MICHELANGELO related technologies and of the therapeutic methods.

# Introduction

Autism spectrum disorders (ASD) encompass a broad spectrum of heterogeneous neurodevelopmental disorders, with a prevalence rate of 1:150 and a 4:1 male: female ratio, characterized by qualitative impairment in social-communication area and restricted repetitive and stereotyped patterns of behaviour, interests and activities (APA, 1994). The causes of ASD are unknown. However, there is a growing neurobiological research indicating complex gene-environment interactions. Despite this evidence there is no approved biological treatment for this disorder and the first line treatments pertain to psychosocial domain (Baird et al., 2006). International guidelines indicate that children with ASD should be enrolled into treatment programs as early as possible (Dawson et al., 1997; National Research Council. Committee on Educational Interventions for Children with Autism. Educating Children with Autism Washington DC 2001; Rogers et al., 2008): the need for early treatment programs becomes more urgent because substantial advances have been made in the early detection and diagnosis of ASD (Charman et al., 2002; Oosterling et al., 2010). Early intervention for children with ASD aims to lessen distress, to protect intellective functioning, to increase quality of life, and to promote independence (Levy et al., 2009; Charman et al., 2003). Despite the recognized importance of early intervention, it is not clear whether early interventions lead to better outcomes compared to intervention later in life (Charman et al., 2003). The poor methodological quality of many studies makes results tentative with little to moderate evidence of intervention effectiveness (Krebs Seida et al., 2009). To address these clinical and research issues we will critically review here the non-pharmacological treatment options for ASD children and will discuss the pros and cons of each strategy. With non-pharmacological treatments we refer to interventions using psychological approaches (behavioural, developmental and educational) without any biological support. We will first briefly summarize the available evidence advocating interventions for children with ASD. Then we will specifically discuss the outcome measures employed in each design and the potential methodological limitations underlying each approach. In a further step we will elucidate the need of parents-mediated treatment to improve the clinical effectiveness of non-pharmacological ASD options. Also, we will discuss the available randomized controlled trials (RCTs) of non-pharmacological treatments for ASD and the findings from large-scale meta-analyses in the field. Finally we'll the present an overview regarding the employment of ICT technologies for treatment in autism.

# 1. Interventions for Autism: the state-of-art

Non-pharmacological ASD treatments can be placed within a continuum ranging from highly structured behavioral approaches guided by a therapist in a non naturalistic setting to approaches that follow the interests of the child in a naturalistic setting and that are based on a developmental curriculum in a relational based context. Given the increasing demand for specific interventions, a summary of strengths and weaknesses of psychological approaches (behavioural, developmental and educational) is of particular importance to provide adequate information to both parents and professionals. Table 1 provides an overview on different treatments that are considered in this paper. Lovaas (Lovaas et al., 1987) was the first researcher to use the principles of Applied Behavioral Analysis (ABA) to treat children with ASD and to document their outcomes. Critics to this approach have been the following: a) difficulties in generalization of learned behaviors; b) mechanical responses (as robots); c) lack of spontaneity; d) excessive dependence from prompt; e) slow progress. These criticisms led to the development of Pivotal Response Training (PRT), a more naturalistic behavioral treatment, with good documented effectiveness (Koegel et al., 1998; Koegel et al., 2001). The principles of PRT are: choosing 'pivotal' skills as target of treatment; following the child's choice of activities and games; strengthening not only the correct answer, expected by the therapist, but also incomplete attempts to answer; alternating acquisition and mantainance; using intrinsic reinforcers. Among meta-analytic studies on behavioral intervention, Virtues Ortega (2010) has studied the effectiveness of long term, comprehensive ABA treatments through a complex method including quality assessment, sensitivity analysis, meta-regression and dose-response. The author finds significant improvements in intellectual functioning; language development, acquisition of daily living skills, and social functioning in children with autism. Nevertheless an accurate previous meta-analysis (Spreckley et al., 2009) did not point out significant improvement (in cognitive level, in expressive/receptive language and in adaptive behaviour) compared to children in standard care programs. Another type of treatment based on the ABA principles is the Picture Exchange Communication System (PECS). This system, developed by Bondy and Frost (Bondy et al., 2001), aims to teach the request as a first communicative function: the exchange of photos is considered a 'communicative action' to achieve a concrete outcome within a social context. PECS is based on the use of reinforcement and it aims to encourage child's spontaneity and initiative in communication. In a meta-analysis on PECS, Filippin (2010) has demonstrated that PECS method facilitates communication in children with ASD (ages 2-11 years) with small to moderate effect because the gains in speech were small to negative. The overall effectiveness of the PECS approach for communication outcomes is considered promising although not yet established. Among developmental treatments, the meta-anlysis of Ospina (Ospina et al., 2008) places the Developmental Individual-differences and Relationship based (DIR) method (Mahoney et al., 2005; Greenspan et al., 1997), which is organized around three axes: 1) level of functional and emotional development reached by the child (Developmental); 2) individual differences in information processing and motor planning (Individual-Difference); and 3) type of interactions that the child establishes with his/her partners (Relationship-Based). The Floor Time is one of the most important components of the DIR method and it consists of sequences of guided play (15-20 minutes) repeated several times throughout the day by parents and regularly supervised by an expert in the method. The DIR principles that should always be respected are: to follow the child's lead and support his/her initiative; to focus on joint attention; to close circles of communication; to create semi-structured problem solving; to contrast repetitiveness through playful obstruction; to support visual attention; to work on imitation. Another developmental intervention is the Denver Model (Rogers et al., 1998; 2001), that is focused on child's initiative, motivation and participation. An extension of this intervention is the Early Start Denver Model (Dawson et al., 2003), which has developed specific curriculum and objectives for children between 12 months and 48 months of age. The Early Social Interaction (Wetherby et al., 2006) is a developmental intervention program developed for pre-schoolers at risk of autism and their families; it is based on a naturalistic approach, centered on the family and on a curriculum developed around the child's unique profile. The *SCERTS* program (social communication (SC), emotional regulation (ER) and transactional support (TS)) (Prizant et al., 2003) is the result of over twenty years of empirical and clinical research, and it works primarily in the area of the language deficit. The purpose of the SCERTS is to increase child's communication and social-emotional functioning, and to support family interactions. Among other treatments there are Therapie d'Echange et Developpment (TED) designed in France by LeLord (Lelord, 1990) and sensory motors therapy (Baranek et al., 2002; Aucouturier et al., 1984; Jean, 1972; Ayres, 1972). The TED is based on the observation of brain electrical behavior that reveals forms of acquisition that are more subtle than conditioning or learning. The TED model substains the hypothesis that children with autism have peculiar difficulties in filtrating, focusing, and maintaining mental processes. These observations inspire general principles shared by the therapist and the child: calmness, receptiveness, and sociability (Lelord, 1991). Sensory motor deficits are frequently reported as challenging in children with ASD (Baron-Cohen et., 2009) and among the allied health interventions; sensory motor treatments are based on the premise that the brain's response to basic sensory input must be normalized before higher-order processes can be addressed (Jean, 1972). This treatments are child-directed and guided by a trained physical or occupational therapist. It is hypothesized that if a child becomes more able to process, modulate, and integrate sensory information, he will be more able to acquire higher-order skills (Baranek et al., 2002). However, although these intervention models (TED and sensory-motor) have a long clinical tradition there are no studies focused on their efficacy pubblished on international journals. Among educational treatments, the TEACCH program (Treatment and Education of Autistic and Communication Handicaped Children) (Mesibov et al., 2005) offers a structured teaching based on the assessment of strengths and weaknesses of each child. It includes a focus on the person and the development of a program around person's skills, interests and need. The work program is tailored on some seminal aspects: to center on the individual, to understand autism, to adopt appropriate adaptations and a broadly based intervention strategy building on exisisting skills and interests. The TEACCH methodology is rooted in a therapy combining cognitive elements (Sallows et al., 2000) guided by theories suggesting that behavior typical of people with autism result from underlying problems in perception and understanding. The strategies put forward by TEACCH do not work on the behavior directly, but on its underlying reasons, such as lack of understanding of what the person is expected to do or what will happen to them next (Cox et al., 1993). Working from the premise that people with autism are predominantly visual learners, TEACCH intervention strategies are based around physical and visual structure, schedules, work systems and task organisation. Individualized systems aim to address difficulties with communication, organisation, concepts, sensory processing, change and relating to others (Mesibov et al., 2003).

