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Developing Telehealth Systems for Parent-mediated Intervention of Young Children with Autism: Practical Guidelines

Marco Esposito[1,2*], Maria Teresa Dipierro[1], Federica Mondani[1], Giovanna Gerardi[1], Bruna Monopoli[1], Carmelo Felicetti[3], Francesco Forieri[3], Monica Mazza[2,4] and Marco Valenti[2,4]

[1]*Autism Research and Treatment Centre "Una Breccia Nel Muro", Rome.*

[2]*Department of Applied Clinical Sciences and Biotechnology, University of L'Aquila, Italy.*

[3]*Giga Management, Rome.*

[4]*Regional Centre for Autism, Abruzzo Region Health System, L'Aquila, Italy.*

[*]Correspondence:
Marco Esposito, Autism Research and Treatment Centre "Una Breccia Nel Muro", Rome.

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ABSTRACT

Autism spectrum disorder (ASD) is a chronic neurodevelopmental condition of early childhood onset characterized by social communication deficits, restricted interests and repetitive behaviors. ASD affects an estimated 6–14 per 1000 children and is a major public health challenge. Availability of empirically supported behavioral interventions, however is scarce. One of the barriers to implementation of empirically supported interventions is the lack of trained specialists especially in underserved areas. The limited access to effective behavioral treatment often results in long delays and additional travel costs for families to obtain services from centers with appropriate expertise. Telehealth (also known as telepractice or telemedicine) uses communication technologies (e.g., computer-based videoconferencing) that allow specialists to consult or deliver services in real-time over a geographical distance. Increasing the availability of empirically-supported, time-limited and cost-effective interventions for children with ASD through the use of telehealth may be a way to close the gap between service demand and availability in rural and underserved areas. The application of these technologies to deliver health services across a range of conditions is growing at a rapid pace, with services increasingly migrating from hospitals and satellite clinics to the home and mobile devices. The aim of the current research is to explore the Evidence-Based teaching strategies and clinical models applied to enhance social and personal skills of children with ASD and to develop and to assess the effectiveness of a multilingual telehealth system able to support the implementation of parent and staff mediated interventions in comparison to early standard behavioral programs.

Keywords

Telemedicine, Autism spectrum disorders, Applied behaviour analysis, Telehealth, Training at distance.

Introduction

Children with autism spectrum disorders (ASD) are characterized by social communication deficit and a tendency to engage in a pattern of restricted and repetitive behaviour [1], including sensory anomalies, feeding issues and challenging behaviours. These atypical developmental trajectories become manifest in the early childhood influencing the quality of life of caregivers and needing of an intensive educational intervention. The cases of autism have been increasing, the Center for Disease Control and Prevention (CDC, 2014) has established an estimate of 1 out of 68, and even though effective interventions for these children are widely diffused having demonstrated progress in different skills [2], the availability of trained clinicians in many communities is limited. Generally, young children receive a neuropsychiatric assessment in paediatric hospital including a standardized assessment as ADOS-2 [3] and ADI-R [4] investigating the following issues: core symptoms, language impairments, social and adaptive skills, executive functions, sensory processing, gastrointestinal problems, neurological and genetic comorbidities. Successively, after having received a detailed assessment the children start an intensive weekly Individual Educational Plan (IEP) provided by trained parents and professionals adopting different approaches as behavioural and

developmental interventions, speech therapy, physical therapy, occupational therapy along with sporting and artistic activities. In the majority of cases autism represent a severe challenge for the caregivers burden either for their perceived stress or about family income issues. For example, the scientific literature has displayed that parents of children with autism commonly show more stress symptoms, comprising anxiety and depression, than caregivers of other disabilities [5], inducing parents to leave frequently a job decreasing the family budget. On the other hand, providing early interventions to children with ASD for the entire life cycle also decrease the public expenditure [6]. In order to resolve these evidences, several researchers along with technicians have been developing software and hardware (telehealth, telemedicine, and so on) to support and/or replace special education services commonly delivered in-person by case manager and therapists, especially for people living in rural areas. Indeed, some researchers mentioned practical difficulties with offering support in-person, such as large waiting lists for support or costs and time involved with traveling around rural areas, further cited a lack of behavioural expertise and support available internationally [7].

Likewise, some researchers have examined costs relating to the use of telehealth in comparison with in-person support. For example, Wacker, Lee, Dalmau, Kopelman, Lindgren, Kuhle et al. [8] estimated that the weekly costs of providing a functional analysis would have been $335.09 per client if training were delivered in-person (when including costs related to the behavioural consultant's time and travel) versus $57.95 when training was delivered via videoconferencing. Similarly, the combination of a functional analysis and Functional Communication Training (FCT) would have resulted in total costs per client of $55,872 if delivered in-person, versus $11,500 when delivered via videoconferencing. Also, Lindgren and colleagues [9] evidenced large cost savings as a result of the use of telehealth, particularly when telehealth support was provided in client's homes rather than regional clinic settings (due in part to the exclusion of costs relating to families travel to the clinics, additional staff support, and use of other resources).

