

Study of social behavior through mixed methodology in the context of a social-skills program for children and adolescents with autism spectrum disorder in a community setting

Carlota Alcover Van de Walle

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DOCTORAL THESIS

Title	Study of social behavior through mixed methodology in the context of a social-skills program for children and adolescents with autism spectrum disorder in a community setting
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No amount of experimentation can ever prove me right; a single experiment can prove me wrong
(Albert Einstein, 1879-1955)

Agradecimientos

Después de varios años de mucho trabajo y esfuerzo, con subidas y bajadas emocionales, con motivación, desesperación e ilusión, termina una etapa que ha sido una de las más importantes de mi vida.

En primer lugar, me gustaría agradecerles a mis dos directoras de tesis, la Dra. M. Ángeles Mairena y la Dra. Eulàlia Arias por el esfuerzo que han puesto en los tres estudios presentes y durante los años. Han sido guías y apoyos en momentos complejos, en los que la distancia no ha sido de gran ayuda, pero el manejo y la coordinación de ambas ha sido esencial para lograrlo. Desde dos orientaciones profesionales completamente diferentes, hemos podido lograr un trabajo del que nos sentimos orgullosas.

Quiero seguir agradeciéndoles a todo el equipo de la UnimTEA del Hospital Sant Joan de Déu, por su colaboración en todo el proceso, desde el desarrollo del proyecto, la intervención grupal y la recolección de datos, hasta la escritura de los resultados. La posibilidad de contar con un gran equipo multidisciplinar ha generado un mayor enriquecimiento de los trabajos que se han elaborado. Ha sido un placer poder disfrutar y aprender de todos los profesionales que forman parte de la UnimTEA. Me gustaría agradecer especialmente a María Díez, por su apoyo tanto en lo profesional como en lo personal.

También me gustaría hacer un reconocimiento especial a mis amigas, Miriam y Andrea, que me han ayudado a disfrutar y volver a la realidad en momentos de pánico, donde el estrés y el cansancio se apoderan de uno.

Por último, quiero agradecerle a mi familia. Han sido desde siempre un apoyo incondicional. El esfuerzo, la constancia y la ilusión por luchar por lo que uno quiere, junto con el reconocimiento que me han brindado siempre han permitido que pudiera enredarme en caminos como el del doctorado. Gracias a mis hermanos Alejandra y Pablo, por estar siempre, y en especial a mis padres, por vuestro amor incondicional.

TITLE: Study of social behavior through mixed methodology in the context of a social-skills program for children and adolescents with autism spectrum disorder in a community setting.

SUMMARY: Over the past decade, numerous studies have been conducted in order to evaluate the effectiveness of social skills intervention groups for people with autism spectrum disorder (ASD). Much controversy remains about which factors benefit certain patients and what methodology is used to detect them, specifically in community settings. The objectives of this thesis were: to assess the effect of the adaptation of a social skills program for children and adolescents with ASD in a hospital context, analyzing the effectiveness of the program to decrease comorbidity symptoms and increases social behaviors and, to use observational methodology to identify social changes. The Bauminger observational scale was adapted and 10 group sessions were coded. Data were analyzed with the polar coordinate technique. The results obtained in the three studies indicate that the affective symptomatology decreased after the intervention. Marginally significant results were also seen in some social behaviors, specifically eye contact and functional communication. We observed that those patients with a higher verbal intelligence quotient (IQ) obtained a better response to treatment in the above parameters. Despite these results, each participant followed a unique course. It is necessary to continue investigating the factors that influence the effectiveness of these programs, such as age or IQ, so that the implemented interventions generate significant changes in these community contexts, where it is more complex to reach a greater number of people.

KEYWORDS: autism spectrum disorder, social skills, intervention, groups, age, IQ, observational methodology.

TÍTULO: Estudio del comportamiento social a través de metodología mixta en el contexto de un programa de habilidades sociales para niños y adolescentes con trastorno del espectro autista en un entorno comunitario.

RESUMEN:

A lo largo de la última década se han realizado se han realizado numerosos estudios para evaluar la eficacia de los grupos de intervención en habilidades sociales para personas con trastorno del espectro autista (TEA). Sigue existiendo mucha controversia sobre qué factores benefician a determinados pacientes y qué metodología se emplea para detectarlos, específicamente en los contextos comunitarios. Los objetivos de esta tesis fueron: valorar el efecto de la adaptación de un programa de habilidades sociales para niños y adolescentes con TEA en un contexto hospitalario, analizando la efectividad del programa para disminuir síntomas de comorbilidad y aumentar las conductas sociales y, utilizar metodología observacional para identificar los cambios sociales. Se adaptó la escala observacional de Bauminger y se codificaron 10 sesiones de grupo. Los datos se analizaron con la técnica de coordenadas polares. Los resultados obtenidos en los tres estudios indican que la sintomatología afectiva disminuyó después de la intervención. También se observan resultados marginalmente significativos en algunos comportamientos sociales, específicamente el contacto ocular y la comunicación funcional. Observamos que aquellos pacientes con mayor coeficiente intelectual verbal (CIV) obtuvieron mejor respuesta al tratamiento en los anteriores parámetros. A pesar de estos resultados obtenidos, cada participante sigue un curso único. Es necesario seguir investigando los factores que influyen en la eficacia de estos programas, como la edad o el IQ, de modo que se implementen intervenciones que generen cambios significativos en estos contextos comunitarios, donde resulta más complejo llegar a un mayor número de personas.

PALABRAS CLAVE: trastorno del espectro autista, habilidades sociales, intervención, grupos, edad, IQ, metodología observacional.

TÍTOL: Estudi del comportament social a través de metodologia mixta en el context d'un programa d'habilitats socials per a infants i adolescents amb trastorn de l'espectre autista en un entorn comunitari.

RESUM: Al llarg de l'última dècada s'han realitzat nombrosos estudis per avaluar l'eficàcia dels grups d'intervenció en habilitats socials per a persones amb trastorn de l'espectre autista (TEA). Segueix existint molta controvèrsia sobre quins factors beneficien a determinats pacients i quina metodologia es fa servir per a detectar-los, específicament en els contextos comunitaris. Els objectius d'aquesta tesi van ser: valorar l'efecte de l'adaptació d'un programa d'habilitats socials per a infants i adolescents amb TEA en un context hospitalari, analitzant l'efectivitat de el programa per disminuir símptomes de comorbiditat i augmentar les conductes socials i, utilitzar metodologia observacional per identificar els canvis socials. Es va adaptar l'escala observacional de Bauminger i es van codificar 10 sessions de grup. Les dades es van analitzar amb la tècnica de coordenades polars. Els resultats obtinguts en els tres estudis indiquen que la simptomatologia afectiva disminuir després de la intervenció. També s'observen resultats marginalment significatius en alguns comportaments socials, específicament el contacte ocular i la comunicació funcional. Observem que aquells pacients amb major coeficient intel·lectual verbal (CIV) van obtenir millor resposta a al tractament en els anteriors paràmetres. Malgrat aquests resultats obtinguts, cada participant segueix un curs únic. Cal seguir investigant els factors que influeixen en l'eficàcia d'aquests programes, com l'edat o el IQ, de manera que s'implementin intervencions que generin canvis significatius en aquests contextos comunitaris, on resulta més complex arribar a un major nombre de persones.

PARAULES CLAU: trastorn de l'espectre autista, habilitats socials, intervenció, grups, edat, IQ, metodologia observacional.

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1. THEORETICAL FRAMEWORK

1.1 Approach to autism spectrum disorders

The first writings about autism date from the XVI century. Since then, experts from different disciplines, such as writers and doctors, have been reporting, publishing, and sharing stories related to people with autism symptomatology (Artigas-Pallarès & Paula, 2011), even before the name autism was in use.

Since 1911, the word “autism” has been in use. The word “autism” derives from classical Greek, *autos* means oneself, and *ismos* mode of being. Originally, autism referred to people that were socially isolated and closed in on themselves. However, this meaning changed after Leo Kanner and persists today.

In 1943, Kanner published the first article concerning autism, “Autistic disturbances of affective contact”. The concept of autism was described as “an extreme aloneness and a desire for the preservation of sameness, with a variety of behavioral, cognitive or affective, symptoms derived from them.” After that, Kanner renamed that concept “early childhood autism.” A bit earlier, Hans Asperger had published similar observations (1944). But it was Lorna Wing who spread the concept of ‘Asperger’ included in autism syndrome. This same author, in collaboration with Judith Gould, provided a new perception of autism, presenting the three difficulties of autism: social interaction, social communication, and repetitive and restrictive behaviors, with or without intelligence disabilities.

Since then, there has been controversy about the etiology and diagnostic criteria of autism. It was not until the third edition of the *Diagnosics and Statistical Manual of Mental Disorders (DSM-III)* that autism was included. Since that moment, the definition and criteria have changed over the years.

1.1.1 Diagnosis and prevalence

Nowadays, the last version of the DSM defines this disorder as autism spectrum disorders (ASD). There is still controversy about the etiology, prevalence, medical prognosis, and treatment/interventions. However, according to current standardized diagnostic classifications, autism spectrum disorders are “neurodevelopmental disorders characterized by difficulties in social communication and social interaction, and restricted and repetitive patterns in behaviors, interests, and activities” (American Psychological Association, 2020). Autism spectrum disorders present deficits in 2 important areas:

a) Social communication and social interaction impairments are related to difficulties in social cognition. These difficulties include impairments or alterations in spoken language, responding or interacting with others, and ideas and imagination (National Institute for Health and Care Excellence, 2017). Specific difficulties include alterations in spontaneously interpreting and understanding verbal and nonverbal communication (gestures, postures, facial expressions, tone voice, proximity, reduced eye contact, reduced or absence of social smiling), in developing the ability to initiate and respond reciprocally (build and maintain social relationships between peers or misunderstanding words or sentences in a literal way), and in identifying and understanding one’s own and others’ emotions (Bauminger, 2002). Moreover, problems related to the social dimension include reduced or absent social interest in people, theory of mind (ToM), such as empathy, problem-solving or abstract or inferential thinking (misunderstanding and a tendency to interpret literally social situations, difficulties in understanding double meanings of phrases or jokes). All these difficulties are manifested differently depending on the person, their age, and functional level (Bohlander et al., 2012).

People with ASD report that these social impairments involve significant difficulties in real life, such as having fewer friends, unsatisfying relationships and friendships, feelings of loneliness, and symptoms of depression or anxiety (Bauminger & Kasari, 2000). Other researchers also report that children or adolescents with ASD present higher rates of bullying and teasing, compared to people with neurotypical developmental problems (Humphrey & Symes, 2010). Furthermore, a relationship between social impairments and high levels of

anxiety and stress has been described (Bellini, 2006). Social impairments tend to develop in avoidance of social situations, which consequently make them miss opportunities to practice social skills.

b) Restricted and repetitive patterns can lead to difficulties at a social and behavioral level, generating inadequacy in different areas of life. They can also present repetitive “stereotypical” movements, rigid and excessive insistence on following routines, repetitive rituals, and strong adherence to rules. Furthermore, these people may present different sensorial conditions, such as auditory hypersensitivity or rigidity in interests, preventing them from adapting to the context they are in (NICE, 2017).

As a neurodevelopmental disorder, symptoms start at an early age and affect functionality in different areas of life. This functionality includes differing levels of cognitive and verbal abilities in each person.

Year after year, the incidence of autism has continued to increase. At present, 1 in 59 children is diagnosed with autism (Centers for Disease Control and Prevention, 2015; World Health Organization, 2019). There is controversy regarding prevalence. It has been stated that professionals now have more accurate information, more research, and significant and valid information that allows them to perform precise and error-free diagnosis of autism. However, it has also been suggested that the increase in the incidence of autism is due to the difficulty in identifying specific problems and misdiagnosing other disorders as ASD. The international standards (National Institute for Health and Care Excellence, NICE, 2017) recommend and emphasize the importance of performing a complete and specific diagnostic evaluation.