# 2. Evaluation of treatment outcomes: issues on scientific validity

For what concern the evaluation of outcomes, the most cited and analyzed study is the Lovaas study (Lovaas, 1987) which describes the effectiveness of an intensive behavioral treatment (40 hours per week) applied to 19 children with autism under the age of 4 years compared to a control group of 19 children who performed a similar but less intensive treatment. The results of the follow-up study after 6 years have indicated a better outcome for the subjects in the experimental group, which in 47% of cases have reached a normal functioning (McEachin et al., 1993). The scientific validity of this study has been questioned because of important methodological issues and lack of replicability of the results (Gresham et al., 1998). Among commentaries against Lovaas work, the most authoritative was the one by Schopler (1989). He pointed out its different methodological weakness: a) the absence of usual outcome measures before and after treatment; b) imprecise criteria for selection and evaluation of child's intellectual level; c) lack of precision in the allocation of subjects to control group. Despite these weaknesses, the Lovaas study had some merits: 1) the scientific community started to talk about autism as a treatable disorder 2) it has shown that early treatment can change the path of autism and improve outcomes; 3) it has stressed the importance of parental involvement in treatment, 4) it has raised the question of how intensive should a treatment be. Recently, different reviews (Spreckley et al., 2003; Howlin et al., 2009; Vismara et al., 2009) have emphasized that about 60% of children treated with behavioral models shows no significant improvement, and have suggested that behavioral treatment is highly effective for some but not all children with ASD. As far as developmental-based approaches are regarded, outcome studies are certainly less numerous and often they do not meet the criteria of sufficient methodological quality. For example Solomon study (Solomon et al., 2003) has evaluated the outcome of 68 children in the PLAY Project Home Consultation (PPHC) in 1:1 interaction using DIR/Floortime model. Also in this study about 50% of children made good to very good functional developmental progress, and overall satisfaction of 90 percent. The Salt work (2002) has involved 12 children with autism engaged in a 10 months developmental based treatment for 8 hours per week in addition to other treatments of about 15 hours. The intervention was focused on core aspects of autism: imitation, shared attention, language, and social reciprocity with parents attending eight 2-hours meetings of parent training. Outcome showed higher scores in almost all scales of the Vineland in the experimental group compared to a control group of 5 children who received other treatments for 20 hours a 2 week.

# 3. Parent-mediated treatments

There is a trend that underlies the importance of including parents in child treatment. Strauss (2012) has examined the impact of parent inclusion in treatment through a measure of how faithfully the parents follow at home the treatment protocols and the intensity of treatment. Twenty-four children receiving parent-mediated EIBI, were compared to a group of 20 children receiving eclectic intervention. The intervention group outperformed the eclectic group in measures of autism severity and of developmental and language skills. Moreover, parent-mediated treatment led to reduced challenging behaviors in the children. The study has also highlighted an association between parental stress and staff treatment fidelity that interferes with decision making in treatment planning and consequently with positive behavior outcome; such results provide important information on parental factors that affect a child's response to treatment. Kovshoff (2011) has conducted a 2-year follow-up outcome study for 41 children with autism and significant differences emerged when a parent-mediated intervention was considered; this result strongly suggests a need for better characterization of those children who would benefit from a more active parent-mediated programs. Oosterling (2010) has conducted a randomized controlled trial to compare results obtained after 12 months of nonintensive parent training plus care-as-usual and care-as-usual alone. The parent training focused on stimulating joint attention and language skills and was based on the intervention already described by Drew (2002). Oosterling concludes her work suggesting that the 'parent training' was not of additional value to the more general care-as-usual because of no significant intervention effects were found for any of the primary (language), secondary (global clinical improvement), or mediating (child engagement, early precursors of social communication, or parental skills) outcome variables. Solomon study (2008) evaluates Parent-Child Interaction Therapy, in which parents of ASD children were trained to interact with their children using behavior management strategies. The Parent-Child Interaction Therapy intervention group showed greater improvements, compared to control group, in behavioral flexibility and a reduction in atypical behaviors and hyperactivity, inattention and challenging behaviors. A RCT has evaluated the Stepping Stones Triple P Parenting Program (Whittingham et al., 2009a; 2009b) which teaches parents how to manage children's behavior by considering the function of the behavior, using procedures such as descriptive praise, planned ignoring, skill acquisition, and communication. Parents of the children in the treatment group reported statistically significant improvements and wait-list controls eventually received the same treatment also reported statistically significant decrease in child challenging behaviors. Similar findings were obtained in Moes and Frea (2002) study; it showed that training on functional communication within the family routines makes behavior problems of children decreasing while increasing their communication skills. Other, different RCT have studied interventions involving parents, such as: Responsive teaching (Mahoney et al., 2005), Play-based approaches based on the Floortime model (Solomon et al., 2007), Mifne model (Vorgraft et al., 2007) and Relationship Development Intervention (Gutstein et al., 2007).