Telehealth behavioural interventions

The results concerning the effectiveness of telehealth services provide initial support for the use of telehealth as a way to effectively train individuals to implement ABA (Applied Behaviour Analysis) techniques including assessments, teaching procedures and specific interventions [10]. In some cases, training via telehealth was found to produce comparable results to traditional in-person training and resulted in behavioural change or useful assessment outcomes for clients. Furthermore, telehealth training was rated as highly socially valid and, in preliminary analyses, resulted in significant financial savings for organizations and reduced travel burdens for trainees. Providing training via telehealth may therefore be a promising method of supporting behavioural change for clients and increasing access to behavioural support. Due to the low number of articles utilizing a group design and other methodological procedures as stable data in the baseline, experimental control, replication of independent variable manipulations, or a lack of adequate data to evidence an effect, it is necessary to extend the research studies in this area.

Firstly, the vast majority of research was conducted by research teams located primarily in the USA; therefore, it could be useful to deliver these systems in other countries. In addition, there are only a few direct comparisons of training provided via telehealth with training provided via in-person methodology. Moreover, it must be considered the variables result relating to trainee fidelity to identify the determinants of and ways to improve trainee's implementation of techniques, and the impact of this on client outcomes. Identifying the characteristics of those who would benefit most and engage with telehealth support would ensure that such methodology is used when it is most appropriate and useful. Conversely, the support provided via telehealth could alter the therapeutic relationship between the therapist/trainer and the trainee [11]. For example, if the therapeutic relationship is indeed altered, it may imply that behaviour analytic telehealth support will be most appropriate for individuals who are more emotionally resilient and require less psychological support from trainers during the training. These implications will need to be investigated and taken into account when implementing support via telehealth. Essentially, telehealth systems could be particularly important in contexts where expertise in behaviour analysis is scarce or not geographically widespread such as the UK, where only 275 professionals are registered as Board Certified Behaviour Analysts (BCBA). This is equivalent to one certified professional per 235,525 people and is much lower than other countries such as the USA, where there is one certified professional for every 12,776 people.

Concerning a recent review [10], telehealth methods used different characteristics of training (e.g., methods and technology used, dosage of training, format of training), various behavioural focus of the training (e.g., type of assessments, skills, or interventions used), and outcomes (for trainer, trainee, client, social validity, obstacles experienced). As reported, 20 articles were identified which focused on using telehealth methodology to train stakeholders in behavioural techniques. Across these 20 articles, 113 agents were trained in behavioural techniques via telehealth and 104 children with intellectual or developmental disabilities, most commonly ASD, received support from someone who had been trained via telehealth. In some cases, additional individuals were also trained including control groups and assistants which supported the families or professionals during the implementation of the intervention. In most cases, training was focused on assessments such as functional analyses [12] or preference assessments [13]. Fewer studies focused on training for specific intervention strategies: in some cases, trainees were supported to develop and implement FCT or differential reinforcement interventions [9,14-17] and in one case, trainees were taught to implement Reciprocal Imitation Training [18], or mand and echoic training [19]. Three studies focused on improving trainee's skills relating to implementing behavioural teaching techniques such as discrete trial teaching or incidental teaching [20-22]. Generally, training was provided via videoconferencing (e.g., real-time communication across a distance using an internet connection with

video and audio facilities) with the trainer providing training and/or coaching from a different location, using a computer, webcam, and microphone. Some researchers provided direct instruction, modeling, or role-playing. In other cases, trainees undertook self-instruction using online modules or videos, or written explanations of the techniques and individual practice. However, it is possible to provide a delayed feedback based on videos made during clinical sessions. In addition to these methods a supplemental training could be delivered as homework, funny learning activities, simple questionnaires, virtual reality solutions, and so on. Generally, it should be considered as a good practice to provide an assistant manual containing information about the techniques, data recording forms and videos as tutorial tools as well as written protocols for trainers to use during coaching/training.