In order to perform an appropriate diagnosis of autism, it is necessary to carry out an exhaustive clinical interview that includes evaluation of all developmental areas of the individual. A wide range of instruments has been developed to assess the three key areas that are affected by ASD, as well as other comorbidities or difficulties that can be present in this disorder. One of the most widely used diagnostic algorithms to determine whether the person

has autism or not is the Autism Diagnostic Interview-Revised (ADI-R, Lord et al., red.). This instrument focuses on the developmental history of the person, using an interview with the closest people to the individual (normally the parents). Another widely used instrument is the Autism Diagnostic Observation Schedule (ADOS-2, Lord et al., ref.), which allows professionals to make a diagnosis of ASD through age, developmental level, and language skills. This tool includes structured and semi-structured tasks of social interaction and communication between the examiner and the person under assessment. In parallel, there are other instruments such as questionnaires that are used to assess autism symptomatology, for example the Social Communication Questionnaire (Berument et al., 1999) or the Autism Behavior Checklist (ABC, Krug et al. 1980). Frequently, these questionnaires are responded to by parents or the people closest to the assessed person. In addition, there are questionnaires that measure comorbid symptomatology that might be present. In order to assess comorbidities, clinicians and researchers may use the Children's Depression Inventory (CDI, Spanish adaptation Del Barrio, 2004.) or Beck Depression Inventory (BDI, 1988), Child Anxiety and Related Emotional Disorders (SCARED; Birmaher et al., 1999), the Behavior Assessment System for Children (BASC-2, Reynolds & Kamphaus, 2004), or the Child Behavior Checklist (CBCL; Achenbach, 1991). Finally, another important factor to measure is the intelligence quotient. The most common instruments used are the Wechsler Intelligence Scale for Children or Wechsler Adult Intelligence Scale (Wechsler, 2014), or Kaufman Assessment Battery for Children (KABC, 2004)

Research in autism spectrum disorders has been improving and growing during the last century, but in the last 20 years investigations have provided more specific information about diagnostic criteria and intervention results.

1.1.2 Etiology and risk factors

Regarding etiology, researchers have studied the possible causes of autism. Literature suggests that different factors are involved, including environmental factors, genetic factors such as heritability, genomic architecture, and sex differences, and neurobiological factors (De Rubeis et al., 2014; Ha et al., 2015; Sanders et al., 2012). Another recent study suggested

that different environmental factors could increase the risk of ASD, for example infections or drugs ingested during pregnancy. However, there is little evidence regarding these factors (Amaral, 2017).

In relation to genetic factors, researchers have studied many different genes that could be involved in autism. To date, genetic differences and specific mutations have not been found in people with ASD, but results have not been totally conclusive or specific in relation to all the possible genes that could be involved in autism. For now, researchers confirm that ASD is more common in boys than in girls (Duvekot et al., 2017). It is also more frequent in identical twins than in fraternal twins. And finally, prevalence indicates that children with a biological sibling with a diagnosis of ASD has a greater risk for developing it too (Sandin et al., 2014).

Neurobiological factors are related to abnormalities in central nervous system functioning. Researchers suggest that “autism is a convergent behavioral manifestation of various brain dysfunction with different causes” (Trottier et al., 1999). In the last decade, researchers explained that these abnormalities are presented in the genetic code and probably result in structural, functional, cognitive, and neurobiological abnormalities. Specifically, studies have uncovered an increase in gray matter in frontal and temporal lobes, a decrease in white matter in comparison to gray matter in adolescence, differences in the cerebellum and limbic system, and synaptic deficits (American Speech-Language-Hearing Association, 2020; Ha et al., 2015).

Finally, environmental factors have been a focus of study in recent years. Researchers have identified but not confirmed factors that could be involved in autism, such as insecticides, pharmaceuticals, heavy metals, and industrial chemicals, among others. Nonetheless, these results do not indicate that these factors specifically cause autism.

1.1.3 Comorbidities in ASD

There are other medical and psychological impairments and comorbid difficulties related to ASD that have been studied over the years (Romero et al., 2016).

Frequent medical difficulties that might concur with ASD include epilepsy, gastrointestinal symptoms, sleep, and feeding problems (Mannion & Leader, 2013).

The relationship between ASD and psychiatric comorbidities has come under study in recent years, as these comorbidities may interfere with key symptoms of autism: social communication, and restrictive and repetitive behaviors. There are differences between the DSM-IV (American Psychiatric Association, 1994) and DSM-5 (American Psychiatric Association, 2013). In the last version of the mental disorders' classification, attention deficit-hyperactivity disorder and anxiety disorders (separation anxiety, social anxiety, and generalized anxiety) were included as a comorbidity of ASD.

There are many research studies that focus on mental comorbidities in ASD. Around 82% of children diagnosed with ASD have other developmental disorders such as language disorders, attention deficit-hyperactivity disorder (ADHD), and intellectual disabilities or sensory disorders.

ADHD is one of the most common comorbidities. The American Psychiatric Association (APA, 2013) describes this as a neurodevelopmental disorder that includes symptoms of inattention, hyperactivity, and impulsivity. This comorbidity in ASD could affect not only the academic area, but also the social and family domains, adding further impediments to benefiting from interventions. ADHD is one of the factors associated with an increased prevalence of autism (NICE, 2017).

Regarding intellectual disability (ID), it is characterized by below-average intellectual functioning (Intelligence Quotient (IQ) >70) simultaneously with social, cognitive, and adaptive skills deficits (Srivastava & Schwartz, 2014). Between 50-70% of all

cases of ASD also have ID (Matson & Shoemaker, 2009). This comorbidity is one of the most important, because high cognitive abilities can become a positive factor in development and improvement in the difficulties related to ASD. Research suggests that results obtained in therapies and specific interventions are more favorable in people with ASD and an average IQ (Gates et al., 2018).

Other comorbid diagnoses are present in approximately 10%, such as anxiety (Llanes et al., 2018), depression (Guerrera et al., 2019; Muratori et al., 2019), obsessive-compulsive disorder, mood alterations (Simonoff et al., 2008), and oppositional defiant disorder (Levy et al., 2010). Moreover, research has been carried out on eating problems and ASD (Kodak & Piazza, 2008; Rastam et al., 2013).

Anxiety and depression comorbid symptomatology tend to be the principal psychological comorbid difficulties that are present in ASD, and they are more present in people with ASD and high functioning. These include social anxiety, separation anxiety, and obsessive-compulsiveness. Regarding the APA (2013), social anxiety consists of a persistent fear of performance and social interactions and is related to social impairments, directly affecting social interaction and communication (Bellini, 2006; Fagan, 2017). Anxiety is related to difficulty in understanding the perspective of others, bullying, and rejection from others or transitions from one activity to another, among others (Paula, 2015).

Sometimes it is difficult to differentiate obsessive-compulsive disorder (OCD) from the restricted and repetitive patterns and interests in ASD. Frequently, similitudes between these two disorders can lead professionals to an erroneous diagnosis. There is controversy regarding the incidence of autism in people with OCD. Researchers estimate the presence of autism in OCD from 3.8% to 27% (Mack et al., 2010; Ivarsson & Melin, 2008). OCD is described by the DSM- 5 as the presence of thoughts, impulses, or images that are obsessive, compulsive, or both, and recurrent and persistent. These have to be present during long periods of time and cause clinical discomfort. One of the main aspects to consider in the diagnosis of ASD and OCD is that in autism the presence of restricted and repetitive patterns of behaviors is accompanied by a pleasurable affective experience. When ASD is present

with an OCD comorbidity it is important to identify the following characteristics (Paula-Pérez, 2012): a) thoughts and obsessions are experienced as recurrent and unwanted mental intrusions; (b) significant effort is expended to suppress, control, or neutralize the thoughts; (c) the thoughts are recognized as a product of one's own mind; (d) there is an elevated sensation of personal responsibility; (e) the thoughts involve ego-dystonic content; and (f) they tend to be associated with neutralizing efforts.

The identification and appropriate diagnosis of comorbid symptomatology in ASD allows clinicians to better understand the difficulties and the context in which ASD is developed, and, consequently, to perform and address better diagnosis and treatment (Matson & Williams, 2013).

1.2 Social skills interventions

Clinicians and researchers have developed various types of interventions with the goal of improving the core symptoms of ASD. Regarding social interaction difficulties, social skills group interventions have been widely proposed. These treatments are therapies developed to promote and increase certain social behaviors and decrease undesirable social behaviors, by means of different methodologies and contexts (Baker, in Bondy & Weiss, 2013). Social skills interventions are focused on those individuals that exhibit significant social difficulties or impairments.

1.2.1 The need for social skills interventions

Following the review of the “NICE Guideline on the management and support of children and young people on the Autism Spectrum” (2013), social skills interventions are recommended to work on the core deficits in the socialization area of children with ASD. To date, evidence that supports the effectiveness of these treatments is growing, specifically in social skills interventions groups (Reichow et al. 2012). The majority of interventions focus on didactic sessions, including instructional methods to improve social deficits and opportunities to practice new skills (Laugeson et al. 2012; White et al. 2010).

The NICE (2013) states that social skills interventions “aim to improve participants’ ability to understand social situations, to communicate with others and to develop coping strategies.” And consequently, this type of intervention is useful to improve related affective symptomatology (Bohlander et al., 2012; Gates et al., 2017). For these reasons, the introduction of social skills interventions in ASD treatment of children and adolescents is highly recommended and useful (Reichow et al., 2012).

1.2.2 Types of social skills interventions

Different modalities of social skills interventions have been studied. First of all, it is important to distinguish individual from group interventions. The scientific literature has demonstrated that individual social skills training (SST) offers less in the way of ecologically valid social interactions. Moreover, there is a lack of opportunities to get social practice interactions. In contrast, group interventions promote interaction among peers, generating a variety of opportunities to practice the skills that are being learned and developed (Choque et al., 2017; Chester et al., 2019; Dekker et al., 2019).

Another important aspect is the different types of intervention. Over the years, many studies have evaluated the effectiveness of different types of SST (Bohlander et al., 2012; Kaat and Lecavalier, 2014; Reichow et al., 2012; Tierney et al., 2014). For example, there are interventions such as peer mentoring (Wolfberg, 2003), video modeling (Buggey, 2009), social stories (Golzari et al., 2015), picture books, and the most common, social skills training groups (SSTG). In recent years, researchers have included new agents that have been determined to be effective. Some of these studies include siblings (Castorina & Negri, 2011), neurotypical peers (Matthews et al., 2018), and parents and teachers (Dekker et al., 2014).

Regarding *peer mentoring*, Bohlander and colleagues (2012) reported that this type of intervention is regularly applied in preschool-age children and performed in classrooms. Neurotypical peers are taught to interact with children with autism and help them develop their social skills. Training is a must, because typically developing children tend to play with

other typically developing peers. This intervention has proved to be one of the most effective in increasing social skills and maintaining them over the time.

Another type of social skills intervention is *video modeling*. This intervention includes video demonstration of children with ASD and other neurotypical children performing appropriate social skills in order to show how to interact. After watching the video, children with ASD are requested to imitate the behaviors shown. This intervention has demonstrated effectiveness when it is combined with other interventions. Like peer mentoring, research has proved that skills learned by video modeling tend to be generalized and maintained.

Social stories and *picture books* are tools to complement social skills training. Both can be used to teach different skills and situations that require social skills. However, studies evidence that these interventions are effective when they are used as a part of a social skills programs (Bohlander et al., 2012). Children and adolescents can perform the new skills learned in stories or books in groups of social skills.