# 4. RCT of the effectiveness of treatments

Randomized controlled trials (RCTs) studies are important because they are able to provide a major contribution to clinical practice (Medical Research Council Health Services and Public Health Research Board, 2005). Through the use of randomized controlled trials it is possible to show that some treatments may be more effective than others. However, it is difficult to carry out a randomized clinical trial in autism for several issues. First, the parents are very informed about the various treatments that they think to be most useful for their children and therefore many parents operate their own choices without listening the suggestions of the clinicians (Lord et al., 2005). Second, many studies on autism interventions are made with very little funding compared to those necessary to conduct an RCT. Third, a control group "without treatment" poses ethical problems; because there is strong evidence that providing a treatment is better than to provide nothing (Jocelyn et al., 1998; Smith et al., 2000; Drew et al., 2002; Eldevik et al., 2006; Sallows et al., 2005; Dawson et al., 2010). Thus, RCT have to consider comparison groups compared of children undergoing some type of treatment. Jocelyn (1998) has conducted a study on 35 children with autism aged between 24 and 72 months, using a randomized assignment of subject to two groups. In the experimental group, parents and educators underwent specific training for 15 hours over three months where goal was the understanding of the behavior of their children and the facilitation of communication, play and social interaction (in Jocelyn work (1998), the development of social communication took precedence on the management of behavior problems). The control group received the same type of intervention but parents and educators received a non-specific training for autism. After 12 weeks children in the experimental group showed significantly higher scores in language development. Although the level of intensity of this intervention was much lower than in other studies, this RCT was able to show significant effects in a short time for a low cost intervention. Drew (2002) has conducted an RCT on the adjunctive effects of a home treatment program for parents of 24 children who received standard treatment including speech therapy and occupational therapy. The parents were prepared in two main areas: social communication (through the development of routines of shared attention, imitation, turn taking, use of visual aids for communication) and management of aberrant behavior involving the use of behavioral techniques (i.e. prompting). The training was provided at home by a speech-therapist whose main aims were to evaluate the child's progress and to suggest to parents new targets for the next six weeks. After 12 months this experimental group improved significantly in comprehension and expressive language. In the Aldred study (2004) 28 preschoolers were randomly assigned to two groups receiving speech therapy, TEACCH treatment and social skills training. In the experimental group parents received also a manualized guide for the implementation of five skills: 1) dyadic activities; 2) child sensitivity and responsiveness to signals; 3) communicative behaviors; 4) communicative interactions; and 5) development of the child's skills repertoire. This group showed significant improvements compared with the control group regarding severity of autism, expressive vocabulary, communication, and parental responsiveness during parent-child interactions. Sallows and Graupner (2005) examined the outcomes of 23 children with autism (mean age: 35 months) randomly assigned to a more or less intensive individualized Lovaas plus PRT treatment. Parents of both groups were invited to participate in weekly meetings with a team specialist and they were encouraged to practice the techniques of treatment with their children at home. The supervision at home was higher in the experimental group (6-10 hours per week vs. 6 hours per month). All children were evaluated periodically until the age of 7/8 years: the results (related to IQ, level of language, adaptive behavior, social-emotional functioning and school functioning) showed an overall improvement but no significant differences between the two groups. Rickards (2009) has conducted RCT to determine whether an extra home-based programme provided over 12 months resulted in sustained improvement in development and behaviour. Compared with the control group, improvement in cognitive development was higher in children who received the extra home–based intervention and it was sustained 1 year later; in contrast to the control group who deteriorated, language skills in the intervention group remained stable.

Moreover, improvements were significantly associated with higher stress in the families suggesting the importance of involving families in early childhood intervention programmes. In 2010 Wong (2010) has studied a 2-week 'Autism-1-2-3' early intervention for 70 children with autism and their parents immediately after diagnosis. Treatment focus were: (1) eye contact, (2) gesture and (3) vocalization/words. Results show that parents, randomized to treatment, besides a reduction of their own stress level perceived significant improvement in their children's language and social interaction. This contribute is important because it shows the importance of a short-term parent training on both child development and parents wellbeing during the long waiting time for public health services. Yoder (2010) has conducted a RCT comparing two social-communication interventions in young children with autism: the Picture Exchange Communication System (PECS) and the Responsive Education and Prelinguistic Milieu Teaching (RPMT). Post-treatment measurement favored the PECS intervention: this finding was interpreted as support for the hypothesis that a coordinated attention to object and person can be obtained without requiring direct eye contact to children. Pajareya and Nopmaneejumrusler (2011) have conducted the first RCT study designed to test the efficacy of an adjunctive home-based Developmental, Individual-Difference, Relationship-Based (DIR)/Floortime intervention: the intervention group made significantly greater gains on the Functional Emotional Assessment Scale (FEAS), on CARS and on Functional Emotional Questionnaires. Other RCT have been focused on the potential for specific interventions based on joint attention or symbolic play (Kasari  et al., 2010; Landa et al., 2011). Kasari (2010) has shown how a specific intervention on Joint Attention and Symbolic Play can ameliorate the child; showing toys to an adult, shared looks between toy and parent, and symbolic play skills with maintenance of these skills 1 year post-intervention. Landa (2011) studied toddlers randomized to an adjunctive Interpersonal Synchrony treatment targeting socially engaged imitation, joint attention, and affect sharing. Findings showed that significant treatment effects were found for socially engaged imitation in the Interpersonal Synchrony group after the intervention. This skill was generalized to unfamiliar contexts and maintained through follow-up.

# 5. Outcome ratings

There is considerable variety in methods for assessing treatment outcomes in autism and many studies have no outcome data during treatment. Studies tend to provide data as a follow-up after completion of the intervention and the average time between the baseline and assessment outcome is 39.2 months (Howlin et al., 2009). Differences in outcome measures do not allow a comparison between different studies: the measures vary from study to study, often from child to child and from baseline assessment to the follow-up evaluation. This wide variation in outcome measures does not allow to generalize the findings (Magiati et al., 2001). Charman (2004) has pointed out that among tools to assess outcome, Vineland and Social Communication Questionnaire are the most recommended. Another raccomandation is relative to the choice of standard scores vs raw scores, in fact although the raw scores are difficult to be interpreted for the evaluation of clinical significance of changes, raw scores are recommended when the child does not reach the baseline level to calculate the standard score (2004). Lovaas (1987) has considered an increase of IQ as the most important outcome measure. Nevertheless, there is a shared consensus that the change in IQ cannot be considered the main outcome measure: in fact, a child may show a gradual increase of intellectual level without improving his/her ability in social functioning. A possible explanation for the focus on IQ as the primary outcome measure, especially in the literature on behavioral treatments, is that this type of intervention is directly related to the teaching of cognitive skills rather than to communicative behaviors and social skills. Studies reporting IQ increase describe this increase only in the first part of treatment and not lomg term. For example, in the original Lovaas study (1987) the average IQ increased between the initial assessment and the follow-up evaluation was 30 points, while in the following FU the average IQ increase was only 1,5 points. Eikeseth (Eikeseth et al., 2002) found that in the first year of treatment the IQ increase was around 17 points, but the subsequent increase was only 8 points. Cohen (2006) and Remington (2007) report a similar trend of the IQ increase in time. Although the increases in IQ is not negligible, its small long term size suggests that the main impact of the intervention occurs during the first year of treatment. In some studies researchers have used the ADOS-G to monitor changes in autism severity over time (Aldred et al., 2004; Dawson et al., 2010; Green et al., 2010). In Aldred RCT study (2004) the active treatment group showed significant improvement compared with controls on the primary outcome measure Autism Diagnostic Observation Schedule (ADOS) total score, particularly in reciprocal social interaction. Suggestive but non-significant results were found also in ADOS stereotyped and restricted behaviour domain. In Dawson study (2010) on Early Start Denver Model, diagnostic shifts within the autism spectrum were reported in 30% of children but they were not associated with clinically significant improvements on ADOS severity scores. Green (2010) pointed out that at follow-up, most children were still classified as having an ADOS-G diagnosis of core autism. In particular, the group assigned to Preschool Autism Communication Trial (PACT), 30% had changed to autism spectrum disorder and 5% to non-spectrum; moreover in the control group assigned to treatment as usual, 24% changed to autism spectrum disorder and 7% to non-spectrum. Green underlines that after 13 months of treatment, ADOS scores improved in both groups, with a small estimated group difference in favour of the PACT intervention. However, effect of the intervention on ADOS scores in relation to diagnostic thresholds was small. In studies on interventions centred on nuclear aspects of autism such as communication, the outcome variables are more directly related to social and communicative skills (Aldred et al., 2004; Drew et al., 2002; Yoder et al., 2005; Greenspan et al., 1997; 1998). For example, Greenspan and Wieder (1997) have used scores on socio-emotional development as a measure for treatment. This retrospective study involved 200 children with autism between 22 months and 4 years followed for a period of 2 years with the DIR/Floor Time model and 58% of the cases had a favourable outcome on socio-affective scores. Finally, few studies have evaluated the outcomes in terms of the impact of autism on family quality of life. Parental coping skills, family relations and parental stress have not been systematically studied even if the inclusion of this outcome variables represent a necessary step in the assessment of effectiveness and efficacy of treatments.