Nevertheless, a range of outcomes have been displayed for both the trainee themselves and the client. Two studies compared outcomes of training conducted via telehealth with in-person methods [9,21], and both found comparable results between the two delivery formats suggesting that delivery of training via telehealth may be as effective as delivery via traditional in-person methods. Outcomes reported for trainees related in most cases to trainee fidelity or skills, with only one article examining changes in trainee knowledge about the procedures and reporting large increases [22]. One of the studies which focused on teaching techniques presented client outcomes, reporting large increase in children's use of mands [18]. Where trainees implemented functional analyses, a social function was identified. The results of the analyses were directly verified using a function-based intervention [8,9,16,17]. Moreover, Machalicek and colleagues [23] presented results of preference assessments conducted by trainees for three children. In this instance, preferred items were identified for each child and these preferences were subsequently verified using an instructional intervention in which children were observed to choose the task associated with access to the items identified as preferred. Finally, telehealth interventions focused on training agents to implement specific procedures such as FCT or differential reinforcement, Reciprocal Imitation Training, mand and echoic training were found to be generally effective when implemented by trainees, and a number of studies [9,14,17] reported large reductions also in challenging behaviour for the majority of clients.

For these reasons, the aim of the current study is to explore the Evidence-Based teaching strategies and clinical models applied to enhance social and personal skills of children with ASD and to develop and to assess the effectiveness of a multilingual telehealth system able to support parent and staff mediated interventions in comparison to behavioural programs as usual. To sum up, we endeavor to respond to the three research questions:
(1) how effective is the use of telehealth for training individuals in ABA approaches in relation to improving trainee skills or fidelity, and/or changing children behaviour?
(2) is it possible to discover a similar outcome in comparisons of training provided via telehealth with training provided via in-person methodology?
(3) Is the use of telehealth for training in ABA approaches socially acceptable and are there any obstacles reported that researchers and practitioners in the field should consider when utilizing such methodology?

Method

Participants: Trainer, trainee and children's characteristics

Trainer characteristics: These professionals should have a prior experience or training in behaviour analytic approaches, along with certified practical experience working with children.

Specifically, the trainers could have a Master's degree in Applied Behaviour Analysis and two years of experience in treatment of children with ASD. Also, trainers could be recruited by Doctoral or Master's courses with experience using behavioural approaches. It will be asked trainers to follow a protocol concerning procedural fidelity in teaching to trainees along with a continuous assessment.

Trainee characteristics: This group includes parents (generally caregiver) of children with an ASD diagnosis as well as their close assistants (relatives, baby-sitter, private therapists, psychologists, social worker and so on). This possibility will offer a practical and clinical aid to family in order to warrant a better fidelity concerning the application of the telehealth intervention. These individuals could assist parents during the sessions in relation to setting up the room, ensuring availability of materials, and providing physical assistance on-site during the implementation of procedures. In many cases, trainees could not have prior experience or knowledge of behavioural techniques.

Children: Clients (N=30; aged under six years) will be selected on the basis of the diagnosis of ASD, made by experienced clinicians operating in the public health services, based on the criteria of the DSM-5 and assessments by means of standardized diagnostic instruments, e.g. the ADOS-2 and ADI-R. Furthermore, a cognitive skills' assessment as the Griffiths Mental Developmental Scale-Extend Revised [24], Leiter-3 [25] or other similar instruments will be useful in providing an updated cognitive profile of the children in order to develop a tailored educational plan. Children will be excluded if they have had seizures or an additional medical diagnosis (e.g., genetic syndromes). Subsequently, the sample will be divided into two parts assigning children to two test conditions (standard behavioural intervention and training with telehealth system), so fifteen children will be assigned to an experimental group (EG) and the others will constitute a control group (CG). The groups will be similar on all variables at baseline assessment and no other behavioural interventions will be undertaken during the experiment for any of the children. The research will be conducted with prior consent by both parents and with the approval of the host institution. The project will be submitted for prior approval to the local ethics committee and conducted in compliance with the Code of Ethics of Research in Psychology according to national (Code of Ethics AIP) and international guidelines (Code of Ethics SRCD — Society for Research in Child Development).

Standard behavioural intervention

The children taking part to the standard behavioural intervention

will follow a comprehensive ABA treatment that include 6 hours a week of 1:1 therapy with a behavioural therapist (half of the time spent in quasi-natural settings) divided between Discrete Trial Teaching (DTT) and Naturalistic Environment Teaching (NET) [26]. The IEP planned for the children will involve preschool goals regarding communication, attention, imitation, social play, gross and fine motor skills, receptive and expressive language and autonomy. Each child's skill strength and deficits will be also evaluated on the basis of their performance in the Assessment of Basic Language and Learning Skills [27] carried out by the assigned supervisor. The ABLLS is used both to identify learning goals and to control either progress or regression during the standard treatment. Additionally, the intervention comprises direct supervision (one hour a week) by an expert professional to ensure the reliability of teaching procedures and parent inclusion (parents spent two hours a week in the therapy room with clinical staff). Parents will attend a parent education course at the beginning of the behavioural program with an expert supervisor on six main units (evidence-based treatments, teaching methodologies, Verbal Behaviour approach, Augmentative Alternative Communication, analysis and management of challenging behaviours, development of play skills). Every unit will last three hours and after the course parents take part in the treatment by first observing and then implementing the ABA therapy with their children (following their children for one hour a day through the generalization and maintenance of the targets acquired with the therapist at the centre). Data from the standard therapy will be gathered from data sheets provided by supervisors for therapists. During the training with telehealth system none of these aspects will be changed in order to guarantee the greater reliability of internal validity of the study (for more information concerning the conceptual frame of behavioural intervention, please see the following discussion).