Finally, the most common and best-studied type of intervention is *social skills groups*. These tend to be used in school-aged children and adolescents. Frequently, these groups include 4 or 5 children with ASD, are managed by teachers or therapists, and are usually performed in school rooms or outpatient clinics. Generally, the contents of these interventions include (Bohlander et al., 2012; McMahon et al., 2013): verbal communication (starting and maintaining conversation, reciprocity, tone voice, humor and jokes, metaphors and sarcasm), nonverbal communication (eye contact, facial expressions, gestures, postures, and general cues of nonverbal language), social interaction (emotion recognition, greeting others, being friendly, joining or initiating play with others, theory of mind) and solving problems (strategies to solve conflictive relationships, bullying, and teasing, and to control negative emotions). Nowadays, many researchers and clinicians include new content, such as mindfulness and relaxation exercises (Pahnke et al., 2014). These techniques might be useful to promote strategies to manage anxiety, stress, and depression symptomatology that may be present in their participants

Regarding the effectiveness of these interventions, there are a lot of manualized, published programs and curricula that have been produced and studied. Most of these programs have been developed by teachers and therapists. For example, Think Social! (Winner & Crooke, 2010; Crooke & Winner, 2017), Social STAR (Gajewski et al., 1994; Vernon et al., 2016), Navigating the Social World (McAfee, 2013), KONTAKT (Choque et al., 2016), Program for the Education and Enrichment of Relational Skills - PEERS (Laugeson et al., 2009; Schohl, 2012), the Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communications Problems (Baker, 2004), and Social Adjustment Enhancement Intervention (Solomon, 2004). All these programs tend to include fun and interactive lessons. However, to date, the effectiveness has not been totally proved and it is unclear whether these programs promote generalization and maintenance over time. Several studies report significant effects on standardized questionnaires and other measures, but little research has demonstrated improvement in generalization by children to other contexts.

The *Think Social!* Program, based on the Social Thinking Methodology developed by Michelle Garcia Winner, is one recognized program to work on social skills. The curriculum is addressed to people with communicative and social-cognitive challenges that affect different contexts of their life. It is addressed to preschoolers, children, and adults with high-functioning autism, among others. It is made up of 69 lessons that can be adapted and adjusted to the group for the professionals.

Another useful and recognized curriculum program is the *Program for the Education and Enrichment of Relational Skills* (PEERS), which is one of the most common and widely used interventions in research to provide evidence-based effectiveness of social skills intervention to preschoolers, adolescents, and young adults with ASD. This intervention is used in more than 80 countries. The program includes sessions of 90 minutes every week over 16 weeks. Participants attend the sessions with their caregivers to provide strategies to maintain the skills learned in the intervention. Children and teenagers learn social skills such as making and maintaining friendships, handling conflict and rejection,

sharing and taking turns, asking for and giving help, and listening and following directions, among others. All these skills are taught through didactic lessons and role-playing, also providing the chance to practice the skills in socialization group activities (Semel Institute for Neuroscience and Human Behavior, UCLA PEERS Clinic, 2020).

The *Social Skills Training Project*, developed by Jed Baker, is recognized as one of the most effective for teaching social and emotional skills. This program uses a cognitive-behavioral approach to teaching social skills to children, adolescents, and adults that have social-communication difficulties. Specifically, the Social Skills Training for Children and Adolescents with Asperger Syndrome and Social-Communication Problems includes the development and practice of 70 social skills, such as conversational skills, cooperative play skills, friendship management, self-regulation, empathy, and conflict management. The content is developed through didactic lessons and activities that allow participants to practice.

Another social skills group training program that has become more popular and has demonstrated effectiveness is Lego Therapy (LeGoff, 2004). This program assigns responsibilities for each participant that involve collaboration, cooperation, and interaction among them, and also provides many opportunities to interact. Bohlander and colleagues (2012) proposed that this kind of intervention be applied to other concepts of social skills groups (e.g., cooking)

Regarding social skills groups, different strategies have been used, but the most traditional and common interventions are the structured-learning approach. These strategies include didactic instructions, modeling, role-playing, structured practice, inappropriate behavior correction, accurate instructions, and structured play (for example PEERS program). However, during the last twenty years, other strategies have been applied to teaching and performing social skills. Clinicians and researchers have developed interventions that include social performance training. These programs train social skills implicitly, while participants are engaged in different activities or games. There are also programs that try to teach through implicit social skills instructions, such as Lego therapy, which motivates participants to collaborate in activities that are interesting for them. Another

strategy used is the social skills support group, where participants discuss and reflect on social experiences (McMahon et al., 2013). Finally, there are programs that try to combine a structured-learning approach and social performance training strategies. For example, Solomon (2004) developed a program that is less structured than most traditional programs. It includes semi-structured instructions, positive reinforcement, motivation for social interactions, and free-time play as an opportunity to practice. The global vision of this latest intervention is the *inside out vision*, which aims to promote and motivate the necessity of the social world (Baghdadli et al., 2013; McMahon et al., 2013).

There is no evidence as to which strategy is the most effective. Many studies have focused on the structured-learning approach, but few studies have evaluated the effectiveness of the other approaches.

In order to acquire generalization and maintenance, social skills training groups have included other participants in addition to the children: parents (Stichter et al., 2010; Webb et al., 2004), siblings, and typically developing peers (Koenig et al., 2010; White et al., 2010). These agents provide support and psychoeducational training at home, both during and after the intervention. Also, peers and siblings serve as a role model of positive and adaptive social competence. However, not all interventions include other agents. Other strategies used to promote generalization and maintenance include monthly meetings with participants, proposing tasks related to the intervention for practice at home and school, and organizing meetups during or after the intervention (Laugeson et al., 2012; Lopata et al., 2008).

A number of systematic reviews (Gates et al., 2019; Jonsson et al., 2016; McMahon et al., 2013; Reichow et al., 2013) have pointed out that there are many differences regarding length and intensity of interventions, the settings where they are performed, the numbers of therapists, and the number of participants.

There is controversy regarding the required duration for the intervention to achieve effectiveness (Gates et al., 2018). Some SSTs are short and intensive programs that can be implemented in brief periods of time, for example during the summer, such as the

“SummerMAX” program (Thomeer et al., 2016). These interventions tend to include interventions of one or two months’ duration. In contrast, other interventions may be implemented for as long as two years (Kamps et al., 2015; Lopata et al., 2010). The majority are designed to run concurrently with the academic year (Katt & Lecavalier, 2014).

There is also variability in the number and the length of the sessions. They vary from 1 or 2 hours a week (Reichow et al., 2013; Katt & Lecavalier, 2014) to 5 or 6 hours a week (McMahon et al., 2013). Jonsson and colleagues (2016) reported that some studies include less than 10 sessions (Lerner & Mikami, 2012), and others more. However, the majority of the programs include between 12 and 20 sessions of 60 to 120 minutes each. The results as to which is more effective are inconsistent. Finally, in relation to generalization and maintenance of the abilities, studies suggest that less than 30 hours of intervention is not enough.

Another important aspect is the setting where the intervention is carried out. This may be in schools and classrooms, clinics and research clinics (Baghdadli et al., 2013; Begeer et al., 2011; Frankel et al., 2010; Koenig et al., 2010 and Schohl et al., 2014), the university, or elsewhere in the community (Lopata et al., 2010; Solomon et al., 2004, Thomeer et al., 2012). According to McMahon and colleagues’ (2013) review, each setting could be positive or negative depending on different aspects. For example, one setting might be more effective for people with hypersensitivity or hyperactivity and another more positive for anxious people. To date, it is proved that naturalistic environments facilitate generalization and maintenance of learned skills.

There are also differences regarding several aspects of trainers, such as quantity, qualification, and role. In relation to the number of trainers, there is a range of from 1 to 4 per group (Jonsson et al., 2016; Reichow et al., 2013). Secondly, there is variability in the qualification and education of the trainers. Some interventions include post-graduate, graduate, or undergraduate students (Beaumont and Sofronoff, 2008; Laugeson et al., 2009; Lopata et al., 2010; Schohl et al., 2014; Thomeer et al., 2012; White et al., 2013; Yoo et al., 2014). Other programs include clinical psychologists, psychotherapists, psychiatrists, social

workers, registered nurses, and speech and language pathologists (Solomon et al., 2004; McMahon et al., 2013). Furthermore, there are interventions carried out by teachers. Finally, the role of the trainer is another important factor. Some trainers are more active and others tend to be more passive. It depends on the level of structuring of the intervention.

In relation to participants, the majority of interventions in SSTG are applied to children and adolescents. The age range varies from 6 to 13 years old (Jonsson et al., 2016), or up to 18 years old (Katt & Lecavalier, 2014). The number of participants is also different between interventions. Some studies include 2 to 6 participants (Reichow et al., 2013) and others 4 or 5 children (Bohlander et al., 2012).

Finally, inclusion and exclusion criteria are also important factors in social skills interventions.

For inclusion in an SSTG, there are many common criteria in the majority of interventions. Two generally important criteria are that participants and their families be interested in the intervention purposed, and that participants have deficits in social skills that may be improved in the intervention program.

Regarding specific criteria, researchers show a great deal of agreement. One of the most important and consistently present inclusion criteria is the intelligence quotient (IQ). Most of the interventions require an IQ above normal range or superior. Others are more specific, and demand a sufficient or average verbal IQ (McMahon et al., 2013). Another important criterion is the absence of severe comorbid mental health problems and severe behavioral problems, such as aggressiveness (Jonsson, 2016). Additionally, there are other studies that request that children or adolescents spend some time in general education settings before participating in an SSTG.

There is also concordance with the instruments that are used to assess and measure these criteria. First of all, the most common instruments to confirm ASD are the Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2001) and the Autism Diagnostic

Interview Revised (ADI-R, Rutter et al., 2003, 2008). Both instruments are frequently used (Solomon et al., 2004; Vernon et al., 2016). Another screening for ASD symptomatology is the Social Communication Questionnaire (SCQ, Rutter et al., 2003) (Koenig et al., 2010; Lerner & Mikami, 2012). The Vineland Adaptive Behavior Scales is another instrument to assess adaptive behavior and developmental disabilities that has been used by many researchers (Schohl et al., 2012; Matthew et al., 2019; Rabin et al., 2018). Regarding one of the most important criteria, the IQ, two instruments are most often used: the Wechsler Intelligence Scale for Children or Adults (WISC and WAIS, Wechsler, 1991, 2003, 2014) (Dekker et al., 2019; Guivarch et al., 2017) and the Kaufman Assessment Battery for Children (K-ABC, Kaufman & Kaufman, 2004) (Baghadadli et al., 2013), or its shorter version (KBIT-2, Kaufman & Kaufman, 2004) (Dolan et al., 2016). Finally, to assess several psychopathologies and behavioral problems, researchers (Choque et al., 2016; Jonsson et al., 2019) use the Kiddie Schedule for Affective Disorders and Schizophrenia for School Aged Children (6-18 years old) (K-SADS-PL, Kaufman et al., 2016). This long interview includes evaluation of depressive and bipolar disorders, schizophrenia spectrum and other psychotic disorders, anxiety, obsessive-compulsive and trauma disorders, neurodevelopmental, disruptive and conduct disorders, eating disorders, and substance disorders.

1.2.3 The relationship between social skills interventions and anxiety

As mentioned earlier, anxiety may be present in ASD as a comorbidity. Recent studies have confirmed the relationship between autism and social anxiety. Social anxiety is defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V, 2016) as “persistent fear of one or more social or performance situations in which the person is exposed to unfamiliar people or to possible scrutiny by others. The individual fears that he or she will act in a way that will be embarrassing and humiliating”. Moreover, “the feared situations are avoided or else are endured with intense anxiety and distress. Finally, the avoidance, anxious anticipation, or distress in the feared social or performance situation(s) interferes significantly with the person's normal routine, occupational (academic) functioning, or social activities or relationships, or there is marked distress about having the phobia” (American Psychiatric Association, 2013).

