Play with online virtual pets as a method to improve mirror neuron and real world functioning in autistic children

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Summary  Autism is a severe disease with no known cause and no cure or treatment. Recently, ourselves and subsequently others found that so-called ”mirror neurons” — neurons that respond not only when a person moves, but upon observation of movement in another — are dysfunctional in autistic children. Here I suggest an easy, simple, inexpensive and fun method to improve mirror neuron functioning in autistic children, increase appreciation in autistic children for the theory of mind and thinking of others, and most importantly hopefully to improve real world functioning: play with virtual online pets that are the ”embodiment” of a stuffed animal the child has. Adoption and then care and play with online pets forces, in a fun way, one to think about the world through the eyes and needs of the pet. A simple method to test this play with online virtual pet therapy is described.

Introduction

The cause of autism is not known, and there is no known cure or dramatically effective treatments. Ourselves and subsequently others found that so-called ”mirror neurons” — neurons that respond not only when a person moves, but upon observation of movement in another — are dysfunctional in autistic children. I here suggest an easy, simple, inexpensive and fun method to improve mirror neuron functioning in autistic children, increase appreciation in autistic children for the theory of mind and thinking of others, and most importantly hopefully to improve real world functioning: play with virtual online pets. Adoption and then care and play with online pets forces, in a fun way, one to think about the world through the eyes and needs of the pet. A simple method to test this play with online virtual pet therapy is described.

The mu EEG wave activity is defined as the integrated power in the 8–13 Hz range measured from the motor cortices, when these cortices are at rest. Mu wave suppression relative to this baseline activity can be quantified by comparing with the mu activity when a subject is moving their fingers — e.g., opposition of the thumb to fingers.
We showed that the mu activity is also blocked, suppressed, not only by movement itself, but by observation of movement, e.g., a video tape of another person opposing their thumb to fingers [1]. Subsequently ourselves [2] and then others subsequently replicated this finding [3–5]. Furthermore, ourselves [2] and then others [3,5] showed that autistic individuals do not show mu wave suppression upon observation of movement, but do upon moving themselves. This mu wave suppression upon observation of the movement of another person, may be a correlate in humans of so-called ‘‘mirror neurons’’ found by Rizzolatti and colleagues in cortical area F5 macaque monkeys found to respond not only to movement of the monkey, but observation of movements made by another monkey (Ref. 6 and references therein). Thus, autistic individuals may have a poorly functioning mirror neuron system [2].

One treatment strategy for autism might then be to utilize biofeedback to try to get autistic individuals to suppress the mu wave to observation of movement. However, such an approach might not generalize easy to other real world functional activities. Thus I suggest here play with virtual online pets as a therapy approach in autism. After buying a stuffed animal the child then goes online and ‘‘adopts’’ an online version of the pet (see Ref. 7 for an example). Immediately this approach brings in theory of other minds as the child must associate the real stuffed animal they have with its online virtual ‘‘embodiment’’. After adopting the pet online, the child must then provide housing, food, medical care and entertainment for their virtual pet. The online site encourages not only subsistence in these spheres but ones that are most appropriate and enjoyable for a given online pet. For example, large animals appreciate a large or even outdoor room. Thus, online play with virtual pets illustrates, encourages and provides practice and reinforcement in situations where having a theory of other minds is beneficial. Kids get virtual money to obtain things for their pet by playing games and contests online. The need to get money to get things for one’s online virtual pet then provides a higher level of thinking in terms of theory of other minds.

**Testing the hypothesis**

Like any proposed treatment in medicine, the only way to test ownership of virtual online pet therapy for autism would be to show its efficacy in a randomized, controlled trial. In this case, that is easily done in principle: measure functional interactions of autistic children of a given homogeneous IQ range. Then randomize the children to virtual online pet therapy or a control therapy. After some months then remeasure the functional interactions. If ownership and play with virtual online pets – an easy, safe inexpensive and fun therapy – is fond beneficial it would be a useful addition to the treatment armamentarium for autism.

**Acknowledgement**

I thank Benjamin and Daniel Altschuler for helpful discussions.

**References**

Case Report

Can Dogs Prime Autistic Children for Therapy?
Evidence from a Single Case Study

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Ana Magalhães, PhD4 and Liliana de Sousa, PhD1,2

Abstract

Background and objectives: Canine-assisted therapy has been receiving growing attention as a means of aiding children with autism spectrum disorder (ASD). Yet, only limited studies have been done and a great deal of literature related to this intervention is anecdotal. The present study aims at providing additional quantitative evidence on the potential of dogs to positively modulate the behavior of children with ASD.

Settings/location, subjects, and interventions: A 12-year-old boy diagnosed with ASD was exposed, at his usual treatment location (the Portuguese Association for Developmental Disorders and Autism at Vila Nova de Gaia, Portugal), to the following treatment conditions: (1) one-to-one structured activities with a therapist assisted by a certified therapy dog, and (2) one-to-one structured activities with the same therapist alone (as a control). To accurately assess differences in the behavior of the participant between these treatment conditions, the therapist followed a strict research protocol. The behavior of the participant was continuously video-recorded during both treatment conditions for further analysis and comparison.

Treatment outcomes: In the presence of the dog, the participant exhibited more frequent and longer durations of positive behaviors (such as smiling and positive physical contacting) as well as less frequent and shorter durations of negative behaviors (such as aggressive manifestations).

Conclusions: These findings are in accordance with previous experimental work and provide additional support for the assertion that dogs can prime autistic children for therapy. Ultimately, this study may contribute toward a change for full acceptance of canine-assisted therapy programs within the medical milieu. Additional studies using a similar research protocol on more autistic children will certainly help professionals to work on the most effective methods to individually serve this population through canine-assisted interventions.

Introduction

The autism spectrum disorder (ASD) is a neurodevelopmental childhood condition characterized by variable difficulties in social behavior and communication, restrictive interests, and repetitive activities.1 According to recent epidemiological surveys, 1 child in 166 is affected with this disorder, which represents a major increment compared to assessments from a few decades ago (4 children in 10,000).2

As the prevalence of ASD has increased, so has the number of therapeutic modalities used to treat its symptoms (e.g., educational programs3; early behaviorally based intervention programs4; pharmacological interventions5). To date, however, none has proved dramatically effective, and complementary methods have been suggested.1 For example, the introduction of a dog into psychodynamic therapy sessions has been receiving growing attention as a legitimate means of aiding this population.6 In a study involving animal-assisted therapy and children with autism, Redefer and Goodman showed that supervised interactions with dogs increased prosocial behaviors, decreased self-absorption, and lessoned stereotyped behaviors.7 Similarly, Martin and Farnum found that children with autism exhibited a more playful mood, were more focused and were more aware of their social environments when in the presence of a dog.8

Although encouraging, the findings above have not been replicated by further experimental work, and full acceptance

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of canine-assisted therapy programs into the medical milieu is still depending on additional studies incorporating rigorous scientific protocols. Following this line of reasoning, the single case study here presented was planned to explore the effect of the presence of a certified therapy dog on the behavior of a boy diagnosed with autism during one-to-one activities with a therapist.

Materials and Methods

The participant

The participant in this study was a 12-year-old boy diagnosed with DSM-IV autistic disorder through observation conducted by a health care professional (along with a semi-structured interview of the caregivers). The boy was recruited via the Portuguese Association for Developmental Disorders and Autism and was selected, among the younger patients who were not being followed by a psychologist and had no allergies to dogs, by a simple random sampling procedure (picking a name out of a box). His clinical reports referred a long history of language delays, poor social skills, aggressive behaviors, anxiety, as well as obsessions about magazines and newspapers. Permission for participant inclusion in the study was obtained through informed consent provided by the caregiver.

The therapy dog

The dog, a female Labrador retriever, was recruited, trained, and certified as a therapy dog by Ânimas. This Portuguese association, member of the Assistance Dogs International Inc. (ADI), tests the animals primarily for temperament, carefully assessing their potential to work safely and comfortably within institutionalized settings. Evaluation also includes a veterinary check, proof of vaccinations, and good health. All training programs use positive reinforcement (reward-based) approaches, and follow the minimum standards and ethics developed by the ADI Standards and Ethics Committee.9

The therapist

The therapist involved in this study was dual qualified as a psychologist and as a certified therapy dog handler. She took specific training from Ânimas and passed an evaluation of knowledge about how to mediate the interaction of dogs appropriately with various client populations, namely, autistic children. As handler, she was obliged to be in full and direct control of the dog at all times.

The therapist was selected for this experiment due to her vast experience on animal-assisted interventions, thus minimizing the effect of extraneous variables (such as her own motivation throughout the entire duration of the study) on the behavior of the participant.

Experimental design and data collection

An experimental design, approved by both clinical (Portuguese Association for Developmental Disorders and Autism) and academic (Instituto Superior de Psicologia Aplicada) units, was planned to expose the participant to two treatment conditions: structured sessions of one-to-one activities with the therapist in the presence of the therapy dog (Tdog) and structured sessions of one-to-one activities with the therapist without the presence of the therapy dog, serving as a control (T). Each week, the participant was exposed to T and Tdog sessions, for 45 minutes, on different and nonconsecutive days. All sessions were video-recorded for data-coding purposes and were held at the participant’s usual treatment place.

Sessions were preceded by a 15-minute acclimatization period during which the therapist either (1) modeled and verbally encouraged approaching and exploring the dog through touching, holding, and petting activities (prior to Tdog sessions); or (2) followed the participant’s initiatives and gave no indications about any particular task (prior to T sessions).

To assess differences in the behavior of the participant between the two treatment conditions (T and Tdog) accurately, the therapist followed a strict research protocol instead of a more versatile agenda (as described in previous studies [e.g.8]). This protocol included structured one-to-one activities previously defined to promote prosocial behaviors in the participant (e.g., playing ball with the participant, questioning the participant about specific events). Both the order of presentation and the duration of activities were maintained across sessions so that the unique difference between the two experimental conditions was the presence of the dog, used by the therapist as a facilitator to communication with the participant. Fifteen (15) minutes of each session, including 5-minute periods (randomly selected by an independent researcher) of the initial, middle, and last parts of the video recordings, were analyzed and the following variables were coded: (1) negative behaviors of the participant, including physical aggressive behavior, verbal aggressive behavior, repetitive smelling, obsessive staring, grabbing behavior, as well as self-absorption; and (2) positive behaviors of the participant, including affectionate behavior, play, visual contact, as well as smiling. These variables were selected based on the clinical reports of the participant along with naturalistic observations (i.e., observations of behaviors as they occur naturally, without any intervention) conducted at the participant’s treatment place, prior to the beginning of the study. Their categorization (into positive and negative) followed previous studies assessing the effects of interaction with dogs on children with autism (e.g.7,8). The definitions of all recorded behaviors are presented in Table 1. Coding was performed using the Observer XT Software version 7.0 (Noldus Information Technology, Wageningen, The Netherlands), which allows an automatic reading of duration and frequency of behavioral events.

Interobserver reliability, using Pearson’s r correlation, was assessed between two coders who independently scored all video recordings. Obtained values of r were above 0.9 for the frequencies and durations of all the behaviors of the participant recorded throughout the study.

Statistical analysis

Inferential statistics used in the analysis of group data are generally considered invalid for use with data from single-case experimental designs.10 Instead, randomization tests are commonly used as valid statistical analyses for all designs that incorporate a random procedure for assigning treatments to subjects or observation periods, as was the case in the present study.10–12 Therefore, the recorded frequencies and durations of the behaviors exhibited by the participant in the two
treatment conditions (Tdog and T sessions), over a period of 15 minutes, were compared by means of a randomization test provided by Todman and Dugard\textsuperscript{13} and run using the Statistical Package for the Social Sciences 17.0 (SPSS Inc.).

**Results**

**Negative behaviors**

The results presented in Table 2A show that the frequencies and durations of both physical aggressive behavior toward inanimate objects and verbal aggressive behavior toward the therapist were significantly lower in the sessions that included the therapy dog (Tdog sessions) than in those that did not (T sessions). Similarly, the frequency and duration of grabbing behavior were significantly lower in Tdog than in T sessions. Also, the duration of absorption was found to be significantly lower in Tdog than in T sessions. Finally, pronounced differences in the frequency and duration of obsessive staring between were also observed (both being lower in Tdog than in T sessions), but no significance was found.

**Table 1. Positive and Negative Behavioral Measures Coded in the Participant**

<table>
<thead>
<tr>
<th>Behavioral measures</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative</strong></td>
<td></td>
</tr>
<tr>
<td>Physical aggressive behavior</td>
<td>Engaging in actions (other than verbalizations) causing pain and physical harm to the therapist (including biting, pushing, and hitting)</td>
</tr>
<tr>
<td>toward the therapist</td>
<td></td>
</tr>
<tr>
<td>Physical aggressive behavior</td>
<td>Engaging in actions causing damage to inanimate objects (including biting, pushing, and hitting)</td>
</tr>
<tr>
<td>toward inanimate objects</td>
<td></td>
</tr>
<tr>
<td>Verbal aggressive behavior</td>
<td>Using hostile words to insult, threaten, anger, or intimidate the therapist</td>
</tr>
<tr>
<td>Repetitive smelling</td>
<td>Inhaling the odor of the therapist or inanimate objects with direct contact</td>
</tr>
<tr>
<td>Obsessive staring</td>
<td>Gazing fixedly and steadily at journals and magazines</td>
</tr>
<tr>
<td>Grabbing behavior</td>
<td>Taking possession of journals and magazines by force</td>
</tr>
<tr>
<td>Self-absorption</td>
<td>Adopting an absent expression, appearing to be totally emotionally detached</td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
<tr>
<td>Affectionate behavior</td>
<td>Accepting and giving physical contact from/to the therapist (including hugs and kisses)</td>
</tr>
<tr>
<td>Play</td>
<td>Initiating and maintaining symbolic and/or organized games with the therapist</td>
</tr>
<tr>
<td>Visual contact</td>
<td>Looking directly into the eyes of the therapist</td>
</tr>
<tr>
<td>Smiling</td>
<td>Change in facial expression by turning up the corners of the mouth/spreading the lips</td>
</tr>
</tbody>
</table>

**Table 2. Mean (± Standard Error) Frequencies and Durations of the Behaviors Exhibited by the Participant in the Two Treatment Conditions (with [Tdog] and Without [T] the Presence of the Dog), Over a Period of 15 Minutes**

<table>
<thead>
<tr>
<th>Behavioral measures</th>
<th>Tdog</th>
<th>T</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Negative</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical aggressive behavior</td>
<td>5.54±3.21</td>
<td>10.38±6.56</td>
<td>0.091</td>
</tr>
<tr>
<td>toward the therapist</td>
<td>72.88±20.19</td>
<td>100.34±21.22</td>
<td>0.082</td>
</tr>
<tr>
<td>Physical aggressive behavior</td>
<td>0.67±0.49</td>
<td>2.5±0.34</td>
<td>0.025*</td>
</tr>
<tr>
<td>toward inanimate objects</td>
<td>6.87±9.10</td>
<td>30.09±11.71</td>
<td>0.019*</td>
</tr>
<tr>
<td>Physical aggressive behavior</td>
<td>3.17±1.74</td>
<td>4.83±2.07</td>
<td>0.036*</td>
</tr>
<tr>
<td>toward inanimate objects</td>
<td>7.17±2.81</td>
<td>11.32±2.39</td>
<td>0.041*</td>
</tr>
<tr>
<td>Verbal aggressive behavior</td>
<td>28.87±17.15</td>
<td>37.60±10.27</td>
<td>0.462</td>
</tr>
<tr>
<td>(f)</td>
<td>95.31±20.11</td>
<td>121.99±15.01</td>
<td>0.471</td>
</tr>
<tr>
<td>Repetitive smelling</td>
<td>11.01±4.72</td>
<td>20.11±6.26</td>
<td>0.051</td>
</tr>
<tr>
<td>(f)</td>
<td>347.71±39.60</td>
<td>406.69±25.96</td>
<td>0.053</td>
</tr>
<tr>
<td>Obsessive staring</td>
<td>17.67±5.09</td>
<td>19.99±7.10</td>
<td>0.886</td>
</tr>
<tr>
<td>(f)</td>
<td>110.42±28.75</td>
<td>571.64±23.00</td>
<td>0.036*</td>
</tr>
<tr>
<td>Obsessive staring (d)</td>
<td>17.67±5.09</td>
<td>19.99±7.10</td>
<td>0.886</td>
</tr>
<tr>
<td>Self-absorption</td>
<td>28.87±17.15</td>
<td>37.60±10.27</td>
<td>0.462</td>
</tr>
<tr>
<td>(f)</td>
<td>95.31±20.11</td>
<td>121.99±15.01</td>
<td>0.471</td>
</tr>
<tr>
<td>Grabbing behavior</td>
<td>15.43±3.41</td>
<td>30.01±5.99</td>
<td>0.048*</td>
</tr>
<tr>
<td>(f)</td>
<td>5.67±1.54</td>
<td>9.00±1.29</td>
<td>0.049*</td>
</tr>
<tr>
<td>Grabbing behavior (d)</td>
<td>5.67±1.54</td>
<td>9.00±1.29</td>
<td>0.049*</td>
</tr>
<tr>
<td><strong>B. Positive</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affectionate behavior</td>
<td>21.83±2.81</td>
<td>11.83±1.60</td>
<td>0.030*</td>
</tr>
<tr>
<td>(f)</td>
<td>50.11±17.16</td>
<td>21.43±4.78</td>
<td>0.051</td>
</tr>
<tr>
<td>Affectionate behavior (d)</td>
<td>50.11±17.16</td>
<td>21.43±4.78</td>
<td>0.051</td>
</tr>
<tr>
<td>Play (f)</td>
<td>5.02±0.49</td>
<td>3.91±0.95</td>
<td>0.094</td>
</tr>
<tr>
<td>Play (d)</td>
<td>23.45±3.92</td>
<td>19.01±4.60</td>
<td>0.101</td>
</tr>
<tr>
<td>Visual contact (f)</td>
<td>55.67±10.60</td>
<td>31.83±5.24</td>
<td>0.015*</td>
</tr>
<tr>
<td>Visual contact (d)</td>
<td>193.01±37.51</td>
<td>117.81±24.23</td>
<td>0.035*</td>
</tr>
<tr>
<td>Smiling (f)</td>
<td>8.18±3.57</td>
<td>2.34±1.86</td>
<td>0.016*</td>
</tr>
<tr>
<td>Smiling (d)</td>
<td>8.18±3.57</td>
<td>2.34±1.86</td>
<td>0.016*</td>
</tr>
</tbody>
</table>

(f), frequency; (d), duration in seconds.

*Indicates significant differences between the two treatment conditions (randomization tests).
Positive behaviors

The results presented in Table 2B show that the frequencies and durations of both visual contact and smiling were significantly higher in the sessions that included the therapy dog (Tdog sessions) than in those that did not (T sessions). Affectionate behavior was also significantly more frequent in Tdog than in T sessions).

Discussion

Compared to the control condition (T sessions), the presence of the dog during one-to-one activities with the therapist was not only associated with a higher engagement of the participant with the therapist but also with a lower level of negative behaviors, namely, aggressive and obsessive manifestations, which is in accordance with preliminary experimental work conducted by Redefer and Goodman as well as Martin and Farnum. See also Beck and Ketcher.

One could question whether the poorer behavioral scores recorded during T sessions might have been motivated by some disappointment due to the absence of the dog. In a report describing the use of feral cats as adjuncts to psychotherapy, for example, Wells and colleagues mentioned that clients sometimes verbalized disappointment, because the cats were not present when they arrived for a scheduled appointment. To these authors, however, unpredictability and potential for emotional risk constitutes a positive attribute of therapy as “an accurate mirror of life as it truly exists.” Moreover, these same authors mention an expectation and confidence that frustration will be tolerated without the fear of permanent loss or catastrophe, thus allowing the therapist to use the animals as effective motivators of positive behavior and communication. Regarding the present study, it is possible that disappointment might have contributed to the obtained results, but it certainly did not totally account for them. The participant was never informed of the days of the sessions (which were randomized within each week), nor of the continuity of the study, and so expectation, and by consequence disappointment, might have been minimal. Also, the reduced number of sessions conducted (N = 6 for each treatment condition) likely prevented a strong emotional attachment with the animal. Hence, differences observed between the two treatment conditions were most probably due to a positive modulation of the behavior of the participant (in the presence of the dog) rather than the result of a negative reaction caused by the absence of the animal.

At this point, one could also question whether the observed positive results are attributable to the presence of the dog per se or to the introduction of a novel element into the experimental environment. Recent research does, however, point to specific benefits of dogs. For example, in a study exposing children with ASD to different elements (a toy, a stuffed dog, and a live dog) while interacting with a therapist, researchers found that children were significantly more compliant and involved during therapy in the presence of the animal. The current understanding of the role of pets in modulating psychoneuroendocrine responses also seems to support the effect of dogs per se. Studies with hospitalized children, for instance, show that exposure to a friendly animal can induce a release of endorphins and a relaxation response (as indicated, for example, by reduced heart rate, reduced blood pressure, and reduced respiratory rate), leading to a feeling of well-being that improves the outcome of therapeutic interventions.

Conclusions

Although the present study did not aim at evaluating canine-assisted therapy per se (the therapist used a research protocol, not a therapy protocol), it provides quantitative indications for the potential of dogs to prime children with autism so that they may be able to participate in therapeutic interactions better and respond more effectively to the demands of therapy (as also previously reported by Redefer and Goodman). Given that maintenance and generalization have long been recognized by clinicians as persistent problems in this population, further research should focus on assessing whether positive effects can (1) generalize to therapeutic contexts that do not involve the presence of a dog, and (2) be maintained outside a therapeutic environment. Moreover, given the marked phenotypic diversity in ASD, additional case studies are necessary for the characterization of individual differences that likely exist across children with ASD in their responses to canine-assisted therapy. With such studies, professionals could work on the delineation of the most effective methods to individually serve this population through animal interventions.

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Disclosure Statement

No competing financial interests exist.

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Abstract

Background: Autism spectrum disorders (ASD) are characterized by deficits in social reciprocity and communication, and by unusually restricted, repetitive behaviors. Intervention strategies based on the exploitation of the emotional aspects of human–dog relationships hold the potential to overcome the difficulty of subjects with ASD to relate and interact effectively with others, targeting core symptoms of this disorder.

Methods: This review summarizes the results of six published studies on the effects of brief interactions with dogs and the effects of introducing dogs in families with a child diagnosed with ASD, with an emphasis on social behaviors and language use. Furthermore, the possible mechanisms responsible for the beneficial effects observed are discussed.

Conclusions: Although the studies described here are encouraging, further research with better designs and using larger samples is needed to strengthen translation of such interventions to the clinic. In addition, potential applications of analyzing child–dog interactions are highlighted to screen for early signs of the disorder.

Introduction

In 1943, Leo Kanner first described children who lacked interest in other people, using the term “early infantile autism.” One (1) year later, Hans Asperger independently reported of a group of children characterized by similar behavioral features but with milder severity and higher intellectual abilities.1

Autism is the prototypical form of a spectrum of related, complex, neurodevelopmental disorders referred to as autistic spectrum disorders (ASDs), also known as pervasive developmental disorders (PDDs). These include autism, Asperger syndrome, and atypical autism,2 and it has been estimated that they affect 1 child in about 150 children,3 although several factors may lead to an underestimation of the prevalence.4 ASDs are strongly biased toward males (with a male/female ratio of 4:1 for classic autism), suggesting a potential involvement of perturbations in the typical trajectory and maturation of the sexually dimorphic brain in the etiology of this disease.3,5,6 Impairments in reciprocal social interaction and deficits in age-specific play patterns and symbolic behavior are key features indicative of autism in infants and preschoolers. In particular, a diagnosis of autism, based on the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) and on the International Statistical Classification of Diseases and Related Health Problems,2,7 implies impairments in three behavioral domains: (1) social interaction; (2) language, communication, and imaginative play; and (3) restricted range of interests and activities. The onset of the disease must be before the age of 3 years.

Autism is recognized as a neurobiological condition involving central nervous system dysfunctions with a strong genetic basis, involving multiple, interacting genes, as confirmed from twin and family studies.8–11 However, the precise etiology of ASD still remains unknown because of the complex behavioral phenotypes and multigenic factors characterizing this disorder. In addition, exposure to environmental modifiers might contribute to variable expression of autism-related traits.12 Indeed, recent studies suggest that programming effects on the developing offspring, resulting from stressful experiences, maternal diet and infections, advanced parental age, prematurity, and low birth weight—just to mention a few—might act through epigenetic mechanisms resulting in critical determinants of disease “predisposition,” including autism.6,12–15 By contrast, intensive behavioral interventions carried out during early childhood have been shown to decrease symptom severity.16,17

Section of Behavioral Neurosciences, Department of Cell Biology and Neurosciences, Istituto Superiore di Sanità, Rome, Italy.
A growing number of therapeutic approaches exist for the management of infantile autism.16,18 Some of these involve developmental/behavioral strategies; others are based on sensory-integration or social skills training, whereas pharmacologic therapies are not specifically meant to target the core symptoms of ASD, but rather to act on some psychiatric aspects associated with this pathology (hyperactivity, inattention, aggression, irritability, and self-injurious behaviors).16,19–24 Intervention programs based on behavioral strategies, such as the Lovaas program,25–27 have shown to successfully improve communication, social skills, and management of “problematic” behaviors, and currently represent the most effective methods for ASD management.28–31 However, despite the large number of therapeutic approaches, at present, neither proven therapies nor preventive measures exist for the universal treatment of infantile autism. Therefore, further research and the development of individualized therapies for the ASD population appear imperative.

It is possible to hypothesize that intervention strategies based on exploiting the emotional aspects of the relationship with a dog might represent an effective tool to dampen withdrawal of children with ASD by targeting some of the core symptoms of this disorder. The simple and interpretable pattern of movements that characterizes dogs might facilitate the engagement of children with ASD in structurally simple social actions that do not require the interpretation of verbal cues and are highly repeatable and predictable (e.g., throw, fetch and retrieve play, walking the dog on a leash, giving a hand command).25–28 Sams and colleagues suggest that acquiring the ability to interpret and respond to the social and behavioral cues of dogs may provide a bridge toward learning to interpret the more subtle behavior of human beings.28 It has also been suggested that dogs, representing a powerful multisensory stimulus—strong and clear sounds, a vivid visual impression, a special smell, and a stimulation to touch—might target the low sensory and affective arousal levels characterizing children with ASD.29 In this context, it is worth noticing that the Denver Model, a therapeutic intervention that integrates applied behavior analysis with developmental and relationship-based approaches,30,31 involves the use of “sensory social routines” (i.e., repeated dyadic interactions, based on pleasurable activities, that have strong sensory, movement, and social foundations).19 Thus, dogs appear to be good candidates to assist therapists in building such pleasurable dyadic interactions.

Generally, dogs are receiving increasing attention because of their potential use in various therapeutic/activity programs (therapy dogs), also known as Animal-Assisted Interventions (AAI), aimed at targeting a large number of health-related problems in different clinical populations.32,33 Different reports have also shown the overall ability of assistance dogs (which are owned by individuals with different disabilities) to act as social catalysts, enhancing social interactions and increasing social networks, especially for those with severe disabilities, who very often suffer social discrimination.34–38

Despite the growing body of evidence showing the potential of interaction with dogs to benefit people, including those with disabilities, only a limited amount of studies have specifically focused on the role of child–dog relationships in the ASD population. In addition, most of these studies are lacking a standard methodology, making it difficult to evaluate the efficacy of the intervention.

The aim of this review is to provide a critical and systematic reading of the literature assessing the effects of therapy and assistance dogs on children with ASD and the possible overall reflection on the welfare of their families.

**Targeting Autism Through the Interaction with Dogs: A Review of the Literature**

Although the first reports on the beneficial effects of dogs with severely withdrawn children date back to the 1960s with the experience of Boris Levinson,39 successive studies aimed at evaluating the efficacy of systematic interactions of children affected by ASD with dogs are scarce. In the late 1980s, Redefer and Goodman29 were pioneers in the scientific approach of the effects of interaction with dogs on children with autism, although a systematic review of the literature revealed that it was only from 2000 that this field of research has been receiving growing attention, as reflected in the increasing amount of studies published.

For the purpose of this review, only experimental studies, semistructured interviews, and case studies, published in the English language in peer-reviewed journals, have been taken into account. Qualitative (anecdotal) studies were excluded, as well as published PhD theses and conference proceedings. The literature search included the following databases: PubMed, Google Scholar, ScienceDirect, and ERIC. Reference lists in studies and review articles about this intervention were also consulted to identify potentially relevant studies. Participants were children (age range: 3–15) diagnosed with ASD, with a PDD, according to DSM-IV. Research that did not entirely focus on autistic disorders (i.e., large range of clinical syndromes, small number of people with autism) was excluded. Interventions involving therapy were distinguished from those involving assistance dogs. As for therapy dogs, interactions occurred in the presence of the therapist, who followed a predetermined research protocol that included structured one-to-one activities designed to stimulate social behaviors and language use. Assistance dogs were introduced into the families with the primary function to ensure child safety, at home and in public, by inhibiting children from bolting or moving dangerously (e.g., walking off the sidewalk).40 Results of this literature search revealed that only six articles met the inclusion criteria: two of them describe the effects of assistance dogs (Table 1) and four interventions involve the effects of therapy dogs (Table 2) on children with PDD, including ASD.

**Effects of Interventions**

**Assistance dogs**

When studying the effects of the introduction of assistance dogs on the general welfare of families with children affected by ASD, Burrows and colleagues41 observed that the contribution of these animals extended beyond children’s physical safety to therapeutic and communicative domains. In fact, the integration of assistance dogs resulted in beneficial effects on children’s behavior with decreased anxiety and anger, increased calmness, reduction in the number of emotional outbursts (tantrums), and more manageable bedtime routines. These authors also report an additional sense
of security for the parents, especially at night, which improved their quality and quantity of sleep and their sense of independence. In addition, all the members of the family experienced an increase in the social acknowledgment perceived, thanks to the presence of the assistance dog. Cortisol levels prior and after the introduction of the dog were the same; CAR (cortisol awakening response) was found to be considerably reduced when dogs were present and rose again when dogs were removed from the families.

A different study focused on the specific effect of assistance dogs in regulating a physiologic response to stress in autistic children. Viau and colleagues measured physiologic variables (i.e., cortisol levels) before, during the staying of the dogs, as well as after they were removed from the families. Authors found that the cortisol awakening response (CAR) was decreased upon the introduction of dogs (acute effect), whereas it rose again when the animals were removed from the families (long-term effects). Indeed, these results show that, in children with ASD, CAR is sensitive to the presence of assistance dogs, suggesting that this measure might represent a reliable physiologic marker of a positive/negative psychologic state. Interestingly, parents also reported a decrease in the number of problematic behaviors (such as self-stimulation, repetitive, disruptive behaviors, tantrums) when the dogs were living in the families, which lends support to the potential behavioral benefits of assistance dogs for children with ASD.