Training with telehealth system

For this study we will provide a telemedicine system to the experimental group to verify an increment in the children's mastered targets after 24 weeks, along with an assessment of knowledge, competencies and fidelity of the trainees, while the control group will follow only the standard therapy described above. In reality, the research staff before the beginning of the experiment will develop three single tests (pilot study) for a month with three children to guarantee the reliability of the electronic products, applying a multiple baseline single case design approach. These single tests will be excluded from the experiment with the groups, respecting the gradual research phases [28]. Successively, the training will be provided through the telehealth system at the children's homes with the assistance of parents. Prior to the training, the parents of participants will be trained in the use of the electronic platform and on technical equipment in order to support the parents throughout the practice and to offer informatics assistance. Access to the telehealth system will be protected by user name and personal password released by a member of the project staff. The video-conferences will be provided at distance one session a week (90 minutes) by an assigned supervisor through via Wi-Fi connection and recorded for data collection. Nevertheless, the first week of the training will include six intensive sessions at distance exclusively to offer a parent education course (approximately 720 hours of lessons). Parent education aim to train caregivers about the main aspects of the behavioural program. As required, it will be possible to offer a psychological support by a psychotherapist throughout the training. All the interventions will be covered by a corresponding insurance. Especially, the telehealth training will allow conducting real time direct observation of client behaviour and supervision, coaching parents to implement assessment and treatment procedures, and to store video and audio files of the observation sessions in order to offer a clinical delayed feedback.

Contents of the telehealth system

Researchers along with external technicians (engineers, programmers, designers and computer scientists) and a project manager will set up a project called P.O.T. (parents on training) program that aim to create an electronic tool for children with autism and their parents with the aim to transfer effective behavioural programs from practical experience of clinical staff to a system at distance. The training at distance could support the same areas of the ABA treatment. Firstly, a detailed parent manual (free download) will be provided to caregivers highlighting therapy strategies related to: increasing the child's attention and motivation, stimulus preference assessment, listener, echoic and mand training, non-verbal communication and exchange of pictures [29], imitation, antecedent behaviour-consequence relationship (ABCs of learning), cognitive skills, toilet training and other autonomies, functional and symbolic play, and finally fine and gross motor skills. The same contents will be delivered also during the first intensive week of training. Moreover, it will be offered a list of videos recorded examples of the therapist demonstrating each ABA topic with young children of different skill level along with homework and self-managed learning activities for parents like simple games or self-administered questionnaires. Likewise, an extension of this electronic tool could include a structured virtual reality setting (for example users could move an avatar through a multiple choice system with a keyboard) so that to practice behavioural teaching strategies and to manage some simulated challenging behaviours in a safe environment before the actual training with the child, while respecting ethical issues.

Educational plan, teaching strategies and data collection

After the baseline assessment the assigned supervisor will provide to the parent a list of comprehensive educational goals concerning language, imitation, play, motor skills, toileting, feeding, and so on along with procedures for the data collection. For example, relating to the DTT, each therapy session should consist of 9 teaching trials for every one acquisition, mixed with trials that assess previously mastered targets. In these cases, the caregiver teaches more than one acquisition target during an instructional session according to the daily educational plan (usually not more than eight acquisition targets a day). The caregiver should provide the initial instruction at the start of each trial and wait 3 seconds for a child's response. If the child responds incorrectly or do not respond, the caregiver delivers a prompt. The parent fades the prompts by starting with the most intrusive to the less intrusive prompts across trials. Likewise, the