Bauminger and Kasari (2000) revealed that people with ASD tend to be in a vicious circle of social isolation: they have a desire to socialize with others but do not have relationships or poor friendships, so they express feelings of loneliness and depression, and do not know how to interact appropriately with others. Avoidance and isolation of social situations become habitual responses and, in turn, the reduction of social contact promotes deterioration of social skills and higher levels of anxiety and depression. Researchers have described these difficulties as being more present in high functioning autism spectrum disorders (Bellini, 2006; DeRosier et al., 2010 and Pickard et al., 2017).

Research suggests that children and adolescents with ASD who participate in an SSTG tend to improve their skills and knowledge about social competence and reduce their avoidance of social contact. As a consequence, their social anxiety is lowered (Schohl et al., 2012; McMahan et al., 2013; Guivarch et al., 2017).

In recent decades, specific interventions and programs to reduce anxiety in children and adolescents with ASD have been developed. One of the most important programs to treat anxiety is *The Coping Cat* (Kendall & Hedtke, 2006.). This is an integrative program for children between 7 and 13 years old that presents a diagnosis of anxiety type. This program allows professionals to teach children how to recognize and face anxiety through different strategies that allow them to reduce the levels of symptomatology. Through this program, researchers adapted a version for people with ASD and anxiety, the C.A.T (McNally et al., 2014). This program includes 16 sessions for adolescents (between 12 and 17 years old) with a diagnosis of anxiety disorder and ASD (e.g., social phobia, social anxiety, generalized anxiety, and separation anxiety, among others).

1.2.4 Factors that influence social skills interventions

The scientific literature has examined the factors that may influence the effectiveness of social skills training groups. There is controversy in the results.

Firstly, one important factor is the intelligence quotient (IQ). In the last twenty years, researchers have been developing interventions addressed to children and adolescents with a specific IQ range. A recent systematic review confirms that participants with higher cognitive abilities and good verbal intelligence quotient demonstrated greater improvement and benefit after the intervention (Gates et al., 2018). Furthermore, Solomon and colleagues (2004) observed that children grouped with higher IQ improved their depression symptoms. However, other studies have not found differences in improvements related to IQ (McMahon et al., 2013).

In relation to IQ, many researchers not only consider general intelligent quotient, but also contemplate and measure verbal IQ. It is known that ASD involves language impairment or difficulties; therefore, these investigations include evaluation of verbal comprehension abilities before including patients in interventions (LeGoff, 2004).

Secondly, age has been studied as another important factor that might interfere with the effectiveness of social skills interventions. First of all, it is important to bear in mind that social skills begin to develop in the early years. A number of studies have revealed that parents observe that social skills increase from kindergarten through third grade. Between 2 and 5 years of age children are expected to show cooperation, assertive behavior, and self-control (Takahashi et al., 2015), and up to 21 years of age there are many heterogeneous developmental trajectories for social skills (Luengo et al., 2013). These same authors also observed in their study that adolescents showed an initial decline in prosociality from age 13 to 17 and a subsequent increase until age 21, suggesting that adolescence could be an appropriate period for strengthening social behavior, and developing and working on the foundations for subsequent development. But there are many controversial results as to what age is the most suitable for working on social skills.

On the one hand, there are some authors that found positive results regarding social skills in adult ages (Howlin & Yates, 1999; Herbrecht et al., 2009; Hillier et al., 2007). On the other hand, some researchers have found that children demonstrated better improvements than adolescents (McMahon et al., 2013). Specifically, in the McMahon et al. study the

authors observed that adolescents made fewer social initiations than children. In contrast, Choque and colleagues (2017) observed greater improvement in adolescents, specifically females, with positive effects in social responsiveness, general clinical severity, and adaptive functioning. Much research has been done, but larger samples are needed to assess the differences between ages (Jonsson et al., 2019).

Thirdly, sex has also been studied and analyzed as an influencing factor, but like the other two factors, little has been found and the results reported have been controversial (Gates et al., 2018). The main difficulty in trying to obtain powerful results is that there are big differences and no equivalence in the numbers of male and female participants. The majority of studies include males and females, but the samples are insufficient to perform statistical analysis and derive significant results. Only the two studies already mentioned reported significant numbers of females compared to males. One of these studies observed greater improvements in females than males (Choque et al., 2017). The other observed that at the beginning of the intervention, males spent significantly more time by themselves than did females, indicating less needed for or abilities in social interaction (McMahon et al., 2013).

Finally, there are some comorbidities that have been studied as influencing factors in the effectiveness of social skills interventions. Like the other factors, some researchers had found that ADHD and anxiety symptoms decreased ToM performance in autistic children (Sinzing et al., 2008). But another study did not observe that these two comorbidities moderated the effectiveness of the treatment (Deckers et al., 2016).

More research regarding the influence of different variables in effectiveness is needed, to improve social skills interventions and derive the maximum benefit for participants.

1.2.5 Conclusions on social skills interventions

In collecting and summarizing all the information that has been published in recent years in relation to social skills interventions, we find that the literature highlights the need to develop and apply interventions that focus on social competence in ASD people.

To date, there are many differences between interventions. Clinicians and researchers developed individual and group interventions. There are differences between the structure of such programs, including sessions that are more structured or less, didactic sessions, role playing, and with free play time. Recent interventions are starting to include new agents such as parents, siblings, teachers, and peers. Regarding the methodologies, some interventions include peer mentoring, others video modeling or new materials (stories and picture books), but all them aim to improve social skills and social competence in people with ASD.

Notwithstanding the above, there are still many controversial results and areas of incomplete understanding about some factors that can or cannot influence the effectiveness of these interventions. Researchers do not agree on aspects such as, the setting, duration, and the number of participants or trainers. Other important aspects studied as influencing factors include the cognitive ability that participants must have to benefit from the intervention, the appropriate age for it, and the sex of the participants. Nor is there a consensus on whether comorbidities influence the effectiveness of the programs.

For all these reasons, it is important for researchers to continue to research and carry out social skills interventions, which we know to be effective in increasing and improving social skills and social competence, even though there is still a lack of knowledge as to what types of interventions and which factors influence the effectiveness. Therefore, we need to improve our research and our method of assessment and evaluation of the effectiveness of these interventions.

1.3 Methodologies to assess changes in social skills training interventions

1.3.1 The need for new methodologies

Different outcome measures have been used over the years to assess the effectiveness of programs to improve social skills in children and adolescents with ASD. However, there has always been some controversy regarding the different aspects that can be assessed in a social skills intervention and the different ways to assess the effectiveness and their validity.

On the one hand, it is important to stress that most of the studies assess the evolution and changes in social skills, including improvements in social knowledge and social performance (Gates et al., 2018). This includes the measurement of different social areas of participants, including assessing the improvements in social abilities, the number of friends after intervention, and social behavior before and after intervention, as reflected in, for example, improvements in eye contact, verbal and nonverbal communication, or the number of interactions (Bauminger, 2002; McMahon et al., 2013).

On the other hand, comorbid symptomatology has become another important focus in assessing these studies. Many researchers have been interested in measuring improvements in anxiety or depressive symptoms after social skills interventions (Schohl et al., 2012; Guivarch et al., 2017.).

Scientific researchers use different sources of information, such as parent-reports, teacher-reports, self-reports, observer-reports, and task-based assignments to assess changes. Gates and colleagues (2019) reported that self-reporting reveals significant effectiveness in intervention, comparing experimental groups and control groups, while parent-reporting also informs about effectiveness, but less than self-reporting does. Regarding teachers, their reports did not evidence significance in interventions. Finally, observer reports and task-based measures supply significant evidence of effectiveness in intervention, but there are few investigations that have used them.

These sources contribute to determining whether there are changes after a specific intervention. To date, different methodologies have been used over the years.

1.3.2 Questionnaires as a measure

The most common quantitative measures to assess social skills interventions are questionnaires, which are implemented before and after the intervention. These have been used over the years to assess difficulties related to social impairments such as social skills, loneliness, problem solving, ToM, emotional recognition, and problems related to comorbid symptomatology.

In order to assess these different dimensions, there are common measures that have been used by researchers. Social skills competence has been assessed with many questionnaires. The ones regularly used are the Social Skills Rating Scale (SSRS, Gresham & Elliot, 1990), the Pro-Social Index of the Social Competence Inventory (SCI, Rydell et al., 1997), the Social Responsiveness Scale (SRS, Constantino, 2012.), and the Test of Adolescent Social Skills Knowledge (TAASK, Laugeson & Frankel, 2006). To assess other topics related to social skills, researchers tend to use the Theory of Mind Assessment Scale (Th.o.m.a.s; Bosco et al., 2009) and the Loneliness Scale (Asher & Wheeler, 1985) (Bauminger, 2002; Barry et al., 2003; Rabin et al., 2018; Matthew et al., 2019).

One of the questionnaires most widely used by researchers is the SSRS. This questionnaire includes information from parents, teachers, and the children themselves (from 3 years old to 18 years old). It provides information on different social behaviors (e.g., relationships, peer acceptance, academic performance). It also assesses cooperation, empathy, assertion, self-control, and responsibility. Another of the most widely applied questionnaires is the TAASK, which assesses knowledge about the specific social skills worked on during the intervention.

Regarding comorbid affective symptomatology such as anxiety and depression, researchers tend to use the Social Interaction Anxiety Scale (SIAS, Mattick & Clarke, 1998), the Screen for Child Anxiety and Related Emotional Disorders (SCARED; Birmaher et al., 1999) (Deckers et al., 2016), the Perceived Stress Scale (PSS; Cohen et al., 1983) (Choque et al., 2017), the Stress in Children questionnaire (SiC; Osika et al., 2007) (Jonsson et al., 2019), and the Spence Children's Anxiety Scale (SCAS; Spence, 1997).

The SIAS is a valid and reliable self-rating scale that is often applied in research to assess distress and social anxiety when interacting in social situations with friends, the opposite sex, and strangers.

In order to assess other psychological comorbidities such as problem behavior, aggressive behavior, and obsessive behavior that may be present in different areas, families, or schools, investigations include the Achenbach school-age assessment (Achenbach, 2001) (Koenig et al., 2010) or the Behavior Assessment System for Children - 2 (BASC-2; Reynolds & Kamphaus, 2004) (Thomeer et al., 2016).

The Achenbach school-age includes different dimensions to assess symptoms of anxiety, depression, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. It also has two global dimensions that include internalizing and externalizing problems. This questionnaire provides clinicians and researchers a general view of symptomatology present before and after an intervention. There are three different formats: the Child Behavior Checklist (CBCL), completed by parents, the Teacher's Report Form (TRF), and the Youth Self-Report (YSR).

None of these questionnaires is specific to assessment of difficulties and comorbid symptoms in autism spectrum disorders, but they have been used for years with useful results.

Positive results have been observed in social skills interventions, through questionnaires. Researchers observed greater improvements in experimental groups (Solomon et al., 2004, Schohl et al., 2013). Furthermore, there has been observed to be an

enhancement in problem-solving, social awareness, mannerisms (DeRosier et al., 2011), understanding of idioms, and emotional empathy, as well as reduced symptoms of ASD (Thomeer et al., 2016; Matthew et al., 2019; Rabin et al., 2018).

Regarding comorbidities, improvements have also been detected. Solomon and colleagues observed a diminution in depression symptoms in children with higher intelligence quotient. Coinciding with these results, another research study assessed the decrease in social anxiety symptomatology (Schohl et al., 2016) and feelings of loneliness (Rabin et al., 2018). Conversational skills and familiarity with other peers can provide improved abilities to maintain reciprocal conversations, and, as a consequence, these skills may in turn lower social anxiety (McMahon et al., 2013). Moreover, other studies have reported a decrease in oppositional and problem behaviors and anger (Guivarch et al., 2017; Matthew et al., 2019).