It is important to stress that, in both of these studies, the effect of an assistance dog on children with problematic behaviors was assessed by means of semistructured interviews and a questionnaire distributed to parents, possibly reflecting the parents’ satisfaction more than an actual modification in their child’s behavior. The analysis of behavioral changes based on systematic observations might represent a more useful and comprehensive approach.

Therapy dogs

Interventions with therapy dogs rely upon brief interactions with these animals (AAI). All the interventions reviewed here occurred in the presence of the therapist, who followed a predetermined research protocol that included structured one-to-one (individual) activities designed to stimulate social behaviors and language use. In all cases, results were encouraging since interaction with dogs was able to dampen social isolation and withdrawal in children.

Redefer and Goodman observed that, following the introduction of a friendly dog into a therapeutic session, seriously withdrawn children with ASD showed a sharp increase in the frequency of both verbal and nonverbal social behaviors; this increase was directed toward the dog and the therapist and was paralleled by a decrease in children's withdrawal. This general improvement appeared to be maintained for 1 month after dog exposure (follow-up), although it was more evident in children with higher intensity of autism spectrum disorder (i.e., lower IQ scores and more severe social impairment) and less evident in children with lower intensity of autism spectrum disorder (i.e., higher IQ scores and less severe social impairment).

Martin and Farnum observed children's social behavior when they were interacting with a live dog, and when they were interacting with a ‘visiting dog’ (a picture of a dog). They found that children were more engaged and showed more positive social behaviors when they were interacting with a real dog, compared to a picture of a dog.

Table 1. Studies Involving Assistance Dogs on ASD Population

<table>
<thead>
<tr>
<th>Authors</th>
<th>Participants</th>
<th>Design</th>
<th>Animal-related situations</th>
<th>Outcomes</th>
<th>Main results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burrows et al.41</td>
<td>Diagnosis: ASD N=10 Age: range 4.5–14 Sex: 7 M, 3 F Setting: home</td>
<td>Semistructured interview for children’s parents; ethological observations</td>
<td>Placement of an assistance dog with the families of autistic children</td>
<td>Perceived safety and well-being for families</td>
<td>Participants reported improved child’s safety (at home and in public), motor function, calmness, and compliance with the parents’ directives. Participants also reported an improvement in the daily routines, and increased positive social acknowledgments.</td>
</tr>
<tr>
<td>Viau et al.42</td>
<td>Diagnosis: ASD N=42 Age: range 3.6–14.8 Sex: 37 M, 5 F Setting: home</td>
<td>Longitudinal, repeated-measures (pre- and post-test) design</td>
<td>Placement of an assistance dog with the families of autistic children</td>
<td>Basal salivary cortisol; problematic behaviors (e.g., self-stimulation, repetitive, disruptive behaviors, tantrums)</td>
<td>Participants reported decreased number of problematic behaviors as well as improved cortisol levels prior and after the introduction of the dog. CAR (cortisol awakening response) was found to be considerably reduced when dogs were present and rose again when dogs were removed from the families.</td>
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ASD, autism spectrum disorder.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Participants</th>
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<th>Outcomes</th>
<th>Main results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redefer and Goodman²⁹</td>
<td>Diagnosis: ASD N=12 Age: 5–10 Sex: 9 M, 3 F Setting: not specified</td>
<td>Longitudinal, repeated-measures (pre- and post-test) design</td>
<td>Twenty minutes of interaction with a therapist in the presence of a therapy dog</td>
<td>Changes in isolation (play or self-stimulatory activities directed to self) and social interaction (any instance of verbal or nonverbal behavior directed toward the therapist and the dog)</td>
<td>Increase in social interaction and decrease in isolation when the dog was introduced in therapy sessions. By follow-up (1 month after the treatment), social interaction declined but was still above baseline and isolation increased but was still below baseline.</td>
</tr>
<tr>
<td>Martin and Farnum⁴³</td>
<td>Diagnosis: PDD(^a) N=10 Age: range 3–13 Sex: 8 M, 2 F Setting: school</td>
<td>Crossover, repeated-measures design (all participants experienced all three conditions)</td>
<td>Fifteen minutes of interaction with a therapist in the presence of a therapy dog, a stuffed dog, or a ball</td>
<td>Language use and social behaviors directed toward the therapist and the dog; nonsocial behavior (i.e., hand flapping)</td>
<td>In the presence of the therapy dog, children showed a more playful mood, were more likely to keep their gaze focused on the dog, to talk to the dog and engage the therapist in discussion regarding the dog. Children touched the dog less often than the ball or stuffed dog. Children exhibited more hand flapping in the presence of the dog.</td>
</tr>
<tr>
<td>Sams et al.²⁸</td>
<td>Diagnosis: ASD(^b) N=22 Age: range 7–13 Sex: not specified Setting: school</td>
<td>Crossover, repeated measures design (all participants experienced all two conditions)</td>
<td>Between 20 and 30 minutes of occupational therapy sessions incorporating animals (i.e., llamas, dogs, rabbits) or standard occupational therapy sessions</td>
<td>Language use; spontaneous or prompted social interaction with humans or animals</td>
<td>Children showed greater use of language and greater social interactions (number per minute) in the occupational therapy sessions incorporating animals.</td>
</tr>
<tr>
<td>Silva et al.⁴⁴</td>
<td>Diagnosis: ASD N=1 Age: 12 Sex: M Setting: outpatient therapy center</td>
<td>Case study</td>
<td>Forty-five minutes of structured sessions of one-to one activities with the therapist in the presence of a therapy dog or without the presence of the therapy dog</td>
<td>Negative behaviors (e.g., physical and verbal aggressive behaviors, repetitive behaviors, self-absorption) and positive behaviors (e.g., play, visual contact, smiling) toward the therapist and inanimate objects</td>
<td>Aggressiveness and self-absorption less frequent in the sessions that included the therapy dog; visual contact, smiling and affectionate behaviors more frequent in the sessions that included the therapy dog.</td>
</tr>
</tbody>
</table>

\(^aN=7\text{ PDD not otherwise specified, }N=2\text{ Asperger's disorder, }N=1\text{ autistic disorder.}\)

\(^b\text{Two of the participants carried a secondary diagnosis of cerebral palsy.}\)

ASD, autism spectrum disorder; PDD, pervasive developmental disorders.
playing either with a nonsocial toy (i.e., a ball) or a stuffed dog. These authors found that children were less distracted, exhibited a more playful mood, and were more aware of their social environment when in the presence of the therapy dog. Furthermore, verbal interactions were stimulated by the presence of the animal. Children were more likely to talk to the dog, engaging the therapist in discussions regarding the animal, and speaking less about topics unrelated to the therapeutic protocol during the dog condition. An increase in hand flapping was also reported in children exposed to the therapy dog. Although such a behavior is usually considered as a stereotypy and therefore viewed as undesirable, the authors believe that this “was a mode of expressing excitement and exhilaration.” It is worth noticing that this study represents a first important attempt to perform a thorough analysis of the effects of AAI with a dog through the comparison with behavioral changes resulting from the exposure to different stimuli (ball/stuffed dog).

Similar results were obtained by Sams and colleagues, who found that the incorporation of animals (i.e., llamas, dogs, and rabbits) in a school-based occupational therapy program was able to encourage language use and social interaction in children with ASD, particularly in comparison to occupational therapy using standard techniques.

The efficacy of the dogs’ presence in increasing the engagement and decreasing negative behavioral patterns (such as aggressive and obsessive manifestations) was also confirmed in a very recent case-study by Silva and colleagues. In particular, physical and verbal aggressiveness, as well as self-absorption, were significantly reduced while smiles, visual contacts, and affectionate behaviors were increased.

**Discussion**

By being able to respond affectionately to human attention, to elicit prosocial behavior and positive feelings, animals seem to possess a unique capacity to serve as an emotional bridge in specific therapeutic contexts and to act as social catalysts. The forms and manifestations of human bonds with companion animals, particularly with dogs, have led to their extensive inclusion in different educational and therapeutic interventions. In this context, attitude toward animals is thought to be sufficient to explain some of the beneficial effects observed, since things that tend to absorb people’s attention in nonthreatening ways are also known to exert a calming and de-arousing influence. A more relaxing environment might, in turn, increase people’s responsiveness and willingness to communicate. In fact, different studies reported that, when a dog was present, children appeared more prone to engage with peers and adults.

Taken together, the studies reviewed here are encouraging, since the interaction of children affected by ASD with therapy dogs was able to promote verbal and nonverbal behaviors, directed both towards the dog and the therapist. Some authors have suggested that being able to gain access to pets, or to talk about them, might represent a strong drive for children with ASD to increase social interactions with the therapist. In this context, it is important to stress that language impairment is one of the most pervasive symptoms characterizing children with ASD early during postnatal life, and thus being able to act upon such a domain is a main challenge of current behavioral therapies. However, it is also important to take into account that the observed effects on verbal and social skills might in some cases be related to symptom severity; however, none of the studies reviewed considered this variable.

The introduction of assistance dogs into the families of children with ASD allows investigation of the long-term effects of interactions with dogs. In particular, Viau and colleagues found a decrease in problematic behaviors in addition to a specific reduction in a stress-related hormonal parameter (CAR) only during the time the dog was housed with the family. By contrast, when the dog was moved away, the CAR rose again, suggesting that this measure of neuroendocrine activation is very sensitive to the presence of the dog. These data are in line with a substantial body of evidence showing the overall “de-arousing effect” of human-animal interactions on human physiology.

The study by Burrows and colleagues found that the introduction of assistance dogs resulted in beneficial effects not only on children’s behaviors but also on the overall welfare of the family. Family members reported a sense of security and independence, a result particularly important when considering that the impulsivity, hyperactivity, irritability, and aggressiveness of children with ASD profoundly influence parents’ everyday activities, which eventually result in extremely stressful and unsafe experiences for the whole family. Moreover, an increase in the social acknowledgment helped the whole family to feel integrated into the community. This is indeed a desirable result, considering that these families have to deal with social isolation and often experience elevated levels of pessimism and of depressive symptoms. Overall, these findings are not surprising and are in agreement with reports showing the ability of dogs to act as social catalysts, enhancing social interaction between people and increasing social networks, especially for those who have severe disabilities and who very often suffer social discrimination.

Despite these positive and encouraging results, a note of caution must be placed here. In particular, it has been reported that the presence of a dog might elicit an increase in undesirable stereotyped behaviors (such as the hand-flapping), which are thought to attenuate or intensify the arousal levels of children with ASD, depending upon the environmental circumstances. Almost all individuals affected by autism are characterized by hyper- or hyporesponsiveness to sensory inputs, therefore, stimuli that are experienced as neutral by typically developing children might result either in highly rewarding or aversive responses for children with ASD. Thus, in the case of assisted interventions with dogs, these might involve individualized programs tailored to each child’s profile, taking into special account sensory difficulties and arousal levels.

In conclusion, intervention strategies, based on exploiting the emotional aspects of the relationship with a dog, can overcome the inability of children affected by ASD to relate and interact with others by targeting some of the core symptoms of this disorder. However, it is important to take into account that overall most of the AAI programs lack a standard methodology, and there is a need for basic research aimed at including larger sample sizes to assess their effectiveness, using randomized controlled trial designs. In addition, studies specifically aimed to examine whether the
effects of contact with dogs are enduring or are strictly related to a continuous exposure to the animal are still lacking. The use of systematic, detailed studies of behavior should be encouraged since they can better clarify the effectiveness of dog-oriented programs on children' behavior and overall quality of family life.

Future Perspectives: Child–Dog Interaction as a New Screening Tool for Early ASD Diagnosis

A diagnosis of autism is achieved early during childhood, with symptoms becoming manifest within the first 3 years of life. However, parents often recall having had developmental concerns between the first and the second birthdays of their children. This delay in the diagnosis prevents the possible benefits of an early intervention during a time window characterized by higher brain and behavioral plasticity.16,70–73 A promising study reports that characteristic interaction patterns exist during child–dog encounters, and this may be effective to diagnose psychiatric disorders including autism. Patients demonstrated significant diagnosis-specific behavioral differences; in particular, autism patients looked at the dog for a considerably shorter time, showed longer phases of distancing behavior from the dog, and stroked it less than other diagnostically grouped (i.e., anxiety disorder, anorexia, bulimia).74 In this scenario, it is possible to hypothesize that the identification of specific behavioral patterns displayed during child–dog interactions might provide a novel additional tool for the early diagnosis of some ASD signs, such as deviation from typical attentive and social behaviors (gazes, smiles, directed vocalizations) and changes in posture and movements towards the dog.

Acknowledgments

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Autism as a developmental disorder in intentional movement and affective engagement

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We review evidence that autistic spectrum disorders have their origin in early prenatal failure of development in systems that program timing, serial coordination and prospective control of movements, and that regulate affective evaluations of experiences. There are effects in early infancy, before medical diagnosis, especially in motor sequencing, selective or exploratory attention, affective expression and intersubjective engagement with parents. These are followed by retardation of cognitive development and language learning in the second or third year, which lead to a diagnosis of ASD. The early signs relate to abnormalities that have been found in brain stem systems and cerebellum in the embryo or early fetal stage, before the cerebral neocortex is functional, and they have clear consequences in infancy when neocortical systems are intensively elaborated. We propose, with evidence of the disturbances of posture, locomotion and prospective motor control in children with autism, as well as of their facial expression of interest and affect, and attention to other persons’ expressions, that examination of the psychobiology of motor affective disorders, rather than later developing cognitive or linguistic ones, may facilitate early diagnosis. Research in this area may also explain how intense interaction, imitation or “expressive art” therapies, which respond intimately with motor activities, are effective at later stages. Exceptional talents of some autistic people may be acquired compensations for basic problems with expectant self-regulations of movement, attention and emotion.

Keywords: autism, motor development, emotional expression, communication, education, therapy

INTRODUCTION TO A DIFFERENT, PSYCHOBIOLOGICAL APPROACH

“Generality of the problem of Syntax: Not only speech, but all skilled acts seem to involve the same problems of serial ordering . . . Analysis of the nervous mechanisms underlying order in the more primitive acts, may contribute ultimately to the resolution even of the physiology of logic.”

(Lashley, 1951, pp. 121–122)

“A Different Approach to the Problem: In so far as an organism perceives a given object, it is prepared to respond with reference to it. This preparation-to-respond is absent in an organism that has failed to perceive.”

(Sperry, 1952, p. 296)

Lashley (1951) and Sperry (1952) observed that perception, intelligent action and thinking depend upon impulses that move the body purposefully. The animal brain contributes systematic and serial organization, in time and space, to muscle activity under expectant perceptual and emotional control. It is always active, not passively reactive to stimuli. Nor is the human brain ever animated by thoughts of external events alone. All mental and behavioral skills depend on preparation to respond with serial ordering of acts. “The sole product of brain function is motor coordination” (Sperry, 1952, p. 297). This is a psychobiological theory of motives and affects in the mind, clearly articulated before the advent of the “cognitive revolution” that divorced mind from vital body in the 1960’s (Miller, 2003).

The motor theory of consciousness was inspired by the research of Charles Sherrington (1906) on “the integrative action of the nervous system.” It has support from developmental neurobiology and neuroembryology (Trevarthen, 1986a; Prechtl, 2001), from ethology of the adaptive action patterns of animals and how they communicate emotional evaluations for social cooperation (Gallistel, 1980; Marler, 1984; Fentress and Gadbois, 2001; Panksepp, 2005), and from infant psychology and communication (Trevarthen, 1986b, 2001a, 2009a; Stern, 2000, 2010).

Research focused on cognitive disorders of perceptual information processing, selective awareness, and representational thinking articulated in language, all of which skills develop after infancy—disregards the developmental foundations of experience in motor coordination, and in the expression of vital states as emotions for regulation of social life. In an animal’s perceived world, its “Umwelt” (von Uexküll, 1957), conceptions of objects are created by the intentional subject’s attempts to locate and perceive “sign stimuli” detected in the environment by dedicated receptors (Buchanan, 2008; Berthoz and Christen, 2009). Self-regulation of knowing, with emotional assessments of risks and...
benefits, becomes in humans the source of cultural sign systems of social cooperation—for sustaining health, for reproduction and for learning how to use environmental resources collaboratively (Sebeok, 1990; Trevarthen, 1990; Stern, 2010; Porges and Furman, 2011).

We relate autistic disturbance of cognitive functions to growth errors in creative agency attributable to events in brain development of embryo, fetus and infant (Trevarthen et al., 1998, 2006; Trevarthen, 2000; Trevarthen and Daniel, 2005; St. Clair et al., 2007). We address development of the autopoietic subcortical neuropsychobiology that makes possible manifestations of intentions and emotions before birth (Delafield-Butt and Trevarthen, 2013), and the cooperation of movements after birth within an intimate infant-parent intentional system (Sander, 2008), which sustains itself by the primary emotional processes of consciousness (Solms and Panksepp, 2012). The motivation of the developing human organism is environment expectant, ready for sharing agency and emotions in movement, but this sharing is “anaetic”; that is, not dependent on acquired categorical knowledge of the structure and uses of the environment (Vandekerckhove and Panksepp, 2011). The infant is adapted physically and motivated psychologically to receive not only vital care in attachment to the mother, but also “companionship” for the young mind’s growing purposes in imaginative movement and the uptake of new experience (Trevarthen, 2005, 2013). Shared health and meaning are created in human awareness by primary processes of joint agency and emotional sympathy between the movements of human bodies (Trevarthen, 1986b, 2012; Reddy, 2008; Stuart, 2010).

We need to have a clear conception of the nature of animal movement and its affective sociability if we wish to understand how children with autism fail to organize and time their movements effectively, hesitate to become affectively engaged with their parents as infants (Muratori and Maestro, 2007), and fall behind their peers in learning how to share and use knowledge of the human world playfully (Reddy et al., 2002).

Based on evidence of early neural growth errors in core brainstem systems during fetal ontogenesis, and on new evidence of disturbance of primary prospective motor control of expressive action, we present the following hypothesis on the etiology of autism for testing and argument:

(1) A primary cause of autism spectrum disorders is an error in early growth of intrinsic motive and motor systems of the brainstem during prenatal ontogenesis.

(2) This interferes with efficient integration of sensory information with motor timing, and is accompanied by disturbance of autonomic functions, disrupting timing and control of prospective sensory perception in movement as well as vital regulation of functions within the body. All these disorders become most obvious in early childhood, when a toddler normally gains many new powers of movement in engagement with the environment, including speech.

(3) Social isolation, socio-emotional and cognitive delay, and language disorder in children and adults with autism are secondary consequences developed within socio-emotional systems as experience-dependent compensations for primary sensori-motor and affective integration errors and poorly regulated motor intentions. These compensations are elaborated mainly by cortical systems that grow after birth.

AUTISM IS A DISORDER OF SELF-RELATED MOTOR-AFFECTIVE PROCESSES, WHICH CONTROL DEVELOPMENT OF SHARED COGNITIVE REPRESENTATIONS

People diagnosed as autistic exhibit disabilities in regulation of the order and timing of moving, in the feelings of their bodies and emotional control, in selective expectation of objects for experience, in attention to other persons expressions, in the playfulness and humor of their social engagements, and in collaborative learning (Baron-Cohen et al., 2000; Reddy et al., 2002, 2010; Rogers and Williams, 2006; Mundy et al., 2009; Hobson and Hobson, 2011; Torres, 2013). Cognitive disabilities attributed to failure in special modular mental functions of perceptual selection, of conceptual grouping, or of a capacity to conceive and think about the emotions behind other persons' face expressions, orientations and practical actions, or to imagine the representational contents of their minds (Baron-Cohen et al., 1985; Frith, 1989/2003; Morton, 2004), may only be identified after infancy. Similarly, definition of autistic disturbance by reference to neuropsychological tests that identify faults in praxis, gnosis, reasoning and language in adults after local brain injury ignores the large transformations in brain function and behavior that take place during psychological development (Karmiloff-Smith, 2009; Thomas and Karmiloff-Smith, 2002; Karmiloff-Smith, 2009).

We propose that faults in higher mind functions of persons with autism arise out of disorder in the early development of primary, non-reflective sensori-motor factors that regulate moving-with-awareness of an integrated Self. These affect vitality dynamics, the qualities of motor control that express essential expectancies of action and enable communication of emotion in purposes (Stern, 2010; Gowen, 2012; Gowen and Hamilton, 2013; Rochat et al., 2013). The primary processes of mental agency do not require conceptual representation or explicit reference to external events; they are primary conscious experience (Vandekerckhove and Panksepp, 2011). Growth errors found in formation of brain stem motor control and emotional systems of the embryo and fetus (Prechtl, 2001; Rodier and Arndt, 2005), interfere with the maturation of sensory-motor skills at significant periods in a child’s early life, impairing cultural learning mediated in postnatal elaborations of the neocortex and dependent on creative emotional engagement with human company (Trevarthen et al., 2006). Interpreting autism in these terms requires attention to the environment–expectant processes of morphogenesis by which human bodies and brains are formed in utero, with special adaptations for intersubjective communication (Trevarthen, 2001a,b), and information on how additional brain networks grow and learn after birth (Thomas and Karmiloff-Smith, 2002). This is a “developmental psychobiology,” not a “developmental cognitive neuroscience” based on the neuropsychological definition of disorders inferred retrospectively from effects of damage to parts of the adult brain (Baron-Cohen et al., 2000). Psychological theory must also explain how individuals with high-functioning autism and Asperger’s disorder perform certain feats of perception or action with remarkable precision,
but with inadequate awareness of the context, or “weak central coherence,” in their self-related conceptions and plans for action (Frith, 1989/2003; Rinehart et al., 2001).

No single genetic, neurobiological or environmental factor has been identified as the cause of autism, which is also not attributable to the loss of a single cerebral function or capacity (Bauman and Kemper, 2005; Aitken, 2010). The complex and varied cognitive problems of people with autism, and the abnormalities in habits of action and of social response or use of language, are consequences of core disabilities, manifestations of which might be recognized, and compensated for, in infancy, before the development at the end of the first year of “joint attention” (Trevarthen, 2000). A new scientific recognition of these core disabilities in autism, and their relationship to imagination for action and to qualities of movement, is emerging from attention to the emotions that evaluate other persons actions (Hobson, 1993, 2002/04; Reddy et al., 2002, 2010; Reddy, 2008; Hobson and Hobson, 2011), and from a brain science of intentions in movement and the intersubjective sharing of their dynamics of expression (Gallese, 2006; Stern, 2010; Gowen, 2012; Gallese and Rochat, 2013; Rochat et al., 2013).

**AUTISM COMPROMISES AFFECTIVE SHARING, AND REQUIRES CREATIVE RESPONSE TO THIS**

When Leo Kanner (Kanner, 1943) distinguished “autistic disturbances of affective contact” in 1943, he accentuated that the disorder is emotional. Hobson and Hobson (2011) quote examples from Kanner’s sensitive case studies that identify a difficulty in engagement with other person's intentions, experiences and feelings. Kanner also recorded that parents of these children were often concerned from the first year about their child's detachment or aloneness. Reddy (2008, 2011) cites a large number of studies that prove normally developing infants “know minds” and learn complex cooperative activities by deliberately engaging playfully and inquisitively with the way other persons display their interests, experiences and feelings. This eagerness for enjoyment of shared experience, a sympathetic activity, which goes beyond “joint attention to objects,” is weakened in autism.

The cognitive deficiencies of autism measured by tests of perceptual recognition, rational choice, and language are skills that must be gained by learned accommodation to objective experience, and normally depend on deliberate adult instruction. But all can be attributed to deep subjective causes that impair imaginative moving, the pleasures of the body in explorative action, and a motivation to deliberately share this “seeking” in inventive and playful, assimulatory, communication, going “beyond the information given” (Bruner, 1974). It appears likely that autism results from disorders of imaginative and sociable playfulness itself, for which the motives and emotions are apparent from birth. Such disorders can be traced back to creative developments of movement and awareness in body and mind before birth (Trevarthen and Delafield-Butt, 2013), to disorders of sensory-motor circular reactions that become the tools for mastery of engagement with the world (Piaget, 1951, 1954) and for the development of shared cultural understanding (Baldwin, 1902).

Though some medical treatments lead to improvements in associated conditions, there is no drug or surgical intervention for autism. A prescribed course of training or instruction in behaviors, cognitive abilities or communication by learned symbolic language may help, but can have adverse consequences, increasing the subject’s anxiety, isolation and dependency (Trevarthen et al., 1998). Moreover, the activity, cognitive capacities, relationships and emotional well-being of a child or older person with autism can be improved by a variety of non-verbal, non-cognitive activities in which a therapist, who engages sensitively with the individuality of their impulses and felt experiences, accompanies the autistic person in the emotions of intimate engagement to more productive and less defensive states of activity and awareness. This type of relational and creative “art” therapy, which responds to and guides the primary actions, interests and feelings of individuals with autism, much as mother engages her affections with her animated infant from birth, can benefit language learning and both social and practical education (Malloch and Trevarthen, 2009; Stern, 2010).

Evidence that autistic behaviors express abnormalities of prenatal development of the brain stem (Rodier and Arndt, 2005) relate to evidence that early postnatal communication, if it is to support social and cognitive development, must be ready to protect the infant against autonomic reactions of protective withdrawal and depression, as well as to support positive initiatives promoting advances in social communication (Panksepp and Sahley, 1987; Panksepp and Watt, 2011; Porges, 2011; Porges and Furman, 2011). Infant psychology and paediatric practice have been transformed by abundant confirmation that precise coordination of well-formed intentions, interests and feeling may occur within the child and between the child and an attentive and affectionate adult from the neonate stage (Brazelton and Nugent, 1995; Trevarthen, 1977, 1998, 2009a; Stern, 2000; Sander, 2008; Nagy, 2011). This is the arena in which we must be alert for weaknesses in developing human sense and for special support it may need from the parental and social environment (Narvaez et al., 2013).

**PSYCHOBIOLOGY OF HUMAN MENTAL FUNCTIONS**

**DEVELOPMENTAL NEUROBIOLOGY OF SELF-CONSCIOUS INTENTIONS WITH EMBODIED FEELINGS, AND SOCIAL AWARENESS**

Evidence concerning the generation of animate intentions, awareness and emotion in deep processes of the brain (Panksepp and Biven, 2012) questions the “thalamo-cortico-centric” theory of conscious awareness, thought and memory, which focuses on abilities that depend on learned definition of objects from information picked up outside the body, on the routines of fine articulate skills for using the environment, and on educated conventions of representation and reflective thought about objective information. Functional brain research shows that the primate neocortex is excited to regulate motor activities prospectively in reference to their goals, seeking perceptual confirmation by imaginatively simulating the completion of the action within an established context of multimodal information (Fogassi et al., 2005; Pezzulo et al., 2008; Pezzulo and Castelfranchi, 2009; Hessler, 2012; Gallese and Rochat, 2013). The process of intending to act in a particular way is not a consequence of backward coupling of frontal cortex “executive functioning” to recollections of the past objects and events mediated impersonally in the temporal lobe. It is the product of a forward-looking creative imagination that
builds an episodic memory of past events related to an intentional personal self (Tulving, 2002), with an autopoietic imagination equipped from the start with “implicit experiential and procedural memory processes that generate non-reflective qualia” (Vandekerckhove and Panksepp, 2011, p. 7). These animating functions of the primate brain mediate intersubjective coordination of self-related experiences in intimate direct communication of purposes and feelings with others. The anticipations of experience are charged with emotional values linked in the brain stem with autonomic regulation of vitality within the body (Damasio, 2010; Solms and Panksepp, 2012), and these affections are communicated between subjects by a reciprocal sympathetic cooperation of purposes and experiences (not a one way imitation or shadowing of emotional processes now commonly called “empathy”). Human relationships and mutual awareness depend on relational emotions that promote social cooperation in performance of creative actions and thinking, to increase collective well-being (Stern, 1993; Hobson, 1993, 2002/04; Trevarthen, 2009a).

The well-coordinated performances and expressions of affect of newborn infants in expectant orientation to real or imagined objects, and to persons (Trevarthen, 1984, 1986b; Nagy, 2011), the development of intentional movements and rhythmic emotional expressions of fetuses (Trevarthen and Delafield-Butt, 2013), and the behaviors of anencephalic children (Merker, 2007) support phylogenetic evidence that primary conscious states and emotional evaluations, which are essential regulations in all goal directed consciousness, are indeed first generated and regulated sub-cortically (Solms and Panksepp, 2012), without neocortical involvement. These motor-emotional systems are elaborated in the orbito-frontal cortex and the temporal lobe of human beings, which continue to develop to adult stages (Schore, 1994, 2005). Before these developments they play a central role in maternal care, and in the repair of emotional disorders (Schore, 2003).

Affective self-regulation and emotional communication to regulate engagement with other individuals have evolved in vertebrates by elaboration of intrinsic neurochemical systems in the brain stem linked to the hypothalamus (Trevarthen et al., 2006). Regulation by the vagal nerve of essential self-related vital processes of heart activity, respiration and feeding is adapted for intersubjective coordination in the primate social brain by means of communication employing expressive movements of eyes, face, and vocalization. Throughout development of a child, from the time of maternal support of the infant through birth and nursing, there is a dynamic process that balances changes in self-regulation against the need for collaborative regulations of relationships with other persons in various degrees of intimacy (Porges and Furman, 2011; Carter and Porges, 2013). These have particular significance for identifying and explaining autism (Patrquin et al., 2013).

The importance of rhythmic emotionally expressive hand gestures in human communication from infancy (Trevarthen, 1986b; Trevarthen et al., 2011), indicates that forebrain systems for guiding action of the hands in complex manipulations have been recruited into the brain stem and limbic systems for assisting autonomic regulations by self-touching or holding and further adapted to the service of social coordination. Hands are part of the human emotional motor system (Holstege et al., 1996). Indeed, movements of “mimesis” for social celebration in dance and song, appears likely to have preceded evolution of speech and contributed to its power to communicate thoughts as Homo sapiens sapiens evolved (Donald, 2001; McNeill, 2005; Mithen, 2009; Gillespie-Lynch et al., 2013). The roots of this human talent for expressive gestural mimicry is apparent in infancy and an essential contributor to the intimacy of parental care (Trevarthen, 1999, 2013; Dissanayake, 2000).

Both gestural and linguistic languages develop in intense interpersonal communication mediated by vitality dynamics and expressions of emotional investment that provide a basis for the transmission of more differentiated semantic references by symbols (Stern, 2010; Lüdtke, 2012). Dynamic communications carried by consistent innate measures of moving in time (Poppel and Wittmann, 1999), over intervals from fractions of a second to minutes and longer, are cultivated in all human societies in the arts of music, dance and theatre. They begin as a universal human regulation of rhythms of the mind or “biochronology,” active before birth and elaborated in the communicative musicality and rhythmic action games parents play with infants in the middle of the first year (Trevarthen, 1999, 2009b; Malloch and Trevarthen, 2009).