parent can offer differential reinforcement in order to increase the frequency of behaviour. Teaching terminate following a minimum of three consecutive sessions with (a) correct unprompted responses at or above 88% of the trials (continuous data) and (b) a correct unprompted response on the first trial [30]. One session a week will be recorded and managed at distance by the case manager for the caregiver's adherence to the teaching procedures (n=4 sessions in a month). Inter-observer agreement will be programmed for a percentage of the recorded sessions. Subsequently, the sum of the mastered targets for any educational programs and the latency of the children learning will be collected for all educational programs such as attention, receptive identification of objects and the imitation of actions with objects. For instance, the attention program could group the following targets: immediate response to name, or during play and conversation, to maintain eye contact for 5 seconds, joint attention and selective attention by barrage tasks. The receptive identification of objects program generally include the discrimination of listened words regarding common objects (animals, body parts, foods, musical instruments, cartoons and so on) as well as the imitation of actions with objects program ask children to replicate the action of the adult (rocking a doll, waving a flag, moving a car, beating a drum, drinking from a glass and so on). To clarify, pre and post experiment the means of mastered targets divided for educational programs and the corresponding latency of learning (number of sessions) will be collected in order to compare groups (standard and telehealth behavioural intervention). During the parent education and parent training at distance it will be possible to face the following teaching strategies commonly implemented in the behavioural interventions as Verbal Behaviour Approach, DTT and NET; incidental teaching (IT), visual schedules, Augmentative Alternative Communication (AAC), prompting strategies (prompt delay, most-to-least, least-to-most), fading, task analysis, differential reinforcement, stimulus preference assessment (free-operant, multiple and paired choice), timer and potty alarm, forward and backward chaining, schedules of reinforcement, token economy, video-modeling and social stories (to find further information about teaching strategies please see http://www.scienceofbehaviour.com/).

Equipment

The only equipment that the telehealth centre need for the purposes of the project are: headsets with microphones to minimize the breach of confidentiality in an office space with multiple workstations and video recording software to record the telehealth sessions for subsequent data collection. The researchers' decisions about the equipment needs for each computer system will be based on determining (a) what options would work best for two-way audio and video transmission; (b) how to keep costs as low as possible while maintaining acceptable audio-video quality; (c) what systems would be simple, secure, and reliable to use; and (d) what equipment would offer the best practical options for scalability so that behavioural telehealth services could be spread as widely [31]. Moreover, to achieve optimal speeds for videoconferencing, there are numerous types of Internet connection options available to consumers. These services include dial-up (via phone line), coaxial cable (via cable TV line), digital subscriber line (DSL; via phone-line), local-to-dish microwave transmission, satellite, fiber optic service and so on. Generally, Cable-based Internet offers a direct continuous connection to the Internet, which is less likely to result in signal interruptions or interference. Concerning the hardware, the researchers could provide computers at the start of the project, with a minimum of an i5 ®Intel processor, 4 gigabytes (GB) of RAM, integrated graphics, 250 GB of hard disc drive storage, 15-in. screen, and open universal serial bus (USB) 2.0 ports. The parents could use external and headsets, which provide both speakers and microphones in each unit. The benefit of these headsets is that noise going to the participant as well as participant sounds that might be heard by others in the clinic environment is minimized. Finally, for this project, a videoconferencing software should be sufficient for telehealth and as a result it is important to have OS and software updates installed prior to conducting telehealth sessions.

There are diverse software options as widely diffused SkypeTM that offer the best price-performance ratio of any of the videoconferencing software options available, however other providers may prefer to use alternative software (e.g., Vidyo®, Adobe® Connect™, vSee, etc.). Also, a video recording software should be used to record the A/V input from telehealth sessions for subsequent data collection and data analysis using a video capture software professional. Concluding, the degree to which technology support is needed will likely depend on the provider's knowledge of technology and on how the provider structures the telehealth services. On the other hand, after internal preparation and testing, the providers become relatively conversant with the majority of technological issues that may be encountered. For this reason, technology support could be used most often at the beginning of the participation in the project and faded across time as the provider and parents become more familiar with the system.

Assessment

During baseline, children and parents will receive a pre-intervention evaluation.

Firstly, we will gather socio-demographic data with the purpose of investigate the following characteristics of the participants (age, education, ethnicity, income and received services), simultaneously collecting a detailed and blinded assessment for the children by an external neuropsychiatric team, concerning the following dimensions: core symptoms, cognitive skills, language, challenging behaviours, parental stress and adaptive abilities. For these reasons, it will be employed about core symptoms the following instruments: the ADOS-2 and ADI-R, both mentioned above and the Social Communication Questionnaire [32], The ADOS-2 is a well-established diagnostic instrument that places the child in naturalistic situations, designed to evoke communication and interaction with the examiner. It is organized into four separate modules, based on the age and expressive language level of the child, ranging from pre-verbal toddlers to verbally fluent adults. Behaviours are coded in the areas of social communication, social relatedness, play and imagination, and restricted interests and repetitive behaviours. A child meets criteria for a classification