# 6. Methodological quality of outcomes studies

Outcome studies can be classified on the basis of scientific merit (Eikeseth et al., 2009; Rogers et al., 2008) which is assessed on the presence of: (1) accurate diagnosis, (2) research design, (3) type of variables, (4) fidelity to treatment. Based on these criteria, the studies are classified in four levels ranging from Level 1, which represents the highest score, to Level 4. In Level 1, the diagnosis is performed by an independent clinician according to the international standards (ICD-10 or DSM-IV) and confirmed by gold standard instruments such as ADOS-G and ADI-R; the research design provides a randomized assignment with two or more treatment groups; outcome measures are comprehensive of the evaluation of intellectual and adaptive functioning; standardized instruments are administered by examiners external to treatment; the treatment is manualized. Beside the scientific merit, the impact of the results can be described also in four levels (Eikeseth et al., 2009). To get a Level 1, significant differences between the groups on both IQ and adaptive functioning must be reported. Level 2 requires to get significant differences on IQ or adaptive functioning. Level 3 accepts the evaluation of significant differences based on non standardized measures. Level 4 refers to those studies that show significant general improvements. There are only a few Level 1 studies in the field of autism treatments (see Table 1). First, the work of Smith (2000) is a randomized study in which pre-schoolers were assigned to an intensive ABA treatment (25 hours per week) or to a group of parent training. At follow-up, the receiving intensive ABA treatment obtained higher scores on IQ, visual-spatial abilities, language, socio-emotional functioning and school performance. However, the lack of significant differences on adaptive functioning led to a classification of Level 2. Second, Dawson's study (2010) evaluated the efficacy of the Early Start Denver Model (ESDM) on 48 children (aged between 18 and 30 months) randomly assigned to ESDM group or to the usual treatment available in the territory. The ESDM treatment consists of 15 hours with a therapist and 16 hours of parent training who used ESDM strategies and 5 hours of other therapies (i.e. speech therapy) for two years. The control group performed an individual treatment of 9 hours and a 9 hours group therapy for the same period. Children who had received ESDM treatment showed higher scores in cognitive and adaptive functioning. Dawson's work is the first study that demonstrates the effectiveness of an integrated treatment model based on developmental and behavioral theory principles according to high methodological quality criteria. Third, in Green (2010) study the preschoolers with core autism were randomly assigned to a parent-mediated communication-focused (Preschool Autism Communication Trial-PACT) intervention or treatment as usual. Those assigned to PACT were also given treatment as usual. Primary outcome was severity of autism symptoms 13 months after. Complementary secondary outcomes were measures of parent-child interaction, child language, and adaptive functioning at school. Treatment effect was positive for parental synchronous response to child, child initiations with parent and for parent-child shared attention. Effects on directly assessed language, adaptive functioning at school and on ADOS-G were small. A recent review of the literature (Eikeseth et al., 2009) has identified four Level 2 studies without randomization (Strauss et al., 2012; Kovshoff et al., 2011; Drew et al., 2002; Solomon et al., 2008). All four contributions refer to the ABA model. Some of these studies reach Level 1 on impact because they have shown that the ABA group obtained significantly higher scores in IQ, language and adaptive behavior. In Remington study (2007), children in the ABA group obtained overall scores higher than children in the control group except IQ, adaptive functioning and language, so that the study has received a Level 2 regard the impact of the results. Eleven studies have achieved a Level 3 merit. Two have used the TEACCH method (Mukaddes et al., 2004; Ozonoff et al., 1998) and both have achieved a level 3 also on the impact of the results. Ozonoff study (1998) does not specify the diagnostic system used, does not define whether the diagnosis was made by independent clinicians regarding the treatment, the use of diagnostic tools was not reported, group assignment was not randomized and the evaluation did not include adaptive functioning. Notwithstanding these methodological limitations, the Ozonoff study (1998) indicated that children in the TEACCH improved significantly compared to the control group in the sub-tests of imitation, up-motor, gross motor skills and concepts. Other Level 3 have evaluated ABA treatments. The Lovaas (1987), McEachin (1993), Andersen (1987), Birnbrauer (1993), and Sheinkopf (1998) studies did not include measures of adaptive functioning. Sheinkopf (1998) and Eldevik (2006) used the archive methodology as experimental design. Sallows and Graupner (2005) have showed significant improvement in the level of language, in cognitive abilities and in adaptive functioning but no standardized instruments as Vineland were used. In Magiati (2007) the cognitive level was evaluated exclusively for visual-spatial aspects, the groups were not homogeneous for baseline cognitive level, for adaptive functioning, for level of parental education, and the treatment was not supervised. Several studies have obtained an insufficient scientific value because they did not use control groups: six programs evaluated ABA treatment (Bibby et al., 2002; Handleman et al., 1991; Harris et al., 1991; Harris et al., 1990; Hoyson et al., 1984; Luiselli et al., 2000), one study evaluated the TEACCH (Lord et al., 1989) and two studies evaluated the Denver Model (Rogers et al., 1991; 1986). In 2010 Coolican showed that brief parent training in pivotal response treatment (PRT) can enhance communication skills of preschoolers with autism who were waiting for, or unable to access, more comprehensive treatments; moreover parents' fidelity in implementing PRT techniques improved after training, and was maintained at follow-up. Wallace and Rogers (94) point out that for ASD infants and toddlers under age 3 years there is a scarcity of empirically validated treatments and of empirical investigation into successful intervention characteristics for this population. In their work the authors had reviewed 32 controlled, high-quality experimental studies that revealed that the most efficacious interventions routinely used a combination of four specific intervention procedures including (1) parent involvement, including ongoing parent coaching focused both on parental responsivity and sensitivity to child cues, and on teaching families how to provide intervention, (2) individualization to each infant's developmental profile, (3) a broad rather than a narrow range of learning targets; (4) beginning as early as the risk is detected; (5) intensivity and duration of the intervention. These five characteristics of interventions likely represent a solid foundation from which researchers and clinicians can build efficacious interventions in early ASD.