From the beginning, questionnaires have been the principal measure used to assess almost all kinds of intervention. But despite all the new developments and advances, many researchers describe problems in obtaining real objective and complete measurement of social skills evolution and changes after intervention in this population (McMahon et al., 2013). Some authors have found significant results in their assessments through questionnaires (Lopata et al., 2010; Schohl et al., 2012) but others describe multiple problems in obtaining completed measures and significant results in questionnaires. They have also encountered controversy in the divergence between results obtained in questionnaires and the clinical observations made by the professionals carrying out the intervention (Koenig et al., 2010; Lerner & Mikami, 2012). Scientific literature highlights the difficulties in obtaining objective and truthful results from teachers' questionnaires. Generally, reported information gets lost, because questionnaires are not completed or returned to the clinicians, so they end up being discarded (Tyminski & Moore, 2008). In general, measurement through questionnaires has turned out to be an unreliable and ineffective manner to assess evolution in social skills and social competence. Furthermore, questionnaires that assess social skills may sometimes be measuring the knowledge or social understanding of the respondents, but

not their performance with social skills, especially in the format in which the respondent is the person being evaluated.

Regarding comorbidities, the outlook is different. Many researchers have used specific questionnaires to measure symptoms, obtaining appropriate results and reliability (Solomon et al., 2004; Schohl et al., 2012).

1.3.3 Observational methodology

Of late, a number of different methodologies have begun to appear to assess, more effectively and accurately, improvements and evolution of participants of social skills training interventions. These methodologies aim to be more specific and accurate, providing a holistic view of the person.

In recent decades, there has been some controversy regarding qualitative and quantitative data (Jonsson et al., 2016; MacMahon et al., 2013; Reichow et al., 2013). Lately, a new concept has begun to take on importance in research, allowing scientists to use qualitative and quantitative data. This mix of data is what scientists call a *mixed method perspective* (Anguera et al., 2017). This new concept allows the researcher to assess changes in behaviors, obtaining objective and high-quality data (Ruble et al., 2008; Koning et al., 2012; Webb et al., 2004).

One of these methodologies is observational. This methodology allows one to analyze spontaneous behaviors that occur in different natural contexts (Bakeman and Gottman, 1986), such as interactions between therapist and patients, interactions between participants of a therapy group, or even interactions that occur within the daily life in the family, at school, or with friends (Anguera, 1979, 2003, 2017; Anguera & Izquierdo, 2006; Portell et al. 2015; Sánchez-Algarra & Anguera, 2013). The methodology is based on the observation of behaviors through different approaches. Using different instruments, for example video and audio recording, allows researchers and clinicians to observe, study, and analyze the spontaneous behaviors that occur in the natural situation or relation being studied.

Observational methodology allows observers to obtain qualitative data and transform it into quantitative, combining inductive logic with deductive throughout the process (Bergan, 2010, Castañer et al., 2013).

This methodology requires structure and discipline in performance, data collection, and analysis. Scientists that apply this method need to be very rigorous, to delimit the objectives and obtain good knowledge of all the possible branches and procedures that exist within this methodology.

Researchers can use direct or indirect observation (Anguera, 2020; Casal et al., 2019). On the one hand, direct observation is that captured on video and allowing observation of eye contact, gestures, facial expressions, postures, movements, and conversations. But there is also indirect observation, offering information on the content of data such as *WhatsApp*, writings, tweets (Arias-Pujol & Anguera, 2020a), and additional information about what the message is.

Another important aspect is the design of the observational methodology. As many as eight different designs have been described. The design is a guide that provides information for the following decisions regarding the instrument or the analysis of data. Following Anguera, Blanco-Villaseñor and Losada (2001), designs are set up under three criteria: units of the study, continuity of recording, and the number of dimensions.

1. The units of the study refer to the number of units that will be observed. This could be ideographic (one only unit, for example, or only one subject) or nomothetic (more than one unit, for example a psychotherapy group).
2. The temporality of the register involves the time that the observation is going to be made. It could be static (point and single observation) or dynamic (follow-up, for example, observation of various sessions of psychotherapy).
3. Finally, the last criterion is dimensionality. This refers to the levels of response: unidimensional (only one dimension is observed, for example eye contact) or multidimensional (several dimensions are observed).

Taking these criteria into account, we may obtain up to 8 different designs:

1. Idiographic - Point - Unidimensional (I/P/U)
2. Idiographic - Point - Multidimensional (I/P/M)
3. Idiographic - Follow-up - Unidimensional (I/S/U)
4. Idiographic - Follow-up - Multidimensional (I/F/M)
5. Nomothetic - Point - Unidimensional (N/P/U)
6. Nomothetic - Point - Multidimensional (N/P/M)
7. Nomothetic - Follow-up - Unidimensional (N/F/U)
8. Nomothetic - Follow-up - Multidimensional (N/F/M)

Once the design is selected, the instrument can be developed. Observational instruments for clinicians (Bauminger, 2002; Lerner & Mikami, 2012, McMahon et al., 2013) and for parents and teachers (Social Skills Observation (SSO, 200 by Deckers et al., 2016)) have been developed. In observational methodology, instruments are developed *ad hoc* or adapted by the researchers to suit the studied situation. Furthermore, on some occasions, an instrument already validated in previous investigations can be adapted. This developed or adapted instrument is adjusted to the objectives and the reality that researchers want to study. Behind the instrument, there is a huge effort and work defining and exploring the behavior definitions. The most common instruments in this methodology are the *category system* and the *field format*. The instruments have to consider the participants, the activity, and the context (Anguera et al., 2007).

The *category system* involves the development of an instrument that integrates theory and reality. These categories should obey exhaustive and mutually exclusive criteria. All the categories should be described perfectly. It is very useful to include examples and counterexamples.

The *field format* is more flexible than the category system. It is also faster to develop than other instruments, because it does not require a theoretical framework. The catalog of behaviors should be mutually exclusive but not exhaustive.

The format most commonly used in recent years is a combination of the category system and the field format. This instrument includes the strengths of both and allows researchers to include different dimensions.

There are two different types of instrument reported: recording devices and observational instruments created by the researchers. After the observational instrument is developed, researchers should select the recording instrument. There are several options in doing this. To collect visual data, researchers tend to use video recorders. If the data to be collected are auditory, researchers can record the event. Sometimes researchers use direct and *in vivo* observations. All these manners of collecting data should be conducted with previous informed consent or informed assent and also following the principles of the 2000 Helsinki Declaration.

With the aim of preserving and guarantying the objectivity and rigor and quality of the data, interobservers that collect data and code must reach an appropriate degree of agreement. This agreement may be calculated with Cohen's Kappa coefficient (Cohen, 1960) or an adaptation, Krippendorff's canonical agreement coefficient (Krippendorff 2013).

These kappa coefficients can be obtained using various computer programs (LINCE, HOISAN, GSEQ5, among others). Landis and Koch (1977) propose a scale to assess the level of agreement of kappa: <0.00 (poor), >0.00 - 0.20 (slight), 0.21 - 0.40 (fair), 0.41 - 0.60 (moderate), 0.61 - 0.80 (substantial), and 0.81 - 1.00 (almost perfect).

After obtaining the appropriate agreement, researchers code and analyze the data. To record and code all data recorded with video or audio, different programs may be used. Some of the most common instruments for direct observation (videos) are Lince multiplatform sports analysis software (Gabin et al., 2012), GSEQ Software for the Analysis of Interaction Sequences, and HOISAN 1.2 (Hernández-Mendo et al., 2012). For indirect observation (interviews), the choices include Atlas.ti (Gibbs, 2007), AQUAD7 (Huber & Gürtler, 2012), and ELAN (Wittenburg et al., 2006). All these instruments allow the researchers to transform qualitative data into quantitative data, analyzing large bodies of textual, graphic, and video material and performing analysis to better understand the behavior in question.

Through these instruments, researchers are able to use quantitative data obtained from observational recordings (Blanco-Villaseñor, Losada, & Anguera, 2003; Sánchez-Algarra & Anguera, 2015).

Two different approaches have been described: the diachronic and the synchronic. The first offers the study of behavioral structures. The second contributes the study of the type and intensity of a relationship in a particular situation.

With the diachronic approach, three different techniques may be employed (Arias-Pujol & Anguera, 2020a):

1. Sequential retarded analysis: this analysis allows detection of behavior patterns that emerge from the statistically significant association relationships between different sequentially recorded codes. This technique was proposed by Bakeman (1978) and computerized through two different programs, SDIS-GSEQ and GESQ5 (Bakeman & Quera, 1996, 2011).
2. Polar coordinate analysis: this was applied by Sackett (1980) and later by Anguera (1997). This technique allows the reduction of data using the Zsum statistic ($Z_{sum} = \Sigma Z / \sqrt{n}$), where Z represents the independent values obtained from the adjusted residuals found for the respective delays of - 5 to - 1 and 1 to 5, and n represents the number of delays considered. The Zsum values allow one to estimate the type of relationships established between the selected focal behavior and the other behaviors (conditioned behaviors) that constitute the instrument of observation. The type of relationship between focal and conditioned behaviors is shown qualitatively (Quadrant I, II, III, or IV) and quantitatively (vector length). This analysis may be performed with the HOISAN program (Hernández-Mendo, López-López, Castellano, Morales-Sánchez, & Pastrana, 2012).
3. T-patterns detection analysis: this technique is the most recent one. It allows one to observe the hidden structures that are under the development of the recorded behavior. This analysis contributes to predicting behavioral patterns. The mathematical algorithm that enables to perform this analysis and obtain this information was created by Magnusson (1996,2000).

Once the analytical techniques used offer some results (sequential patterns of behavior, polar coordinates, or T-patterns), researchers interpret them according to the established theoretical framework. This task requires rigour and dedication, as the data have been transformed and offer new information that is not often obvious to the naked eye.

Progressively, observational methodology has been used in different contexts. In the field of psychology, we see different studies with diverse objectives that use this methodology to assess behaviors, communication, or relationships in different areas of the same field.

This methodology has been used in the study of babies (Mitjavila García, 1990; Riberas Bargalló, 1998) and adults (Cuervo, 2014), as well as children (Arias-Pujol et al., 2015; Venturella, 2016) and adolescents (Arias-Pujol & Anguera, 2004, 2005, 2017, 2020b), and to assess experience in specific interventions (Friedlander et al., 2016). It has been employed in areas such as the elaboration of the bereavement, the interaction between patient and therapist, and the interaction between participants in a psychotherapy group.

Many researchers have used this methodology to observe different aspects of relations and communication or even to measure adherence (Jonsson et al., 2019). One study used this methodology to observe and measure friendship reciprocity in an autism population, analyzing temporal patterns and associations between behaviors. The authors performed different analyses that are part of mixed methods: lag sequences and polar coordinates (Rodríguez-Medina et al., 2018). Behavior patterns were also analyzed in another research study to describe interaction in neurotypical adolescent group therapy, finding that certain behaviors exhibited by the therapist stimulated the appearance of positive behaviors in the child (Arias-Pujol and Anguera, 2017). Another study assessed behavior patterns in siblings of ASD children (Venturella et al., 2019). A recent study used mixed methods through systematic observation to analyze how specific modes of therapists and depressive patients are involved in the early therapeutic alliance in each participant. They found that therapists' and patients' verbal and non-verbal modes determine stable patterns and associations related to the reciprocal construction of the alliance in the patients (Del Giacco et al., 2020).

In other disciplines, polar coordinate analysis has been used to observe child interactions in a school context (Herrero, 2000; Escolano-Pérez et al., 2019) and to assess relations in motor skills interactions in football (Castellano et al., 2003; Castañer et al., 2017).