of autism if the scores in the social and communication domains and the total on the algorithm meet or exceed pre-specified cutoff scores. The ADOS has been shown to have sensitivity in the upper 90% range and specificity in the upper 80% to lower 90% range in relation to effectively discriminating between individuals with and without ASD. In addition, the SCQ is a 40-item parent-reported questionnaire designed to support the diagnosis of ASD in individuals from 4 to 40 years of age. Each item is checked as 'yes' or 'no', and assigned a point rating of '1' (presence of abnormal behaviour) or '0' (absence of abnormal behaviour). The points are summed and result in a total possible score of 0–33 for nonverbal children and 0–39 for verbal children. Totals are compared to a cut-off of 15 for ASD and 22 for autism. Using the cut-off score of 15, discriminant validity of the SCQ is adequate for differentiating ASD from non-ASD conditions (sensitivity = 0.71; specificity = 0.71). In order to measure the cognitive skills, the GMDS, Leiter-R or similar instrument will be adopted. The Griffiths Scales include six sub-scales for the two to eight year age group as gross motor skills, including the ability to balance and co-ordinate and control movement, daily living skills, receptive and expressive language, eye and hand co-ordination, fine motor skills, visuospatial skills including speed of working and precision, ability to solve practical problems, understanding of basic mathematical concepts and understanding of moral issues. On the other hand, to assess the adaptive abilities of the children the Vineland Adaptive Behaviour Scales — Interview Edition [33] will be completed by the primary caregiver in order to measure the child's adaptive behaviour across four domains: socialization, communication, motor and daily living skills. The VABS asks parents to rate what the child "does" (as opposed to what the child is capable of) in the course of daily living using the following scale: 0 (cannot perform), 1 (sometimes performs), or 2 (performs independently). The Vineland domains have been standardized (mean of 100 ± 15). Moreover, in order to explore the comprehension and expression of language (vocabulary) the McArthur Communication Developmental Inventories will be administered [34] as well as measurements regarding challenging behaviours displayed by children as aggression and stereotypes (Autism Spectrum Disorder-Behaviours Problems for Children Scales, ASD-BPC; [35]) or about restricted and repetitive behaviours (RRB). Furthermore, it will be important to consider parental stress since it generally affect children outcomes [36]; or likewise the quality of family life [37]. The PSI is a self-report screening tool that helps providers and families identify the sources and different types of stress that come with parenting. Parents report their level of agreement with 36 items that fall into three subscales: Parental Distress (PD), the extent to which parents feel competent, restricted, conflicted, supported, and/or depressed in their role as a parent; Parent-Child Dysfunctional Interaction (P-CDI), the extent to which parents feel satisfied with their child and their interactions with them; Difficult Child (DC), how a parent perceives their child to be, whether the child is easy or difficult to take care of and Total Stress, indication of overall level of stress a person is feeling in their role as a parent. All of these individually and combined are believed to affect the overall relationship between parents and their children. Finally, supervisor will gather data from the video conferences with parents once per week to observe parent-child interactions inside ecological environment and to analyses the mastered target and the latency of child learning along with procedural fidelity of parents (note that the same data will be also partially examined to calculate an interobserver agreement). Concluding, at post-intervention and at follow-up (2 months after the conclusion of the training), other than the replication of the baseline assessment it will be adopted a project satisfaction protocol to parents and clinicians (including cost/benefit ratio and technical/schedule issues) and about the knowledge regarding behavioural teaching strategies acquired by caregivers (effects of parent training or parent education).

Analytical approach

Firstly, a set of descriptive analyses on the sample will be conducted on the characteristics of participants (trainers, trainees and children). A single-subject, multiple baseline design will be programmed for the pilot study with only three families. To verify whether groups differed at baseline and at post intervention assessment, we will apply T-Test analysis between the groups, as the data met the assumption of normal distribution. As dependent variable we will select the means of mastered targets of standard therapy and the corresponding latency of learning dived for educational programs. Subsequent logistic regression analysis considering the improvement in the target score after the experiment will be applied to investigate if for the children taking part in the experimental group it could represent an advantage in learning. Then, a correlational analysis will be conducted to study the relationship between fidelity (integrity of teaching procedures, time spent on sessions, parent education, data collection) and outcomes. The correlation analysis will be applied selecting a significance level $\alpha<0.05$. Finally, linear regressions will be conducted to control the value of possible predictors. Data analyses will be performed using the R Package Version 3.3.3, SAS Enterprise Guide Version 7.14 and SAS Enterprise Miner version 14.1. Note that the first author is an international certified SAS data analyst.

Discussion

In recent years the scientific literature regarding comprehensive and focused behavioural intervention programs has been growing, and both types of approaches have been shown to be effective in improving communication, social skills, and management of problem behaviour for children with ASD [39]. In general, an Early Intensive Behavioural Intervention (EIBI) includes a tailored educational plan carry out by a case manager (supervisor), applied by trained therapists for more than 20 hours a week in multiple settings (school, home and community) following the principles of the Applied Behaviour Analysis (ABA), developmental psychology, social neurosciences and special education. The interventions can be mediated partially or exclusively by parents or other caregivers providing strategies to manage primarily some challenging behaviours and increasing the functional communication of children.