# 7. Predictors of outcome

The individual variability in response to treatment has led some researchers to consider pre-treatment variables to identify children who will have better outcomes. Usually the initial IQ value is considered a good outcome indicator (Howlin et al., 2000; Venter et al., 1992), although some studies have not shown any correlation between initial IQ and outcomes (Sallows et al., 2005). In many longitudinal studies the initial IQ seem to be able to predict the level of autonomy and acquisitions after treatment (Sigman et al., 1999; Ingersoll et al., 2001). The good social-cognitive functioning has been identified as a predictor of language development in autism (Moes et al., 2002). Among the factors that may predict a better outcome, there is also the age in which children begin treatment. Handleman and Harris (1991) found that children who begin intervention earlier than 4 years of age have better results in terms of academic achievement and IQ scores than those who begin treatment after 4 years. Smith (2000) reported that children with less severe autism tend to have best progress during treatment, but Remington (2007) has not confirmed this result. Remington study shows that children with higher baseline behavior problems and autistic symptoms are those that show most important changes during treatment. Ingersoll, Schreibman, and Stahmer (2001), have studied the role of social availability toward peers as a mediator of the effects of treatment. Six ASD children aged between 2 and 3 years and low social avoidance of peers were compared, with three ASD children with high social avoidance of peers: children with low social avoidance progressed more than those with high social avoidance on language development, cognitive development and autism severity. Another variable that was examined in some studies is the amount of treatment. Sheinkopf and Siegel (1998) have found comparable scores at post-test in children who had received few hours or many hours of Lovaas treatment model. In a similar study Luiselli (2000) examined the number of hours per week, number of months of treatment and the total hours of treatment in a study that involved children aged 2-3 years who received Lovaas therapy. In this study only the number of months of treatment (rather than total hours) was significantly related to the language, cognitive and social-emotional functioning improvement. Studies on the amount of treatment seem to consider that the child learns only by the amount of therapy, however, children with autism have many additional opportunities for learning. For example many studies of outcome evaluation should considered all the learning opportunities available outside the formal treatment. For example, the influence of family characteristics has been considered as a "moderator" of treatment results and it has been studied in recent years (see Parent-mediated treatment paragraph).

# 8. ICT and Autism: An overview

As stressed by Konstantinidis and colleagues of the Lab of Medical Informatics at the Aristotle University of Thessaloniki, during the last years there is considerable advance in the research on innovative information computer technologies (ICT) for the education of people with special needs such as patients suffering from ASD. The specialists and educators are aided by interactive environments in facing the daily abnormal reactions by autistic persons (Habash, 2005), which can generally be classified as problematic social interaction, communication impairment dealing with verbal and non-verbal channels. Inflexibility in thinking, language and behavior is the third main autism impairment (Howlin et al., 1999). Autistic persons realize both world and human behavior uniquely since they react in an abnormal way to input stimuli while there is problematic human engagement and inability in the environmental generalization (Rajendran et al., 2000). According to previous studies (Mitchell et al., 2006), education is considered as the most effective therapeutic strategy. More specifically, early stage education has proven helpful in coping with difficulties in understanding the mental state of other people (Howlin et al., 1999). Towards this direction, computer tools may be a beneficial aiding instrument. Consequently, during the last years the field of collaborative interactive environments, such as virtual environments (VE), is of seminal relevance. Their advances are the control of the input stimuli and the monitoring of the child's behavior. A recent effort led to the development of an interactive computer games aiming at the enhancement of the collaboration between multiple users like children with ASD. Moreover, the human-computer interaction (HCI) is regarded as a "safe" and enjoyable experience. This can be explained by the fact that the interaction with computers does not pose severe expectations and judgment issues in contrast to the social interaction. So, computer systems tend to be a controlled environment with minimal distractions and therefore an attractive one for the education of autistic children (Green et al., 1993). This is further supported by several reports which mention that this type of interaction elicits positive feelings, whereas the communication with human could be highly problematic (Hutinger et al., 1997). Moreover, this feeling is a generic and uncorrelated with the type of the software interfaces. Furthermore, tutors often report that behavioral alterations during the educational process are a common phenomenon among autistic persons (Jordan et al.,2001). The person state may be described by specific educational parameters such as the time and the processes needed to complete a goal and the percentage of success. Moreover, the behavior monitoring during a period of time may reveal important factors for the children's progress. A large portion of the traditional educational tools employs real world environments, hardening the task of autistic children (Frith et al., 1991), since it requires rapid and flexible thinking. Moreover, real world environments cannot be fully controlled because of the lack to provide the same set of conditions more than one times.

## 8.1 Interactive Environments

As reported by McCue and colleagues (in press) various interactive environments have been developed for the rehabilitation of children with autism. In most of the cases, these environments are introduced by means of software educating platforms (Luneski et al., 2008; Marnik et al., 2008). In order to provide knowledge in an attractive way, these platforms use entertaining content in educational settings (edutainment). Photos of real objects (used in daily life) or sketches of them are presented on the monitor of a computer so as to encourage people with autism to distinguish objects based on their size, color, type, etc. Moreover, this kind of interactive learning platforms motivate the children to correlate the objects with sounds and words. For adding to the attractiveness, platforms make use of animated pictures or videos. The comprehension of the task is supported by verbal and visual (usually makaton symbols) guidance in order to minimize the role of the monitoring teacher (Lányi  et al., 2004).

## 8.2 Robotic Systems

The use of robots in education is an idea that has been studied for a few decades (Papert, 1980). Robotic systems are now often included in the interactive environments (Robins et al., 2005). Developed as interactive toys for children, humanoid robots are used as research platforms for studying how a human can teach a robot, using imitation, speech and gestures. Increasingly, robotic platforms are developed as interactive playmates for children. Recent literature reveals that robots generate a high degree of motivation and engagement in children with learning disabilities, especially in autistic persons, including those who are unlikely or unwilling to interact socially with human educators and therapists (Scassellati et al., 2007). Additionally, studies over a long period of time allowed the children to explore the interaction space of robot–human, as well as human–human interaction. Repeated exposure to an interactive small humanoid robot increased basic social interaction skills in children with autism (Robins et al., 2005). In more recent times, researchers have looked at using robots to assist clinicians in teaching children with ASD. Because this field is so new, the research is in an exploratory stage. Some research looks at driving robot behavior autonomously based on the child's behavior as determined by tracking the child's distance from the robot (Feil-Seifer et al., 2009). Other researchers have looked at loading the robot with some behaviors that are activated when the child or clinician presses a button on the robot itself (Francois et al., 2009). Another approach has the robot autonomously play a collaborative game with the child (Wainer et al., 2010).