Autistic children show abnormalities in production and reception of communication by both speech and gesture, and in writing (Rapin and Allen, 1983).

**THE NEUROLOGY OF COMMUNICATION BY TRANSFER OF THE DYNAMICS AND FORM OF INTENTIONS AND FEELINGS IN MOVEMENT**

New data from social neuroscience confirm the “common sense” that we are aware of other person’s states of mind by immediate or direct engagement with the Other’s motor intentions, by whatever modality or movement these intentions are expressed, matching them by instantaneous “affect attunement” (Stern, 1993, 2010) to the animation by which we generate intentions of our own Self (Gallese, 2006; Bråten, 2009). Sensitivity for the intentions, interests and feelings of other individuals, for the social affordances of their behaviors, must depend upon matching regulatory processes that govern the rhythm or pulse and expressive tonality or quality of movements of the human body as well as by “mirroring” their body-related form (Trevarthen, 1986b, 1999; Stern, 2010).

Regions in the adult cerebral hemispheres of a monkey or human being that are sensitive to organism-object relations, and that respond selectively to perceived capacities for action of the self, also respond to the possible actions available to, and enacted by others (Gallese, 2007). The same neural system is responsible for perceiving one’s own possibilities for action and the possibilities for action of another. Direct intra-personal neural resonance within the “mirror neuron system,” reflecting the Self, gives one individual direct inter-personal access in “felt immediacy” (Bråten, 2009) with intentions in the mind of an Other made manifest in their body movement, in “intersubjectivity” (Trevarthen, 1979, 1998; Trevarthen and Aitken, 2001). Further, data from imaging of brain activities show there exists substantial overlap in activity of this system for awareness of actions with activity excited by merely thinking about an intentional act (Decety and Grezes, 2006).
Direct resonance between preparation, execution, observation and thought in action depends on “motor images” (Bernstein, 1967), which underpin perception, observation, and planning of goal-directed action, and also integrate Self-related experience (Llinás, 2001; Northoff and Panksepp, 2008). An amodal perception-action system is also the means by which complex embodied human intentions may be communicated between agents across many channels of expression, in a “consensuality,” which, when further elaborated and mediated by language, becomes a tool for sharing abstract concepts and plans (Maturana et al., 1995).

Disruption of the neural systems of motor planning in time and space, by epigenetic dysregulation of early development in the brain stem, or by environmental insult to the growing brain, will have pervasive effects in maturation of consciousness, behavior and social engagement, such as occurs in autism (Aitken and Trevarthen, 1997; Trevarthen et al., 1998; Trevarthen, 2000).

PRENATAL GENESIS OF AUTISM
We have described the coordinative mechanisms in the brain as an “intrinsic motive formation” (IMF), “ready at birth to share emotion with caregivers for regulation of the child’s cortical development, upon which cultural cognition and learning depend. . . many psychological disorders of childhood can be traced to faults in early stages of brain development when core motive systems form.” (Trevarthen and Aitken, 1994, p. 597). The IMF, laid out in development of the fetus, is a core component of all of the sensory-motor mechanism of human communication—by gesture and dance, speech and song, or by writing, playing musical instruments and other manual or digital media (Trevarthen, 2001a,b). Rodier and Arndt (2005) relate autistic behaviors that limit expressive movements of the eyes, face and vocal productions, and anticipatory attention to expressive movements of other persons, to malformation in the embryo of core regulatory systems in the midbrain, the brain stem visceral efferent and afferent nuclei, and the olivary nuclei and cerebellum. They conclude, “there is no region but the brain stem for which so many lines of evidence indicate a role in autism” (Rodier and Arndt, 2005, p. 146).

IMAGINATIVE INTENTIONS AND EMOTIONS OF THE PRIMARY SELF
There has been, in the last two decades, a highly significant re-evaluation of the relationship between emotion and cognition, and their functional inseparability in human experience and in communication at all stages of development (Damasio, 2010; Panksepp and Biven, 2012). Comparative studies of the mammalian emotional system demonstrates that an affective core sense of the Self (Northoff and Panksepp, 2008; Solms and Panksepp, 2012) does not depend on learned conceptual knowing. This “anoe tic” consciousness of a live body (Vandekerckhove and Panksepp, 2011) develops before a child becomes familiar with the external world through practice of intention and testing of actions which explore the affordances of situations and objects. At all stages of the development of human conscious intelligence this mobile self-with-feelings remains active, generating an innate spatio-temporal context for the arousal of movements to engage with the environment, and affective values for sustaining core vitality (Stern, 2010). From mid gestation through infancy the developing self is sensitive to other persons’ responses to its activities and vitality, first showing signs of vital state to achieve shared “amphoteronomic” regulation of its own autonomics with those of the mother. After birth the infant signals its own rhythmically intended and affectively measured acts in responsive ways that lead to the “synrhythmic” communication for cooperative learning and cultural development (Maturana et al., 1995; Donald, 2001; Trevarthen et al., 2006; Malloch and Trevarthen, 2009; Porges and Furman, 2011).

DEVELOPMENT OF HUMAN AGENCY IN INFANCY, AND BEFORE BIRTH
MEASURES OF INFANT SENSORY-MOTOR INTELLIGENCE, SELF-REGULATION AND SOCIABILITY
Movements of a baby under 2 months old are coordinated and integrated within a rhythmic awareness of a single intentional subjectivity (Trevarthen, 1979, 1984). These movements were described by Prechtl (2001) and Einspieler and Prechtl (2005) as “general movements” (GM), which, “involve the whole body in a variable sequence of arm, leg, neck, and trunk movements. They wax and wane in intensity, force and speed, and they have a gradual beginning and end. Rotations along the axis of the limbs and slight changes in the direction of movements make them fluent and elegant and create the impression of complexity and variability. If the nervous system is impaired, GMs loose their complex and variable character and become monotonous and poor.” (Einspieler and Prechtl, 2005, p. 61). General movements are not precisely focused, intentional and directed by discrimination of discrete objects, but they can orient head, eyes and limbs to external events in coordinated sequences within a body-related space (Trevarthen, 1984). Visually directed reaching in newborns compensates for changes in the “load” of a limb, which proves the responsiveness of this non-reflex imaginative coordination to proprioceptive reafference, or “body self awareness” (Van der Meer et al., 1996).

A newborn infant’s movements are especially sensitive to sight, hearing and touch of an attentive the mother in face-to-face engagement, and they can take a creative part in a shared narrative of expressive action (Trevarthen and Delafield-Butt, 2013). Her voice was learned in utero (DeCasper and Fifer, 1980) and its sound motivates rapid visual learning of her face. Imitation tests, made with care to allow the infant to focus attention and regulate a state of responsive arousal, prove that a newborn can initiate eye-movements, face expressions, vocal sound patterns and hand gestures of another person (Meltzoff and Moore, 1977; Maratos, 1982; Field et al., 1983; Heimann et al., 1989; Kugiumutzakis, 1999; Nagy and Molnar, 2004; Nagy, 2011). These behaviors signaling a “second person other-awareness” are adapted for sharing curiosity for others’ mental states of interest and affective appraisal (Reddy, 2011).

At 2 months, after a period of rapid maturation of sub-cortical and cortical visual-motor regulations of foveal sight (Trevarthen, 1986a), the infant’s precisely timed responses of looking, smiling, and vocalization give evidence of preparation for sharing ritual practices and language (Bateson, 1979). Electroencephalic data on the activity of a 9-week-old infant’s brain when looking at
the photograph of a woman’s face (Tzourio-Mazoyer et al., 2002) confirmed that complementary neocortical areas in left and right brain, which 2 years later will become involved in a child’s learning of expression and reception of spoken language, are already components in cerebral regulation of interpersonal contact by a “social brain,” long before the training of a “social intelligence” by life with other persons (Frith and Frith, 1999). The subcortical visual and auditory systems that mature from the early fetal period show an asymmetry related to differences in left and right parts of the brain stem that mediate in complementary autonomic regulations (Trevarthen, 1996). Schore (1994, 2005) proposes that the early developing right brain motivates shared learning of perception and articulation of meaning in language when the left cerebral hemisphere shows an acceleration of growth in the second and third year, the period when diagnosis of autism becomes possible.

Developments around 3–5 months correlate with more differentiated movements of the baby’s extremities when new neocortical sensory-motor functions are developing. Einspieler and Prechtl, label these subtle gestures “fidgety,” and describe them as, “small movements of moderate speed with variable acceleration of neck, trunk, and limbs in all directions” (Einspieler and Prechtl, 2005, p. 61). They lead the infant to make more discriminating orientations of head, eyes and hands intending to reach for and touch or take hold of objects at a distance from the body, and are accompanied by a fall in attention to the mother. This incites the mother to be more animated and playful, and to incorporate the baby’s selective interest in objects into “person-person-object” games (Hubley and Trevarthen, 1979; Reddy, 2011).

PROGRAMMED DEVELOPMENT OF THE INFANT-PARENT SYSTEM

Longitudinal studies of developments in actions, perception and communication in the first two years, with information on internally regulated brain growth changes, confirm that there are transformations in the motives and emotions of the child for collaboration with parental care (Trevarthen and Aitken, 2003). Sander’s studies of infants with their mothers from birth over the first 36 months showed that growth of a human life is sustained by a series of stages of adjustment within a system of human-to-human engagement (Sander, 2008). Both mother and child are significant actors, but in the creative process of development the child must normally set the pace and the times of important advance. Brazelton extended Sander’s system approach to an interpersonal paediatrics accepting the conscious and personal powers of the newborn, and defining “touch points” in the developing life with parents and in the community (Brazelton and Nugent, 1995; Brazelton and Sparrow, 2006). Periods of change in developing powers that are both sensitive and significant, are symptoms of advances in motivation for learning and for communication (Johnson, 2005). Their consequences depend on collaboration with parents who are “attuned” to the infant (Stern, 2000), and both intimate and playful in their accommodation to the child’s impulses.

Data from a review of the literature on changes in the child’s psychology and brain over the first 18 months (Trevarthen and Aitken, 2003) point to natural emergence in the child of new levels of mastery of action and awareness at around 6 weeks, 4 months, 7 months, 9 months, and between 15 and 18 months. These agree with longitudinal studies of infant’s capacity to take initiative in joint activities (Trevarthen, 1977; Hubley and Trevarthen, 1979; Reddy, 2011). These five advances in adaptive processes correlate with temperamental changes commonly referred to as “regressions.” They adapt to cultural differences in the frequency of parental initiatives or directives (Reddy et al., 2012). They are products of the active system of “intent participation” in the environment with companions that drive cultural learning (Trevarthen, 2013).

SENSORI-MOTOR INTENTIONALITY BEFORE BIRTH: GENESIS OF PRIMARY SELF-CONSCIOUSNESS AND THE FIRST INTERSUBJECTIVITY

Spontaneous movements develop in the late embryo and fetus, showing increased sensory awareness of their purposes (Delafeld-Butt and Trevarthen, 2013). The first integrative actions of the nervous system are to move the body, and the first nerve tracts in the central nervous system are those that will activate movements to express different orientations and emotional states (Trevarthen, 1986a). After 8 weeks the core neurochemical systems of the subcortical brain that will link motor centers and select and evaluate experiences throughout life make their appearance. At this stage the fetus makes the general movements of Prechtl (2001). These become increasingly differentiated and controlled with the benefit of re-afference from sensory systems that grow in the following weeks. Detailed studies of by real-time ultrasonography demonstrate a fetus’s exploratory sensation-testing to touch their own body, their face, the placenta, umbilicus, and the uterine wall with their hands at 11 weeks. They make jaw movements and swallow amniotic fluid, expressing pleasure or disapproval at tastes, sucking and smiling or grimacing with disgust. Complex movements of trunk, arms, and legs position the body, and may react to movements of the mother’s body and to the contractions of the muscles of her uterus (Lecanuet et al., 1995; Trevarthen et al., 2006; Piontelli, 2010). In weeks 10–14 fetal movements become differentiated into individual, isolate actions with increasing goal-direction to particular parts of the body (Prechtl, 2001; Piontelli, 2010). The arms and hands “test” sensitive zones of the body, especially to the face and head, exploring the border of sensory innervation on the top of the head (Piontelli, 2010, p. 61–67).

In singleton pregnancies motor planning of action patterns adapted for different goals is evident before 22 weeks gestational age (Zoaia et al., 2007). In twin pregnancies, movements directed by one twin to the other are “carefully” slowed, even by 18 weeks, which the researchers interpret as evidence of a primary “social awareness” (Casteillo et al., 2010). At this time the motor centers of the brain stem and spinal cord are directing the coordinated behavior of the fetus (Okado, 1980). Neocotical cells do not develop dendrites until after 26 weeks of gestation (Hevner, 2000).

This natural history of human movement at a stage of development when the sensori-motor environment can only be the properties of an organized body itself appears to support Lashley’s conclusion that propositional thought may depend on, and indeed be derived from, the spontaneous syntactic ordering of movement.
sequences (Lashley, 1951, p. 122). The fetus has an imaginative “motor intelligence” and can formulate orderly projects without neocortical skills.

Expressions in fetuses, in addition to twisting movements of distress and tentative exploration by touch, give evidence of emotions—of discomfort, curiosity or pleasure, adapted for communication of interests and feelings. In the third trimester, movements of the face visualized by 4D ultrasound develop into complexes that define a “cry face gestalt” or a “laughter gestalt,” expressing emotions that will communicate powerfully immediately after birth in the regulation of parental care (Reissland et al., 2011). Maternal hunger with depletion of energy supply to the fetus drives “anxious” patterns of fetal movement. The mother and the fetus are already affectively connected. These discoveries prompt a revolution in psychological theory and medical ethics. There is a consensus in modern paediatrics that by 24 weeks the fetus should be considered a conscious agent deserving the same standard of sympathetic medical care as adults (Royal College of Obstetricians and Gynaecologists, 2010).

**READY FOR SUPPORT OF THE BODY IN RHYTHMS OF MOVEMENT, AWARE OF SURROUNDINGS, AND ATTENTIVE TO HUMAN COMPANY IN MOVEMENT**

Infants demonstrate the regulations of an innate time for life in movement. Research on their dynamics and coordination with a parent’s movements have led to a natural science of human “musicality” (Trehub, 1990; Papousek, 1996; Malloch, 1999; Malloch and Trevarthen, 2009). Inspired by discoveries of precise analysis of films, revealing self-synchrony of movements of individual actors and inter-synchrony between actors in conversations (Birdwhistell, 1970; Jaffe and Felstein, 1970; Condon and Ogston, 1971) researchers found that infants and adults share matching rhythms (Condon and Sander, 1974; Beebe et al., 1985; Jaffe et al., 2001). One remarkable video recording made by Saskia van Rees of a 2 month premature infant in precisely timed coordination of dialogue of simple “coo” sounds vividly demonstrates how this shared sense of time for combining syllables in phrases may lead to a narrative in wordless dialogue (Trevarthen, 1999).

Two bands of time are shown to be fundamental in dialogues, games and songs between young infants and their parents (Trevarthen, 1999, 2009b). Faster rhythms of syllables and phrases in speech and song, or dancing steps and gestures, correspond with arm and hand grasping for object manipulation, or of the head and eye rotations that perform visual inspection. These range from the median syllable frequency of 1.5–3 per second—the same as a running or fast stepping, a glance or eyebrow rise, a laugh or a hand wave—to every 3–5 s for a visual scan, a manipulative sequence, a phrase of speaking or song, and a cycle of deep breathing. These are somato-motor coordinations that achieve use of the environment and pickup of information for perception, or of a communicative message, in the “psychological present,” the “here and now” of consciousness in action.

Slower periods of sensed vitality, as expressed in the “extended present” of an episode in a story, a verse of singing or a stanza of poetry, occupy 10–25 s. Longer times of imagined activity and narrations form natural elements of 25–50 s in the rhythmic verses, playful or calming, of baby songs in all languages. These slower events are identified with autonomic events that regulate arousal, hunger and wakefulness throughout life, and regulation of the rate of heartbeat and breathing by the vagal nerve (Delamont et al., 1999). They are accompanied by bursts of electrical activity in the cerebral cortex that have a role in the fluctuating experiences of dreaming. They link the imagination with the economy of life energy in the body, and with the expressive arts.

Stern (1993, 2000, 2010) called the cycles of arousal or variations in vitality dynamics in mother infant play “emotional narratives” expressing “implicit relational knowing.” Malloch analysed the controlled patterns of change in voice qualities and pitch of the voices of mothers and infants in dialogues and baby songs as “narratives” that, “allow two persons to share a sense of passing time, and to create and share the emotional envelopes that evolve through this shared time. They express innate motives for sharing emotion and experience with other persons and for creating meaning in joint activity.” (Malloch, 1999, p. 45). These shared “routines” are identified by Bruner (1999) as the medium for reference in language. We have recently been finding evidence of the same “narrative” cycles of arousal in the “general movements” of newborn infants, which may be shared with a sensitive mother who coordinates with her baby by modulated vocal sounds, touches or rocking. They participate in tides of consciousness of being together that later will regulate the changes of meaning in a story or the recollections of episodic memory (Trevarthen and Delafield-Butt, 2013; Trevarthen and Delafield-Butt, 2013).

**SENSO-R-MOTOR DIS-COORDINATION IN AUTISM, FROM INFANCY**

**DEFICIT IN PROSPECTIVE MOTOR CONTROL IN AUTISM AND ITS CONSEQUENCES FOR DEVELOPING INTENTIONALITY AND LEARNING**

The complex disorder of childhood autism, and how it has serious effects on a young child’s life, may be described as follows:

“By about one to two years after birth . . . at a time when infants usually become acutely aware of other people and what they are doing, full of playful imagination and eager for new experiences, these babies became strangely self-contained or isolated in their own world and increasingly unresponsive or irritable, and difficult to understand; their vocalizations movements often seemed repetitious and pointless, and their gestures and postures were also odd. Throughout their childhood they continued to express themselves in ways that made parents, teachers and other children feel unable to make contact.

As pre-schoolers, the children are not insensitive to others or unaffectionate, and they can show strong likes and dislikes for particular people. Sometimes they imitate or seek to interact, but never in a free and easy way, and sometimes with a peculiar ritualistic insistence, and remarkable inattention to their effects on other people. Strange postures and movements and a need for sameness, combined with obsessive interest in certain objects and experiences, cut them off from others. At times they seem to be in a trance, “floating off,” “looking” or “listening” when nothing is there, often with strange flapping of the hands, or an enigmatic smile, and they only make unintelligible baby-like vocalizations. They may get into inexplicable panics and seem very distressed, anxious or terrified, especially when forced to have close contact with people or in strange environments. In general they do
Disorders of movement in children with autism particularly affect expressive movements in communication (Ricks and Wing, 1975; Damasio and Maurer, 1978; Gillberg and Coleman, 1992; Frith and Frith, 1999; Oller et al., 2010). These have lead to an interpretation in terms of a deficit in “executive functioning” (Rumsey, 1985) attributed to a developmental fault in the frontal lobes that manifests itself in the second year. Recent data point to a more basic and probably earlier developing deficit in prospective control of movements (Mari et al., 2003; Rinehart et al., 2006a; Dowd et al., 2012; Gowen and Hamilton, 2013). For example, in an automated vocal analysis of a large body of data recorded from natural expressive behavior of infants 10–50 months of age, Oller et al. (2010) identified massive delay in development of movements of vocal articulation in children developing autism or language delay. Such disorders affecting communication behavior can be explained as originating as faults in the timing and integration capacities of the brainstem sensorimotor system, which develops prenatally and affords prospective control for later developments in psychological functions. Failure in cognitive strategies of “action planning” and “action execution” (e.g., Rinehart et al., 2001; Nazarali et al., 2009) attributable to change in mirror neuron systems (e.g., Cattaneo et al., 2007; Fabbri-Destro et al., 2009), require higher-order cortical processing, which develops after birth.

Children with ASD differ from typically developing children in the efficiency of three types of prospective motor control:

(i) Generation of single actions, such as when extending the hand to touch, or indicate, an object of interest;
(ii) Organization of a series of actions to perform more complex tasks or projects, including speaking, and
(iii) Simultaneous coordination of multiple action units to achieve coherent purpose, as in postural accommodations when standing or walking.

Simple “action units” and serially organized “action chains” both require precise coordination of muscle actions that are conceived or imagined “ahead-in-time” so that they achieve a desired future effect efficiently (Bernstein, 1967; von Hofsten, 1993; Lee, 2009).

And an integrative control of movement is a necessary foundation for learning more advanced and complex tasks, such as speaking and reading (von Hofsten, 2004, 2007). Awareness of others’ intentions requires detecting prospective control in their movements, and this is apparent in how infants participate in dialog and games (Trevarthen, 1986b). Failure to time movements prospectively and meet expectation in movement will thwart efficient goal acquisition, confuse awareness and frustrate a sense of success, causing negative emotions of self-protection and avoidance (Bower et al., 1970; Rovee-Collier et al., 1978).

(i) Evidence for disturbance in prospective control of single action units.

Autistic persons exhibit significant differences in the timing and patterning of single movements (Rinehart et al., 2001, 2006a; Mari et al., 2003; Nazarali et al., 2009; Dowd et al., 2012). The type of disturbance varies with the task and the sub-group examined. For example, in a reach-to-grasp task individuals with ASD grouped by low or average to high intellectual ability, with full-scale I.Q. scores below and above 80, exhibited different kinematics, and both groups acted significantly less efficiently than typically developing children (Mari et al., 2003). Differences between ASD groups were thought to reflect different compensatory coping strategies for a primary deficit in motor planning. The autistic individuals also failed to coordinate the two sub-actions in the reach-to-grasp task, i.e., reaching of the arm and the opening of the fingers. They performed one act and then the other separately. Typical children coordinate the sequence of arm and hand actions in “pre-reaching” and gesturing fluently from early infancy (Trevarthen, 1984; Rönnqvist and von Hofsten, 1994; Prechtl, 2001).

(ii) Evidence for disturbance in serial organization of multiple action units.

The progressive planning of “action chains” communicate intentions. When we see someone grasping a bottle, for example, the initial reaching movement of the arm differs depending on whether the goal is to shovel it or to serve some wine (Jeannerod, 1999). The postural preparation of the body and extension of the arm, with shifts of gaze, are adjusted from the start in different ways depending on the final goal. Children with ASD have deficits in this preparatory coordination for motor sequencing or action chaining (Cattaneo et al., 2007; Fabbri-Destro et al., 2009). Typically developing children, when asked to perform an object manipulation task, such as turning an upside-down drinking glass right-side up, adjust their body posture at the start of the action so that their final posture is comfortable (Rosenbaum et al., 1990). Children with autism begin with a comfortable posture at the start of the action so that their final posture is uncomfortable (Rosenbaum et al., 1990).
Disordered intentional movement and affects

Trevarthen and Delafield-Butt

Toward their mouth, demonstrating a failure to couple the action chains efficiently. This lack of anticipation was also evident when the children were asked to watch another person perform the reach-to-grasp-to-eat action. The mylohyoid activation occurred in typically-developing children at the onset of the other’s movement toward the food, but in autistic individuals there was no mylohyoid activation at all.

(iii) Evidence for failure in simultaneous integration of multiple action units.

Measurements of children’s postural adjustments and muscle tensions during load shifting shows that prospective control of whole-body posture and perception of body-space goals, which require synchronizing and co-ordinating action units throughout the body in shifts of the legs, chest, back, and arms, are also disrupted in autism (Schmitz et al., 2003). Disturbances of prospective control for the whole body are confirmed by data on gait differences in individuals with autism, showing an increase stride length and variability of the width of stride, but also significant differences in postural adjustments of the upper-body to maintain balance (Hallett et al., 1993; Vernazza-Martin et al., 2005; Rinehart et al., 2006b; Calhoun et al., 2011; Nayate et al., 2011). They also have difficulties in perceiving the environmental context for their movements (Gowen and Hamilton, 2013).

DIFFERENCES IN PROSPECTIVE MOTOR TIMING AFFECT SOCIAL EXPECTATION AND UNDERSTANDING

The subtle deficits in prospective motor control of children with ASD must be involved in the symptoms of social isolation and emotional distress that they show. They have difficulties in communicating their intention in gestural acts, and in sensing the dynamics of another’s intentions from their movements (Cattaneo et al., 2007; Zalla et al., 2010; Gowen, 2012). Imitation-based or interaction therapies for ASD employing sensitive response to signs of intended movement are able to assist because they facilitate both anticipation of actions and psychological and emotional connection (Escalona et al., 2002; Nadel, 2006; Zeedyk, 2008; Field et al., 2011; Solomon et al., 2012). The therapist acts to excite anticipation, which simplifies and supports the performance of desired actions. It also explains why insistence on evidence from repeated measures of performance in tasks to test perceptual preferences or cognitive mastery can fail to detect or explain the cause of failure (Wigram and Gold, 2012). Such external measures, focusing on achievement of goals or response to facts, neglect the tempo-spatial phenomena of prospective motor control within the subject.

Problems of intentionality and its perceptual guidance in autism, and pathological defense against sensory overload (Rosenhall et al., 1999; Foxton et al., 2003), may be due to faults in motor regulations of sense organs; of the inner ear to adjust the sensitivity of hearing, and of head and eye movements to control selection of detail by foveal fixation which is guided by pick-up of global information from the ambient field. Hearing and production of speech sounds, which autism impairs in differing degrees, is particularly demanding, requiring detection and control of affective expression transmitted by small modulations in the timbre, pitch and loudness of vowel sounds, and their constraint by consonants produced in rapid sequences to articulate intelligible words in information-rich phrases. Autism, however, interferes not only with the motor controls of selective hearing and seeing, but with attention to all the expressive movements of other persons.

In high functioning persons with autism, exceptional abilities in detecting, separating and combining visual details or pitches of sounds (O’Riordan et al., 2001; Bonnet et al., 2003; Mottron et al., 2006) may be a consequence of compensatory hypertrophy in higher cortical sensory systems driven by a bias to detect affective self-related feedback or support. Ockleford’s experience with supporting exceptional performative talents in autistic children who cannot speak suggest that pleasure from control of pitch in sounds from musical instruments activates a primary reward system different from that which discriminates speech components (Ockleford, 2012, 2013). In confrontation with another, a person with autism avoids looking at the eyes, directing attention to the mouth (Senju and Johnson, 2009). Given that rapid movements of the eyes transmit important information about the direction and intensity of interest, in preparation for shifts in locomotion, posture or reaching by hand, as well as selective attention to individuals in a group, they implicate tracking of sequences of intended action to engage with others’ prospective control in thought and action (Bal et al., 2010). Lower face expressions and mouth movements express affect and are essential for emotional sympathy. They attract attention of an observer for judging another person’s feelings.

Failure to appreciate playful teasing and humor and avoidant or defensive reaction to strangers, as well as preference for familiar surroundings and consistency in placement of objects or execution of routines, characteristics of ASD, all point to a disturbance of imaginative curiosity for prospects of action. They are as much disorders of self-regulation of pleasurable movement-awareness as of affective other-awareness, and they impair intentional and emotional engagement (Hobson and Hobson, 2011; Reddy, 2011).

DISORDERS OF AUTISM IN THE FIRST YEAR

Teitelbaum and colleagues (1998, 2002), studying home movies of infants later diagnosed as autistic, made a comparative analysis of the developmental stages of turning over, crawling, sitting, standing and walking, which infants typically master in the first year. Using the Eshkol-Wachman Movement Notation for temporal and spatial parameters of human body movement they showed deficits in whole body control and sequencing of the movements of trunk, head and limbs to control balance and posture changes, which were interpreted as disordered sensory-motor reflexes. These detailed observations have been helpful for parents who suspect their infant may be developing autism, assisting them to engage the attention of medical specialists and therapists (Teitelbaum and Teitelbaum, 2008).

Similar disturbance of anticipatory regulations of whole body postures were found by Danon-Boileau (2007) in films made of two sisters while they were being bathed by their mother; one, at five months, who later developed autism, and the other who developed normally, at 3 months. The films show the anxiety and awkwardness of the first girl who scarcely looked at her mother, and an analysis of the mother’s speech shows she was not “in
contact” and was using her voice with a detached tone, to draw response. With the normally developing sister the mother’s speech is lively and addressed to the child as person seeking to share the experience. This infant keeps eye contact with the mother and reacts expressively. Similar observations were made in an analysis of home movies of identical twin girls at 10 months, when their father was helping them to walk or playing a game with them in the family living room (Trevarthen and Daniel, 2005; St. Clair et al., 2007). One girl later diagnosed as autistic, and who did not speak until the age of 3, showed clear delay in motor coordination for stepping and for regulation of her sitting posture. She lacked attention to other persons’ eyes and made fleeting smiles and she could not participate in a teasing game with her father that required anticipation of his rhythmically phrased behaviors and speech. The rhythms and expressions in response to teasing and tickling with the father were different from those of the typically developing twin, and the father was unable to reciprocate, creating confusion in games and interactions. Her sister who had a mild retardation at school age, developed normally through the first years showing no evidence of autism.

The lack of responsive attention by the infant developing autism to her father’s attempts to play caused him to become irregular and insistent in his solicitations, which afterwards he could see only confused the child. The same transformation of parents’ responses to avoidant or disengaged behavior of an infant developing autism have been noted in other studies of home movies and in prospective studies of siblings of autistic children, i.e., a change to a more insistent and monotonous mode that tries to excite a response (Baranek, 1999; Saint-Georges et al., 2010, 2011). For example, there is a lack of the affective modulation of the parent’s voice in speech to an infant who later develops autism (Mahdhaoui et al., 2011). Disorder in development of the child’s vocal control on the way to mastery of speech, such as that demonstrated by Oller et al. (2010) for the crucial period from 1–4 years, will affect the parents ability to share talking, and prompt them to use stimulating or coercive ways of engaging with the child.

Two research strategies have been used to search for evidence of abnormal development before medical diagnosis is possible: prospective study of the infant siblings of older children with autism. The two procedures confirm important conclusions about manifestations of autistic disorder that are developing in the first 18 months after birth (Zwaigenbaum et al., 2005; Saint-Georges et al., 2010). They highlight effects of the “flatness” and lack of seeking for engagement and also changes associated with the phases of motor development which were recorded by Teitelbaum (Teitelbaum et al., 1998, 2002), and the development of interest in objects. Attention to objects was normal in the first six months in infants developing autism when their attention to social engagement was significantly low (Maestro et al., 2002). There is a specific loss of interest in other persons’ expressions early in infancy (Muratori and Maestro, 2007).