In conclusion, these types of methodology provide more objectivity and ecological validity, and allow us to observe and understand human behaviors and relationships. However, they have been described as a time-consuming and resource-intensive (McMahon et al., 2013). Moreover, although research studies are using this methodology to assess social behavior, there have not been not enough investigations with sufficient samples to allow researchers to generalize the results obtained.

1.3.4 Summary of methodologies

To date, different methodologies and analyses have been made to assess not only comorbidity, but also social behaviors and experiences perceived in ASD interventions. Both methodology types, quantitative and qualitative, have yielded interesting and valid results, which are more exhaustive and precise when they are combined, as a mixed method. Nevertheless, there is still controversy about which is the most appropriate method to measure the different variables that are present in ASD interventions. Questionnaires seem to be useful to measure comorbidity such as, anxiety, depression, and ADHD. Despite the large number of studies that evaluate social skills programs in children with ASD using questionnaires, there are still doubts about the utility of measuring social competence and social skills with these measures. In contrast, not as much research has been done on qualitative measures in the same field, but the little that has been done has reported specific and detailed information about social behavior that allows researchers and clinicians to better understand their participants and patients.

1.4 The importance of continuing research in social skills intervention in ASD

In general, the literature suggests that children with high functioning ASD benefit from social skills interventions, improving their social competence (Solomon et al., 2004;

Baghdadli et al., 2013), and that small improvements in social skills may have significant implications in children's lives (Deckers et al., 2016).

Some studies have examined the different profiles and variables that directly affect the effectiveness of these interventions (Solomon et al., 2004). Many agents and factors are present in the interventions, and it can be difficult to understand what the effectiveness in the progress is. Also, there is a need to evaluate social behaviors through operational observations (Lopata et al., 2010) or to use qualitative measures to assess different aspects. Some researchers propose observational measures to corroborate report fidelity (Lerner & Mikami, 2012) and assess changes in natural contexts, to acquire more ecologically valid data and generalizable results (Deckers et al., 2016; Vernon et al., 2016; Thomeer et al., 2016). Finally, it is important to bear in mind that surveys or questionnaires are susceptible to random responding, social desirability biases, and demand characteristics, especially among parties invested in a particular outcome. Consequently, the use of new alternative measures is necessary.

In conclusion, since autism was recognized as a mental disorder, research has grown abundantly, especially in the assessment of the effectiveness of social skills intervention. Many researchers describe the necessity to continue investigating the different factors that could interfere in the effectiveness of these types of intervention. Large numbers of studies have been made to determine whether age, intelligent quotient, sex, and comorbidities interfere with effectiveness, or whether the number of participants or therapists, or duration of sessions, is related to the effect of the intervention. Finally, there has been controversy concerning the methodologies used to measure improvements in this population, especially concerning what is actually measured and the validity of those results.

For all these reasons, more studies of mixed methods methodology (quality-quantity) are needed, in order to determine whether this methodology can contribute powerful results and information that would be useful to clinicians.

2. OBJECTIVES AND HYPOTHESIS

Based on the theoretical framework discussed above, this doctoral thesis offers the following objectives and hypotheses.

OBJECTIVES

Objective of study 1: To evaluate the effect of a community adaptation of a social skills training program developed by Solomon et al. (2004) on a group sample of children and adolescents with ASD through specific indicators: a) assess comorbid symptomatology present in ASD before and after the intervention; b) measure changes in core symptoms (i.e., social behavior) in a specific sub-sample; c) and conjoin the previous two and attempt to assess whether there is a better response to treatment in participants with a Verbal Intelligence Quotient (VIQ) higher than 90 and whether there is a better response in relation to age (Study 1).

Objective of study 2: To demonstrate how polar coordinate analysis can be useful in studying social behaviors in adolescents with ASD during a group of social skills intervention. Moreover, to observe how Bauminger's scale adaptation (2002) could be combined fruitfully with polar coordinate analysis, and, finally, to investigate whether typical ASD behaviors show similar interrelations (prospective and retrospective sequentialities) to behaviors observed in psychotherapy (Study 2).

Objective of study 3: To identify changes in social behaviors through analysis of the type of relationships established between the selected focal behavior and the other behaviors in children with ASD who participated in a social competence intervention program and detect whether there exist differences in these behavior relationships in children regarding comorbidities and the intelligence quotient (Study 3).

HYPOTHESES

Hypothesis of study 1: a) Regarding comorbidity, we expect that anxiety and mood difficulties will decrease after the intervention; b) in relation to social behaviors, we hypothesize that the quantity of social conducts will be higher at the end of intervention; and finally, c) we hypothesize that age and range of VIQ will be factors that influence the evolution and improvements of social skills (Study 1).

Hypothesis of study 2: a) We expect that polar coordinate analysis will provide specific and detailed information about social behaviors in adolescents with ASD during an intervention of social skills, and b) we hypothesize that similar social behaviors will be observed during the psychotherapy (Study 2).

Hypothesis of study 3: a) We expect that behavioral patterns will be different between the initial session and the final session, and b) we hypothesize specifically that we will observe improvements in the quality of behavioral patterns in children without comorbidities and high VIQ (Study 3).

3. METHOD

A number of study formats were developed to achieve the objectives and hypotheses raised. Methodologies were selected and applied according to the objectives to be investigated. All three studies are based on one large study; therefore, the *participant selection, instruments* applied to *assess inclusion and exclusion criteria*, and the *procedure* are the same. The *design, sample, and instruments to assess changes* and the *analyses* are different for each objective described in each study.

Participants and design: All subjects were recruited by psychologists and psychiatrists from the Multidisciplinary Autism Spectrum Disorder Unit (UnimTEA), Hospital Sant Joan de Déu (HSJD), following the hospital's ethics policy.

For the three studies, the same inclusion criteria and exclusion criteria were proposed. Inclusion criteria included an age range of 8-12 years old (for children) and 13-17 years old (for adolescents), diagnosis of ASD confirmed according to DSM-5 criteria (American Psychiatric Association, 2013), evaluated with the Autism Diagnostic Observational Schedule-2 (ADOS-2; Lord et al., 2000), and a level of verbal comprehension within the normal range according to standardized assessment, using the Wechsler Intelligence scale for children and adolescents, Fourth edition (Wechsler, 2007) or Fifth edition (Wechsler et al., 2014). The exclusion criteria included severe behavioral problems and/or mental psychopathologies. A total of 94 participants were required for participation in the intervention program during a 3-year period (2017, 2018, 2019). Of the total sample, 15 participants dropped out.

For each study, a different design was used to assess the stated objectives.

Study 1: A *multimethod* study was developed, based on a randomized control trial (using a waiting-list as a control group). Of the total sample, 79 children (n = 36) and adolescents (n = 43) had their comorbid symptomatology assessed before and after the intervention (mean age: 11.92; mean VIQ: 105.73; 82,3% were male; experimental group n

= 42, control group n = 37), as they completed all sessions and all questionnaires. A subsample of 39 participants was included to study and measure social behavior through observational methodology (mean age: 11.27; mean VIQ: 104.08; 84,16% were male; experimental group n = 26, control group n =13). The rest of the participants were not included for the video coding analysis because they did not attend all sessions or were not eligible for coding due to audiovisual problems.

Study 2: This was a *mixed method* study. We applied systematic observation to analyze our goals, and observe social behaviors in a sample of adolescents with ASD during a social skills intervention. Of the total sample, 16 adolescents with ASD were included in this study to assess their social behavior throughout the intervention. No control group was included. Of this sample, 5 adolescents were finally included for the study, as they attended all sessions and it was possible to code their social behaviors through the video records (mean age: 14.6; mean VIQ: 100.5; 1 female/4 males).

Study 3: An *observational methodology* was applied in this study. To achieve our goals, we made a comparison between an initial session (session 2) and a final session (session 10) of a 10-session intervention, to assess the similarities and differences between participants. Of the total sample, 36 children with ASD were recruited for this study to assess social behaviors pre- and post-intervention (sessions 2 and 10). No control group was included. Of the total sample, 21 children were finally included to perform the analysis, as they attended all sessions and it was possible to code their social behaviors through the video records (mean age: 9.52; mean VIQ: 103.8; 85,7% were males). Of the total, 9 participants had ADHD comorbidity, 9 had no comorbidity, and the rest had different comorbidities (learning disorders, anxiety, depression or behavioral disturbances, but not several).

In all three studies, a systematic observation was applied to analyze social behaviors in groups of children and adolescents with ASD. A total of 10 sessions of 90 minutes each were conducted per group. The observational design (Anguera et al., 2001) for the three studies was: nomothetic (several participants were observed), follow-up included (different sessions

from the intervention were registered and coded), and multidimensional (several dimensions of the observation instrument were considered suitable) (N/F/M).

Instruments:

Data gathering instruments

In **study 1**, questionnaires were administered to parents in order to assess comorbid symptomatology, before and after the intervention. The *Child Behavior Checklist* (CBCL/6-18; Achenbach, 1992) was used to evaluate emotional and behavioral problems and The *Spence Children's Anxiety Scale* (SCAS; Spence, 1997) was used to assess anxiety disorders in childhood and adolescents (self-report and parents' version, SCAS-P; Nauta et al., 2004).

In the three studies (**study 1, study 2, and study 3**), observational methodology was applied, therefore a recording instrument and observational instrument was developed and applied.

Recording instrument: Following the principles of the Declaration of Helsinki, the Spanish Official College of Psychologists General Council's Ethical Code, and the Ethical Committee for Clinical Research of Sant Joan de Déu Foundation, 14 minutes of free play time in all sessions were recorded with two different cameras (one regular and one *GoPro Hero3*) located at two different angles. Participants were informed about the research, the cameras, and the positioning of them. Cameras were discreetly placed to avoid inconvenience to participants.

Observational instrument: To assess social behaviors, an observational scale was applied, inspired in Bauminger (2002) and by the approach of social difficulties by the authors of ADOS-2 and ADI-R (Lord et al., 2000, Rutter et al., 2003). Bauminger's instrument has been previously used in other research (MacMachon et al., 2013) to assess social behaviors in a sample of ASD children and adolescents. We modified the scale to adjust it to our sample, adding new ones. We made two adaptations:

1. The first adaptation used in **study 2**: behavior was grouped into two categories (*social initiation* and *social response*). Subsequently, each category was organized into two dimensions (regarding quality of interaction): *high-level interaction* (including social verbal communication, eye contact, smiling, or sharing objects) and *low-level interaction* (including proximity, looking, but not in the eyes or functional communication). Finally, a third dimension was added to assess *gestures* (conventional gestures, descriptive gestures, emphatic gestures, pointing gestures, and emotional gestures).
2. The second adaptation was used in **study 1 and study 3**: the instrument was reorganized and evolved to adjust it to the behavior of our participants in 6 dimensions. Eight behaviors were eliminated (proximity, sharing objects, affection, talk that reflects an interest in another child hobbies, giving help, imitation of peer or therapist, idiosyncratic language, and repetitive behavior). The 6 dimensions were *Interaction type* (include low-level interaction, high-level interaction, and negative level interaction), *social behavior* (including responses to an interaction, initiations of interaction, and avoidances), *verbal communication* (including functional communication, social verbal communication, sharing experiences, non-functional communication, and aggressive verbal communication), *facial expressions* (smiling), *looking* (include looking at an object or another situation, eye contact, and looking without eye contact), and *gestures* (include pointing gestures, emotional gestures, conventional gestures, affirmation or denial gestures, and descriptive gestures).

Procedure: All three studies followed the approval according to the standards of the Institutional Research Committee Review Board at Sant Joan de Déu Hospital (Barcelona), the Ethical Committee for Clinical Research of Sant Joan de Déu Foundation, and the 2000 Helsinki Declaration on developing and performing research. Ethical aspects were evaluated by specialized members of the ethics committees. These committees included evaluation of the content and objectives, the impact on the sample to be investigated, and relevant ethical issues that could affect the research.