## 8.3 Virtual environments

Virtual Enviroments (VEs) have proven to be another active area of research for social interventions with autistic children. Various successful software platforms with virtual environment for autistic people have been developed since in the last decade (Enyon, 1997; Eddon et al., 1992). VEs are able to mimic specific social situations in which the user can role-play. The stable and predictable environment provides such types of interaction that eliminate the anxiety (Parsons et al., 2000). Moreover, VEs offer safe, realistic-looking 3-D scenarios that can be built to depict everyday social scenarios. The value of virtual reality comes from the fact that children with autism may have difficulty understanding 2D visual representations, so they require the actual object or a stronger representation like a 3D animated humanoid avatar. The use of animation is also in line with research indicating that children with learning disabilities prefer programs which include animation, sound and voice (Trepagnier et al., ). Recent work have demonstrated the ability of participants with ASDs to use and interpret VEs successfully, and learn simple social skills using the technology (Parsons et al., 2006). Additionally, one of the most important aspects of VEs used by participants with ASDs in educational settings, is their level of enjoyment. It has been realized that persons with ASDs, especially children, are more interested in interacting with computers more than other toys (Konstantinidis et al., 2009). Moreover, virtual peers (Tartaro et al., 2007), life-sized, language enabled, computer-generated, animated characters that look like a child, are frequently a part of a virtual environment. For example, a virtual peer accompanies a child with ASDs during a game or a storing telling scenario. Some researchers have developed interesting research contributions, using storing telling scenario; for example Mitchell et al. (2007) developed and tested a virtual cafè for children with autism to address impairments in social interaction. The participants were required to complete specific tasks in the virtual cafè, such as ordering and paying for a drink, and finding a place to sit. Again, navigation was achieved through a mouse. A Virtual Reality social-understanding training program was administered to 6 adolescents, 14–16 years old, each with formal diagnoses of an autism spectrum disorder. During the training sessions, 4 types of activities were taught and practiced. These activities were graded in difficulty and created based on certain social conventions associated with finding a seat in an empty or crowded café, ordering, paying and engaging in appropriate conversation with others. The social understanding of these adolescents was assessed using ratings of their verbal descriptions of their decision-making process of how they would behave in two different social scenarios: a café and a bus. The former was similar to situations encountered in the virtual café, while the latter assessed the generalizability of the participants' learned social understanding. The results were variable and only 2 participants showed gains in social knowledge in both scenarios. Actual performance in real situations was not assessed. As real-café interactions usually require touching objects, such as money or coffee mugs, the integration of more complex haptics into this type of program may facilitate more realistic interaction between the user and VE. Increased realism would influence the degree of ecological validity achieved and subsequent degree of skill transfer. Increasing in complexity, touchscreen technology has facilitated human-computer interaction without the traditional mouse and joystick. Herrera et al. (2008) created a virtual supermarket on a flat screen monitor to teach 2 children, 8 and 15 years old, how to think abstractly and play imaginatively. The children explored the virtual supermarket through touching the screen. They interacted with objects in increasing more imaginative ways, such as transforming a pair of flying pants into a highway. The authors assessed the outcomes using a test of functional object use (i.e. how an object should be used), the Symbolic Play Test (SPT) (1976), the Test of Pretend Play (ToPP) (1997) and the Imagination and Magic Understanding Tests. Children improved on all tests except on the SPT. The authors concluded that their VR tool is useful in improving the symbolic thinking skills of these children, and that these skills translate into concrete symbolic play behaviours. The touchscreen facilitated easy interaction between the children and the display interface, and allowed the instructor to participate as well. This multidimensional interaction is naturally afforded by touchscreen technology; it allows interaction between child and computer, instructor and computer, and instructor and child. Diamond Touch (Circle Twelve Inc., Framingham, Mass., USA), a state-of-the-art multiuser and multi-touch display table, allows many people to interact with objects on the table-top display screen simultaneously through touch. Similar to the touchscreen in Herrera et al. (2008), the Diamond Touch table immerses users in an imaginative scene where their actions and decisions have real time consequences within the virtual world. Diamond-Touch technology was integrated with the Story Table interface to allow multiple children to create an imaginative story together by selecting, combining and sequencing a series of on-screen virtual characters and events. Some story elements required 2 children to touch it before being integrated into the story, reinforcing joint attention, communication and negotiation. Bauminger et al. (2007) evaluated this system with 3 dyads of children with autism, ages 9–11 years, to teach and reinforce key social skills such as eye contact, turn-taking, sharing and joint directed behaviour. During the intervention, the dyads were instructed to create and narrate stories using backgrounds and characters that were jointly chosen. The instruction was focused on three goals: performing shared activities, helping and encouraging each other, and persuading and negotiating when creating the stories. Ratings of social behaviours from videos of the Story Table sessions were completed; in addition, the authors assessed the generalizability of the children's social skills through a Lego-like assembly game, Marble Works. After the training sessions, the children were all rated as having more occurrences of positive social behaviours during Story Table and more positive behaviours during Marble-

Works. In addition to the improvements in positive social behaviours, the quality of play of the dyads improved from simple parallel play without eye contact to complex, coordinated play. Lastly, the types of meaningful utterances transitioned from less narrative utterances (about technical aspects of the program) to more narrative, relevant utterances (about characters, setting, and plot of the story). The authors concluded that the Story Table intervention increased both the quantity and the quality of social interaction between the dyads. Both Herrera (2008) and Bauminger (2007) provide evidence that touchscreen technology shows great promise in promoting creative and imaginary play between multiple users. Wang (2011) hightlights that future studies should consider using typical peers as participants with this multiuser technology, rather than atypical peers. In fact, research has shown that same-aged, typical peers serve as effective role models for children with autism to reinforce pro-social and age-appropriate behaviours (Di Salvo et al., 2002). It is important to note that although devices such as the mouse, joystick and touch-screen cannot simulate real-life haptic interactions, such as feeling the texture of a surface, incorporating the sense of touch adds yet another layer of interaction within the program. Participating in real-time cause-and-effect behaviours may contribute to the overall sense of presence and motivation of the child during the intervention program.

## 8.4 Avatars for Autism

Playing in most cases essential role as instructor, emotionally expressive avatars are one of the most interesting options of such an educating system. Current literature reveals that avatars, being humanoid or not, advance the educational process (Konstantinidis et al., 2009). Additionally, educators suggest that most of the times persons with ASDs are able to recognize the avatar’s mental and emotional state provided by facial expressions (Konstantinidis et al., 2009). Avatars, as inhabitants of the virtual space, can enhance the interaction level in VE. Their behavioral capabilities are envisaged with emotional and facial expressions (Fabri et al., 2006). The use of emotional expressive avatar is of crucial importance in the educational process, since their ability to show emotions and empathy enhances the quality of tutor-learner and learner-learner interaction (Fabri et al., 2007). Therefore, emotion-aware computers are regarded as a considerable and valuable educational technique (Rajendran et al., 2000). A significant effort has been done in using emotionally avatars due to the findings in psychology and neurology that suggests emotions as important factor in decision-making, problem solving, cognition and intelligence in general. Results of surveys among educators of autistic children in recent literature illustrate that not only most of the children recognize the avatars emotion but also the avatar’s emotional state advances the educational process (Konstantinidis et al., 2009). Moreover, the findings are better in case of the avatar using native voice (Konstantinidis et al., 2009). Apart from the instructor form, the avatar is responsible for providing feedback to the user’s action by means of the appropriate emotion (happy for success and sad for failure). Training studies in (Rosset et al., 2008) have suggested that children with autism show greater improvements in emotion recognition when programs include cartoons rather than photographs of real faces. Moreover clinical and parental reports also state that autistic children spend long periods of time looking at cartoons (Rosset et al., 2008). Additionally, parents and professionals often report that “autistic children know more about cartoons than about people” (Rosset et al., 2008).

## 8.5 TEACCH Method

A widely used method for educating people with ASDs, TEACCH (Treatment and Education of Autistic and related Communication handicapped CHildren), tries to provide a controlled environment to the children during their normal educational process in order not to confuse the autistic children (Konstatntinidis et al., 2009). The approach of this method involves a structured teaching method and the use of visual materials (Gary et al., 2004). In addition, TEACCH principles involve changing the behaviour and skill level of the person as well as developing an environment that matches the person's unique needs. A wide variety of the interactive and virtual environments espouse the principles of this method by targeting to the person's visual processing strengths by organizing the environment and providing a visual conduct to supply information about activities. Moreover, visual structure is provided at a variety of levels such as organizing areas of the environment, providing a daily schedule using pictures or written words, as well as visual instructions and visual organization signalling the beginning and end of tasks. This technique is based upon the observation that children with autism learn and connect information differently than other children.