Expression of intentions and affects is achieved with cross-modal fluency between voice and gesture that promotes sympathetic action and shared experience with “affect attunement” (Trevarthen, 1986b, 2009a; Tronick, 1989; Stern, 2000; Reddy, 2008). Expressive acts, like all goal-directed voluntary movement, require prospective control, and by assimilation of the form and flow of the movements of the body and voice of one subject states of intention, affect, arousal and interest are conveyed to the awareness of the other in “felt immediacy” (Bråten, 2009; Stern, 2010; Trevarthen et al., 2011). If predictive control of the timing and harmonization of these expressive body movements are disrupted, then psycho-motor attunement with the perceptual and motor experiences of others will be confused.

Magnetic resonance imaging of the brains of autistic children indicate reduction in size of the brainstem and midbrain at birth, a loss of tissue more than compensated for by excessive growth of the brain as a whole postnatally (Hashimoto et al., 1995). Detailed neuroanatomical investigation of brains from children with ASD also indicate limbic midbrain structures and brainstem regions are affected (Rodier and Arndt, 2005). Of particular note is an abnormality in the inferior olivary nucleus, a prominent lower brainstem nucleus known to be involved in perceiving and controlling of the timing of movement (Welsh et al., 1995), indicating a likely primary site of disruption underpinning ASD motor deficit (Welsh et al., 2005).

The data on motor impairments in ASD and their early manifestation in infancy confirm a primary deficit in the capacity to perceive and move the body in a planned way, which limits the capacity to control the timing of actions of the body and their perceptual consequences, and thence impairs the communication of intentions and ideas.

AN INTERACTIVE RELATIONAL APPROACH TO THERAPY AND TEACHING, NURTURING INTIMACY AND CREATIVEY MOVEMENT

“Musical structure in improvisation can provide a framework for creative development, and ... more creative skills may well-emerge given a structure than one might see from a purely free form of improvisation—where a lack of direction and model may leave the “non-musician” client struggling to find out how they can “create” music... Creativity is a key process in improvisational music therapy, and demands substantial skill and flexibility in the therapists to nurture in clients for therapeutic benefit.” (Wigram, 2006). Interactive music therapy for both diagnosis and treatment of autism indicates that the aim of a therapist or teacher is to provide support for creativity, and that this requires both a “direction and model” and “skill and flexibility.” It requires a guide that protects the learner from “struggling to find out how they can create.” And it requires descriptive evidence from single case studies (Wigram and Gold, 2012). In the controversial field of therapy for children with autism there is a bewildering range of theories and advice for procedures, which range from strict teaching of skills to control disordered actions and feelings and to coax communication, to permissive environments where possible distractions are eliminated and attempts are made to give comfort (Trevarthen et al., 1998; Teitelbaum and Teitelbaum, 2008). Given the evidence that the core deficit in autism concerns prospective sensori-motor control and affective self-regulation, especially for activities of communication, we focus our final comments on evidence that intimate or intensive engagement with the impulses of affected children in ways that bring pleasure from control of actions and
mutual recognition may bring benefit for creative learning of practical skills and artificial rituals of shared experience, including language.

Finely measured pulse, form and flow of the enactments of the sensuous body and voice convey psychological states of intention, affect, arousal, and interest (Trevarthen, 1986a,b; Stern, 2010; Trevarthen et al., 2011; Hardy and Blythe LaGasse, 2013). Gestures made in communication are controlled and directed in body-space and by selecting transitory goals with precise timing of muscular energies that display affective content in “narrative” sequences (Schögler et al., 2008; Trevarthen and Delafield-Butt, 2013). It follows that, if the common control of body movements is disrupted, then the individual will have difficulty finding psycho-motor attunement with the perceptual and motor experiences of typical others.

Understanding of the fundamental and deeply felt disorder in autism as failure of integrative brain activity for carrying out sensori-motor intentions with ease and creativity, that it is a disorder that also affects communicative expression and perceiving the motor intentions of others, may help explain how intensive, imitation-based therapies attentive to emotions may be effective and may foster enjoyable response and interest (Nind, 1999; Field et al., 2002, 2011; Nadel, 2006; Nordoff and Robbins, 2007; Zeedky, 2008; Caldwell, 2010; Frank and Trevarthen, 2012; Lüdtke, 2012; Solomon et al., 2012). By consciously “attuning” to the motor acts of the autistic patient and feeling their affective and intentional content in “intense interaction,” before re-enacting creative collaborations with adaptation to responses, the therapist provides an exterior pattern of actions that are timed and directed sensitively to compensate for repetition of uncertain, anxious attempts (Hardy and Blythe LaGasse, 2013). A responsive, “listening” makes communication possible, as well as progress to new self-confident and joyful experience, which may free an exceptional talent (Ockleford, 2013).

Sensorimotor attunement in therapy embodies mental/affective components as much as it does the motor expression, and in so doing is able to open up a co-regulation of arousals, interests, and intentions in a person otherwise unavailable and isolated. All movements are considered valid expressions of purposeful states, and even stereotypies are regarded as affective sensori-motor acts capable of initiating communication, not disregarded an unintentional, non-mental motor acts. As the therapist attends to the movements of the person, attuning to them with her own body movements, so they begin to generate an implicit, affective, and inter-subjective psycho-motor connection. Such therapy can aid not only the autistic child to achieve communication, but can be of great help to a parent. It may bring an autistic person of any age and to more self-confident and articulate participation in an intimate community of knowledge (Frank and Trevarthen, 2012; Lüdtke, 2012).

It is the experience of any therapist who works with persons suffering from autism that a conscious care must be taken to “stand back” and allow any impulse the child or adult may show to take its course, indeed shadowing or mirroring it to aid its motivation. This is the principle put into the practice of interactive music therapy (Robarts, 1998; Wigram and Gold, 2006; Nordoff and Robbins, 2007; Wigram and Elefant, 2009; Ockleford, 2013). A more explicit standing back, called “asocial,” is practiced by the method developed by the paediatric neurologist Waldon to assist persons with a wide range of disabilities in acting and thinking. The therapist places him or herself behind the client, holding the arms to guide the hands in performance of tasks to move objects in such a way that a goal or project is completed bringing a sense of satisfaction. This method has proved effective in helping young children overcome the confusion and isolation of autism in a way that makes productive and progressive motor learning possible (Solomon et al., 2012).

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RESEARCH ARTICLE

**Pilot Study: Efficacy of Sensory Integration Therapy for Japanese Children with High-Functioning Autism Spectrum Disorder**

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**Abstract**

This study's objective was to investigate the efficacy of sensory integration therapy (SIT) for children with high-functioning autism spectrum disorder (HFASD). The subjects were 20 HFASD children with IQs above 70 selected from previously collected data. Eight participated in individual SIT sessions, and 12 participated in group therapy (GT) including social skill training, communication training, kinetic activities, and child–parent play for 8–10 months. Changes in Total score and five Index scores on the Japanese version of the Miller Assessment for Preschoolers before and after therapy between children in the SIT and GT groups were compared. The results showed that Total score and all Index scores except for Verbal Index increased significantly in the SIT group, while only Total score increased in the GT group. Furthermore, the SIT group showed more improvement compared with the GT group in Total score and on Coordination, Non-verbal, and Complex Index scores. SIT might have a more positive effect on motor coordination abilities, non-verbal cognitive abilities, and combined abilities of sensory motor and cognition in children with HFASD when compared with GT. This study has limitations such as being an analysis of previously collected data. Further study should be conducted with a randomized control trial. Copyright © 2013 John Wiley & Sons, Ltd.

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**Keywords**

autism spectrum disorder; sensory integrative therapy; paediatric occupational therapy

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**Introduction**

Sensory integration (SI) theory was originally developed by A. Jean Ayres to focus on the neurological processing of sensory information (Ayres, 1972). Sensory integrative therapy (SIT) or SI approach has been used for the treatment of challenged children since the 1970s. Many studies have demonstrated the effectiveness of the SIT approach for challenged children (Grimwood and Rutherford, 1980; Ottenbacker, 1982; Ziviani et al., 1982; Polatajko et al., 1991; Allen and Donald, 1995; Case-smith and Bryan, 1999; Linderman and Stewart, 1999; Candler, 2003; Miller et al., 2007a, 2007b; May-Benson and Koomar, 2010).
Sensory integrative therapy has also been applied to children with autism spectrum disorders (ASD). An Internet survey questioning treatments used for children with ASD revealed that SI was the third most commonly reported intervention (Green et al., 2006). Some researchers have investigated the efficacy of SI treatment for children with ASD. For example, Miller et al. (2007a) indicated that children with ASD undergoing occupational therapy using the SI approach (OT-SI) made significant gains compared with an Activity Protocol group and a no treatment group on goal attainment scaling, the Attention subset, and the Cognitive/Social composite of the Leiter International Performance Scale—Revised. The OT-SI group improvement trends on the Short Sensory Profile, Child Behavior Checklist, and electrodermal reactivity were in the hypothesized direction. Additionally, Fazioğlu and Baran (2008) reported that statistically significant differences in the Sensory Evaluation Form for Children with Autism scores between SI groups and control groups indicated that SI programmes positively affected children with autism. Pfeiffer et al. (2011) identified significant positive changes in children with ASD in a SI group when compared with a fine motor treatment group and a significant decrease in autistic mannerisms in the SI group. Additional studies of children with ASD or pervasive developmental disorder have provided preliminary support for SI in areas such as reducing self-stimulating behaviours and increasing functional behaviours such as social interaction and play (Case-Smith and Bryan, 1999; Linderman and Stewart, 1999; Smith et al., 2005; Watling and Dietz, 2007). However, some studies have not affirmed the effectiveness of SI compared with other therapy forms. A review study (Baranek, 2002) suggested that outcomes of SI for children with autism in psychoeducational and motor categories are stronger than in other areas, at least for SI studies compared with no treatment conditions; however, effects appeared to be equal when compared with alternative treatments. Devlin et al. (2011) reported that behavioural intervention was more effective than SI in the treatment of challenging behaviour of children with ASD. Section On Complementary And Integrative Medicine; Council on Children with Disabilities; American Academy of Pediatrics cautioned that parents should be informed that the amount of research regarding the effectiveness of SI is limited and inconclusive (Section On Complementary And Integrative Medicine; Council on Children with Disabilities; American Academy of Pediatrics et al., 2012). Thus, although SI has been adopted for children with ASD, its effectiveness is controversial.

Many studies demonstrated that improvements in sensory-motor skills, motor planning, and reading-related skills in children with learning disabilities, with mental retardation, or with developmental coordination disorder (DCD) were seen using SI or SI treatment (Grinwood and Rutherford, 1980; Humphries et al., 1990; Wilson and Kaplan, 1994; Allen and Donald, 1995; Leemrijse et al., 2000; Wuang et al., 2009). However, there were no studies investigating the effectiveness of SI for cognition, motor performance, or motor planning in children with ASD except for a single case report (Schaaf et al., 2012). Hence, an examination of the effectiveness of SI for not only behaviour but also cognition, verbal, motor, or praxis abilities in children with ASD is warranted.

In order to clarify the effectiveness of SI on cognition, verbal, motor, and praxis abilities on children with ASD, a comprehensive test tool is needed. The Japanese version of the Miller Assessment for Preschoolers (JMAP) (Tsuchida et al., 1989) is a standardized test that assesses cognitive abilities, verbal abilities, and sensory-motor abilities. Therefore, we expect the JMAP would be able to detect changes in the cognitive, verbal, and sensory-motor abilities in children before and after therapy. To examine the effectiveness of SI, we compared score changes on the JMAP for individual SI to common group therapy (GT) treatment methods by analyzing previously collected data from children with HFASD.

Thus, the purpose of this study was to examine the effectiveness of SI on cognition, verbal, and sensory-motor abilities in children with ASD.

Method

Subjects

Subjects who satisfied the following conditions were selected from Nagasaki Prefectural Medical Treatment and Education Center’s clinical records and a clinic of Nagasaki University clinical records by the first author while serving there from 1995–2011 (Table 1).

(1) The subject was diagnosed with autistic disorder, Asperger’s disorder, or pervasive developmental disorder not otherwise specified by paediatricians according to DSM-IV (APA, 1994).

(2) The subject had an IQ above 70 using the Tanaka–Binet test.
Table I. Descriptive statistics for participants and period of therapy

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<td></td>
<td>Individual sensory</td>
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<td>Group therapy</td>
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<tr>
<td>Number</td>
<td>8</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
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<tr>
<td>Male: female</td>
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<tr>
<td>IQ</td>
<td>100.7 ± 9.6</td>
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<td></td>
<td>94.8 ± 9.1</td>
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<tr>
<td>Autism: Asperger</td>
<td>3:5</td>
<td></td>
<td></td>
<td>6:6</td>
<td>ns</td>
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<tr>
<td>Age in months at start of therapy</td>
<td>56.8 ± 9.0</td>
<td></td>
<td></td>
<td>56.3 ± 6.8</td>
<td>ns</td>
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<tr>
<td>Therapy duration (months)</td>
<td>9.3 ± 1.0</td>
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<td></td>
<td>9.3 ± 0.9</td>
<td>ns</td>
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</table>

(3) The subjects had participated in individual SIT or GT for durations of between 8 to 10 months.
(4) The subject took the JMAP examination and completed data both before therapy and after therapy.
(5) Age at first and second testing was within the target age of JMAP, which was between 2 years and 9 months, and 6 years and 2 months.
(6) Parents gave informed consent to use data for this study during the first visit.

The basic programme at Nagasaki Prefectural Medical Treatment and Education Center was GT. However, some children could not participate in these groups because the groups were full. The first author conducted SIT in this institution to the children who could not enter GT. Some children were chosen from the clinic at Nagasaki University. These children were given SIT by the first author in a SIT room at Nagasaki University. Most of the subjects in both institutions were introduced by public health nurses or kindergarten teachers in order to provide possible therapies and to get advice for children’s behaviour or communication problems. Therefore, the parents of this study’s subjects did not choose institution and therapy style.

Therapy for children with autism spectrum disorder

Subjects were given either SIT (1 h) or GT (1.5 h) weekly. SIT was conducted by the first author individually. The first author is a SI therapist certified by the Japanese Sensory Integration Association. During SIT, the first author, also an occupational therapist, and a child interacted in a therapy room equipped with sensory and kinetic equipment such as a swing, ball pit, balance beam, ladder, and trampoline. The child interacted with the sensory and kinetic materials in an active, meaningful, and fun manner. Recently, the Ayres Sensory Integration Fidelity Measure (ASIFM) (Parham et al., 2011) was proposed with the following parameters: 1) Ensures physical safety; 2) Presents sensory opportunities; 3) Helps the child to attain and maintain appropriate levels of alertness; 4) Challenges postural, ocular, oral, or bilateral motor control; 5) Challenges praxis and organization of behaviour; 6) Collaborates in activity choice; 7) Tailors activity to present just-right challenges; 8) Ensures that activities are successful; 9) Supports a child’s intrinsic motivation to play, and 10) Establishes a therapeutic alliance. However, the SIT used in this study was not formally examined by the ASIFM because it had not yet been established. Instead, the first author incorporated the principles of SI (Ayres, 1979; Koomar and Bundy, 1991). For example, the therapist established a safe environment both physically and emotionally, provided praise, feedback, and instruction, made challenges on postural, ocular, and bilateral motor controls, and made appropiative challenges on praxis and organization. The activities were individually planned to present just-right challenges and to tap the client’s inner drive, chosen with regard to be client’s interest and opinion, consistently modified to succeed and to engage, and designed to offer opportunities for enhanced sensory intake of tactile, vestibular, and proprioceptive information.

The GT programme included social skill training, communication training, kinetic activities, and child–parent play. In this therapy, an occupational therapist, a speech therapist, and three nursery school teachers interacted with five to six challenged children. Because the contents of GT were not adapted to each child, GT only fulfilled parameters “1. Ensures physical safety” and “2. Presents sensory opportunities” in ASIFM.

Instrument

Subjects were assessed using the JMAP (Tsuchida et al., 1989), a re-standardized version of the Miller Assessment for Preschoolers (MAP) for use with Japanese children. The JMAP is composed of the following five major developmental indices: 1) Foundation Index; 2) Coordination Index; 3) Verbal Index; 4) Non-verbal Index; and 5) Complex Index. Items in the Foundation Index evaluate the child’s sense of spatial position and movement, sense of touch, and development of the basic components of movement. The Coordination Index includes items that
evaluate gross, fine, and oral motor abilities. The Verbal Index includes items that examine memory, sequencing, comprehension, association, and expression in a verbal context. The Non-verbal Index includes items that test memory, sequencing, visualization, and the performance of mental manipulations not requiring spoken language. The Complex Task Index includes items that measure the combined abilities of sensory motor and cognition (Miller, 1988). Total and Index scores are expressed using percentile scores.

**Procedure**

The first author, who has been trained to administer and interpret the JMAP, administered the JMAP to all of the subjects individually before and after therapy. Data were excluded for children who could not follow or comprehend the instructions for the JMAP, or whose score was noticeably affected by his inattention, impulsiveness, hyperactivity, or inability to understand the instructions.

**Data analysis**

The Kolmogorov–Smirnov test indicated that JMAP’s Total score and several Index scores for both groups at first examination were not normally distributed. Therefore, we used nonparametric statistics. First, before and after therapy, JMAP data were compared for each group using the Wilcoxon signed-rank test. Next, changes in Total score and each Index score before and after therapy were compared between the SIT group and GT group using Mann–Whitney test.

**Results**

**Subject selection**

The Japanese version of the Miller Assessment for Preschoolers data were available from a total of 243 children. Of these children, 84 did not have autistic disorder or Asperger’s disorder and were excluded from the present analyses. Of the remaining 159, 29 were excluded for having IQ scores less than 70. From the 130 children left, 78 were excluded for having been tested only once. From the remaining 52, 28 were excluded for having a test–retest period shorter than 8 months or longer than 10 months. Thus, data from the remaining 24 children fulfilled the conditions outlined in the Method section. However, test reports described that several item scores in four cases were lacking in reliability because these subjects had problems in attention or hyperactivity. Therefore, these children were excluded, and the data from the remaining 20 subjects were analyzed in this study. In these subjects, 8 children received individual SIT and 12 children received GT. Seventeen of the subjects who met the inclusion criteria were treated in Nagasaki Prefectural Medical Treatment and Education Center. Twelve children of them received GT and five received SIT. Three children who received SIT were treated in the clinic at Nagasaki University. All individuals who worked with the children (e.g., public health nurses or kindergarten teachers) and all parents had no knowledge of SIT before the first visit. All of the subjects belonged to regular kindergartens or nursery schools, and none of the subjects were medicated. Additionally, no subject had previously received any other type of therapy.

**Japanese version of the Miller Assessment for Preschoolers Index score changes before and after therapy within each group**

Figure 1 presents mean scores and standard deviations for the SIT group before and after therapy on Total and Index scores on the JMAP. There were significant gains from before to after therapy for Total score (mean gain ± SD = 34.38 ± 21.98) \( (W = 36, p = 0.012) \), Foundation Index score (mean gain ± SD = 34.13 ± 34.21) \( (W = 28, p = 0.018) \), Coordination Index score (mean gain ± SD = 46.75 ± 36.26) \( (W = 361, p = 0.012) \), Non-verbal Index score (mean gain ± SD = 45 ± 24.26) \( (W = 28, p = 0.018) \), and Complex Index score (mean gain ± SD = 30.75 ± 20.73) \( (W = 28, p = 0.018) \). However, Verbal Index score showcased no significant changes (mean gain ± SD = 13 ± 44.26) \( (W = 24, p = 0.401) \).

Figure 2 shows mean scores and standard deviations for the GT group before and after therapy on Total and Index scores. While Total score showed a significant gain from before to after therapy (mean gain ± SD = 13 ± 44.26) \( (W = 43, p = 0.015) \), Foundation Index score (mean gain ± SD = 11.33 ± 25.54) \( (W = 13, p = 0.138) \), Coordination Index score (mean gain ± SD = 8.92 ± 17.87) \( (W = 30.5, p = 0.08) \), Verbal Index score (mean gain ± SD = 14.67 ± 31.2) \( (W = 45, p = 0.075) \), Non-verbal Index score (mean gain ± SD = 8.25 ± 36.6) \( (W = 49, p = 0.433) \),
and Complex Index score (mean gain ± SD = 3.83 ± 31.2) 
(W= 40.5, p=0.505) showed no significant changes.

**Discussion**

The purpose of the present study was to clarify the effectiveness of SIT for children with HFASD. Although the present study did not employ a planned controlled trial, the efficacy of SIT and GT for HFASD was compared by examining differences in JMAP data changes before and after therapy in children with HFASD who had either received SIT or GT by analyzing previously collected data from children with HFASD retrospectively.

In the GT group, Total score was significantly improved from before to after GT; however, there were no significant changes in Index scores. Changes in item scores could not inflate Index scores to a significant level, whereas Total score might change significantly because all item score changes were combined in the Total score. Although the possibility that maturation
or other factors that may produce changes in JMAP scores cannot be ruled out, GT might have little positive affect on abilities that were examined by JMAP. In the SIT group, Total score and all Index scores except for Verbal Index score significantly increased after SIT. The results in score changes from before to after therapy indicated that SIT might improve fundamental sensory-motor abilities, coordination abilities, non-verbal cognitive abilities, and visual-motor abilities.

Comparison of score changes between the SIT group and the GT group using Mann-Whitney analysis showed differences in changes in Total score and three Index scores between the two groups. Because the change in the Coordination Index score was greater in the SIT group than the GT group, the efficacy of SIT for motor coordination abilities in children with HFASD was suggested. The present findings of improved motor coordination with SIT agree with the results of previous studies conducted on children with learning disabilities and mild mental retardation (Humphries et al., 1990; Wilson and Kaplan, 1994; Wuang et al., 2009). The Complex Task Index score was also improved in the SIT group compared with the GT group. Therefore, SIT was suggested to be effective on a combination of motor and cognitive abilities in children with HFASD. The SIT in the present study incorporated principles of SI (Ayres, 1979; Koomar and Bundy, 1991), included activities that were individually planned to present “just-right” challenges, was consistently modified for success and engagement, and made appropriate challenges on praxis and postural, ocular, oral, or bilateral motor control. These elements of SIT might contribute to improved motor abilities and combined abilities in motor and cognition in children with HFASD. Although motor coordination problems are not described in either the diagnostic criteria of Pervasive Developmental Disorder in the DSM-IV (APA, 1994) or ASD in the DSM-5 (APA, 2013), most children with ASD have motor problems. Green et al. (2009) reported that 79% of children with ASD had obvious motor dysfunction. Moreover, Mostofsky et al. (2006) suggested that children with ASD had problems in praxis. Several studies indicated that motor problems affect daily activities. For example, poor motor skills are a strong risk factor for becoming bullied (Bejerot et al., 2011). Children with probable DCD had an increased risk of mental health difficulties in later years (Lingam et al., 2012). Motor impairment in children with DCD was independently associated with lower participation diversity (Fong et al., 2011). Because SIT was demonstrated to be effective in motor coordination and for the combination of motor and cognitive abilities, it might provide a positive impact on abilities related to daily life functions. Changes in Non-verbal Index score from before to after therapy were greater in the SIT group compared with the GT group. Additionally, changes in the Complex Index score that reflect visual-motor function were greater in SIT than GT. Therefore, the effectiveness of SIT for visual cognitive abilities in preschool children with HFASD was suggested.

While three indices significantly changed, the Verbal Index did not showcase any significant differences in the scores from before to after SIT. In addition, there were no differences in the scores between the SIT and GT groups. Therefore, these results suggested that SIT did not improve verbal abilities in children with HFASD. Therefore, the results from the present study might indicate that skills closest to sensory-motor activities related to SIT are more likely to show changes than verbal skills that are further from these training elements.

Although previous work has criticized the efficacy of SIT compared with alternative treatments (Devlin et al., 2011; Section On Complementary And Integrative Medicine; Council on Children with Disabilities; American Academy of Pediatrics et al., 2012), the authors did not examine motor or praxis abilities. To date, there has been no studies examining the efficacy of SIT on motor, praxis, or cognitive abilities of ASD compared with no treatment or alternative treatment using standardized tests. Although the present study could not provide counterevidence for previous critical studies, it demonstrated the efficacy of SIT for motor, visual cognition, and visual-motor abilities, which had not been previously investigated in children with ASD.

The findings of the present study should be interpreted with a few limitations in mind. First, the present study did not compare changes in the score for SIT with other specific therapies. Additionally, the sample size was small, and the present study did not employ a randomized control trial. The number of children in each group was different, because the present study included a retrospective analysis of previously collected data. Both types of therapy were different in their therapy members. Each session length was different (1 h in SIT and 1.5 h in GT). Although treatments were different, there was overlap in that GT training included kinetic activities that were similar.
to activities provided in SIT. The same therapist conducted SIT, but multiple staff members took part in GT, because the data were accumulated over a 16-year span. Parents' characteristics such as socioeconomic status were also unavailable. Furthermore, the first author did both testing and SI treatment. This may have biased the findings. Further study should be conducted with a randomized control trial to clarify the differences in the effectiveness of SIT and other forms of therapy for children with ASD.

**Conclusion**

The present study indicated that SIT was more effective for motor coordination abilities, non-verbal cognitive abilities, and the combined abilities of sensory motor and cognition in children with HFASD when compared with GT. Thus, occupational therapists could use SIT as one technique for the treatment of motor, visual cognition, and visual-motor abilities in preschool children with HFASD.

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Kingkaew Pajareya and Kaewta Nopmaneejumruslers
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A pilot randomized controlled trial of DIR/Floortime™ parent training intervention for pre-school children with autistic spectrum disorders

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ABSTRACT This pilot study was designed to test the efficacy of adding home-based Developmental, Individual-Difference, Relationship-Based (DIR)/Floortime™ intervention to the routine care of preschool children with autistic spectrum disorder. Measures of functional emotional development and symptom severity were taken. It was found that after the parents added home-based DIR/Floortime™ intervention at an average of 15.2 hours/week for three months, the intervention group made significantly greater gains in all three measures employed in the study: Functional Emotional Assessment Scale (FEAS) (F = 5.1, p = .031), Childhood Autism Rating Scale (F = 2.1, p = .002), and the Functional Emotional Questionnaires (F = 6.8, p = .006). This study confirms the positive results obtained by a previous DIR pilot study (Solomon et al., 2007).

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Autistic spectrum disorder (ASD) is a severe developmental disability. Children with ASD typically are diagnosed before age 3. Once considered to be a very rare disorder, occurring in around 3 or 4 children per 10,000, recent epidemiological research indicates that the prevalence rate of ASD is approximately 9.0 per 1,000 population (95% CI 8.6–9.3) (Centers for Disease Control and Prevention, 2006).

Children with ASD have challenges at two levels. At one level, they are compromised in the basic foundations of relating, communicating, and...
thinking, such as having difficulty with reciprocal social communication as part of a relationship. At a second level, they frequently show superficial symptoms such as repetitive behavior, self-stimulation, and self-absorption (Richler et al., 2007; Watt et al., 2008).

Children with ASD need a lot of help in developing early skills in establishing joint attention, imitation of caregivers, communicating with gesture and symbols, tolerating change and thinking logically.

This broad agenda has led to a broad range of approaches to early, comprehensive and intensive intervention, with concomitant controversial claims for their efficacy. Among the intensive therapeutic approaches, two broad types of intervention, behavioral and social-pragmatic, are typical (Prizant, and Wetherby, 1998).

On one end of the continuum is ABA, a behavioral approach based primarily on teaching practices derived from tenets of learning theory and operant conditioning (Lovaas, 1987). This approach shapes the child with autism's behavior through an operant learning paradigm using discrete behavioral trials to increase language and socialization and decrease repetitive behaviors. ABA usually consists of up to 40 hours per week of one-on-one intervention, involving repetitive practice of tasks where an adult determines the focus and goals of the intervention. Lovaas published results of a study evaluating the efficacy of this intervention in 1987, which had a tremendous impact. It was the first study to present empirically validated gains in children with autism. ABA became one of the dominant ways to work with children with ASD for many years.

In the intervening years, a number of critiques have focused on problems both with the internal and external validity of the Lovaas (1987) study (see for example, Gresham and MacMillan, 1997; Conner, 1998; Magiati and Howlin, 2001; Matson, 2007). The study has been criticized for the use of different IQ tests before and following treatment, and for its reliance on IQ as the sole psychometric measure of functioning.

Recent years have brought additional questions about the efficacy of the ABA model. In particular problems have been reported with a child’s ability to generalize, dependency on cues, lack of spontaneity and self-initiated behavior, rote responding, and failure to generalize behavioral gains across settings and responses (Matson et al., 1996; Schreibman, 1997). In addition, more recent studies, which partially replicated the UCLA/Lovaas Model, showed that IQ gains were substantially smaller than in Lovaas’ original study (Weiss, 1999; Harris and Handleman, 2000; Smith et al., 2000; Cohen et al., 2006). Some studies indicated little or no adaptive behavioral gains (Salt et al., 2002; Cohen et al., 2006; Reed et al., 2007), and no emotional differences when compared to a control group (Smith et al., 2000).
On the other end of the autism intervention continuum are social-pragmatic approaches that are based on typical child development (see for example, Rogers and Lewis, 1989; Greenspan and Wieder, 1997; Gutstein and Sheely, 2002; Mahoney and Perales, 2003). The prototypical social-pragmatic approach is represented by the Developmental, Individual-Difference, Relationship-Based (DIR)/Floortime™ model of Greenspan and Wieder (Greenspan and Wieder, 1997).

DIR focuses on relationships, social skills, meaningful, spontaneous use of language and communication, and integrated understanding of human development. The integrated model of human development includes interaction with caregivers and the environment, biological, motor and sensory differences, and the child’s functional emotional developmental capacities. In addition to the study of 200 children with ASD (Greenspan and Wieder, 1997), there have been more recent studies which have used a relationship-based approach incorporating the fundamentals of the DIR/Floortime model. These studies demonstrate positive results for children with ASD (Mahoney and Perales, 2003; Solomon et al., 2007). However, the biggest challenge with the studies based on the DIR/Floortime model is the absence of a control group.

In Thailand, all of the hospital and special education nurseries use ABA as their main systematic treatment. Ranging from 20–40 hours per week of intensive intervention, it represents the gold standard of treatment. However, this approach is not feasible for almost all of the families in Thailand as there is a national shortage of personnel trained in these approaches. Some institutes provide additional training for parental intervention in specific skills with a range of intervention approaches involving parents in behavior management and promotion of communication skills which are non-intensive, utilizing teaching in everyday situations.

We focus this pilot study on testing whether adding the new DIR/Floortime treatment would confer additional benefits over routine clinical care available to both groups in terms of climbing ‘the developmental ladder’ and reducing autistic symptoms.