Concerning the different clinical models studied for autism in the last decades Christina Corsello [40] displayed two main Evidence-

Based approaches the UCLA Young Autism Project which uses the Lovaas method of intervention, specifically discrete trial intervention, implemented in one-to-one setting by trained ABA therapists, supervised by trained professionals. The focus of the first year of this behavioural program is on imitation, interaction, play, and response to basic requests. In the second year, the focus shift to work on language, descriptions of emotions and pre academic skills. To teach generalization, the children practice the skills in other situations and with other people, once they have acquired them in a one-to-one setting. On the other hand, The Denver model currently well-known as Early Start Denver Model [41] is also based on a developmental model of intervention. This program is delivered within a classroom setting on a 12-month calendar and meet 4 to 5 hours a day, 5 days a week. The focus is on positive affect, pragmatic communication, and interpersonal interactions within a structured and predictable environment. Almost all activities and therapies are conducted within a play situation. Goals of the program include using positive affect to increase a child's motivation and interest in an activity or person, using reactive language strategies to facilitate communication, and teaching mental representation.

To date, the effectiveness of EIBI and of the corresponding clinical models is well-established. It should be stated that behavioural interventions can increase language, cognitive and adaptive skills of children and adolescents with ASD [42]. Moreover, the EIBI has been demonstrated being effective in meliorating cognitive competencies, social and communication skills, autism symptoms, and quality of life either in clinical setting or in the natural environment [43-54]. However, although to date there is a claim around the effectiveness of the behavioural interventions, some important literature reviews suggest receiving the majority of research results with caution since the heterogeneity of response of children to treatment [51].

Although the well-established methodology limits concerning the clinical research studies, there have been promises that relating variables regarding the pre-treatment profile of the child and treatment variables to later child outcome will enable professionals to match individual children to specific treatment programs. The inherent heterogeneity of the ASD with a variety of different symptom clusters ranging from severe to minor impairments, naturally complicates the scientific and clinical goal of identifying such predictors likely to affect a child's response to treatment. Well-established factors include the child's age at the initiation of treatment, with younger children yielding better outcomes [55-57]. Cognitive ability at intake has a moderate relation to outcome [46,47,58,59], and children with better adaptive behaviours at intake tend to achieve better outcomes, and more language skills at intake accurately predict ''rapid responders'' to treatment [52,59]. The predictive value of autism symptom severity in determining developmental trajectories has rarely been investigated. Nevertheless, autism severity has been proven to account for additional explanation of different child outcomes [60,61]. Studies that address treatment factors such as intensity of intervention have revealed inconsistent results, with one group claiming that comprehensive and high-intensity treatments produce better outcomes [50], and others suggesting that intensity does not necessarily correlate with outcome [60,62]. Finally, training and support to parents and their inclusion in the interventions led to a maintenance of the children skills and of their functional behaviours [63]. Despite the well-established variables studied for the application of an effective behavioural program for children with ASD, there has been few studies which consider the long-term effects of these interventions [64]. Currently, there are three important studies which include a follow-up measure after one, two and nine years from the conclusion of the interventions [65-67]. These studies on long-term effects reported positive outcomes for the children but not for the entire samples showing a heterogeneity in the response to treatment.

Furthermore, offering training and support to parents of children with ASD is widely considered a good practice. Parent training may be useful for younger children particularly for improving social communication, language use, and, potentially, symptom severity and family functioning, but the current evidence base for such treatment remains insufficient, in particular outcomes assessed in these studies were frequently short-term and indirect (intermediate) measures [2]. However, there is some indication of short-term improvements in language, social, and adaptive skills for children whose parents received training in these areas. In the 2012 [68] proved an advantage for children following the staff and parent mediated EIBI. These children showed a significant decrease in autism symptom severity, gains in mental developmental state and early language production, improvements that were not achieved by children following Eclectic interventions (controls showed gains in socialization and motor skills). Parents that followed Eclectic intervention benefit in decrease of parental stress that, in contrast, remained relative stable in the intervention group. This result joins previous research findings indicating a relation of parental stress and parent treatment provision: with decreases in parental stress in low-intensity treatments and increase in parental stress in intensive treatments, where parents are involved in treatment provision. The study highlights an important association between parental stress and staff treatment fidelity that interferes with decision-making in treatment planning and consequently with positive behaviour outcome. These results shed lights on the importance of the psychological support and supervision offered to the parent and the capability of the case manager to include families balancing their needs and personal resilience during the intervention time. On the other hand, it could be important consider the teaching approach provided to families. For instance, Strauss, Esposito, Polidori, Vicari, Valeri, & Fava [69], examined the differential effect of a highly structured adult-directed behavioural treatment condition and a more flexible child-oriented blending of behavioural and developmental treatment strategies in a clinical group setting with children with ASD. The children with autism following the more flexible child-oriented treatment condition engaged significantly more in higher-order play activities allowing for peer proximity and demonstrated better social functioning during activities with other peers with autism.