## 8.6 Special Input Devices: touch screens and other Apple technologies

While people with ASDs enjoy interacting with computers, more attractive forms of input are used. As mentioned in previous paragraph, most of the recent research projects use as input feedback a touch screen instead of the common mouse device (Konstantinidis et al., 2008). A multi-user touchable interface that detects multiple simultaneous touches by two to four users was used by (2005). Each user sits or stands on a receiver (a thin pad) such that touching the table surface activates an array of antennas embedded in its surface (capacitive touch detection) (Gal et al., 2005). The function of this screen was very easy to be obtained by people with ASDs. Moreover, big colored buttons subserve user selection. Moreover, studies in using virtual reality for the rehabilitation of people with ASDs include visual devices that represent the 3D virtual world (Strickland et al., 1996). Alternative interaction methods include remote controllers like the Wii-mote (part of a commercial game console) like in Gonzalez's work (2007). This device is capable of monitoring not only remote buttons' selection but also movements (based on internal accelerometer). Furthermore, external devices are used in order to measure and monitor user's internal and emotional state, such as wearable measurement devices (Konstantinidis et al., 2008). In Takacs (2003), web camera, eye tracker and data glove is used for this purpose. Besides that, scientists try to provide more attractive virtual worlds by using video projectors and depicting the educational material in a wall of a room (Horace et al., 2006). As it is mentioned, TEACCH principles involve changing the behaviour and skill level of the person based on his personal unique needs. In order for a platform to achieve this goal it has to be capable of recording the user's interaction/education process. By using all the records in the proper way, a longitudinal record may be achieved indicating "a learning curve" for each autistic person separately, thereby enhancing and normalising the educational procedures toward each person's needs. Consequently, the educators are enabled with track record of the users' progress and modify the difficulty levels accordingly. Recently also several Apple devices have used with ASD patients. Kagohara (2012) conducted a systematic review of studies that involved iPods, iPads, and related devices (i.e. iPhones) in teaching programs for individuals with developmental disabilities. The search yielded 15 studies covering five domains: (a) academic, (b) communication, (c) employment, (d) leisure, and (e) transitioning across school settings. The15 studies reported outcomes for 47 participants, who ranged from toddlers to adults and had a diagnosis of ASD and/or intellectual disability. Most studies involved the use of iPods or iPads and aimed to either (a) deliver instructional prompts via the iPod Touch or iPad, or (b) teach the person to operate an iPod Touch or iPad to access preferred stimuli. The latter also included operating an iPod Touch or an iPad as a speech-generating device (SGD) to request preferred stimuli. The results of these 15 studies were largely positive, suggesting that iPods, iPod Touch, iPads, and related devices are viable technological aids for individuals with developmental disabilities. Jowett and colleagues (2012) evaluated the effectiveness of a video modelling package to teach a 5 year-old boy diagnosed with an autism spectrum disorder (ASD) basic numeracy skills. The treatment package consisted of iPad-based video modelling, gradual fading of video prompts, reinforcement, in vivo prompting and forward chaining. They showed clear gains in the participant's ability to identify and write the Arabic numerals 1-7 and comprehend the quantity each numeral represents in association with the lagged intervention. Generalization and maintenance data demonstrated the robustness of the treatment effects. This study confirmed that IPad-based video modelling, when used in a package, can be an effective technique for teaching numeracy skills to children with an ASD. Flores and colleagues (2012) showed that Augmentative and alternative communication (AAC) interventions improve both communication and social skills in children and youth with autism spectrum disorders and other developmental disabilities. AAC applications have become available for personal devices such as cell phones, MP3 Players, and personal computer tablets. It is critical that these new forms of AAC are explored and evaluated. The authors investigated the utility of the Apple iPad as a communication device by comparing its use to a communication system using picture cards. Five school children (6-10 years old) with autism spectrum disorders and developmental disabilities who used a picture card system participated in the study. The results were mixed in fact communication behaviours either increased when using the iPad or remained the same as when using picture cards.

## 8.7 The Telerehabilitation for Autism

Telerehabilitation is an emerging method of delivering rehabilitation services that uses technology to serve clients, clinicians, and systems by minimizing the barriers of distance, time, and cost. More specifically, telerehabilitation can be defined as the application of telecommunication, remote sensing and operation technologies, and computing technologies to assist with the provision of medical rehabilitation services at a distance. Much attention has been paid to the efficacy of telerehabilitation in efforts to decrease time and cost in the delivery of rehabilitation services. Some studies have also compared telerehabilitation services to face-to-face interventions to discover whether these approaches are ‘‘as good as’’ traditional rehabilitation approaches. However, telerehabilitation may in fact provide new opportunities that are more effective by increasing accessibility and creating the least restrictive environment. Technologies that enable telerehabilitation services, such as increased computer power and availability of high-speed data transmission lines, have become more prominent in recent years (Diamond et al., 2008). Winters provides a comprehensive review of the conceptual models of telerehabilitation (Winters et al., 2002). Diamond (2008) explains that telerehabilitation falls under a broader category of services that use telecommunication to provide health information and care across distance, termed telehealth. Telehealth is broken into 3 subcategories: telemedicine, telehealthcare, and e-health/education. Much of the research literature on telerehabilitation has focused on outcomes measures on decreasing costs, saving travel time, and improving access to specialty services and expert practitioners (Bashshur et al., 2002). The rationale proposed to support the exploration and implementation of telerehabilitation has been essentially based on the use of various technologies to address geographic and economic barriers, and potentially enhance cost effectiveness. There is also significant impetus to support the value of medical rehabilitation services delivered in the home. Although much of this literature seems to be motivated by providing a rationale for expeditious discharge from the inpatient setting for cost-saving purposes, the research supports that the delivery of some home-based rehabilitation services is at least as effective as the delivery of those services in hospitals, and in some cases adds contextual factors that enhance rehabilitation and outcomes. These findings support the development and implementation of telerehabilitation approaches to facilitate naturalistic rehabilitation treatment in the home. Intervention in the home or work environment has been provided remotely for numerous needs, including cognitive rehabilitation using the Internet constraint induced movement therapy using a computer and sensors to guide the patient through exercises (Lum et al., 2006) and speech pathology for children with autism (Parmanto et al., 2005). An interesting research contribute about the use of telerehabilitation used for intervention with children with Autism comes to us from University of California, in fact from 2010, some researchers at the UC Davis MIND Institute are examining technology tools that will enable families to interact from their own homes with therapists and receive "long distance" guidance for intervention with their children (Vismara et al., 2010). At present, there are various challenges to delivering health care to families with Autism Spectrum Disorder (ASD) with long waiting lists and few specialist services. Barriers to service delivery and utilization are even more exacerbated for families living in rural or remote areas, often resulting in limited access to preventative mental health services in general and parenting ASD interventions in particular. Telecommunication technology can support long-distance clinical health care; however there is little information as to how this resource may translate into practice for families with ASD. The Vismara's study examined the use of telemedicine technology to deliver a manualized, parent-implemented intervention for families of children with ASD, ages 12-36 months. It was hypothesized that telemedicine technology as a teaching modality would optimize parenting intervention strategies for supporting children's social, affective, communicative, and play development. Recruited families received 12 weekly one hour sessions of direct coaching and instruction of the Early Start Denver Model (ESDM). Parent Delivery Model through an Internet-based video conferencing program. Each week parents were coached on a specific aspect of the intervention through video conferencing program and webcam, allowing parent and therapist to see, hear, and communicate with one another. Parents were taught how to integrate the ESDM into natural, developmentally and ageappropriate play activities and caretaking routines in their homes. Video data were recorded from 10 minutes of parent-child interaction at the start of each session and coded by two independent raters blind to the order of sessions and hypotheses of the study. Preliminary findings o this study suggested that integrating telemedicine as a teaching modality enabled: (a) parents to implement the ESDM more skillfully after coaching; and (b) increase in children's number of spontaneous words, gestures, and imitative behaviors used. The current findings support the efficacy and cost-effectiveness of using telemedicine to transfer a developmentally based, relationship focused, and behaviorally informed intervention (i.e., the ESDM) into parents' homes to be delivered within typical parent-child activities. Additional research is needed to confirm the promise and utility of telemedicine for transporting services to families with limited access.