**Method**

**Ethics approval**

The study was approved by the Institutional Ethical Committee of Mahidol University. Written informed consent was obtained from the children’s parents before enrollment in the study.
Participants
Subject recruitment was conducted by paper, advertising the DIR/Floor-time model shown at the National Institute for Child and Family Development, Mahidol University, Thailand. The parents who were interested in this new treatment method could call in for registration or more information. All of the registrations were arranged in sequence and the families were serially called in to the office for screening and to confirm the diagnosis. The children whose diagnoses were confirmed by a developmental pediatrician and met clinical criteria for autistic disorders according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) were invited to participate in the study, if they were 2–6 years of age. The children were excluded if a) they had any additional medical diagnosis (e.g. genetic syndromes, diagnosed hearing impairment, diagnosed visual impairment or seizures); b) they were geographically inaccessible for follow-up visits; or c) their parents were not literate or had known chronic psychiatric or physical illness.

Thirty-two participants were enrolled in the study. Children were assigned to either the typical treatment or DIR/Floortime–supplemented treatment groups using stratified random assignment based on age and symptom severity. Four strata were thus generated within both treatments to guarantee baseline similarity: mild autism and age 24–47 months, mild autism and age 48–72 months, severe autism and age 24–47 months, severe autism and age 48–72 months. The Childhood Autism Rating Scale (Schopler et al., 1986) was used to rate the degree of severity. Children with scores from 30 to 40 points on the CARS scale were placed in the mild autism category, and children with scores between 41 and 60 were placed in the severe autism category. There were 8 children in each stratum.

Intervention
The target treatment was based on the DIR/Floortime™ intervention developed by Greenspan and Wieder (Greenspan and Wieder, 1997). The first author, who has degrees in rehabilitation medicine, had been trained in the DIR/Floortime model from books (Greenspan and Wieder, 1998; ICDL, 2000), manuals (Greenspan and Lewis, 2005), the Floortime DVD training series (ICDL, 2005a, 2005b, 2005c), and practiced this technique as a home consultant for two years before the study started.

The study treatment involved intervention entirely with parents of children with ASD, rather than directly with the children themselves. Before the first session, all parents in the intervention group attended a one-day training workshop with the first author, to learn about the DIR/Floor-time™ model. In addition, all parents received a 3-hour DVD lecture, recorded from the workshop presented by the first author. The lecture
consisted of the basic concept of DIR technique and the biological challenges of the children with ASD in terms of sensory reactivity, processing of the sensory data and planning motor responses. This lecture also included the details of Greenspan’s Six Functional Developmental Levels (FDL) (Greenspan and Wieder, 1997): 1) self regulation and interest in the world; 2) engagement and relating; 3) purposeful emotional interaction; 4) social problem solving; 5) creating ideas and 6) thinking logically.

At the first one-on-one visit, the parents were trained for 1.5 hours. They were trained to observe their child’s cues, follow the child’s lead, and implement the Floortime™ techniques that were appropriate for their child’s current level of functional development to achieve the identified goals.

If the child could not calm down or could not be warm and loving their parents were encouraged to do Floortime level 1: joining their child in an activity that gave them pleasure and maintaining mutual attention and engagement. Floortime level 1 contributed to milestone 1 and 2.

If the child could not engage in two-way gestural communication, did not express a lot of subtle emotions, or could not open and close many gestural communications in a row, their parents were encouraged to do Floortime level 2: using simple communication through animated face to face interaction with increasing back and forth communication. This achievement correlated with milestones 3 and 4.

If the child could not engage in pretend play and/or use words to convey intentions or wishes, the parents were encouraged to do Floortime level 3: helping their child to express needs, wishes and feelings through pretend play and using their ideas in daily conversation. This achievement correlated with milestone 5.

If the child could not connect thoughts logically and hold a conversation for a period of time, the parents were encouraged to do Floortime level 4: helping their child become a logical and critical thinker. This achievement correlated with milestone 6.

All of the parents were advised to help their children exhibit these aforementioned skills through a full range of emotions.

Because children with ASD do not naturally master the milestones in complete sequential order, some parents had to learn more than one technique to promote their child’s development.

Modeling involved the investigator showing parents how to use Floortime™ with their child. After parents observed the investigator modeling the skills, they were asked to independently demonstrate the same skills. Modeling skills first and then asking parents to play after having observed the investigator was more accepted by Thai families than asking them to play without previous modeling from the investigator. Coaching involved...
the investigator observing the parents playing with their child and giving them feedback about their performance.

In addition, each family had a manual or ‘pocket book’ that helped them identify activities for semi-structured problem-solving daily exercises. These activities were designed to enhance affect-based communication skills of the children and to improve basic neurological problems. The manual was based on the affect-based language curriculum (ABLC) (Greenspan and Lewis, 2005). The goals and home program were set for each family and they were asked to carry out their Floortime™ and semi-structured problem-solving activities for a minimum of 20 hours per week.

The intervention group was followed up with at the end of the first month. The observer provided feedback to the parents about how they related to their children. Controlling and intrusive responses were replaced with responses aimed at facilitating two-way emotional signaling and communication between parents and their children. Modeling and coaching were used to improve their performance. The goals, methods and techniques of the home program were refined to synchronize with the child’s progress.

Families in the intervention group used the study intervention in addition to ongoing routine care of one-on-one treatment intervention based on behavioral or discrete trial principles throughout the study period.

Meanwhile, the children in the control groups continued their routine care for three months while they were waiting for the DIR/Floortime™ parent training. The baseline assessment and follow-up time schedule were similar to those of the intervention group.

**Measures**

Baseline demographic data included the children’s profiles and their families’ characteristics: marital status, having siblings or not, educational status of the mother, working status of the parents and participation in a special education (or regular) preschool program.

**Primary outcome measurement**
The Functional Emotional Assessment Scale (FEAS) (child behaviors) (Greenspan et al., 2001) is an observational measure that was used at the beginning of the first session and the end of the study to measure changes in children’s functional development. The FEAS is a valid and reliable, age-normed, clinical rating scale that could be applied to videotaped interactions between children and their caregivers. A 15-minute videotaped child–parent interaction was collected for each child. Each parent was asked to play with their child as they normally would at home using a standard
set of toys (including symbolic, tactile and movement play materials). The change of the FEAS child score was used as the primary outcome of the overall progression.

The assessment team consisted of two developmental psychologists who had experience in assessing children with autism and were blinded to the children’s group status. Intra-class correlation coefficient was applied to test the agreement between two raters. Data from 20 randomly chosen subjects were analyzed and it was found that the correlation coefficient was 0.96.

At the follow-up period, all of the children were assessed by the same FEAS items as the beginning of the study. The scores from two assessors were averaged. The increment of the averaged follow-up score from the averaged baseline score was used to determine the improvement.

Secondary outcomes measurement
The Childhood Autism Rating Scale (CARS) (Schopler et al., 1986) was used to rate the degree of autistic symptoms on a scale of 15–60. The decrement of the follow-up score from the baseline score was used to determine the improvement.

Developmental rating of the children was estimated by the parent at baseline and the end of the study using the Functional Emotional Developmental Questionnaire (FEDQ) (Greenspan and Greenspan, 2002). The questionnaire was related to Greenspan’s Six Functional Development Levels (FDL): 1) shared attention and regulation; 2) engagement and relating; 3) purposeful emotional interaction; 4) social problem solving; 5) creating ideas; and 6) thinking logically. The difference between the increments determined the clinical progression.

The original version of the FEDQ was translated into Thai by the first author and then translated back into English by a fluent English speaker. The Thai version was tested for its face validity by three health care professionals who had worked in the field for more than 3 years and by one parent of a child with ASD. All of them agreed that the FEDQ had face validity as they appeared to measure the fundamental development of the children. They then examined each item of the questionnaire to find the content validity. It was found that the intra-class coefficient of each item varied from 0.75–1. The content validity of the Thai version of the FEDQ was then accepted.

Compliance, contamination and co-intervention
At the first visit, the parents were supplied with a set of weekly logs in order to help them estimate the average number of hours per week that they used the home-based DIR/Floortime™ technique as well as any other methods of interventions for their child.
Because it was nearly impossible to control the co-intervention, the input from other health and education services (e.g. part-time placement in a nursery, kindergarten) were reported.

**Results**

**Baseline characteristics of the children with ASD and their families**

Table 1 summarizes the demographic and pre-treatment scores of the intervention and control groups. The gender make-up is an 8:1 male to female ratio. Ten of sixteen children (62.5%) of the control group and 13 of 16 children (81.2%) of the intervention group were diagnosed with autistic disorder. The remaining children were classified with Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS). The difference of these ratios was not statistically significant ($p = .430$). There was no statistical difference in the other baseline parameters of either group including average age of the children at entry, level of development and symptom severity.

In the sub-category of the overall status, the proportion of the children who had islands of the capacity to symbolize in the intervention group (10 of 16) seemed to be greater than the proportion in the control group (6 of 16) but the difference was not statistically significant (chi-square test, $p = .16$).

Regarding the families, parents in the intervention group tended to have lower levels of education than the parents in the control group and the ratio of children who had a sibling in the intervention was lower than in the control group. However, these differences were not statistically significant (chi-square test, $p = .10$).

At the beginning of the study, most of the participants in the intervention group ($n = 14$) and the control group ($n = 14$) attended either full-time or part-time special education or a (regular) preschool program for 22.6 ($SD = 15.2$) and 19.5 ($SD = 9.9$) hours per week accordingly. They also received a mixture of services including one-on-one speech therapy, occupational therapy or other treatments based on behavioral principles with 3.1 hours per week for the intervention group and an average of 3.3 hours per week for the control group.

During the study period, 11 families in the intervention group used home-based DIR/Floortime™ activities in addition to their routine programs, 3 families decreased their child’s time in a pre-school classroom and 2 families stopped attending the schools in order to increase their Floortime™ at home. During the study, the intervention group performed the DIR/Floortime™ intervention at an average of 15.2 hours per week ($SD = 12.4$).
<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Intervention group</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>n = 16</td>
<td>n = 16</td>
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<td><strong>The children</strong></td>
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<td>Mean age in months (SD)</td>
<td>51.5 (13.9)</td>
<td>56.6 (10.1)</td>
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<td>Gender (male/female)</td>
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<td>15/1</td>
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</tr>
<tr>
<td>Diagnosis (autism/PDD-NOS)</td>
<td>10/6</td>
<td>13/3</td>
<td>p = .43*</td>
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<tr>
<td>Mean CARS (SD)</td>
<td>39.7 (6.6)</td>
<td>37.2 (6.2)</td>
<td>p = .28*</td>
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<td>Mean FEAS (SD)</td>
<td>23.5 (12.6)</td>
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<td>p = .86*</td>
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<td>Mean FEDQ (SD)</td>
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<td>44.0 (12.9)</td>
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<td>No affective engagement</td>
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<td>0</td>
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<tr>
<td>Only intermittent engagement, no reciprocal communication</td>
<td>4</td>
<td>3</td>
<td>p = .71***</td>
</tr>
<tr>
<td>Intermittent reciprocal communication, no symbolization</td>
<td>6</td>
<td>3</td>
<td>p = .50***</td>
</tr>
<tr>
<td>Islands of symbolization</td>
<td>6</td>
<td>10</td>
<td></td>
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<tr>
<td>Associated with moderate-to-severe motor planning problem</td>
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<td>6</td>
<td>p = .71***</td>
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<td>On medication</td>
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<td>5</td>
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</tr>
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<td>Participation in special education (or regular) preschool program</td>
<td>11</td>
<td>11</td>
<td>p = .50***</td>
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<td>Average hour per week (SD) of paramedical services</td>
<td>3.3 (1.4)</td>
<td>3.1 (1.8)</td>
<td>p = .62*</td>
</tr>
<tr>
<td>(e.g. speech therapy, occupational therapy)</td>
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<tr>
<td><strong>Their families</strong></td>
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<td></td>
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<tr>
<td>Mother has bachelor degree or higher</td>
<td>14</td>
<td>10</td>
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<tr>
<td>Mother in full- or part-time employment</td>
<td>4</td>
<td>6</td>
<td>p = .70***</td>
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</tr>
<tr>
<td>Sibling in family (yes/no)</td>
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<td>3/13</td>
<td>p = .06***</td>
</tr>
</tbody>
</table>

* from Student-t test; ** from chi-square for trend test; *** from chi-square test.

Note. SD = standard deviation; PDD-NOS = pervasive developmental disorder – not otherwise specified; CARS = Childhood Autism Rating Scale (Schopler et al., 1986); FEAS = Functional Emotional Assessment Scale (Greenspan et al., 2000); FEDQ = Functional Emotional Developmental Questionnaire (Greenspan and Greenspan, 2002).
Fourteen families in the control group continued their routine care whereas two families in the control group acquired Floortime™ techniques from their friends who were already trained and they used this technique in addition to their routine care with their children during the control period. In order to protect the RCT design, an ‘intention to treat’ analysis approach was undertaken.

Thirty-one subjects completed the study. One parent from the intervention group refused to use Floortime™ technique and decided to drop from the study after the first visit because they did not appreciate the goal set for their child of increasing engagement before trying to make the child ‘talk’.

Table 2 shows the mean (SD) changes of the three outcomes for the control and intervention groups. The change of the FEAS score for the control group reflects the overall developmental progression of only 1.9 (SD = 6.1), compared to the increment of 7.0 (SD = 6.3) for the intervention group. The Student t test shows that the difference is statistically significant ($p = .031$). If the primary outcome of the child who dropped out of the study was estimated as a worst-case scenario (zero gain in FEAS) the difference is still statistically significant ($F = 4.6, p = .045$).

The CARS score change reflecting the overall autistic severity improvement of both groups shows a significantly greater decrease for the intervention group as compared to the control group.

Developmental rating of the children was estimated by the parent using the Thai version of the Functional Emotional Questionnaires at baseline and follow-up. The change in data for the intervention group shows that there was a more statistically significant gain in it than in the data of the control group.

If the secondary outcomes of the child who dropped out of the study were estimated as worst-case scenarios (zero change in CARS score and FEDQ) the differences are still statistically significant ($F = 1.9, p = .004$ for CARS and $F = 6.4, p = .007$ for FEDQ).

<table>
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<tr>
<th></th>
<th>Control (n = 16)</th>
<th>Intervention (n = 15)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEAS</td>
<td>1.9 (6.1)</td>
<td>7.0 (6.3)</td>
<td>$p = .031$</td>
</tr>
<tr>
<td>CARS</td>
<td>0.8 (1.2)</td>
<td>2.9 (2.0)</td>
<td>$p = .002$</td>
</tr>
<tr>
<td>FEDQ</td>
<td>0.8 (1.4)</td>
<td>7.7 (8.1)</td>
<td>$p = .006$</td>
</tr>
</tbody>
</table>

Note. FEAS = Functional Emotional Assessment Scale (Greenspan et al., 2000); CARS = Childhood Autism Rating Scale (Schopler et al., 1986); FEDQ = Functional Emotional Developmental Questionnaires (Greenspan and Greenspan, 2002).

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**Fidelity and outcomes**

We compared the results of the intervention group to parents’ reports of fidelity in delivering the weekly hours of intervention. It was found that the parents who added home-based DIR/Floortime™ intervention 10 hours per week or more \((n = 9)\) made greater gains in FEAS than the parents who added the intervention less than 10 hours per week \((n = 6)\), but the difference was not statistically significant \((p = .095)\).

**Discussion**

This pilot study reported an RCT of a DIR/Floortime™ parent training intervention for preschool children with ASD. It employed a low-cost and widely applicable professional-as-consultant, parent-as-therapist model.

Overall the parents in this study were well educated and families were intact. Many families had one parent who was not working outside. Half of the families had only one child. The families in this pilot study were volunteers and thus more likely to get the benefit from a parent training model.

Even though the aim of the study was to test the efficacy of Greenspan’s DIR (Developmental, Individual-Difference, Relationship-Bases)/Floortime model (Greenspan and Wieder, 1997) added to the children’s routine care, there were some families in the intervention group who decided to partially or totally change their approaches; 5 families decreased or stopped their children’s time in a pre-school classroom in order to increase their Floortime™ at home. The reason for their decision was their satisfaction with the results after they started the new intervention.

On the contrary, there were many parents who appreciated the results of their attempt but found it difficult to implement and maintain the recommended activities as much as they wished, often because of demands of other children, work, or their family life. Another difficulty encountered was that parents had to change their practice from giving ‘an order’ and waiting for ‘the right response’ to challenging their children to be truly interactive with them.

On the primary outcome measure, the intervention group showed a gain of 7.0 points during the 3-month period, which was a statistically significant difference compared to the gain of 1.9 points in the comparison group. Translated clinically, the newly added intervention could help the autistic child to better engage, relate and communicate with their caregiver than those who received the routine behavioral interventions.

A similar effect was found on the secondary outcome measures. The differences were directly attributed to the home-based training. This data confirms the results of the treatment intervention based on DIR/Floortime theory reported by Solomon and colleagues (2007).
Compared to the results of Solomon’s study, in which the FEAS increased from 38.1 to 44.6 within a 1-year period of DIR/Floortime-based intervention, our children in the intervention group showed similar results within a shorter duration. The positive results shown in such a short period could be explained by the fact that at baseline our children had fewer opportunities for interaction and lacked adequate and appropriate treatment. They went to school too early and spent more time in school than those in Solomon’s study. Many children in this study participated in special education or regular preschool programs even while they were not yet fully engaged with their parents. In such a situation the teacher or teacher’s aides could not conduct one-on-one interaction with each child, and the partially engaged autistic child was therefore being left self-absorbed most of the time.

Another reason for this impressive improvement related to the fact that children in our study had lower baseline scores than those in Solomon’s. This prevented the possibility of a ceiling effect, and also allowed DIR/Floortime™ work to address more basic capacities such as regulation and attention.

In addition, it was found that the majority of the parents in the beginning of our study did not know how to play with their children. They spent most of their time controlling and teaching their children. This may be the results of Thai culture and educational background that do not prefer the young to express themselves but rather do only what adults tell them to do. This was different from the parents in Solomon’s study. As a result, the parent in our study had a greater chance to improve their abilities after being coached.

In the situation of being determined as under-treated, adding home-based DIR/Floortime™ intervention for an average of 15.2 hours per week for three months could ensure more statistically favorable outcomes.

There were a number of methodological limitations. Since the recruitment process included a flyer advertising this new intervention, the results of the study could have been affected by involving families that were particularly interested in learning this new intervention. There was some contamination, with varying types and amounts of interventions in the control group. Additionally, the treatment group also contained a varying amount of intervention.

Families in the intervention group used DIR/Floortime™ in addition to their children’s routine and behavioral treatment, whereas the control group received only their routine behavioral care. It is possible that the results, which demonstrated gains in the intervention group, could be attributed not only to the DIR/Floortime intervention, but simply to more time spent with parents and more time spent in intensive intervention.
The outcome measurement also presented some limitations. Our main measurement was the FEAS, which is DIR theory–specific. Information on other important outcomes was not measured, such as cognitive skills, social functioning and school performance. Additionally, the impact of the competing demands of other children, work, and family life was not measured.

Although it is difficult to verify the accuracy of parent’s reports regarding the number of hours spent doing the intervention at home, parents’ logs have been systematically used by other studies evaluating parents’ delivery of intervention (Solomon et al., 2007; Mahoney and Perales, 2005; Dawson et al., 2010).

In conclusion, this trial confirmed the replicability of the home-based DIR/Floortime™ intervention across sites. A large-scale randomized controlled trial should be carried out to enable investigators to analyze variables, such as subjects’ characteristics, that may be associated with favorable or unfavorable responses to interventions. In addition, the outcome measurement should be more comprehensive.

References


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Pilot study of a parent training program for young children with autism: The PLAY Project Home Consultation program
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What is This?
Pilot study of a parent training program for young children with autism

The PLAY Project Home Consultation program

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ABSTRACT The PLAY Project Home Consultation (PPHC) program trains parents of children with autistic spectrum disorders using the DIR/Floortime model of Stanley Greenspan MD. Sixty-eight children completed the 8–12 month program. Parents were encouraged to deliver 15 hours per week of 1:1 interaction. Pre/post ratings of videotapes by blind raters using the Functional Emotional Assessment Scale (FEAS) showed significant increases (p ≤ 0.0001) in child subscale scores. Translated clinically, 45.5 percent of children made good to very good functional developmental progress. There were no significant differences between parents in the FEAS subscale scores at either pre- or post-intervention and all parents scored at levels suggesting they would be effective in working with their children. Overall satisfaction with PPHC was 90 percent. Average cost of intervention was $2500/year. Despite important limitations, this pilot study of The PLAY Project Home Consulting model suggests that the model has potential to be a cost-effective intervention for young children with autism.

KEYWORDS autism; DIR model; intervention; parent; training

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For further information on UK workshops in September 2007, please see www.mindbuilders-consulting.com, or contact Sibylle Janert (e-mail: sibylle.janert.info).
There is a growing consensus that young children (18 months to 6 years of age) with autistic spectrum disorders (ASDs) benefit substantially from comprehensive and intensive therapies (American Academy of Pediatrics, 2001; Dawson and Osterling, 1997; Filipek et al., 2000; Howlin, 1998; Hurth et al., 1999; Lord et al., 2001; Matson et al., 1996; Rapin, 1997; Rogers, 2000). Comprehensive therapies address the multiple areas of developmental differences (i.e. language, sensory, social, educational) in children with ASDs (Campbell et al., 1996; Rogers, 2000). Intensive therapies are characterized by: 25 hours per week; high teacher to pupil ratios (1:1 or 1:2); early intervention (age 18 months to 6 years); and structured, strategic approaches that address the language, social and behavioral deficits of ASDs (Lord et al., 2001). Typically the therapies are implemented over 2–4 years until the child is 6 years old. The cost of these interventions when delivered by professionals is very expensive, ranging between $25,000 and $60,000 per year. When children who receive intensive intervention improve their functioning, the cost savings for society may be substantial (Jacobson and Mulick, 2000; Järbrink and Knapp, 2001). Obviously, an efficient, cost effective intervention is needed both clinically and financially. A pilot project – The PLAY Project Home Consulting program – is described which is designed to provide an intensive, cost effective, structured intervention that addresses the language, social and behavioral deficits of children with ASD. Specifically, the program evaluation of The PLAY Project’s Home Consultation (PPHC) program is reported here.

Among the intensive therapeutic approaches, two broad types of interventions – behavioral and social-pragmatic – are typical (Prizant and Wetherby, 1998). Though the approaches differ deeply in their fundamental theoretical underpinnings, they share key elements: early, intensive, one-on-one intervention to start, a strategic direction (language, social skills and/or pre-academic skills) and structured programs.

The prototypical behavioral approach is represented by the work of Lovaas and associates (Lovaas, 1987; McEachin et al., 1993; Smith and Lovaas, 1998). Based on applied behavioral analysis (ABA), this approach shapes the child with autism’s behavior through an operant learning paradigm using discrete behavioral trials to increase language and socialization and decrease repetitive behaviors. ABA methods have been carefully evaluated (Matson et al., 1996). Lovaas’s original randomized controlled trial found that 47 percent of the 19 intervention children were mainstreamed in regular classrooms with only one of the control group children making equivalent gains (Lovaas, 1987). Long term follow-up of the original study group revealed that gains were maintained (McEachin et al., 1993). Careful analysis of the original study, however, has revealed several serious design flaws; and various replications of the model have fallen short of the original ‘best
outcome’ criteria (including especially being in typical classrooms without aide support) (Shea, 2004). Limitations of this behavioral approach include: (1) the difficulty of maintaining the 40 hours per week of intervention, (2) the high quality of supervision needed and (3) the difficulty replicating findings in non-research settings (Mudford et al., 2001). Several other studies, using ABA methods, have shown that children can make significant gains in specific targeted behavioral areas using this approach, though maintenance and generalization of skills were problematic (Matson et al., 1996). Critics often point to difficulties with generalization to natural environments, continuing difficulties with social pragmatic skills with peers, and the aversive nature of the discrete trial type of intervention. The original punishment-based program is no longer used and thus throws doubt on the generalization of outcomes to current programs.

The prototypical social-pragmatic approach is represented by the work of Greenspan and his developmental, individualized and relationship-oriented (DIR) model (Greenspan and Wieder, 1997a) designed to increase socialization, improve language and decrease repetitive behaviors. Joint attention and the promotion of contingent interaction are at the methodological core of the DIR model (Kasari et al., 2001; Siller and Sigman, 2002). Greenspan’s case series (Greenspan and Wieder, 1997b) involved a cohort of 200 children. This sample had a highly motivated, middle- to upper-income parent population. It can only be considered as an observational study, as there were no controls and no detailed description of the specific intervention protocols used. Nonetheless, after 2 years of intervention, 58 percent of treated children showed improvements and no longer met the criteria for ‘autistic disorder’ on key measures (e.g. CARS). The PLAY Project uses Greenspan’s theoretical DIR framework to inform its play-based intervention approach. The DIR model is one of several social-pragmatic programs in clinical use. Several other types are extant (Aldred et al., 2004; MacDonald and Carroll, 1992; Mahoney and Perales, 2005; Prizant and Wetherby, 1987; Rogers and Lewis, 1989). Despite clinical acceptance of play-based, social/pragmatic approaches, the scientific evidence for their efficacy has been limited (Dawson and Galpert, 1990; Rogers, 2000; Siller and Sigman, 2002). These approaches are more difficult to operationalize and quantify than behavioral approaches (Rogers, 2000).

Though 25 hours per week of intensive intervention is recommended by the National Research Council report (Lord et al., 2001), the approach is not feasible in most financially strapped state departments of education and is well out of financial reach for most families to obtain privately if delivered by professionals. Additionally, there is a national shortage of personnel trained in these approaches even as the number of children identified with ASDs is increasing (Croen et al., 2002; Scott et al., 2002).
Recent prevalence estimates range from 6.5 per 1000 to 4 per 1000 children (Bertrand et al., 2001; Fombonne, 1999). Until more developed, institutionalized services are available, a staged approach to intervention using parents as first interventionists has been recognized as the most practical way to deliver initial services (Anderson et al., 1987; Howlin, 1980; Rogers, 1996; Schopler and Reichler, 1971; Schreibman and Britten, 1984).

Methodologically rigorous research on parent training interventions is scant (Drew et al., 2002) but promising. Diggle et al. (2003) were able to find only two of 68 studies on parent training for young children with autism that met their strict criteria (randomized controlled studies). Jocelyn et al. (1998) evaluated a caregiver-based intervention program for children with autism in community day-care centers. Using an eclectic 12 week training approach for parents and day care personnel, this randomized controlled study showed that children with autism improved language skills significantly and parents reported greater satisfaction when compared to the control group. Smith et al. (2000) used a randomized controlled design of parent training versus intensive ABA treatment. His group found better outcomes for the intensive treatment approach though child outcomes in the parent training group, while statistically less successful on some measures, were comparable clinically. Mahoney and Perales (2005) used a controlled design and a parent training model very similar in hours and methods to The PLAY Project. Their group found highly significant improvements in the intervention group on social reciprocity and language measures. Finally, a recent randomized controlled trial of parent training, using a social communication intervention methodology, showed statistical and clinical improvement compared with controls on the ADOS (Autism Diagnostic Observation Scale) total score, particularly in reciprocal social interaction (Aldred et al., 2004).

Less rigorously designed studies of parent training also showed promising results in the areas of language, IQ, social skills and school performance. Sheinkopf and Siegel (1998), in a natural experiment, compared parent-led home-based behavioral intervention (i.e. ABA) to a matched control group receiving school-based, educational intervention. They showed significant improvements in IQ and school placement in the intervention group. Ozonoff and Cathcart (1998) used a 4 month, structured home/parent training component in addition to the children’s TEACCH program. They showed highly significant improvements on psycho-educational measures. Even brief parent training interventions have shown immediate effects. Dawson and Galpert (1990) taught mothers to engage in imitative play with their 2- to 6-year-old children with autism. Increased gaze at the mothers’ faces and creative toy play were found. In an interesting longitudinal study, Siller and Sigman (2002) found that certain behaviors of parents predicted subsequent development of the children’s communication skills.
In particular, caregivers who synchronized their behaviors to their children’s attention and activities helped children with autism develop superior joint attention and language when compared to parents who were less contingent or synchronized. In short, parents appear to be able to learn various methods of intervention to help them effectively interact with their young children with autism.

In this article we present the program evaluation results of a piloted parent training program, called The PLAY (Play and Language for Autistic Youngsters) Project Home Consulting model. Over the last seven years, the PLAY Project has established itself in southeastern Michigan as a multi-faceted, statewide, autism training and early intervention center. Fifteen agencies use the model in Michigan and, nationally, 50 agencies in 17 States are using the model. The PLAY Project’s theoretical framework is based on the developmental, individualized and relationship-oriented (DIR) model of Stanley Greenspan MD (Greenspan, 1992; Greenspan and Weider, 1997a). The DIR model focuses on helping children with communication disorders improve social reciprocity and functional/pragmatic communication, an often ignored source of developmental delay (Simpson et al., 2003). The model is typically comprehensive, intensive and multidisciplinary in approach. It includes early referrals especially to speech and language and occupational therapy among other services. The project is consistent with National Research Council recommendations (Lord et al., 2001) including especially the need for intensity (up to 25 hours per week), one-on-one intervention, early start (ages 18 months to 6 years) and strategic direction (social reciprocity).

The PLAY Project has four clinical components:

1 medical consultation at the Ann Arbor Center for Developmental and Behavioral Pediatrics clinic with referrals to community resources
2 training including both community-based workshops for parents, pediatricians and professionals and agency trainings in The PLAY Project Home Consultation model
3 parent support and advocacy services called the Michigan Autism Partnership (MAP)
4 The PLAY Project Home Consultation (PPHC) program which is described in the methods section below.

To our knowledge, this is the first report of outcomes related to a programmatic, carefully operationalized approach based on the DIR model.
Methods

Subjects
All children referred to the University of Michigan Developmental and Behavioral Pediatrics Clinic from October 2000 to February 2002 were assessed clinically by the developmental/behavioral pediatrician (RS). Children were eligible if they were given a diagnosis of autistic disorder, pervasive developmental disorder not otherwise specified (PDD-NOS) or Asperger syndrome according to the Diagnostic and Statistical Manual (DSM-IV) criteria (American Psychiatric Association, 1994). Children were excluded if they had any of the following: an age less than 18 months or over 6 years at the time of diagnosis; residence of more than 60 miles outside the city of Ann Arbor (home consultants travel to families’ homes); participation in any other intensive intervention (e.g. behavioral or social-pragmatic program delivering >10 hours per week of 1:1 or 1:2 teacher to pupil ratio); or the presence of a severe medical disability. Sixty-eight children had pre/post data available.