A relation of child-oriented teaching utilizing less intrusive prompting to more developmentally appropriate play as well as social functioning was found. The findings suggest that child-oriented play and social skill interventions in the clinical context, although being applied in a group of children with ASD, may facilitate social functioning and engagement.

Although there is consensus that parents should be involved in interventions designed for young children with ASD, parent participation alone does not ensure consistent, generalized gains in children's development. Barriers such as costly intervention, time-intensive sessions, and family life may prevent parents from using the intervention at home. Consequently, Telehealth interventions could represent a valid and suitable solution since integrates communication technologies to provide health-related services at a distance. Parents trained through these alternative solutions can become skilled at using teachable moments to promote children's spontaneous language and imitation skills. In fact, the scientific literature suggests the potential of technology for helping parents understand and use early intervention practices more often in their daily interactions with children [70].

The advantages of the use of technology in special education are well documented. Firstly, communication technologies can deliver specialized services in real time over a geographical distance (including multilingual approach). Definitely, the availability of special education services commonly delivered in-person by trained clinicians is poor, especially for people living in rural areas. Indeed, the evidence display practical difficulties with offering support in-person, such as large waiting lists for support or costs and time involved with traveling around rural areas, along with a lack of behavioural expertise. Indubitably, the costs relating to the use of telehealth are minor in comparison with in-person support. Additionally, these systems at distance can be accessed at any time of day, in any location with basic, inexpensive equipment, and use interactive, personalized features to communicate and share information. Telehealth such as computerized software programs, videoconferencing, and virtual 3D interactive programs has been used to teach various communicative, social, emotional, and academic skills to older children and adolescents with ASD. Current software and hardware solutions can provide interesting learning options either for trainees or for researchers such as serious games, real-time data recording [71], virtual reality, bio-feedback, advanced data analytics and data visualization, also supporting research in social and behavioural neuroscience allowing a greater control in clinical trials. Moreover, concerning the financial sustainability of the project, telehealth systems have many possibilities to receive public (European bands as Erasmus+) and private support (families, bank institutes, foundations and social activities).

On the other hand, it is important to consider some obstacles relating to telehealth. The majority of these trainings have occurred in simulated environments, classroom settings or through online distance learning programs with professionals rather than in families' homes. Hence, telehealth programs that do offer parenting resources have primarily focused on behaviour management and general adaptive parenting techniques aim at helping high risk parents and those with behaviourally challenged children rather than families affected by autism. To date, only a few published studies have examined the efficacy of telehealth intervention for parents of children with ASD at home. Likewise, a number of obstacles were identified in the articles relating to the use of telehealth for training. These often related to technical difficulties albeit, in most cases, authors reported that technical issues did not significantly affect the training and were easily resolved. Issues relating to the logistics of using the equipment were also highlighted, including the possibility of needing someone to set up equipment prior to sessions, or transferring potentially large video files [14], and issues with protecting clients' confidentiality or obtaining informed consent [17]. Some authors discussed issues with software being blocked by local firewalls [21], and with insurance companies not covering the cost of support delivered via telehealth. The most common technology problems that the researchers have encountered have been related to audio transmission (as the delay in the exchange of audio information) or video transmission (e.g., video delay, freezing video, jerky movements, and tiled or pixilated images). These problems are related to connectivity, hardware, software, or a combination of these three computer systems.

Conclusion

Telehealth systems allow specialists to consult or deliver services in real-time over a geographical distance, increasing the availability of empirically-supported, time-limited and cost-effective interventions for children with ASD. The application of these technologies to deliver health services across a range of conditions is growing at a rapid pace, with services increasingly migrating from hospitals and satellite clinics to the home and mobile devices. For these reasons, the aim of the current research is to explore the Evidence-Based teaching strategies and clinical models applied to enhance social and personal skills of children with ASD and to assess the effectiveness of a multilingual telehealth system able to support the implementation of parent and staff mediated behavioural interventions. To date, a range of outcomes have been displayed for both the trainee and the children using telehealth solutions, comparing the training conducted at distance with in-person methods. Future research could explore the aptitudes required for having success in a training at distance, as well as the typology, the content and the approach provided by training programs and as a result which children achieve better progress via telehealth interventions.

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