All participants and their parents were informed about the research and they signed the informed consent (parents) and informed assent (participants). This informed consent included description of the investigation and the role of the participants and their families, explanation of all the research process, the benefits and the risks (there were no risks), the confidentiality and protection of personal data, and the voluntary nature participation and the possibility of abandoning the investigation whenever they wanted, at any time and without giving an explanation. Finally, it included information on how to contact the principal investigators to obtain more information or to clarify possible misgivings.

From the qualitative research perspective, a systematic observation was used to obtain data that we managed as a code matrix. Two researchers were trained to observe, analyze, and code data. To obtain Cohen's kappa coefficient (1968), researchers coded 20% of the total material that had previously been randomized. The degree of interobserver agreement calculated with Cohen's kappa (1988) ranged between 0.76 and 0.89. In **study 1** and **3**, sessions 2 and 10 were coded and analyzed. In **study 2**, sessions 1 to 9 were coded and analyzed.

The intervention of social skills was an adaptation of a program of the UC Davis MIND Institute (developed by Solomon, 2004). The original design was made up of 32 sessions. We adjusted this to 10 sessions of 90 minutes each, following the demands and resources of our community hospital setting. The main objective of the intervention was to develop social skills from an inside-out perspective, trying to involve and motivate participants to socialize with their peers, instead of modeling or indicating behaviors.

Every session had the same structure:

1. Greeting: all sessions begin by asking participants how the week had gone, sharing experiences or problems. Aspects of the social experiment (explained below) were also worked on: how things went, what they thought, who helped them, etc. In this part of the session there was an introduction of the topic to be worked on.
2. Free playtime: after the salutation, there was 15 minutes of free playtime. In this space, therapists displayed different games and participants decided if they wanted to

play with others, alone, or not at all. Generally, this was an unstructured space and therapists were not able to interact or solve situations between participants. However, sometimes they discreetly encouraged some interactions to prevent unexpected behaviors (e.g., insulting or words missing)

3. Didactic lesson: this was the most structured part of the session. In this space of time, didactic lessons were presented. Each didactic lesson involved one different topic related to deficits in social competence. This part also involved activities with different materials to make the lessons more playful. Clinicians used strategies and activities based on the theory of social thinking and social competence (Garcia-Winner, 2000).
4. Closure and social experiment: every session closed with a joke-telling time. This included image jokes, *double entendres*, or sayings that therapists and participants brought to the session. At the end, therapists explained the “social experiment”. This was optional homework related to the topic worked on in the didactic lesson. This helped participants to share the information with families, and practice and generalize to real life.

Topics included in didactic lessons included empathy, recognition of one’s own and others’ emotions, problem solving, conversational skills, sense of humor, and stress regulation (through various techniques).

4. RESULTS

Results obtained from the three studies that are included in this doctoral thesis are presented in the following manuscripts:

1. Alcover, C., Aranbarri, A., Balaña, G., Sentenach, A., Mezzatesta, M., Díez-Juan, M., Elías, N., Arias-Pujol, E. & Mairena, M.Á. (2020). Community-based randomized controlled trial of a social-skills program for children and adolescents with autism spectrum disorder: examining improvements (submitted to journal: *Research in Developmental Disabilities*) (Study 1).
2. Alcover, C., Mairena, M.Á., Mezzatesta, M., Elias, N., Díez-Juan, M., Balaña, G., González-Rodríguez, M., Rodríguez-Medina, J., Anguera, M.T. & Arias-Pujol, E. (2019). Mixed methods approach to describe social interaction during a group intervention for adolescents with autism spectrum disorders. *Frontiers in Psychology*. 10:1158. doi: 10.3389/fpsyg.2019.01158. (Study 2).
3. Alcover, C., Rodríguez-Medina, J., Mairena, M.Á., Mezzatesta, M., Balaña, G., Elias, N., Elias, M., & Arias-Pujol, E. (2020). Social Skills Intervention in Children with Autism Spectrum Disorders: Polar Coordinate Analysis (submitted to journal: *Journal of Autism and Developmental Disorders*) (Study 3).

4.1. STUDY 1

Community-based randomized controlled trial of a social-skills program for children and adolescents with autism spectrum disorder: What did we learn?

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Abstract

During the last years, researches have been investigating how social skills interventions are effective to children and adolescents with ASD. Despite all the findings, many controversies have been exposed in the factors and characteristics that could affect the effectiveness of these programs. The main objective of this study is to assess the effect of a community-based social-skills program for children and adolescents with ASD, measuring comorbid symptomatology through questionnaires, and social behaviors through observational methodology. Our results exposed that comorbid symptomatology, specifically affective symptomatology, decreased in children but not in adolescents after intervention. We also observed marginally significant results in two specific social behaviors, eye contact and functional communication. Participants with higher verbal IQ showed a better response to our program. Despite these marginally positive results, we could not conclude that our community-based social-skills program was clinically effective. It is necessary to continue investigating which factors could impact evidence-based treatments effectiveness when adapting them to community settings. Findings in this field would benefit a growing number

of children with ASD who are attended in publicly funded mental health community-services (Bryson & Ostmeier, 2014).

Key words: autism spectrum disorder, social skills program, comorbid symptomatology, social behaviors, observational methodology and community-setting.

Introduction

Autism spectrum disorder (ASD) is characterized by persistent difficulties in social communication and interaction, and the presence of repetitive patterns of behaviors, interests, or activities (American Psychiatric Association, 2013) that limits development of social skills throughout childhood and adolescence. The incidence of ASD continues to increase, both at the global and local levels. According to the latest data in the US 1 in 54 children is diagnosed with ASD (Centers for Disease Control and Prevention, 2015; World Health Organization, 2019). The spectrum includes different levels of functionality concerning the cognitive and verbal abilities of each person, and a wide range of psychiatric and medical conditions. Approximately 82% of children with ASD present coexisting neurodevelopmental disorders (e.g., language disorders, attention deficit–hyperactivity disorder (ADHD), intellectual impairments (between 33% and 70% of persons with ASD also have intellectual disabilities (American Psychiatric Association, 2013; La Malfa et al., 2004) and/or sensory dysregulation), and diagnosis of co-existing psychiatric disorder (e.g., anxiety, obsessive-compulsive disorder, and/or oppositional defiant disorder; Mosner et al., 2019) that affects their behavior and overall functioning.

Core symptoms of ASD interfere with the pragmatic use of language, social skills development, conversational abilities (McMahon et al., 2013; Williams et al., 2007), modulation of eye contact, and the ability to interpret verbal and nonverbal social cues such as voice tone or facial expressions (Schohl et al., 2013). Moreover, those with ASD present a lack of theory of mind (ToM), as they struggle to interpret mental states, feelings, emotions, or acts (including the consequences of their actions on others), and difficulties in social problem-solving (Krasny et al., 2003; Schohl et al., 2013). Consequently, the development of the social area is highly impoverished and generates a significant negative impact on quality of life, making it extremely difficult to participate in everyday social events.

Symptoms of anxiety and depression are also frequent in social difficulties. This symptomatology is sometimes a consequence of atypical sensory integration, the teasing and rejection that those with ASD receive from others, and difficulties in understanding demands

from the environment (Paula, 2015; Bellini, 2006; Schohl et al., 2013) or awareness of their own difficulties (White et al., 2009). Moreover, these symptoms might be related to behavioral disorders (Arias-Pujol et al., 2015; Derosier et al., 2011), isolation, social avoidance, and erroneous interactions with peers, which generate a great barrier against their companions.

In terms of intervention, a variety of treatments have shown efficacy in improving social abilities, from cognitive-behavioral therapies to naturalistic therapies, in school or in the family context. Other therapies such as *mindfulness* and *yoga* might be indicated to reduce associated symptoms (Ridderinkhof et al., 2017). During the last decade, studies have evaluated changes in comorbid symptoms after participation in a social skills intervention, finding a decrease in overall anxiety (Guivarch et al., 2017) and social anxiety (Schohl et al., 2013). Solomon and colleagues (2004) found that symptoms of depression decreased in children with higher IQs.

Literature highlights the effectiveness of social skills training programs for ASD, especially for those without intellectual deficit (Baker, 2014; De Rosier et al., 2010; Pickard et al., 2017). Research has demonstrated effectiveness in increasing peer interaction, decreasing time alone, reducing repetitive behaviors, increasing functional behaviors, and improving understanding and knowledge of emotions (Choque et al., 2017; Matthews et al., 2019; Thomeer et al., 2016).

Solomon et al. (2004) proposed a manualized intervention program to improve social skills and social competence for children and adolescents with ASD. They designed a 20-session program in which therapists try to promote social interactions, such as reciprocal conversation and cooperative play. Sessions were structured consistently into different parts, including initial greeting, free play time, didactic session, jokes, and closing. Topics of didactic sessions were related to social competence, such as empathy, talking about feelings, and solving social problems. Another research project that adapted this program found an increase in the number of socially oriented responding vocalizations and a decrease in non-social vocalizations (e.g., talking alone) after the intervention (McMahon et al., 2013).

Regarding modulating factors, some studies conclude that therapy outcomes depend on the influence of certain factors such as gender, intelligence quotient, and age (Harrop et al., 2014). Literature highlights the effectiveness of social skills intervention programs for participants with IQ superior to 70, specifically improving depression comorbid symptoms (Solomon et al., 2004). A recent systematic review concludes that better cognitive quotient and verbal ability is related to a greater treatment response (Gates et al., 2018). However, other studies have not confirmed this relationship (e.g. McMahon et al., 2013). Regarding age, several studies found more favorable outcomes in adults (Herbrech et al., 2009) and adolescents than in children (Choque et al., 2017; Rabin et al., 2018). In contrast, other studies found more positive results in children than in adolescents (Bauminger, 2002; McMachon et al., 2013).

When it comes to measuring changes and improvements associated with all these programs, there is a lack of consensus about the most effective method. Frequently, social-skills researchers use questionnaires to evaluate changes after interventions, but these instruments are often not sensitive enough to changes in social behaviors (McMahon et al., 2013). Therefore, they may not reflect changes in social skills that are observed during sessions (Kasari et al., 2014;), but they are useful to assess changes in comorbidity, such as anxiety and depression. Considering these facts, new methodologies have been proposed to evaluate improvement in social competence during social skills intervention. In this line, it has been proposed to combine data obtained from questionnaires (quantitative) with observational methodology (qualitative), in order to analyze spontaneous behaviors that take place in natural situations (Portell et al., 2015; Pascual-Leone et al., 2009). Although further research is needed, the use of observational methodology is increasingly emerging in ASD research (Arias et al., 2014; Mairena et al., 2019; Alcover et al., 2019), providing new methods to measure more subtle behaviors occurring in social skills development.

Regarding community-based settings, low-intensity social skills programs, of reduced duration and a limited number of sessions, are needed. Research has shown that low intensity

programs implemented in clinical or community-based settings have identified positive but not significant results. Different studies have demonstrated improvements in school environment and a better perception of low intensity anger (Baghdadli et al., 2013), significant increase in adolescent social skills and a decrease in social anxiety symptomatology and autistic symptoms (Schohl et al., 2013), and overall improvement in social skills in children and adolescents (Bryson & Ostmeyer, 2014). There remains a great need to evaluate the efficacy of adapted manualized interventions in lower intensity community contexts, such as in publicly funded services, where the majority of children and adolescents end up receiving their interventions.