Consent procedure
The study design, protocol, and consent forms were reviewed and approved by the University of Michigan Institutional Review Board. Written informed consent was obtained from the child’s parents or guardian before enrollment in the study.

Intervention: The PLAY Project Home Consultation program
Families with young children (1.5–6 years) who live in southeast Michigan are eligible to receive the services of The PLAY Project’s three trained home consultants. The consultants, who have degrees in child development fields (one MSW, two recreational therapists), receive 1 month of structured, intensive and supervised training in the DIR theory and The PLAY Project model before beginning their work with families. Their training includes readings on the DIR theory and practice, the use of a structured training manual and regular supervision visits with the program’s medical director. Home consultants then make monthly, half-day (3–4 hour) visits to families’ homes to teach parents how to provide intensive, one-on-one, play-based (social pragmatic) services to their young children with autism. A key component of training involves review of videotapes obtained during these home visits and assessment of the child’s progress. The program is paid for with a combination of fee for service and foundation grant funding. Average cost per family per year was between $2500 and $3000, depending on the number of annual visits (e.g. 10 visits/year = $2500).
A detailed training manual is also used to train parents in The PLAY Project approach. All parents in this study learned about the play-based DIR methods through a 1 day workshop given by the project’s director (RS). The aim is to help parents understand the approach needed to contingently and reciprocally engage their children a minimum of 15 hours per week even as the child makes developmental progress. Time spent can be in the form of structured sessions (e.g. 20 minutes play periods) or by taking advantage of incidental daily activities (i.e. mealtime, bathtime, bedtime). A clearly defined seven-step ‘skill sequence’ is used to train parents. In step 1, parents are first taught the principles of play-based intervention and how to strategically apply these principles to (a) their child’s preferred way of relating, (b) their child’s sensory motor preferences and deficits and (c) their child’s current level of functional development. The principles are indebted in part to Greenspan’s DIR theoretical framework. In step 2, they learn to assess their child’s unique profile using the above principles and strategies. In step 3, a list of activities that are likely to be engaging is generated. In step 4, parents are taught methods of observing their child’s cues, following their lead and ‘reading’ the child’s intentions in order to increase reciprocal interaction. In step 5, specific techniques enhance the basic methods of following the child’s lead. After parents observe the consultants modeling the skill sequence, then in step 6, video assessment offers immediate feedback to parents who can review how they are relating with their child. The consultants are taught to be supportive, non-critical and outcome oriented. In the final step, step 7, as the child makes progress up the functional developmental hierarchy, home consultants help parents refine the curriculum, methods and techniques. Thus, the skill sequence is repeated continuously so that methods are synchronized with the child’s progress.

Each monthly home visit uses modeling, coaching, video assessment and written objectives to help implement and then refine the skill sequence. Modeling involves the consultants showing parents how to use the strategies, methods and techniques of the play-based approach. Coaching involves the consultant observing the parents as they play with their child and giving them positive feedback about their performance. A video assessment of parents’ interactions occurs at the end of the session. Written objectives are derived from a clinical tool called The Pre-School Autism Rating Scale (PARS) (Klaw and Solomon, 1990) that profiles the young child with autism’s functioning in key areas of interest (communication, reciprocal interaction, social skills, repetitive behaviors) geared to the DIR model. Home consultants review selected cases and videotaped segments with the project’s medical director on a weekly basis. Observations and suggestions are recorded on a feedback form and shared with parents at the next visit. These sessions also serve as further training for the PLAY home consultants.
Assessment procedure
All children diagnosed with autistic spectrum disorders were evaluated, using a pre/post design, at the start and at the end of the first year of The PLAY Project’s Home Consulting program. Baseline demographic characteristics included marital status, educational status of each parent, number of parents working outside the home, number of siblings, participation in special education preschool programs, and the number of hours and type(s) of interventions being used during the study period.

The following measures were administered before and after intervention to assess changes in children’s behavior and development as well as in parents’ behavior and satisfaction with home consulting services.

The Functional Emotional Assessment Scale (FEAS) ratings   The FEAS (Greenspan et al., 2001) was used at baseline and the end of the study to measure changes in caregiver behaviors and in children’s functional (social/pragmatic) development. The FEAS is a valid and reliable, age-normed, clinical rating scale that can be applied to videotaped interactions between children with autism and their caregivers. The FEAS is divided into two parts — caregiver and child — with six subtests in each part directly related to Greenspan’s six functional developmental levels (FDLs: Greenspan and Wieder, 1997a): (1) self-regulation and interest in the world; (2) forming relationships, attachment and engagement; (3) two-way, purposeful communication; (4) behavioral organization, problem solving and internalization; (5) representational capacity; and (6) representational differentiation. According to Greenspan, typically developing children achieve early two-way communication by 7–9 months, which would correlate to an FDL 1–2. FDL 3 is achieved between 10 and 12 months, FDL 4 between 13 and 18 months, FDL 5 from 25 to 35 months, and FDL 6 between 3 and 4 years of life. On the FEAS, the higher the score, the more functional the child’s behavior and the higher the child’s developmental level. Children with autism are by definition delayed in their acquisition of functional development (i.e. engagement, initiation, reciprocal interaction, problem solving, etc.). Their FEAS scores will, as a result, be lower than would be expected of a typically developing, same-age peer.

The FEAS total scores were used as the primary measure of overall progress for the caregivers and children in this study. To give an estimate of clinical progress, FEAS subscale scores were used (referred to as FEAS scaled scores) based on a predetermined scoring system (see Table 1).

To establish inter-rater reliability for the FEAS, two raters, blind to the caregiver’s and child’s clinical status, were trained to reliability using a selection of 20 training tapes of children with autism who ranged in severity...
across FDLs. Tapes were prepared and reviewed to contain events that captured the items in the FEAS.

Clinical ratings Home consultants subjectively rated children’s clinical progress using the six-point scale (with 0.5 increments) related to Greenspan’s six functional developmental levels (Greenspan and Weider, 1997a).

Intensity At their first visits, families were supplied with a set of daily logs in order to help them estimate the average number of hours per week that they used PLAY Project methods as well as any other programmatic methods of intervention (e.g. speech and language therapy, occupational therapy, etc.) for their child. Home consultants recorded these estimates at the conclusion of each home visit in their clinical notes for the visit.

Client satisfaction survey Parents were asked to rate their experience with The PLAY Project’s Home Consulting program at 3 months and at 1 year. Only the 12 month overall satisfaction survey results are reported, as the 3 month and 12 month survey results were nearly identical.

Statistical analysis

FEAS reliability To determine the reliability of the raters’ scores across all of the testing videotapes, paired t-tests (two tailed) were used to test whether the differences between the raters’ scores were equal to zero for each FEAS subscale and total score per both caregiver and child outcomes. An observer agreement analysis using a kappa statistic was applied to four measures (caregiver pre and post, child pre and post) to test the observer agreement between two raters. Data from 20 randomly chosen subjects

<table>
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<th>Functional developmental level</th>
<th>FEAS possible score by level</th>
<th>FEAS score to obtain 0.5 level score</th>
<th>FEAS score to obtain whole level score</th>
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<td>1</td>
<td>14</td>
<td>5–10</td>
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</tr>
<tr>
<td>6</td>
<td>10</td>
<td>2–3</td>
<td>4–10</td>
</tr>
</tbody>
</table>

* Example: Child FEAS Level 1 score = 12 Clinical FDL assigned to child = 1 Child FEAS Level 2 score = 8 Clinical FDL assigned to child = 0.5 Child FEAS Level 3 score = 7 Clinical FDL assigned to child = 1 Total FDL assigned: 2.5
were selected from the pilot data and were tabulated. Finally, the training tapes were segregated from the testing tapes.

**FEAS scores**  Total and scaled FEAS scores for the caregiver and the child were compared pre- and post-intervention using two-tailed paired t-tests. Scaled FEAS scores provide estimates of functional developmental level (FDL) using 0.5 increments from FDL 1 through 6 (i.e. 1, 1.5, 2, 2.5, etc.).

Autism severity was measured using a numeric scale based on initial medical evaluation by the developmental pediatrician. Medical evaluation scores reflect severity from severe, moderate or mild autistic disorder (5, 4, and 3, respectively,) pervasive developmental disorder not otherwise specified (2) and Asperger syndrome (1).

**Intensity**  Intensity was rated based on the amount of intervention provided by parents of play-based intervention per week. Families consistently reporting 15 or more hours per week were rated as 1 (high intensity), 10 to 14 hours per week as 2 (moderate) and <10 hours per week as 1 (low intensity). Two-tailed paired t-tests were used to test the relationship of intensity to total FEAS scores.

**Satisfaction surveys**  Parental satisfaction with PLAY project home consulting services was rated as very satisfied, satisfied, somewhat satisfied or not satisfied.

**Clinical ratings**  Clinical estimates of improvement, from baseline to post-intervention, were provided by the home consultants using ratings of functional developmental level (FDL) 1 through 6 (i.e. 1, 1.5, 2, 2.5, etc.). To test clinical improvement between baseline and post-intervention, two-tailed, paired t-tests were used.

**Results**

**Withdrawal and losses**  Seventy-four children diagnosed with autistic spectrum disorders from the university's developmental behavioral pediatrics clinic were recruited to The PLAY Project within a 14 month period and enrolled in the study. Six families were unable to complete the year-long evaluation. Reasons for discontinuing participation included decisions to do other therapies (n = 1), moves away from the area (n = 3) and financial considerations (n = 2). Sixty-eight subjects were analyzed in this study.
Sample characteristics
Autism severity by DSM-IV diagnosis is depicted on Figure 1. Demographics and clinical characteristics of the sample are presented in Table 2. On average, children were aged 3.7 years (SE = 0.2) at enrollment with a range of 2 to 6 years. There were 51 boys and 17 girls. Average age at diagnosis was 35 months (SE = 1.5). There were three African-American children, one of whom is of mixed race. No Latino/Hispanic families were part of the pilot sample. One child had Down’s syndrome and two children had seizure disorders. Approximately 70 percent of mothers and 70 percent of fathers had bachelor’s degrees or above.

Other programs and interventions Twelve children less than the age of 3 were enrolled in an early intervention program which involved approximately 2 hours of school-district-based intervention per week. The remaining 56 children older than 3 years of age were enrolled in special education

![DSM IV Diagnoses](image)

**Figure 1  Sample characteristics by severity**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
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<td>Child age at entry (years)</td>
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</tr>
<tr>
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<tr>
<td>Married (%)</td>
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</tr>
<tr>
<td>Number of siblings</td>
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<td>0–3</td>
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</tbody>
</table>
preschool programs which typically provided four to five half-days (approximately 2½ hours each day). Importantly, none of the Michigan intermediate school district preschool programs serving the children in this study routinely provided intensive (more than 5 hours per week), individualized behavioral interventions (e.g. ABA) to any of the children in this study.

**Functional Emotional Assessment Scale**

**Parent and child outcomes**  Table 3 summarizes the primary caregiver and child FEAS outcome measures. There was no change in parents’ FEAS scores before and after PLAY implementation ($p = 0.63$). However, there was an increase in the children’s total and scaled FEAS scores over the 12 months of the project ($p \leq 0.0001$). Based on FEAS scaled scores, 45.5 percent of children made good to very good functional developmental progress over the study period. No statistical relationship was found between initial ASD severity and FEAS total or FEAS scaled scores.

**Intensity and outcomes**  We compared the FEAS ‘scaled scores’ (Figure 2) to parents’ reports of intensity in delivering the weekly hours of intervention. While not statistically significant, our data suggest an association between fewer hours per week of intervention and lower outcome scores ($p = 0.09$).

**Reliability**  Using standard statistical methods we found there to be high reliability ($p \leq 0.05$, two-tailed t-test) between the two raters’ scores in measuring both the caregiver’s and child’s total and scaled FEAS score at pre- and post-intervention testing. Similarly, kappa analysis (Fleiss, 1975; Fleiss and Cohen, 1975) between raters for individual items, pre to post for caregiver and child, on the FEAS revealed very good agreement: caregiver pre-test, kappa = 0.71 (95% CI, 0.66, 0.77)); caregiver post-test, kappa = 0.64 (95% CI, 0.58, 0.70); child pre-test, kappa = 0.78 (95% CI, 0.73, 0.82); child post-test, kappa = 0.65 (95% CI, 0.60, 0.70).

**Table 3  FEAS: caregiver and child outcomes ($N = 68$)**

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEAS caregiver</td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>FEAS child</td>
<td>38</td>
<td>45*</td>
</tr>
<tr>
<td>FEAS scaled child</td>
<td>3.6</td>
<td>4.5*</td>
</tr>
<tr>
<td>Clinical scores</td>
<td>2.5</td>
<td>4.2*</td>
</tr>
</tbody>
</table>

* $p \leq 0.0001$. 

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Clinical outcomes
Children’s progress using clinical FDL levels increased significantly ($p < 0.0001$) from baseline to the end of the first year’s intervention (Table 3). Based on clinical scores, 52 percent of children made very good (1.5 FDLs or better) clinical progress over the study period, with 14 percent making good progress (1 FDL). Clinical scores were also compared to FEAS scaled scores (Table 4). Clinicians consistently over-rated improvements when compared to the FEAS scaled scores of blinded raters. No statistical relationship was found between initial ASD severity and clinical scores.

Table 4  Clinical improvement by FEAS outcome

<table>
<thead>
<tr>
<th>Clinical improvement (1L,2M,3H)</th>
<th>FEAS outcome</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>G/VG</td>
<td>F</td>
</tr>
<tr>
<td>VG (&gt;1)</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Good (=1)</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Fair (≤0.5)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>23</td>
</tr>
</tbody>
</table>
Satisfaction

Of the 68 families, 74 percent (N = 50) of families completed satisfaction surveys. Of these, 70 percent (N = 35) were very satisfied with The PLAY Project, 10 percent were satisfied and 20 percent were somewhat satisfied. None were dissatisfied. Parents who were somewhat satisfied most commonly rated The PLAY Project as not providing enough services.

Discussion

This is the first report of a program evaluation based on Greenspan’s DIR (developmental, individual differences, relationship-based) theory (Greenspan, 1997). Over the last 4 years, the PLAY Project has piloted a community-based, ‘train-the-trainer’ model with the aim of translating DIR’s broad theoretical principles into a well operationalized, community-based intervention program.

Parent skills

The PLAY Project has taken the DIR theory and created a manual, training, and evaluation method. The ‘PLAY skill sequence’ (see ‘Intervention’ above), the use of videotape assessment and the regular, half-day, monthly home visits appear to be an efficient and cost effective way to teach families in a community-based setting. We find that a large majority of parents are capable of interacting with their young children with autism in a reciprocal and contingent manner. Indeed by the time of the first video evaluation 85 percent of parents were rated as appropriately interactive. Families often attended community-based workshops before beginning The PLAY Project’s Home Consulting program. They may also have received one visit with the consultant before the initial FEAS was done. Despite sequential enrollment of children and families, the sample reflects a middle- to upper-middle-income group characteristic of the population served in the Ann Arbor, Michigan vicinity. Indeed, a large percentage of the parents were well educated with intact families. Many families had one parent who was not working. The number of siblings in the family was limited to less than two on average. These facts may, in part, explain the ability of most families to play in a sensitive and contingent fashion. Alternatively, this group of families may have had the innate ability to interact well with their children. In short, the families in this pilot study were self-selected and likely to benefit from a parent training model to help their young child with autism.

Intensity and outcome

On the other hand, there was a nearly statistically significant trend that suggests that parents who were not able to spend as much time in interaction
had children who did not make as much progress regardless of functional developmental level. This dose dependent outcome suggests that it is not enough to know what to do; the number of hours per week spent in intervention also matters (Lord et al., 2001).

### Children’s developmental gains

The results also suggest that, on the more conservative FEAS ratings, 45.5 percent of the children participating in the project made good to very good functional developmental gains. When rated clinically by the home consultants, 66 percent of the children rated made very good gains. Both FEAS scores (FEAS total and FEAS scaled scores) and the clinical scores (clinical FDLs) were highly statistically significant pre to post. A gain of one or more levels of functional development within an 8–12 month time frame is also clinically significant. When a child moves from an FDL 2 to an FDL 3, for instance, this represents the difference between being self-isolating and being able to consistently communicate in a two-way interactive fashion. From an age norm perspective this represents an advance of between 6 months and a year in development. Thus, nearly half of the children made clinically significant developmental gains, with most making very good (i.e. greater than 1.5 FDL of progress) clinical gains.

While the families were highly motivated and skilled at interaction, the children in the sample, however, did represent the typical range of severity along the autistic spectrum. There was approximately equal representation between mildly, moderately and severely affected individuals. Diagnosis was made using the DSM-IV criteria by an experienced pediatric clinician. Boys were overrepresented in the typical 4:1 ratio reported in the literature and most children (70%) were between 2 and 4 years of age. Statistically there were no differences in outcomes based on initial severity. The literature consistently reports poorer outcomes for more severely affected children (Harris and Handelman, 2000). Clinically, it is very hard to predict which children will do well and which will not, especially when the children are very young (18 months to 3 years). Since the groups, when divided into severity types, were relatively small, type II errors cannot be ruled out. The results of child outcomes cannot readily be explained on the basis of selecting high-functioning children with autism.

### Study limitations

Several limitations of the present study need to be noted. First, without a control group, it is impossible to know whether the changes in post FEAS scores are directly attributable to the home-based training. One goal of a pilot study is to pilot the procedures. A phase II comparative study is planned. Second, the finding that the child’s FEAS scores were lower
though not quite statistically significant) for the children whose parents had the fewest hours of interaction suggests that parents’ time of involvement may be more important than the specific effects of the training program. It is a tenet of the DIR model, however, that in order to help the child increase functional development they need the guidance of knowing what to do at each functional developmental level. It is this guidance that is offered by the home consultants and incorporated into the iterative PLAY skill sequence. Nonetheless, theoretically, simply instructing a parent, who is already skilled in interaction, to play 15 hours per week without further guidance may be enough to induce changes in the child’s functional development over time. Future studies should include an ‘education only’ control group that addresses this issue.

Nearly all children in this study were simultaneously enrolled in standard special education early intervention or preschool programs. While it could be argued that these programs confound the outcomes, the total number of hours of other one-on-one, intensive interventions was very limited. In Michigan, intensive interventions in the school system (i.e. ABA, DIR, etc.) are not typically provided. The literature suggests that even when children are given up to 10 other hours of intensive intervention it does not substantially affect the course of their development (Lovaas, 1987). Recent evidence, however, from more ‘social pragmatic’ intervention studies suggests that 15 hours per week may be sufficient to achieve substantial developmental gains (Aldred et al., 2004; Mahoney and Perales, 2005). The development of children with autism who do not receive substantial intervention is poor. In the longest prospective follow-up study with a sound methodological design (Rutter, 1970) fewer than 2 percent could be considered free of clinically significant problems by adulthood. Others have found similar long term courses for children receiving traditional school-based programming alone (Freeman et al., 1991; Nordin and Gilberg, 1998). Thus our results cannot be explained easily on the basis of a natural course of improvement.

Methodological weaknesses

There were a number of other methodological weaknesses in this pilot project. More in-depth, repeated and objective measures of development (i.e. language, IQ and/or developmental outcomes) will need to be added to improve the measurement of the outcomes. Parent measures of stress and the impact of this demanding method of intervention should be added to the evaluation protocol (Bristol, 1985; Shorten, 1996). Intensity was a poorly operationalized concept. Parents were poor at keeping daily logs and their rough estimates of interaction are likely to be inaccurate especially given the social desirability of appearing to spend more time with your child. Though children improved substantially on the FEAS, they did so...
usually with one primary caretaker. Whether or not the gains they made generalized to other environments should be measured in future studies of this kind.

Conclusion

The DIR model supports parents as their child’s primary play partners and offers naturalistic play-based interactions that engage the child’s affect. Greenspan’s ‘affect diathesis hypothesis’ asserts that it is affect that drives meaningful development. While children with autism clearly can benefit from a ‘drill for skills’ approach, it is important to recognize that parents also play with their children as a primary activity. It is a tenet of The PLAY Project that a child with autism’s love of other people will depend on other people doing what he loves. Given the increasing prevalence of these disorders and the extraordinary costs of providing therapist delivered intensive intervention, more rigorous studies are urgently needed to establish the clinical and cost effectiveness of this type of low cost, play-based approach.

References


Family-Centered Occupational Therapy and Telerehabilitation for Children with Autism Spectrum Disorders

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ABSTRACT. The purpose of this pilot project was to explore the use of telerehabilitation for collaborative occupational therapy sessions with parents of children with autism spectrum disorders (ASD). The aim was to improve carryover of therapeutic strategies by parents to address children's sensory modulation in their natural environments. Four families participated in clinic-based sessions with the therapist followed by online sessions for six weeks. Data consisted of family schedules, sensory diets, archived webcam sessions, and Sensory Processing Measure Home Form scores before and after initiation of the telerehabilitation sessions. Results demonstrated the potential for using telerehabilitation as a tool to provide collaborative occupational therapy in order to improve carryover of home programs for children with ASD by providing opportunities for parents to ask questions, review sensory techniques, and understand the therapist's clinical reasoning.

KEYWORDS. Telerehabilitation, family centered, autism, telehealth, sensory integration

With the rise in diagnosis of autism spectrum disorders (ASD), outpatient services are sought more frequently than in previous years (Shimabukuro, Grosse, & Rice, 2008). Clinic-based occupational therapy services are among the outpatient services provided to children with ASD. Children with ASD have atypical responses to sensory stimuli, resulting in impaired ability to regulate and organize sensory input, and they are often unable to achieve or maintain necessary levels of sensory modulation for participation in typical childhood activities. Occupational therapy using a sensory-based approach to treatment has been shown to mediate sensory modulation abilities, allowing some children to realize improvement in their daily functioning (Baranek, 2002).

Parental involvement plays a vital role in the success of occupational therapy intervention for children with ASD (Cohn, Miller, & Tickle-Degnen, 2000). In...
the clinic, skilled occupational therapists provide deliberate and focused treatment techniques in stimulating environments that meet the sensory needs of children, thereby enabling occupational performance (Cohn et al., 2000). As a way to foster carryover of occupational therapy treatment to environments outside of the clinic, occupational therapists often provide parents with recommendations for sensory diets and other home programs (Cohn et al., 2000).

Throughout the continuum of occupational therapy services, parental involvement is critical, with the parent collaboration pivotal in delivering home programs. By creating stimulating and rewarding environments outside the occupational therapy clinic, parents can support the occupational therapy intervention and possibly improve their child’s sensory experiences and quality of life for them and their family (Cohn et al., 2000). When devising a home program, occupational therapists must look at a child’s occupations, environment, and family. With respect to child occupations, the goal of occupational therapy is to facilitate the development of skills a child needs for activities of daily living. For children, play, social interaction, and development are usually the focus. Because home therapy programs affect daily family routines and rituals, therapists must emphasize parent involvement and collaboration to facilitate gains of instrumental goals (Segal, 2004).

Genuine partnership with parents for home programs reflects a family-centered approach to intervention. In contrast to a client-centered approach, a family-centered approach acknowledges the family as the constant in a child’s life and embraces both the child’s and the family’s needs and priorities in the therapy process (Lawlor & Mattingly, 1998). As such, when practicing from a family-centered approach, occupational therapists must respect the need for work, play, and rest for the families involved with the special-needs child. Concurrently, there must be respect for family occupations, which is crucial to the effectiveness of intervention. The practice of only providing a written sensory diet or home program without addressing the broader needs or concerns of the parents and the family as a whole is inadequate for an effective home program (Segal & Beyer, 2006).

Family-centered programs must also take into consideration the family’s economic circumstances. Currently, more individuals are experiencing economic hardship. While clinic-based services are important to parents, cost is a major concern for families of children with ASD (Shimabukuro et al., 2008). The out-of-pocket cost of outpatient services can be huge, ranging from four to six times higher than for those children without ASD (Shimabukuro et al., 2008). Moreover, parents’ concerns about the costs of outpatient services may affect overall reimbursement for occupational therapy services, since parents may cancel appointments, request to attend less frequently, or simply stop using occupational therapy services. Most importantly, poor attendance may lead to difficulty in intervention planning for goal attainment, resulting in decreased follow-through on the home therapy programs.

Technology now exists that may allow more convenient ways to partner with parents (Klein, 2002). Parent collaboration sessions can occur in the clinic, but other options also exist, such as virtual participation using webcams. The use of virtual collaboration allows occupational therapists to develop another method of partnering with families. Virtual collaboration may also improve participation in therapy while reducing the costs incurred by families. For example, travel may affect attendance. Parents who may not be able to travel for occupational
therapy may be able to use technology to continue or increase therapy intensity by eliminating or decreasing geographic and temporal constraints (Chiu & Henderson, 2005; Kairy, Lehoux, Vincent, & Visintin, 2009). And, while the cost of accessing the Internet must be taken into account, other costs to parents such as transportation and childcare for other children (if applicable) are eliminated. As far as costs to the partnering occupational therapist, telerehabilitation still involves the cost of the therapist’s time but may not require an office or clinic space for services. Thus, telerehabilitation has some important advantages and should be evaluated as a possible means for improving carry-over of occupational therapy home programs. Telerehabilitation has been successfully used with videoconferencing, via a high-speed Internet connection, to perform consultations to observe specific areas of play performance in children with special needs (Wakeford, 2002). Additionally, telerehabilitation has also been used as a supportive service for parents of children with cancer and has been shown to decrease parental levels of stress, anxiety, and depression (Bragadottir, 2008). Moreover, telerehabilitation may help facilitate quality of life by enabling service provision within a child’s natural environments (McCue, Fairman, & Pramuka, 2010).

In response to preliminary studies that showed benefits of telerehabilitation, an Internet-based Service Development (IBSD) model was established to form guidelines for occupational therapy practice with telerehabilitation for service delivery (Chiu & Henderson, 2005). The IBSD model has provided a guideline as well as displayed its use for Internet-based occupational therapy services to caregivers. Based on website and caregiver survey, seven guidelines were established for Internet-based occupational therapy services. When used in practice, caregivers showed support for online therapy services and were less likely to seek face-to-face services. The purpose of this paper is to describe a telerehabilitation project used to help parents improve home programs of occupational therapy strategies designed to improve sensory modulation in their children with ASD. The project explored the use of telerehabilitation for collaborative occupational therapy sessions. Telerehabilitation was defined in this pilot project as parent–therapist collaboration in the home therapy program, with the use of Internet-based occupational therapy consultations through webcams (Chiu & Henderson, 2005).

**THEORETICAL FOUNDATION**

The theoretical frameworks that guided this project were the parent–therapist collaborative model (Bazyk, 1989) and the IBSD model (Chiu & Henderson, 2005). Chiu and Henderson's (2005) The IBSD model is a seven-step comprehensive approach to developing such a program (see Table 1).

All are necessary steps and must be involved in developing the Internet-based aspect of the pilot project intended (Chiu & Henderson, 2005).

In addition to the IBSD model, a service model for parent involvement is also necessary to ensure optimal collaboration. Bazyk (1989) developed six guidelines for parent–therapist collaboration that reflect, among other concepts, family-centered care. This model provides an important foundation for the pilot project. The first guideline, *the parent as decision-maker*, places the parent in control as a
TABLE 1. Steps for Implementing the IBSD Model

<table>
<thead>
<tr>
<th>Step</th>
<th>Description of tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do a site survey</td>
<td>Gather needed information such as possible host sites, target users, and existing Internet-based programs.</td>
</tr>
<tr>
<td>Develop the user profile and needs</td>
<td>Identify the targeted population and intended use of the website (create a “persona”).</td>
</tr>
<tr>
<td>Follow regulations and legislations</td>
<td>Identify and adhere to professional code of ethics and standards. This must be followed when developing logins, passwords, and archived information to ensure the personal information of the participants is kept confidential.</td>
</tr>
<tr>
<td>Define the purpose of the service</td>
<td>Develop a purpose statement to inform users of the intent of the service.</td>
</tr>
<tr>
<td>Develop a program logic model</td>
<td>Outline the delivery services and link to outcome statements. The developer thus matches intended services with the expected outcomes and acknowledges the desired goals and intent of the service.</td>
</tr>
<tr>
<td>Identify website design requirements</td>
<td>Ensure that the specific site is user friendly for the occupational therapist and the users.</td>
</tr>
</tbody>
</table>

decision-maker. The therapist’s role is that of the service provider. The family’s needs are taken into account when a program is established. The second guideline, support of parental role development versus the role of parent as therapist, highlights the concerns of the parent. When parents are placed into the therapist role, they are taken away from the role as the caregiver. Placing them into the therapist role could affect the overall parent–child relationship. The therapist needs to take into account all of the parental roles in occupational role development. The third guideline, collaborative home treatment programs, emphasizes treating the parent as equal to the therapist. Both the parent and the therapist must collaborate on treatment ideas. Parental input is necessary due to their knowledge of the child’s daily life and of the child’s likes and dislikes. The fourth guideline, differences in collaboration with families, acknowledges the differences in families and their needs. The therapist must assess the parent’s desired level of involvement. Not all parents will desire to play a major role in treatment. The fifth guideline, options for parents, identifies the need to provide more than one intervention strategy and plan for the parents. The treatment strategies must have options and be flexible to adjust to the changes in the parents’ daily lives. The sixth guideline, the child’s needs, specifies that the children are not seen solely as individuals but within their various family roles. As a family member, he/she may be the only child or sibling. The other family members must have love for him/her and a desire to play and interact. Parental acceptance must be promoted. These guidelines provide a model for developing a parent collaborative program, with the intent to ensure a true collaborative effort and possibly to enhance carryover (Bazyk, 1989).

The pilot project consisted of the therapists and parents formulating sensory diets collaboratively using Bazyk’s (1989) model. However, this paper’s focus is the development of the telerehabilitation program using parent–therapist collaboration. All sessions for the pilot project were conducted in the clinic setting, where sensory integration therapy was the primary form of intervention, followed by
supplemental telerehabilitation sessions. The pilot project was designed to provide collaboratively developed telerehabilitation sessions as an additional strategy to improve carryover of intervention provided for children with ASD.

METHOD

Participants
During the program development phase, six families with computers and Internet service were recruited for the study, with four families agreeing to participation in the study. The families were receiving occupational therapy services through the author’s private pediatric practice in the greater New York City area. All families recruited had children with ASD receiving at least one clinic session per week. The children with ASD were between five and 12 years of age. All of the children were males, living with both parents, with the exception of one child, who lived in a single-parent home. All four families included at least one sibling.

Procedure
The pilot project consisted of three phases. The phases were program development, contact, and evaluation. The Thomas Jefferson University Institutional Review Board granted approval for this project.