## 8.8 The use of computer for Autism

Most computer applications designed for people with autism focus on the relationship between one user and one computer, and aim to help with specific behavioural problems associated with autism (Cheng 2011). Hileman (1996) claims that computers are motivating to children with autism due to their predictability and consistency, compared to the unpredictable nature of human responses. When it comes to social interaction, the computer does not send confusing social messages. Research on the use of computers with students with autism revealed the following (Jordan, 1995): (a) Increase in focused attention; (b) Increase in overall attention span; (c) Increase in in-seat behaviour; (d) Increase in fine motor skills; (e) Increase in generalization skills (from computer to related non-computer activities); (f) Decrease in agitation; (g) Decrease in self-stimulatory behaviours; (h) Decrease in perseverative responses. The importance of assistive technology for children with autism has been established with the fact that it can be used in rehabilitation to the daily activities. Hetzroni and Tannous (Hetzroni et al., 2011) have developed a program ("I Can Word It Too") based on daily life activities in the areas of play, food and hygiene. The study was conducted on five children with autism between the ages of 7 and 12, of the effects of using the program on the use of functional communication. They found that use of the program was effective in improving the communication of all participants, and that the participants were able to transfer the lessons learned to their natural setting in the classroom. A DVD with educational software for emotions, called the Transporters, has been created at Autism Research Centre (ARC), which is one of the most extensively used commercial applications for this purpose (http://www.thetransporters.com/, March, 2009). The Transporters, based around 8 characters who are veichles that move according to rule-based motion. Such vehicles attract the attention of young children with autism. Onto these vehicles have been grafted real-life faces of actors showing emotion, and contextualized them in entertaining social interactions between the toy vehicles. The aim of the Transporters is wheter creating an autism-friendly context of predictable mechanical motion could then be learned more easily than is possible in the real world. The Transporters has been evaluated for its effectiveness for children aged 4 to 8 with Autism. The results are very exiciting: (a) in all tasks o which the children were tested, most caught up their typically developing peers; (b) the results suggest that the Transporters DVD is an effective way to teach emotion recognition to children with autism and that the learning generalises to new faces and new situations. Children with autism who did not watch the DVD remained below typically developing levels (Golan et al., 2009).

# 9. Conclusions

The literature devoted to the description and evaluation of interventions in autism has become quite large in last years. The various issues addressed in this review may allow to formulate some conclusions for the research in this field. First, there is increasing convergence between behavioral and developmental methods. For both types of treatment the focus of early intervention is directed toward the development of skills considered "pivotal" as shared attention, imitation, communication, symbolic play, cognitive abilities, attention, and regulation. Second, the literature shows some guidelines for treatments such as: 1) starting as early as possible; 2) minimizing the gap between diagnosis and treatment; 3) provide not less than 3/4 hours of treatment each day; 4) being centered on family involvement; 5) providing six-monthly development evaluations and updating the goals of treatment; 6) choosing among behavioural/developmental treatment depending on the child's response; 7) encouraging spontaneous communication; 8) promoting the skills through play with peers; 9) being finalized to the acquisition of new skills and to their generalization and maintenance in natural contexts; 10) supporting positive behaviors rather than tackling challenging behaviors. Regarding the evaluation of the treatment effectiveness the studies must comply with certain features such as the presence of a comparable control group, the presence of precise diagnostic criteria, periodic evaluations during treatment and evaluation of different developmental aspects (severity of autism, cognitive and language development, global functioning, and quality of family life, parent-child interaction). A particular topic is related to the word ‘recover’. The efficacy of treatment in very young children should be carefully considered in light of the conflicting results of studies on diagnostic stability. In a recent study (Turner et al., 2007) only 68% of children who received a diagnosis of autism between 2 and 3 years, and only 40% of children diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), received the same diagnosis at 4 years of age. Similar conclusions were reported in the study of Sutera (Sutera et al., 2007). The diagnosis is less stable when placed in children under the age of 30 months, when the symptoms are milder and there is a higher cognitive level. Probably due to a more widespread knowledge about autism, people who comes at consultation are less compromised than those who arrived in the past and they can be considered as children who can be naturally destined for a partial recovery. This finding led to try to better define the concept of ‘recover’. Helt (2008) has proposed that a recovered child must show the following characteristics: to show similar behaviors to typical peers not only in quantitative but also in qualitative terms; to exit from the diagnostic criteria for a Pervasive Developmental Disorder NOS; to have verbal IQ, nonverbal IQ and Vineland scores over 78. As evidenced by studies reported in this paper, the achievement of these goals is not the prerogative of a treatment model over another: ABA vs. DIR (Hilton et al., 2007); ABA vs. TEACCH (Callahan et al., 2010). Rather they seem to be the result of a convergence of factors including: a systematic approach to the ongoing evaluation of treatment and a continuous redefinition of the objectives to be achieved. Finally, the presence of a specialized teams in the management and treatment of autism and of an active collaboration of the family to treatment planning should be considered the two pillars of any treatment program.

Successful autism “treatments” using educational interventions have been reported even a decade ago (Murray et al., 1997). As we have seen, recent years have witnessed ICT-based approaches and methods for therapy and education of autistic children. Individuals with autism have lately been included in the main focus in the area of Affective Computing (AC) or “computing that relates to, arises from, or deliberately influences emotions” (Kaliouby et al., 2006). Technologies, algorithms, interfaces and sensors that can sense emotions or express and thereby influence users’ (autistic persons’) emotions have been continuously developed. Working closely with autistic persons has lead to development of various significant methods, applications and technologies for emotion recognition and expression. Innovative wearable sensors along with algorithms for efficient recognition of human affective states have been developed by the ACG, applicable for autistic individuals (Blocher et al., 2000). However, much has yet to be improved in order to have a significant success in treating individuals with autism. This depends on two aspects: theoretical and practical. The first signifies the theoretical knowledge on autism, the triad of impairments, and the individual difference in coping with such disabilities in the modern complex world. From the practical perspective, many of the existing technologies have limited capabilities in their performance and thus, limit the success in the education of autistic persons. This is especially significant for wearable hardware sensors that can provide feedback from the autistic individuals in the educational process. Much has to be done in order to have a reliable emotional, attentional, behavioural or any type of feedback that can be essential in the alteration of the educational method to better suit the people with autism. Nevertheless, the realisation of autism as a significant health topic in the modern world is nothing but promising fact for the future trends of improvement in the usage of educational ICT to help the autistic people in coping with the everyday surroundings.

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