Program development
The two major components of the program development phase included a needs assessment and development of a website for the contact phase of the project. Preliminary need assessment surveys of parents and occupational therapists were developed as a way to evaluate needs for this program. The parent questionnaire obtained information about parent’s levels of knowledge of their child’s therapy program, telerehabilitation, and family-centered therapy. Four parents whose children were already participating in occupational therapy sessions completed the questionnaire. An occupational therapist who worked at the clinic and six colleagues of the first author were asked to complete the therapist questionnaire designed to elicit insight into interest in the parent–therapist collaboration. In addition to these surveys, websites for telerehabilitation services were identified and reviewed via Internet search engines. The first author created a family schedule and a sensory diet template based on the initial surveys of the parents and therapists (see Figure 1).

An important aspect of the program development phase involved the development of a parent-friendly website, based on the IBSD model. The website was established for parents and therapists to collaborate using webcams. Based on the IBSD model, a profile and intended service were clearly identified. Previously performed website surveys and a program logic model were reviewed by the occupational therapist and a web developer. Information from the website surveys was used for the website design based on the program logic model.

The website, www.piecingthepuzzletogther.com, was established. The web developer designed a webpage and a link to WebEx. The WebEx site included the capability for Internet conferencing through webcams. This allowed for privacy.
limiting access to the therapist and the parent. The website was reviewed, and changes were made based on feedback from parents and professional colleagues. Parents were asked to arrange for their own webcams. If they were not able to obtain one, the occupational therapist provided one for their use during the pilot project. Webcam compatibility was established to ensure use through the website.

### Contact phase

The contact phase consisted of two stages: clinic-based occupational therapy and telerehabilitation. The clinic-based occupational therapy occurred once a week for four weeks and involved 30-minute sessions with the four parents and children from the program development phase. The needs assessment and evaluation of the child’s sensory processing were performed during the sessions. The Sensory Processing Measure (SPM) Home Form was selected as an assessment tool to formulate a baseline for the participating children. The SPM is a valid tool for assessing a child’s sensory processing skills in the home environment and has yielded reliable data in this population (Parham & Ecker, 2007). Norm-referenced standard scores are provided for five sensory areas, praxis, and social participation. The child’s performance on the SPM Home Form was assessed at the start and end of the contact phase. The sections assessed were social participation, vision, hearing, touch, taste and smell, body awareness, balance and motion, and planning and ideas. A four-point Likert scale provided scores ranging from “never” to “always,” relating to a particular action performed by the child. Total scores revealed three categories: typical, some problems, and definite dysfunction.

Weekly 30-minute in-person sessions followed in the clinic for four weeks. They included parent education, involving review of sensory integration and techniques. Techniques were demonstrated by the therapist and also shown through video clips. In addition, weekly family schedules were established within the developed template. The sensory diet activities were identified through collaboration with the parents. Parents’ perceptions of activities seen as important and feasible were included.
The activities identified by the sensory diets were strategically placed throughout the developed family schedules and within the “Activities” section of the sensory diet template. To obtain data on follow-through of sensory diets, the families kept track of their implementation and documented application of the home therapy program by completing the blank areas of the sensory diet templates. The completed sensory diet templates were reviewed during the weekly collaboration sessions.

The second stage of the contact phase was the use of telerehabilitation. Weekly consultations with the parents occurred through the website via webcams. Over a six-week period, parents and the occupational therapist meet online for collaboration sessions. Four 30-minute sessions were scheduled with each family. Sessions involved review of the weekly schedule and the sensory diet template, and discussions of parent challenges and concerns related to the home therapy program. Observations of techniques performed also occurred through parent and therapist demonstration via webcams. In addition, video clips were used for parent review of techniques. With parent permission, sessions were archived for therapist review.

Evaluation phase

The last phase of the pilot project was the evaluation phase. Challenges and successes in using the supplementary telerehabilitation program to improve carryover of the prescribed sensory diets were identified through review of sensory diets and archived sessions. Challenges were defined as activities with poor follow-through, activities causing stress, and activities resulting in poor response of the child. Successes were identified as activities with appropriate follow-through, activities resulting in positive response of the child, and activities enjoyed by the parents. Additionally, program assessment included parents’ completion of sensory diet templates, their level of participation in online sessions, and their overall feelings about the program expressed during an interview at the time of program completion. Eight of the archived webcam sessions were summarized using content analysis (Weber, 1990) to determine primary topics discussed and specific activities performed. The archived webcam sessions included video and audio recordings of each session, from which activities were observed and categorized. Archives also automatically recorded the start and stop times of each session and the length of each session. Reassessment of the participating children was performed upon completion of the contact phase (after telerehabilitation) using the SPM Home Form and was compared with the initial SPM scores obtained at the start of the pilot project. The responses of children and parents to the telerehabilitation were recorded in the typical narrative format that is used at the first author’s clinic.

RESULTS

A summary of the eight webcam sessions is shown in Table 2. All webcam sessions included review of specific techniques in the home program and discussion of the child’s response to the home program. Specific techniques were reviewed by the therapist, who observed the parent or child performing the technique and provided feedback (by the therapist showing a webvideo of correct performance or himself/herself demonstrating the proper technique). In the majority (5/8) of
TABLE 2. Summary of Telerehabilitation Sessions

<table>
<thead>
<tr>
<th>Child/session</th>
<th>Session length (minutes)</th>
<th>Review home program</th>
<th>Parent–child demonstration</th>
<th>Therapist demonstration</th>
<th>Video demonstration</th>
<th>Explain rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>21</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>B1</td>
<td>21</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C1</td>
<td>27</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>A2</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>27</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>A1</td>
<td>24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>26</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Average = 23 minutes

the sessions, parents asked the therapist for specific guidance about correct performance of the home program. Areas in which parents requested clarification included ways to properly position the child on a therapy ball, how much pressure to apply during joint compression, how frequently to perform sensory techniques, and how insistently they should try to engage the child’s participation in the home program. Education of the parent about the reasoning behind specific components of the home program occurred in five of the eight sessions.

**Parent Response to the Telerehabilitation Program**

Parents’ participation and response to the pilot project were gathered through attendance records, post-program interviews, and comments made during the webcam sessions, which were recorded in narrative format on therapy progress notes. Three of the four parents participated in all four telerehabilitation sessions. Two parents also reported positive effects of the program on their child’s participation with peers or siblings. For example, one parent noted that her child was calm and engaged while doing the prescribed swing activity, stating, “he loves the swing! His sister often pushes him while he is on it, they are so close.” Another parent reported, “It was so wonderful to see (her child) being able to do things like the other children (obstacle course with friend),” noting that her child’s motor planning abilities had improved. A third parent verbalized “improvements in his (child’s) attention and focus, noting that (the child) is more available to learn following the sensory diet.” Overall, therapy progress notes indicated that parent–therapist collaboration, parental stress, parental feelings of competence, and family interaction improved for most of the participants.

**Therapy Goals**

Summaries of progress reported in therapy documentation includes both clinical outcomes (see Table 3) and process outcomes (see Table 4). Figure 2 provides a visual image of each child’s initial and post-program SPM scores. It provides a concise image of each child’s specific changes in the various areas assessed. With the exception of Child D, total SPM scores remained stable or improved after the contact phase.
Table 3. Clinical Outcomes Based on Parent and Therapist Report (from Therapy Progress Notes)

<table>
<thead>
<tr>
<th>Clinical outcomes</th>
<th>Child A</th>
<th>Child B</th>
<th>Child C</th>
<th>Child D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine motor skills</td>
<td>• Improved ability to manipulate fasteners.</td>
<td>• Slight improvement observed by therapist with child’s ability to perform appropriate grasp patterns, such as pincer and tripod with graphomotor tasks; required less physical and verbal cueing</td>
<td>• Good improvement observed with the child’s grasp, translation, and graphomotor skills.</td>
<td>• No significant improvement observed by therapist</td>
</tr>
<tr>
<td></td>
<td>• Improved translation, grasp, and graphomotor skills</td>
<td>• Improvement in handwriting skills (parent report)</td>
<td>• Home-based activities involving fine motor exercises increased (parent report)</td>
<td>• Home-based activities involving fine motor exercises increased (parent report)</td>
</tr>
<tr>
<td></td>
<td>• Improvement in handwriting skills (parent report)</td>
<td></td>
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</tr>
<tr>
<td>Self-help skills</td>
<td>• Slight improvement in ability to don socks and shoes (initially required moderate physical assistance), required verbal cueing at the end of the pilot project as observed by therapist</td>
<td>• No significant improvement was observed by therapist</td>
<td>• Improvement observed by therapist in child’s ability to manipulate fasteners and tie his/her shoes</td>
<td>• No significant improvement observed by therapist</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Self-stimulatory behaviors</td>
<td>• Hand flapping was evident at the start of the pilot project and significantly decreased at the end as per parent report</td>
<td>• Parent reported significant decrease in self-stimulating behaviors</td>
<td>• Not applicable</td>
<td>• Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Child was able to seek out more appropriate activities, based on therapist’s recommendations</td>
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</tbody>
</table>
Table 4. Process Outcomes Based on Parent and Therapist Report (from Therapy Progress Notes)

<table>
<thead>
<tr>
<th>Parent and family outcomes</th>
<th>Child A</th>
<th>Child B</th>
<th>Child C</th>
<th>Child D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental stress</td>
<td>No significant changes</td>
<td>Parent reported significant reduction in stress as shown by: • Decreased stress in relation to providing meaningful activities for her child at home • Better understanding of how to meet her child’s sensory needs • Therapist observed that parent was calmer and better able to redirect her son appropriately</td>
<td>Parent did not report any decrease in stress • Parent expressed difficulty getting the child to perform the recommended exercises at home</td>
<td>Parent did not report any decrease in stress • Parent expressed difficulty getting the child to perform the recommended exercises at home</td>
</tr>
<tr>
<td>Parental competence</td>
<td>• Therapist observed good improvement in parent’s ability to deliver recommended activities • Parent reported feeling more competent</td>
<td>• Therapist observed good improvement in parent’s ability to deliver recommended activities • Parent reported feeling more competent</td>
<td>• Therapist observed good improvement in parent’s ability to deliver the therapist recommended activities • Parent reported feeling more competent</td>
<td>• Therapist observed fair improvement in parent’s ability to deliver recommended activities • Parent did not report feeling more competent</td>
</tr>
<tr>
<td>Family interaction</td>
<td>• Parent reported increased interaction with the family; all involved in webcam sessions • Parent noted child’s participation in recommended activities with sibling</td>
<td>• Parent reported increased interaction between the child and his sibling • Due to decreased stress, the parent reported having more time for herself and the other family members</td>
<td>• Parent did not report any changes</td>
<td>• Parent did not report changes in this area and had previously reported poor sibling interaction • Webcam sessions showed sibling assisting brother with ASD in recommended activities</td>
</tr>
<tr>
<td>Parent satisfaction</td>
<td>• Parent reported satisfaction that interaction with therapist increased, but preferred face-to-face sessions as she believed her child was distracted by the webcam • Parent was able to discuss concerns without feeling as if she were interrupting his session time • Parent reported she was extremely happy with the changes seen at home</td>
<td>• Parent reported satisfaction with the increased interaction with the therapist</td>
<td>• Parent reported satisfaction with the increased interaction with the therapist • Parent stated that she was pleased with immediate feedback during the activities and appreciated knowing whether she was doing the exercises correctly</td>
<td>• Parent reported satisfaction with the increased interaction with the therapist • Parent stated that the webcam sessions were no more helpful than clinic based sessions</td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>Parent and family outcomes</th>
<th>Child A</th>
<th>Child B</th>
<th>Child C</th>
<th>Child D</th>
</tr>
</thead>
</table>
| **Therapist satisfaction** | • Increased satisfaction with family interaction, with opportunity for therapist to meet father and sister for the first time  
• Increased ability to view child in the natural environment  
• Increased communication with child's parents  
• Satisfaction noted with the increased communication with the parents; however therapist would have preferred more consistency with sessions  
• Satisfaction noted with the increased communication with the parent  
• Difficulty with and lack of understanding of the suggested home-based activities was observed; therefore, the therapist was able to provide more feedback to the parent during webcam and clinic-based sessions  
• Satisfaction noted with the increased communication with the parent  
• Significant difficulty with and lack of understanding of the suggested home-based activities was observed; therefore, the therapist was able to provide more feedback to the parent during webcam and clinic-based sessions | • Parent stated that she enjoyed having the additional time following clinic-based sessions  
• Therapist noted that parent's knowledge of SI improved following the project  
• Parent reported that she wanted to continue the online sessions in conjunction with the clinic-based sessions  
• Parent did not report optimal participation by child in sensory-based activities in weekly reports but increased participation was noted by therapist  
• Parent's inquiries about therapeutic techniques increased  
• Parent provided video of child participating in home-based activities successfully | • Parent did not report optimal participation by child in sensory-based activities in weekly reports but increased participation was noted by therapist  
• Parent's inquiries about therapeutic techniques increased  
• Parent's inquiries about therapeutic techniques increased  
| **Adherence to sensory diet** | • Parent reported child's increased participation in sensory-based activities to therapist  
• Parent's inquiries about therapeutic techniques increased | • Parent did not report optimal participation by child in sensory-based activities in weekly reports but increased participation was noted by therapist  
• Parent's inquiries about therapeutic techniques increased  
• Parent's inquiries about therapeutic techniques increased  
• Parent did not report optimal participation by child in sensory-based activities in weekly reports but increased participation was noted by therapist  
• Parent's inquiries about therapeutic techniques increased | • Parent did not report optimal participation by child in sensory-based activities in weekly reports but increased participation was noted by therapist  
• Parent's inquiries about therapeutic techniques increased  
<p>|</p>
<table>
<thead>
<tr>
<th><strong>Consultation time</strong></th>
<th><strong>Consultation time significantly increased as the parent–therapist consultation had been limited to less than 15 minutes in each clinic-based session</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consultation occurred throughout the week, at least twice weekly, during the study.</td>
</tr>
<tr>
<td></td>
<td>Both e-mail and telephone communication increased</td>
</tr>
<tr>
<td></td>
<td>Consultation significantly decreased</td>
</tr>
<tr>
<td></td>
<td>While e-mail communication occurred periodically, the parent, along with the child, no longer attended the sessions due to scheduling issues; communication occurred through the grandparent</td>
</tr>
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<table>
<thead>
<tr>
<th><strong>Therapist–parent consultation post study (6 months post)</strong></th>
<th><strong>Consultation significantly decreased</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Consultation significantly decreased.</td>
</tr>
<tr>
<td></td>
<td>- E-mail communication no longer occurred from the parent.</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Consultation time significantly increased as the parent–therapist consultation had been limited to &lt; 15 minutes in each clinic-based session</strong></th>
<th><strong>Consultation occurred at least once weekly, during the study.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Both e-mail and telephone communication increased</td>
<td></td>
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<tr>
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<td></td>
</tr>
</tbody>
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<table>
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<tr>
<th><strong>Consultation time significantly increased as the parent–therapist consultation had been limited to &lt; 15 minutes in each clinic-based session</strong></th>
<th><strong>Consultation did not decrease but occurred primarily face to face</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultation occurred at least once weekly, during the study.</td>
<td></td>
</tr>
<tr>
<td>Both e-mail and telephone communication increased</td>
<td></td>
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<tr>
<td>Parent and therapist continued to collaborate before and after clinic-based sessions</td>
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real-time feedback. The use of telerehabilitation revealed a need for parents to receive continued support. Most telerehabilitation sessions involved parents seeking feedback on techniques demonstrated during clinic-based sessions and frequently requesting clarification on the sensory diets. Thus, therapists should not assume that in-clinic training will automatically result in proper carryover to demonstrate appropriate techniques and strategies in the natural environment. Thus, it may provide much needed guidance without requiring additional clinic visits. The results of this pilot project are consistent with other literature, showing that telerehabilitation can serve as a method to improve continuity (Marshall, Shaw, Honles, & Sparks, 2008).

Three children’s SPM scores either remained stable or improved. This cannot be attributed to the telerehabilitation intervention; however, it does provide support that indicates further research is needed. Two factors may have contributed to the drop in the fourth child’s scores – specifically, the parent’s initial concern about using the computer and the family’s hectic schedule may have made it difficult to follow the sensory diet.

**LIMITATIONS**

The pilot project included a possible selection bias, since all children were recruited from the same (the author’s) clinic. They were currently receiving services; hence, their needs and abilities were already known. Further limitations relate to the time frame. As revealed in previous literature, research involving families’ daily routines
and rituals should be performed in a longitudinal design (Segal, 2004). This would enable researchers to examine the ways in which routines and rituals evolve over time. Interventions must adjust to changes in the family’s and child’s life to be effective.

Since the pilot project included only four participants and a relatively short period (total of eight weeks), outcomes of the SPM cannot be fully attributed to the pilot project nor can they be generalized to the larger population of families with children who have ASD. Moreover, the children’s scores on the SPM Home Form may not reflect their overall level of sensory processing. Completion of the main classroom and school environments forms would have provided more information about the child’s level of sensory processing. The children in this project all attended school for the majority of the day. Evaluation of their performance should have included this crucial time frame, because best practice involves the evaluation of individuals in various natural environments (Miller-Kuhaneck, Henry, Glennon, & Mu, 2007). Thus, completion of the main classroom and school environments forms would not only eliminate parental bias, but that doing so might also encourage team collaboration.

Although improvement as reflected by the SPM was minimal, parents reported appreciation of the collaboration with the therapist in the telerehabilitation program. Most parents expressed a feeling of being more competent in providing their child with needed sensory input and activities. In addition, post-program interviews revealed parents’ belief that the family members were all happier and less stressed as a result. Their newfound appreciation of a family-centered approach parallels previous studies. As seen in research performed by Vanleit and Crowe (2002), parents appreciated this approach versus past therapy experiences focusing solely on their child.

**IMPLICATIONS FOR PRACTICE**

This pilot project provides support for the use and further need of research in the use of telerehabilitation in occupational therapy and informs practice in several areas. First, findings suggest that telerehabilitation may serve as a complementary method of service delivery for families with children who have ASD to better ensure follow-through and enable parents to clarify how to best apply a collaboratively designed sensory diet to their individual needs and schedules. This is consistent with findings from other studies of home interventions that indicate improved follow-through of healthcare professionals’ recommendations and satisfaction with telerehabilitation outcomes by patients/clients and therapists (Kairy et al., 2009). Follow-through, and patient/client and therapist satisfaction are considered process outcomes that have received little attention in previous work (Kairy et al., 2009). Such process outcomes appear to be crucial factors in the successful application of telerehabilitation for specific populations and may be particularly important when evaluating the use of home programs for parents and their children with ASD. Although much more systematic evaluation is needed, the telerehabilitation project described in this paper takes an important step by identifying key process outcomes, which include adherence to sensory diets, parent and therapist satisfaction, family interaction, and consultation time.
Future study of telerehabilitation should also include its use as a supplement to school-based services for consulting with teachers. The children in the project were all school aged who spent the majority of time during the day in school. When the parents completed their weekly schedules, most of the time was left blank, indicating the child was at school. Therefore, the performance of the home therapy programs was limited to small intervals of time. Thus, extending the application of telerehabilitation to the school setting may provide further benefit by revealing a more complete picture of the child’s sensory processing and response to intervention.

Finally, concerns regarding payment need to be acknowledged. Presently, reimbursement for telerehabilitation provided by occupational therapists is very limited (American Occupational Therapy Association [AOTA], 2010). If insurance companies will not cover telerehabilitation services, will parents be willing to participate? Furthermore, therapists must be aware of ethical issues in telerehabilitation, such as applicable licensure laws, standards of practice, and confidentiality (AOTA, 2010).

**IMPLICATIONS FOR PROFESSION**

The AOTA’s Centennial Vision indicates a vision for a “globally connected” field (AOTA, 2009). Klein (2002) discussed potential benefits of the Internet for the field of occupational therapy, such as the use of webcams to allow therapists to reach a more broad geographical range. Those who may not have been able to receive treatment, such as families living in rural areas, can receive direct consultation with a qualified therapist. Telerehabilitation may also promote opportunities for occupational therapy to provide services for those in need in other countries, consistent with initiatives in other disciplines such as speech and language pathology (Mashima & Doarn, 2008).

When evaluating carryover of improved sensory modulation and parent involvement in therapy interventions, several factors must be addressed. Skill, knowledge, daily activities, challenges, and support systems all must be considered when determining the feasibility of telerehabilitation. However, the benefits may be substantial. Telerehabilitation focused on parent collaboration may enable occupational therapy services to become more convenient and accessible to many. Although clinic-based occupational therapy services are frequently sought by parents of children with ASD, telerehabilitation may provide an alternate method of service delivery that assists parents with carrying out home therapy programs and may help to improve the child’s sensory modulation in natural environments. In addition to consulting on the home therapy program, telerehabilitation may assist in providing parent education. Despite the availability of parent support groups and sensory-based play groups, parents may be unaware of specific information about sensory integration and the reasoning behind specific techniques. Thus, parents question the meaning of sensory integration or may avoid or adapt therapist-suggested sensory-based activities when the child responds negatively. As a result, sensory diets may not be performed appropriately or may be avoided (Dickie, Baranek, Schultz, Watson, & McComish, 2009). Occupational therapy has become a familiar service to many parents seeking treatment for their children with ASD (Dickie et al., 2009). Through telerehabilitation, parents can be further educated about the background
and evidence in support of occupational therapy for children with ASD. If occupational therapists can help parents gain a better understanding of the techniques they are expected to use, home programs may be implemented more consistently and increased carryover will occur within the child’s natural environments. This in turn may then lead to increased recognition of the value of occupational therapy for its contributions to these children (Segal & Beyer, 2006). Thus, web-based education for parents might be utilized as a lecture and facilitate conferencing or discussion.

Finally, peer collaboration plays a major role in the field of occupational therapy. On many occasions, individual scheduling needs and lack of time may not allow for direct consultation. Therapists may then have to rely upon documentation and verbal narratives to get assistance from their peers. However, if peers can join an online session or view an archived webcam session, the consultation may be more beneficial to all parties (Lysaght & Bent, 2005).

In summary, telerehabilitation may provide much needed support for parents and facilitate improved practice of occupational therapy. In order to use telerehabilitation wisely, occupational therapists must gain further knowledge and skills in program development of Internet-based service delivery models and uphold state guidelines and ethical standards (AOTA, 2010). The use of telerehabilitation in occupational therapy may help the profession to expand services to various geographical areas and assist occupational therapists in providing services to caregivers, teachers, and other health professionals. Expanded use and additional research demonstrating efficacy for specific uses may make telerehabilitation services for occupational therapy a demonstrated method of care, similar to its integration into other fields such as psychology and speech and language pathology (Chiu & Henderson, 2005). Since it remains unclear how telerehabilitation may affect long-term carryover of home therapy programs, direct patient interaction, use with other diagnoses, and long-term costs require further exploration and research. However, the potential for the application of telerehabilitation shows promise for moving occupational therapy forward to meet the needs of clients in all areas of practice.

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Declaration of interest: The authors report no conflict of interest. The authors alone are responsible for the content and writing of this paper.

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Considering College?: Adolescents With Autism and Learning Disorders Participate in An On-Campus Service-Learning Program

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²The Newgrange School, Hamilton, New Jersey, USA

ABSTRACT. This paper presents an example of successful collaboration between an entry-level occupational therapy program and school-based setting that resulted in innovative programming for high school students living with autism and learning disorders. The two-day programming provided opportunity for high school students (n = 30) to practice a variety of life skills on the university campus as a way to support transition to secondary education and learning in the natural environment. Occupational therapy master’s students developed and implemented the programming as a service-learning experience. Key factors for successful collaboration and outcomes, as well as considerations for future programming and research, are outlined.

KEYWORDS. Autism, secondary education, service learning

This paper highlights a successful, innovative program that was initiated by a school-based occupational therapy practitioner to meet the needs of high school students living with autism and learning disorders. The programming provided opportunity for the high school students to experience college life, while providing a successful service-learning opportunity for occupational therapy master’s students at Kean University, New Jersey. The presentation includes (1) the literature identifying the need for occupational practitioners to address the transition from high school to college for autism and learning disorders, (2) the motivation for initiating the collaboration with the university faculty members and the steps to sustain the collaboration between the school-based setting and entry-level program, (3) how the programming was constructed to fit within the occupational therapy program, and (4) a description of how the innovative programming was structured and implemented. Limitations of the collaboration are briefly presented.
as well as a description of the benefits for all the stakeholders involved and future considerations for programming and research.

DEVELOPING INNOVATIVE PROGRAMMING OPPORTUNITIES

Occupational therapy practitioners work with people of all ages, ethnicities, race, diagnoses, and functional impairments across a variety of settings (American Occupational Therapy Association (AOTA), 2008, 2011a). The largest number of occupational therapy practitioners (24.7%) work in schools and early intervention (American Occupational Therapy Association, 2009a). Occupational therapy practitioners working in school-based settings work with students with a variety of physical, emotional, and cognitive disabilities, including Autism Spectrum Disorders, Nonverbal Learning Disorders, and Learning Disorders (Case-Smith, 2001). The goal of treatment in the school-based setting is to promote successful participation in the area of education, including academic (math, reading, working on a degree), non-academic (recess, lunch, getting from class to class), extracurricular (sports, band, cheerleading, dances), and prevocational and vocational activities (Knippenberg & Hanft, 2004). The school-based occupational therapy practitioner working with high school students may focus treatment on the transition to higher education as a way to support future vocational goals. Students with learning and developmental disorders may have more difficulty with this transition, particularly in the areas of socialization, communication, independent living skills, academic functioning, and self-advocacy (Adreon & Durocher, 2007). Research indicates that students with special needs are able to demonstrate success with the help of proper support systems, accommodations, and preparation (VanBergeijk, Klin, & Volkmar, 2008). Young adult success is frequently characterized by educational attainment (high-school completion, post-secondary degree, or occupational certification), constructive engagement in 35 hr per week in school, employment or homemaking, and civic engagement in volunteer work, political participation, or charitable giving. Physical health, life skills, psychological and emotional well-being, ethical behavior, and healthy family and social relationships are also the markers of young adult success (Bill & Melinda Gates Foundation, 2004; Cronin & Mandich, 2005).

Approximately one in 110 children in the United States lives with an autism spectrum disorder (Centers for Disease Control and Prevention, 2011). Autism spectrum disorders are a group of developmental disorders that significantly impact a person’s socialization, communication, and behavior (Centers for Disease Control and Prevention, 2011). The three most commonly recognized disorders under this umbrella categorization of autism spectrum disorder are autistic disorder, Asperger’s disorder, and pervasive developmental disorder not otherwise specified (Centers for Disease Control and Prevention, 2011).

Autistic disorder is characterized by qualitative impairment in social interaction (i.e., lack of spontaneous seeking to share enjoyment), qualitative impairment in communication (i.e., delay in, or total lack of, the development of spoken language), restricted repetitive and stereotyped patterns of behavior, interest, and activities (American Psychiatric Association, 2000). Asperger’s disorder is characterized by similar qualitative impairment in social interaction and restricted
repetitive and stereotyped patterns of behavior, but with no clinically significant delay in language, cognitive development, development of age appropriate self-help skills, adaptive behavior, and curiosity about the environment (American Psychiatric Association, 2000).

Learning disorders (also known as academic skills disorders and learning disabilities) include the following conditions: reading disorder, mathematics disorder, and disorder of the written expression (American Psychiatric Association, 2000). Research shows that 8 to 10% of American children under 18 years of age have some type of learning disability (National Institute of Neurological Disorders and Stroke, 2011). Nonverbal learning disorder is characterized by deficits in social perception, including identifying facial expressions and gestures, understanding social cues, and making inferences based on emotional factors (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995). These deficits are similar in students with Asperger’s disorder who experience difficulties in social interaction, which are frequently related to misperceptions of social intent, reciprocal communication, and misunderstandings (Klin et al., 1995; Semrud-Clikeman, Walkowiak, Wilkinson, & Minne, 2010). These disorders affect the way the brain processes information for learning and have a direct impact on students’ ability to successfully participate in academic performance, social participation, transition to work, and secondary education.

Students with autism spectrum disorders and nonverbal learning disorders face distinct challenges to achieving young adult success (Adreon & Durocher, 2007). Specifically, post-secondary and employment opportunities for these students have been limited (Hendricks & Wehman, 2009). Most of these students are determined eligible to receive services under Individual with Disabilities Education Improvement Act (IDEA) or 504 plans (US Department of Education, 2012; US Department of Labor, 2012). Transition services are mandated to be included in individualized education plans (IEP), starting when a student is 14 years old. Barriers to effective transition plans for students with autism spectrum or nonverbal learning disorders include executive functioning deficits, such as organization, time management, self-monitoring, planning, problem-solving, and social skills. Specifically, areas to be considered in transition plans for students with autism spectrum and nonverbal learning disorders include deciding the type and size of college, living arrangements and independent living skills, disclosure of disability, identifying appropriate academic and social supports and accommodations, identifying healthy leisure activities, and identifying strategies to assist with adjusting to the environment (Adreon & Durocher, 2007).

According to the literature, learning can be enhanced by providing instruction in natural and community-based environments. However, despite legal mandates to ensure that schools plan for transition (IDEA), transition planning and implementation is falling short of the intended results for students with learning disorders, including autism spectrum and nonverbal learning disorders (Eaves & Ho, 2007; Hendricks & Wehman, 2009). Innovative programming is needed to bridge that gap between intended results and reality. School-based occupational therapy practitioners, entry-level occupational therapy programs, community partners, and other stakeholders can seize this opportunity to develop these innovative programs to meet this societal need.
PRACTITIONER PERSPECTIVE

Professional development is an essential component of occupational therapy practice. In the profession of occupational therapy, it is expected that practitioners stay current with evidence-based research in order to embed that research into their practice in keeping with the AOTA’s centennial vision (Christiansen, 2004; Parkinson, Lowe, & Keys, 2010; Townsend, Sheffield, Stadnyk, & Beagan, 2006). There are many local, state, and national courses and/or workshops available to occupational therapy practitioners to expand their knowledge and practice. However, practitioners often have difficulty finding opportunities for professional development when their goals include contributing to the evidence base of the profession without enrolling in post-professional academic coursework. The occupational therapy literature contains numerous examples of collaboration between academia and practice that is initiated from academic programs (Bazyk, Glorioso, Gordon, Haines, & Peraciante, 2010; Lukasiewicz, 2008; Raiz, 2007; Schindler, 2011; Wall et al., 2008). However, there is a dearth of evidence discussing collaboration between a practitioner and university faculty member, of which is initiated and sustained by the practitioner (Forsyth, Melton, & Summerfield Mann, 2005; Kielhofner, 2005).

School-based practitioners can contribute to the evidence base of occupational therapy by developing innovative treatments based on evidence, writing articles, becoming fieldwork educators, and attending and/or presenting workshops; however, these activities present significant challenges in practical settings (Forsyth et al., 2005). They may also seek to expand their practice by collaborating with university faculty members to develop innovative programs to benefit their students and school communities. An example of how a practitioner can fulfill this role occurred when an occupational therapy practitioner collaborated with teachers and an occupational therapy student to expand intervention and create a method of data collection and analysis to support the validity of the high school’s Nonverbal Learning Disability program. Subsequently, the occupational therapy practitioner invited the coordinator of this program to co-present a poster at the AOTA Conference in Orlando, 2010. The presentation helped to provide an example of interdisciplinary collaboration to the occupational therapy community.

Barriers to participating in research and other academic pursuits include time, funding, and opportunity (Karlson & Tornquist, 2007; Kielhofner, 2005). The occupational therapy practitioner overcame these barriers by networking with fellow clinicians and university faculty members at the AOTA National Conference. This networking resulted in collaboration that created innovative programming while facilitating the transition goals of students with unmet needs.

UNIVERSITY PERSPECTIVE

The definition of “collaborate” is “to work together with a sharing of mutual thoughts and ideas” (American Occupational Therapy Association, 2009b, p. 47). The initial conversation between the occupational therapy practitioner and the university faculty members from a local university at the national conference afforded the opportunity for collaboration to occur between the school-based setting and occupational therapy program. The two parties initially participated in discussion.
and together created programming that met the needs of the stakeholders (high school students living with autism and learning disorders), which resulted in the dissemination of evidence-based practice.

A multitude of factors contributed to creating a strong foundation for the collaboration between the school-based practice setting and occupational therapy program for the success of the program. First, the occupational therapy practitioner initiated collaboration, which helped to ensure continued motivation and execution of the program. Second, Kean University’s mission challenges its faculty members to “prepare students to think critically, creatively, and globally; to adapt to changing social, economic, and technological environments; and to serve as active and contributing members of their communities” (Kean University, 2012). In addition, the Accreditation Council for Occupational Therapy Education (ACOTE) (Accreditation Council for Occupational Therapy Education of the American Occupational Therapy Association, 2011) articulates curriculum standards that require occupational therapy programs to prepare occupational therapy providers to meet society’s occupational needs. One of the current standards charges occupational therapy programs to “apply the principles of the teaching–learning process using educational methods to design experiences to address the needs of the client, family, significant others, colleagues, other health providers, and the public” (Accreditation Council for Occupational Therapy Education of the American Occupational Therapy Association, 2011, p. 25).

Using the University mission and ACOTE standards for support of the collaboration, the Department of Occupational Therapy at Kean University has a course titled, Service learning, which provides the graduate students opportunity to service the community (i.e., high school students with autism and learning disorders) while meeting their academic objectives. Service learning is similar to volunteerism in that it serves a community need; however, service learning also meets an academic need (Flecky & Gitlow, 2011). After learning how to facilitate groups in the first semester of school, the occupational therapy master’s students then practice these skills in the second semester while working with clients within the local community.

A common barrier to the development, and utilization of, evidence-based practice is the mismatch between the university faculty member’s identification of community needs and the occupational therapy practitioner’s identification of clients’ needs. However, using a service-learning model is a natural fit for collaboration between educational systems and practice settings to help overcome this barrier. In fact, the literature highlights the benefits of service learning within healthcare professions, including occupational therapy. Brandon and All (2010) share how a curriculum based on social constructivism and collaboration increased teaching effectiveness while helping student nurses increase their speed and comfort in analyzing evidence and using evidence-based practice. For occupational therapy, Precin’s (2009) aggregate fieldwork model illustrates how service learning can meet the rigorous academic standards. In this case, service learning helped to develop a reciprocal process that allowed the two parties to enter each other’s realities. The occupational therapy practitioner helped to identify a community need and sought the assistance of the university faculty members, which in essence created a clinical question and grounded the university in reality-based care, and develop a program to fulfill an unmet societal need (Ho et al., 2008).
PARTICIPANT AND PROGRAM DESCRIPTION

The Newgrange School, located in Hamilton, New Jersey, is a New Jersey Department of Education-approved school for children living with disabilities (Newgrange School, 2012). The school educates students with language-based and nonverbal disabilities who are aged between 7 and 21 years. The school prides itself in a low student to staff ratio, innovative educational programs and strategies, and experiences to support attainment of academic and life skills. In order to meet curriculum standards, the high school students often participate in various activities, community-based instruction (CBI), and work experiences. Visiting Kean University’s campus served as means to meet a standard related to higher education and the transition process.

The planning of the program began in the fall of 2010. The occupational therapy practitioner received administrative support and collaborated with high school educators and the Transitions Coordinator to determine those students who would benefit from the program. Some of the high school students were striving to attend college, while others were still determining if college was a good fit for their long-term plans. Parents/guardians consented to all school activities outside of the Newgrange campus at the beginning of the school year. Parents and guardians were also specifically informed about their student’s visits to Kean University via a letter, including the purpose and plans for student participation in the transition program. The letter included when the trip was scheduled, the location, who would be attending, including the staff, and the planned group activities to occur.

In order for the occupational therapy master’s students to become familiar with the selected high school students who would attend the program, the high school students created short biographies. The biography included the students’ name, age, grade, and their plans after graduation. It also included interests as well as any questions they may have had about college life and transition to secondary education. Some of the high school students’ questions included are as follows: How many courses do you have to take for the year; how big is the campus; how to get accepted into Kean University; what is college like; how much homework; how hard is college; and how difficult is it to ask for assistance. The occupational therapy master’s students were provided the biographies and questions in advance in order to individualize the program as much as possible. In addition, the educators, occupational therapy practitioner, and other staff members at the high school collaborated to provide an outline of suggested topics and/or needs of the students. This outline was forwarded to the university faculty members for preparation and included (but not limited to) the following: How to apply, how to pick a major, how to make friends, how to get involved on campus, and how to manage the course load effectively and in a timely manner.

A total of 30 (five females, 25 males) high school students participated in the transition programming at the university over two days. These students had mixed diagnoses, including autism spectrum disorder, Asperger’s disorder, nonverbal learning disorder and learning disorders, representing the Newgrange population. Twenty students were in 9th and 10th grades, exposing them to college life early as a way to support their anticipated transition. The remaining students in 11th and 12th grades were those who self-identified their plans to attend college after graduation or those
who were encouraged to attend by the high school staff as a way to explore all possibilities. Although those in 11th and 12th grades had previously visited vocational programs and some community college programs, they had not participated in a transition program specifically designed to target concepts and skills they would need within their roles as college students.

Service learning occurs in the second semester of the first year of graduate school in Kean University’s Department of Occupational Therapy. Therefore, the Kean University’s faculty members planned the two-day program for implementation in spring of 2011. The high school students would arrive at campus approximately at 9:45 am for a 10:00 am start on both days and leave at approximately 1:00 pm for a total of 6 hr, 3 hr per day for the various group activities and lunch in the cafeteria. Regular school hours provided a constraint to the number of hours spent on campus secondary to travel time to and from campus.

While the university faculty members provided the outline of how the overall programming would be structured, the occupational therapy master’s students were responsible for the creation and implementation of the specific learning experiences and activities to be provided via group intervention. When planning for the programming, the occupational therapy master’s students considered the high school students’ needs and those identified by staff (i.e., needs assessment) in combination with the current literature focused on successful transition planning for individuals living with autism and learning disorders. Literature indicates that group interventions are effective for young individuals living with autism spectrum disorders (Fullerton & Coyne, 1999; Hillier et al., 2007; Hillier, Fish, Cloppert, & Beversdorf, 2007; Winner, 2002). Specifically, Orentlicher and Olson (2010, p. 689) encourage occupational therapy practitioners to utilize a variety of intervention approaches when working with this population, including “psychoeducational groups, social groups, occupation-based groups, and self-help groups.” The programming at Kean University primarily used psychoeducational (i.e., time management), social (i.e., welcome and wrap-up groups) and occupation-based groups (i.e., cafeteria).

The occupational therapy master’s students planned and implemented a welcome group as a way to provide opportunity for introductions, as well as a wrap-up group, on both days. Orentlicher and Olson (2010, p. 690) highlight that this type of group provides “an organized, safe, and comfortable environment for practice and development of social relationships.” The development of socialization skills is an identified need for this population. In addition to these social groups, the high school students participated in three psychoeducational classes, which were meant to teach specific skills related to college life (Orentlicher & Olson, 2010). The three classes focused on teaching organizational skills, the decision-making process related to choosing the “right” college for one’s needs, and how to access the numerous resources and extracurricular activities available on a college campus.

The literature indicates that those individuals living with autism spectrum disorders have difficulty in executive functioning, which includes organizing materials (Orentlicher & Olson, 2010). Another activity introduced the high school students to dormitory living via a tour through freshmen housing. In order to expose the high school students to the college cafeteria, the high school and occupational therapy master’s students purchased and ate lunch in the campus cafeteria, an example of an occupation-based group. Those juniors and seniors who were college-bound
attended two specialized psychoeducational classes, including what to expect as a college freshman and how to request assistance from a variety of individuals (i.e., professors, admission, and registration counselors).

On the first day of programming, each high school student was introduced to an occupational therapy student to create a mentee–mentor relationship. The pairs were generated by the university faculty members in advance of the programming in order to help alleviate anxiety for both students. One role of the mentors was to provide extra support throughout the day, especially when the students navigated the campus cafeteria during lunch. The mentor also provided his or her school e-mail address so that the mentee had the option to ask questions in preparation for the next visit.

**OUTCOMES OF THE PROGRAM**

One of the outcomes related to the innovative programming relates to the successful utilization of CBI within the high school’s educational curriculum. CBI is defined as the “use of sustained and repeated instructional activities that take place in various natural community environments outside of the school building in order to facilitate skill development and generalization” (Baker, 2010, p. 3). The resulting collaboration between The Newgrange School and the Kean University’s Department of Occupational Therapy resulted in a transition program that blended Newgrange students’ college preparatory goals with CBI within natural environments and contexts. The students were taught life skills within the physical and social environments of a college campus, as well as the cultural and temporal contexts (American Occupational Therapy Association, 2008).

Other outcomes of the collaboration were positive feedback from the parents and/or guardians. Most parents expressed satisfaction with their child’s report of participation in activities and what they learned over the two-day programming. One mother commented that her daughter “loved everything about the trip, especially the food court.” Another mother commented that her son was “nervous about going to Kean. However, he thoroughly enjoyed the trip and came back relaxed.” Another parent commented: “Thank you for giving the students the opportunity to visit a college.” Parents also commented on the value of their child having a mentor (e.g., “She thought her mentor was great and enjoyed the one-on-one experience,” and “His mentor was very nice.”).

An assignment for the high school students was to write journal reflections about the experiences, what they learned, and the value of the transition workshops. Considering the reality of going to college, student feedback included the following comments: “I was not always sure that I would be cut out for college, but our trip [to Kean] showed me that I am,” “Knowing where to get help [in college] is really valuable to me because it makes me feel safer and more prepared,” “Going to a large cafeteria actually helped me get over some of my anti-social behavior and I wound up enjoying myself,” and “I learned that organization is more important than I thought!” The high school students also indicated the value of the mentors. “When my mentor was showing me around all the campus, he explained half the things I need to do to get ready for college,” “[The mentors] were smart, cool, generous, and they know what they were doing . . . We got a chance to know each other . . . ,”
and “My mentor was really helpful. She talked to me and guided me when I got lost in my thoughts.”

The university faculty members elicited feedback from the occupational therapy master’s students through group processing at the end of each of the two days and the end of semester course evaluations. Facilitated by the university faculty members, all participants were able to offer feedback. The most frequently offered comment related to the occupational therapy master’s students appreciation for client contact during their first year of graduate school. For example, one student commented: “It was neat to work with the kids and use the skills that we learned last semester in activity group process.” Occupational therapy master’s students were pleased to be able to facilitate various socialization opportunities for the high school students in addition to meeting a need that has been identified in the literature. Another student was surprised: “I didn’t think that they would be so talkative in groups and one on one.” The occupational therapy master’s students also indicated feelings of satisfaction related to how prepared they were in group development and facilitation, as well as overall enjoyment with working with the high school students, specifically wishing they had more time with the high school students.

Another positive outcome was the continued collaboration between Kean University’s Department of Occupational Therapy and The Newgrange School through development of Level I and Level II fieldwork sites. Finally, the occupational therapy master’s students who participated in the 2011 programming developed an advocacy project that addressed the transition needs of students living with autism and learning disorders the following year in their administration and supervision course.

**LIMITATIONS OF PROGRAMMING**

Despite the positive feedback and perceived benefits of the programming, there were limitations associated with the way the programming was structured and analyzed. The first limitation relates to the two-day immersion time at the university. Since learning is seen to occur in stages over time, occupational therapy practitioners should expose clients to the specific context and activity for long periods of time. The extended time will ultimately assist with generalization of skills (Vogtle, 2011). In future programming, occupational therapy practitioners are encouraged to advocate for increased time on campus when collaborating with universities. High school students are then afforded the opportunity to practice skills repeatedly.

The second limitation relates to the lack of a complete needs assessment at start of the programming planning and development. A needs assessment is a systematic set of procedures that helps to identify a need of a particular population, in this case, youth living with autism and learning disorders (Cole, 2012), and should include gathering of background data, identification of participants of survey, distribution of a survey, facilitation of face-to-face and telephone interviews, identification of key informants and focus groups, utilization of secondary data, analysis of data, and completion of a participant profile (Cole, 2012). While this collaboration did utilize some of the steps of a needs assessment (e.g., letters written by the high school students that introduced themselves and asked questions, use of curriculum standards to guide needs, educator and transition coordinator feedback), future programming should include a more complete process or assessment.
Occupational therapy master’s students can complete a more in-depth needs assessment improving the program and meeting additional accreditation standards.

Another limitation was the lack of formal assessment of programming efficacy. This program can be strengthened by adding the use of pre- and post-outcome measures to determine the benefits for all stakeholders, including the high school students, occupational therapy master’s students, university faculty members, occupational therapy practitioner, and parents/guardians. While the high school elicited feedback from the students and their parents/guardians via written format, and the university faculty members elicited feedback through group processing, more in-depth and/or formal assessment did not occur. Occupational therapy practitioners can request the assistance of the university faculty members, if desired, in the creation of pre and post measures as a way to capture the benefits. The university faculty members should utilize its office of research and obtain institutional review board approval to collect data for purposes of formal presentation and/or publication.

Finally, good communication is critical. As demonstrated, the occupational therapy practitioner and university faculty member dialogue is crucial to achieve the mutual goals of these stakeholders. Each player must willingly share, cooperate, and check pride or need to “own” the process, respect, trust, effectively communicate, and navigate through conflict. Threats to an effective collaboration may be mutual intimidation, differing work issues, slow return on investment, and lack of team building (McWilliam, Desai, & Grieg, 1997) all of which need to be addressed proactively to maintain success.

CONCLUSION

This paper offers an example of how a school-based occupational therapy practitioner used a networking opportunity at AOTA’s annual conference with university faculty members to develop and provide innovative programming that meets a societal need. Occupational therapy practitioners are urged to network with university faculty members as a way to develop innovative programs to meet the transition needs of youth living with autism and learning disorders in addition to promoting professionalism and occupational-based best practice. Successful collaboration between graduate occupational therapy programs and school-based settings could be a powerful avenue for realization of using occupation-based practice in community-based program as proposed in AOTA’s Centennial vision.

Declaration of interest: The Newgrange School provided approval for the development and dissemination of the paper, as well as identification of the school’s name in print. The authors presented a poster presentation at AOTA’s national conference in 2012. Kean University and The Newgrange School provided travel reimbursement for the 2012 AOTA conference.

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REFERENCES


Title

Social Participation Among Young Adults with an Autism Spectrum Disorder.

Abstract

Investigating social participation of young adults with an autism spectrum disorder (ASD) is important given the increasing number of youth aging into young adulthood. Social participation is an indicator of life quality and overall functioning. Using data from the National Longitudinal Transition Study 2, we examined rates of participation in social activities among young adults who received special education services for autism (ASD group), compared to young adults who received special education for intellectual disability, emotional/behavioral disability, or a learning disability. Young adults with an ASD were significantly more likely to never see friends, never get called by friends, never be invited to activities, and be socially isolated. Among those with an ASD, lower conversation ability, lower functional skills, and living with a parent were predictors of less social participation.

Title

A review of "music and movement" therapies for children with autism: embodied interventions for multisystem development.

Abstract

The rising incidence of Autism Spectrum Disorders (ASDs) has led to a surge in the number of children needing autism interventions. This paper is a call to clinicians to diversify autism interventions and to promote the use of embodied music-based approaches to facilitate multisystem development. Approximately 12% of all autism interventions and 45% of all alternative treatment strategies in schools involve music-based activities. Musical training impacts various forms of development including communication, social-emotional, and motor development in children with ASDs and other developmental disorders as well as typically developing children.
In this review, we will highlight the multisystem impairments of ASDs, explain why music and movement therapies are a powerful clinical tool, as well as describe mechanisms and offer evidence in support of music therapies for children with ASDs. We will support our claims by reviewing results from brain imaging studies reporting on music therapy effects in children with autism. We will also discuss the critical elements and the different types of music therapy approaches commonly used in pediatric neurological populations including autism. We provide strong arguments for the use of music and movement interventions as a multisystem treatment tool for children with ASDs. Finally, we also make recommendations for assessment and treatment of children with ASDs, and provide directions for future research.

**ARTICOLO 3**

sito internet : [http://adc.bmj.com/content/91/12/1018.short](http://adc.bmj.com/content/91/12/1018.short)

**Title**

Auditory integration training and other sound therapies for autism spectrum disorders: a systematic review

**Abstract**

**Objectives:** To determine the effectiveness of auditory integration training (AIT) or other methods of sound therapy in people with autism spectrum disorders (ASD).

**Study design:** A systematic review was carried out of randomised controlled trials (RCTs) of adults or children with ASD. Meta-analysis was attempted.

**Results:** Six RCTs of AIT, including one crossover trial, were identified, with a total of 171 participants aged 3–39 years. 17 different outcome measures were used, with only two outcome measures used by three or more studies. Meta-analysis was not possible owing to very high heterogeneity or presentation of data in unusable forms. Three studies did not show any benefit of AIT over control conditions. Three studies reported improvements at 3 months in the AIT group for total mean scores of the Aberrant Behaviour Checklist (ABC), which is of questionable validity. Of these, one study also reported improvements at 3 months in the AIT group for ABC subgroup scores. No significant adverse effects of AIT were reported.

**Conclusion:** At present there is not sufficient evidence to support its use.
ARTICLE 1


Title

A one-year prospective follow-up study of a DIR/Floortime parent training intervention for pre-school children with autistic spectrum disorders.

Abstract

OBJECTIVE:
Determine the results of 1-year Developmental, Individual-Difference, Relationship-Based (DIR)/Floortime parent training in developmental stimulation of children with autistic spectrum disorder (ASD).

MATERIAL AND METHOD:
Thirty-four, two to six years old children with ASD participated. Parents were encouraged to deliver 1:1 interaction according to their child's developmental level, as they were modeled and coached. Pre-post videotapes were rated by blinded assessors.

RESULTS:
Thirty-one families completed the present study. The data showed that adding home-base DIR/Floortime intervention at the average 14.2 hours/week for one year could help 47% of the children to make good improvement (1.5 Functional Development Level, FDLs or more), with 23% making fair progression (1 FDL), and the last 29% making poor progression (0.5 FDL or less). There were significant increases in children's total Functional Emotional Assessment Scale (FEAS), and Functional Emotional Developmental Questionnaire (FEDQ) scores and there was significant decrease in the Childhood Autism Rating Scale (CARS) scores ($p \leq 0.001$). It showed that fidelity of the parents, severity of the children, and baseline developmental status might affect the outcome.

CONCLUSION:
Adding home-base DIR/Floortime intervention at the average 14 hours/week for one year helped 47% of children with autism to make good improvement in their development, and decreased autism's severity significantly.

ARTICLE 2


Title

[Autism spectrum disorders. Functional-emotional development hypotheses and their relationship with therapeutic interventions].

Abstract

Autism Spectrum Disorders do not have a treatment that offers definitive solution to the serious challenges faced by
people who suffer from them. Consequently, as in other chronic conditions, many therapeutic interventions are offered, each based on different neurobiological or psychological hypotheses. In the present article criteria for the organization of the proposed interventions are suggested, and the main aspects of the affective diathesis hypothesis are summarized. This theory emphasizes the importance of emotional signaling as a basis for development and is the theoretical framework for one of the therapeutic options in the field of autism that is earning recognition in our country: the DIR-Floortime model.

ARTICLE 3


Title

A pilot randomized controlled trial of DIR/Floortime™ parent training intervention for pre-school children with autistic spectrum disorders.

Abstract

This pilot study was designed to test the efficacy of adding home-based Developmental, Individual-Difference, Relationship-Based (DIR)/Floortime™ intervention to the routine care of preschool children with autistic spectrum disorder. Measures of functional emotional development and symptom severity were taken. It was found that after the parents added home-based DIR/Floortime™ intervention at an average of 15.2 hours/week for three months, the intervention group made significantly greater gains in all three measures employed in the study: Functional Emotional Assessment Scale (FEAS) (F = 5.1, p = .031), Childhood Autism Rating Scale (F = 2.1, p = .002), and the Functional Emotional Questionnaires (F = 6.8, p = .006). This study confirms the positive results obtained by a previous DIR pilot study (Solomon et al., 2007).

ARTICLE 4


Title

Pilot study of a parent training program for young children with autism: the PLAY Project Home Consultation program
Abstract

The PLAY Project Home Consultation (PPHC) program trains parents of children with autistic spectrum disorders using the DIR/Floortime model of Stanley Greenspan MD. Sixty-eight children completed the 8-12 month program. Parents were encouraged to deliver 15 hours per week of 1:1 interaction. Pre/post ratings of videotapes by blind raters using the Functional Emotional Assessment Scale (FEAS) showed significant increases (p ≤ 0.0001) in child subscale scores. Translated clinically, 45.5 percent of children made good to very good functional developmental progress. There were no significant differences between parents in the FEAS subscale scores at either pre-or post-intervention and all parents scored at levels suggesting they would be effective in working with their children. Overall satisfaction with PPHC was 90 percent. Average cost of intervention was $2500/ year. Despite important limitations, this pilot study of The PLAY Project Home Consulting model suggests that the model has potential to be a cost-effective intervention for young children with autism.

ARTICLE 5


Title

Considering college?: adolescents with autism and learning disorders participate in an on-campus service-learning program.

Abstract

ABSTRACT This paper presents an example of successful collaboration between an entry-level occupational therapy program and school-based setting that resulted in innovative programming for high school students living with autism and learning disorders. The two-day programming provided opportunity for high school students (n = 30) to practice a variety of life skills on the university campus as a way to support transition to secondary education and learning in the natural environment. Occupational therapy master's students developed and implemented the programming as a service-learning experience. Key factors for successful collaboration and outcomes, as well as considerations for future programming and research, are outlined.

ARTICLE 6

Family-centered occupational therapy and telerehabilitation for children with autism spectrum disorders.

ABSTRACT The purpose of this pilot project was to explore the use of telerehabilitation for collaborative occupational therapy sessions with parents of children with autism spectrum disorders (ASD). The aim was to improve carryover of therapeutic strategies by parents to address children's sensory modulation in their natural environments. Four families participated in clinic-based sessions with the therapist followed by online sessions for six weeks. Data consisted of family schedules, sensory diets, archived webcam sessions, and Sensory Processing Measure Home Form scores before and after initiation of the telerehabilitation sessions. Results demonstrated the potential for using telerehabilitation as a tool to provide collaborative occupational therapy in order to improve carryover of home programs for children with ASD by providing opportunities for parents to ask questions, review sensory techniques, and understand the therapist's clinical reasoning.


This study's objective was to investigate the efficacy of sensory integration therapy (SIT) for children with high-functioning autism spectrum disorder (HFASD). The subjects were 20 HFASD children with IQs above 70 selected from previously collected data. Eight participated in individual SIT sessions, and 12 participated in group therapy (GT) including social skill training, communication training, kinetic activities, and child-parent play for 8-10 months. Changes in Total score and five Index scores on the Japanese version of the Miller Assessment for Preschoolers before and after therapy between children in the SIT and GT groups were compared. The results showed that Total score and all
Index scores except for Verbal Index increased significantly in the SIT group, while only Total score increased in the GT group. Furthermore, the SIT group showed more improvement compared with the GT group in Total score and on Coordination, Non-verbal, and Complex Index scores. SIT might have a more positive effect on motor coordination abilities, non-verbal cognitive abilities, and combined abilities of sensory motor and cognition in children with HFASD when compared with GT. This study has limitations such as being an analysis of previously collected data. Further study should be conducted with a randomized control trial. Copyright © 2013 John Wiley & Sons, Ltd.

ARTICLE 8


Title

Systemic multimodal approach to speech therapy treatment in autistic children.

Abstract

INTRODUCTION:
Conditions in which speech therapy treatment is applied in autistic children are often not in accordance with characteristics of opinions and learning of people with autism. A systemic multimodal approach means motivating autistic people to develop their language speech skill through the procedure which allows reliving of their personal experience according to the contents that are presented in the their natural social environment. This research was aimed at evaluating the efficiency of speech treatment based on the systemic multimodal approach to the work with autistic children.

MATERIAL AND METHODS:
The study sample consisted of 34 children, aged from 8 to 16 years, diagnosed to have different autistic disorders, whose results showed a moderate and severe clinical picture of autism on the Childhood Autism Rating Scale. The applied instruments for the evaluation of ability were the Childhood Autism Rating Scale and Ganzberg II test. The study subjects were divided into two groups according to the type of treatment: children who were covered by the continuing treatment and systemic multimodal approach in the treatment, and children who were covered by classical speech treatment.

RESULTS:
It is shown that the systemic multimodal approach in teaching autistic children affects the stimulation of communication, socialization, self-service and work as well as that the progress achieved in these areas of functioning was retainable after long time, too.

CONCLUSION:
By applying the systemic multimodal approach when dealing with autistic children and by comparing their achievements on tests applied before, during and after the application of this mode, it has been concluded that certain improvement has been achieved in the functionality within the diagnosed category. The results point to a possible direction in the creation of new methods, plans and programs in dealing with autistic children based on empirical and interactive learning.
ARTICLE 9


Title

Autism as a developmental disorder in intentional movement and affective engagement.

Abstract

We review evidence that autistic spectrum disorders have their origin in early prenatal failure of development in systems that program timing, serial coordination and prospective control of movements, and that regulate affective evaluations of experiences. There are effects in early infancy, before medical diagnosis, especially in motor sequencing, selective or exploratory attention, affective expression and intersubjective engagement with parents. These are followed by retardation of cognitive development and language learning in the second or third year, which lead to a diagnosis of ASD. The early signs relate to abnormalities that have been found in brain stem systems and cerebellum in the embryo or early fetal stage, before the cerebral neocortex is functional, and they have clear consequences in infancy when neocortical systems are intensively elaborated. We propose, with evidence of the disturbances of posture, locomotion and prospective motor control in children with autism, as well as of their facial expression of interest and affect, and attention to other persons' expressions, that examination of the psychobiology of motor affective disorders, rather than later developing cognitive or linguistic ones, may facilitate early diagnosis. Research in this area may also explain how intense interaction, imitation or "expressive art" therapies, which respond intimately with motor activities, are effective at later stages. Exceptional talents of some autistic people may be acquired compensations for basic problems with expectant self-regulations of movement, attention and emotion.

KEYWORDS:
autism, communication, education, emotional expression, motor development, therapy

ARTICLE 10


Title

Abstract

BACKGROUND:
Autism spectrum disorders (ASD) are characterized by deficits in social reciprocity and communication, and by unusually restricted, repetitive behaviors. Intervention strategies based on the exploitation of the emotional aspects of human-dog relationships hold the potential to overcome the difficulty of subjects with ASD to relate and interact effectively with others, targeting core symptoms of this disorder.

METHODS:
This review summarizes the results of six published studies on the effects of brief interactions with dogs and the effects of introducing dogs in families with a child diagnosed with ASD, with an emphasis on social behaviors and language use. Furthermore, the possible mechanisms responsible for the beneficial effects observed are discussed.

CONCLUSIONS:
Although the studies described here are encouraging, further research with better designs and using larger samples is needed to strengthen translation of such interventions to the clinic. In addition, potential applications of analyzing child-dog interactions are highlighted to screen for early signs of the disorder.

ARTICLE 11


Title


Abstract

BACKGROUND AND OBJECTIVES:
Canine-assisted therapy has been receiving growing attention as a means of aiding children with autism spectrum disorder (ASD). Yet, only limited studies have been done and a great deal of literature related to this intervention is anecdotal. The present study aims at providing additional quantitative evidence on the potential of dogs to positively modulate the behavior of children with ASD.

SETTINGS/LOCATION, SUBJECTS, AND INTERVENTIONS:
A 12-year-old boy diagnosed with ASD was exposed, at his usual treatment location (the Portuguese Association for Developmental Disorders and Autism at Vila Nova de Gaia, Portugal), to the following treatment conditions: (1) one-to-one structured activities with a therapist assisted by a certified therapy dog, and (2) one-to-one structured activities with the same therapist alone (as a control). To accurately assess differences in the behavior of the participant between these treatment conditions, the therapist followed a strict research protocol. The behavior of the participant was continuously video-recorded during both treatment conditions for further analysis and comparison. Treatment outcomes:

In the presence of the dog, the participant exhibited more frequent and longer durations of positive behaviors (such as smiling and positive physical contacting) as well as less frequent and shorter durations of negative behaviors (such as aggressive manifestations).

CONCLUSIONS:
These findings are in accordance with previous experimental work and provide additional support for the assertion that dogs can prime autistic children for therapy. Ultimately, this study may contribute toward a change for full acceptance of canine-assisted therapy programs within the medical milieu. Additional studies using a similar research
protocol on more autistic children will certainly help professionals to work on the most effective methods to individually serve this population through canine-assisted interventions.

ARTICLE 12


Title

Brief report: pet-facilitated therapy with autistic children.

ARTICLE 13


Title

Play with online virtual pets as a method to improve mirror neuron and real world functioning in autistic children.

Abstract

Autism is a severe disease with no known cause and no cure or treatment. Recently, ourselves and subsequently others found that so-called "mirror neurons" - neurons that respond not only when a person moves, but upon observation of movement in another - are dysfunctional in autistic children. Here I suggest an easy, simple, inexpensive and fun method to improve mirror neuron functioning in autistic children, increase appreciation in autistic children for the theory of mind and thinking of others, and most importantly hopefully to improve real world functioning: play with virtual online pets that are the "embodiment" of a stuffed animal the child has. Adoption and then care and play with online pets forces, in a fun way, one to think about the world through the eyes and needs of the pet. A simple method to test this play with online virtual pet therapy is described