Considering previous literature, the main goal of this study was to evaluate the effect of a community adaptation of a social skills training program developed by Solomon et al. (2004) on a group sample of children and adolescents with ASD through specific indicators. Our secondary objectives were to: a) assess comorbid symptomatology present in ASD before and after the intervention; b) measure nuclear symptoms (i.e., social behavior) in a specific sub-sample; and c) assess whether there was a better treatment response related to participants' IQ and age.

In order to achieve our goal, we proposed to: 1) evaluate changes in comorbid symptomatology. Questionnaires were administered to parents before and after the intervention to assess changes in comorbid symptomatology. We expected that anxiety and mood difficulties would decrease after the participation in the program. 2) Quantitatively compare the amount of social behaviors performed at the beginning of the intervention (second session) versus those at the end (last session). Specifically, the following target behaviors were analyzed: eye contact, functional communication, smile, proximity, looking at others, functional play, affection, sharing objects, sharing experience, verbal social communication, and saying yes/no. In addition, overall high positive interaction and low-level interactions were quantified. It was hypothesized that the amount of social behaviors would be higher at the end of the intervention. 3) We hypothesized that verbal intelligence quotient and age would be factors related to the improvement after the intervention.

Methodology

Participants

Participants were recruited by psychologists and psychiatrists from the Multidisciplinary Unit for Autism Spectrum Disorder (UnimTEA, abbreviation in Spanish), at the Child and Adolescent Mental Health Area of Sant Joan de Déu Barcelona Children's Hospital, in accordance the 2000 Helsinki declaration. Participants were selected based on the following inclusion criteria: age range between 8 and 17 years old, a confirmed diagnosis of autism spectrum disorder according to DSM 5 (APA, 2013) and meeting cut-off at the Autism Diagnostic Observation Schedule-2 (ADOS-2, Lord et al., 2000), with a normal range of Verbal Comprehension (Verbal IQ) according to standardized assessment. Participants with severe behavioral problems, several mental psychopathologies such as schizophrenia, or with intellectual functioning below 70, were excluded. All participants were screened, assessed, and diagnosed by highly trained, specialized clinicians.

A total sample of 94 children (8 to 12 years old) and adolescents (13-17 years old) participated in the study over a three-year period (2017, 2018, 2019). Each year we recruited a group of children and a group of adolescents, which were randomly divided into two groups: for each age group we had an experimental group and an age-matched and verbal IQ-matched control group. In 2017, the children experimental group was composed by 8 participants (control group: n= 7) and the adolescents experimental group was composed by 9 participants (control group=8). In 2018, the children experimental group was composed of 8 participants (control group: n= 9) and the adolescents experimental group were 9 participants (control group=10). Last year, in 2019, the children experimental group was composed of 8 children (control group=7) and the adolescents experimental group included 4 participants (control group=7). A total sample of 94 participants.

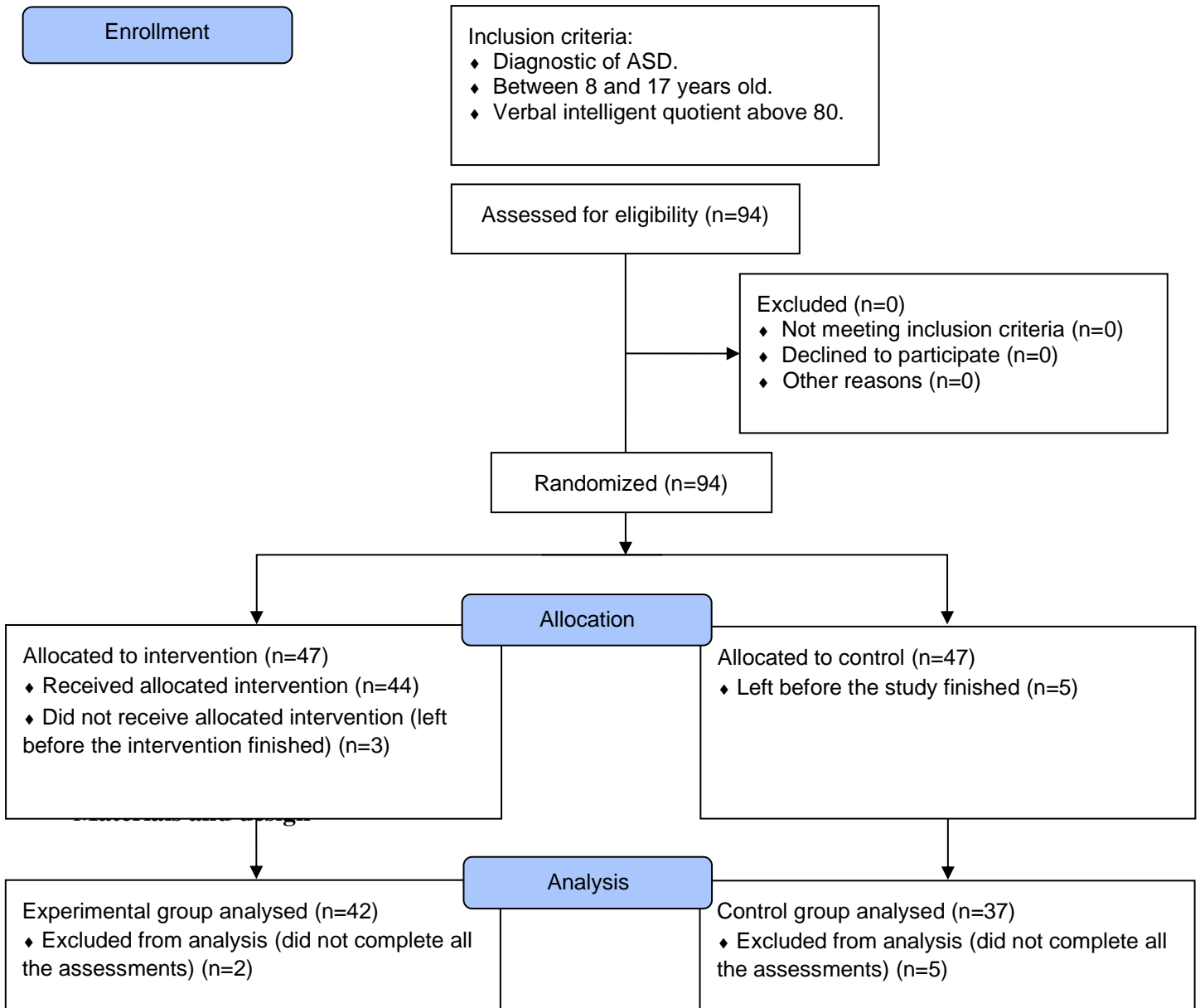
The experimental group of each year received treatment from January to April. The control group was in a waiting-list formula and received the treatment from April to July, after participating in the trial. For both groups, pre-treatment evaluation was performed in January and post-treatment evaluation was done in April. Treatment delivery was composed by one therapist, two co-therapists (psychiatrist or mental health nurse), and with the assistance of

two graduate students in psychology. Some participants left the intervention before the end of the program (n=8) and others did not complete all the assessments or did not attend all sessions (n=7).

Of the total sample (N=94), 79 children (n=36; 8 to 12 years old) and adolescents (n=43; 13-17 years old) participated in the entire treatment program and went through all the pre- and post-assessments. From this sample, we were able to video-code a sub-sample of 39 participants (n=23 children and n=16 adolescents; experimental=26 and control=13). These participants were selected because they attended the specific sessions (i.e., sessions 2 and 10) needed for these analyses and they allowed coders (based on audiovisual characteristics) sufficient video-coding time and angles to code the target behaviors. In order to obtain observational data from the control group, this group was scheduled for a recorded free playtime session in the same week as the experimental group recorded their session 2, with both recordings representing the *pre*-session data. Regarding *post*-session data, we compared session 10 of the experimental group and session 2 of the intervention of the control group (that had been on the hospital waiting list) (see Figure 1).

Figure 1: Participants enrollment description through Consort Flow Diagram (2010)

CONSORT 2010 Flow Diagram



This is a multimethod study, based on a randomized control trial (using a waiting-list as a control group). The experimental group participated in a social skills program with a duration of 10 sessions. First, we administered two different questionnaires to assess comorbid symptomatology before and after the intervention, and we then applied systematic video-coding analyses to code social behaviors that occurred during the 14 minutes of free-play in the second and last sessions.

Diagnostic instruments

In order to confirm the diagnosis of autism spectrum disorder, clinical interviews were conducted with parents, and the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2000) was administered to all participants. To be included in the study, participants had to score above the ADOS cut-off point. Finally, intellectual abilities and verbal comprehension were measured with the Weschler Intelligence Scale for Children and Adolescents: Fourth (Weschler et al., 2007) or Fifth edition (Weschler et al., 2014) edition.

Outcome measurement instruments

a) Pre- and post-questionnaires for parents to assess comorbid symptomatology

We administered the following questionnaires to parents to evaluate comorbid symptomatology and obtain a pre- and post-test evaluation:

Child Behavior Checklist (CBCL/6-18): (Achenbach, T. 1992)

The CBCL is a questionnaire filled out by parents to assess behaviors and emotional problems in subjects aged 1 year 6 months to 5-years old, and 6 to 18 years old. Both internalizing behaviors (e.g., anxiety, depression, etc.) and externalizing behaviors (e.g., aggression, hyperactivity, etc.) are evaluated. Several subareas are evaluated such as withdrawal, somatic complaints, anxiety and depression, destructive behaviors, social

problems, thinking problems, attention problems, aggressive behaviors, and criminal behaviors.

The Spence Children’s Anxiety Scale (SCAS): (Spence, 1997)

The SCAS is a self-report that measures anxiety disorders in childhood and adolescence. It consists of 44 items that assess separation anxiety, obsessive-compulsive disorder, panic, social phobia, generalized anxiety, etc. It is evaluated from a Likert scale, with a maximum score of 114, average 57, and minimum 0. There is also the parallel version for parents (SCAS-P; Nauta et al., 2004).

b) Video-coding

Sessions included 14 minutes of free playtime, consisting of participants playing with each other in a non-structured format, using different games that were offered or remaining alone if they wanted to. Therapists and co-therapists did not interact during free playtime. Coded videos were recorded with two different cameras located at two different fixed angles. Videos corresponded to 9 different group sessions, from session #2 and session #10 (last session). Participants were informed about the recording, the research purpose of the videos, and location of the cameras. For these recordings we followed the principles of the Declaration of Helsinki, the Spanish Official College of Psychologists General Council’s Ethical Code, and the Ethical Committee for Clinical Research of Sant Joan de Déu Research Institute,

c) Observational instrument for quantitative video-coding of social behavior

In order to quantitatively code social behaviors, we applied an observational instrument. First of all, we reorganized and developed an observational instrument (Alcover et al., 2019) inspired by the Bauminger observational instrument (2002) and by the approach of social difficulties of the authors of ADOS-2 and ADI-R (Lord et al., 2000, Rutter et al., 2003). Other research has previously used the Bauminger instrument to assess social behaviors in interventions of social competence in autism (McMahon et al., 2013). This instrument allows

the observer to quantify the number of occurrences of target behaviors according to pre-established categories. The scale includes six defined dimensions and category systems that meet the requirements of exhaustivity and mutual exclusivity: a) *interaction type* (low-level interactions, high-level interactions, and negative level-interactions), b) *social behavior* (responses, initiations, avoidance of interactions, and functional play), c) *verbal communication* (functional communication, social verbal communication, sharing experiences, sharing objects, non-functional communication, and verbal aggression), d) *facial expressions* (smile), e) *looking* (include looking at an object or another situation, eye contact, and looking without the eye), and finally, f) *gestures* (conventional gestures, descriptive gestures, affirmation and denial gestures, pointing gestures, and emotional gestures) (see Table 1). We decided to include this last dimension of gestures because atypical use of gestures and difficulties in interpreting gestures has been described as a specific characteristic related to social-communication impairment (Schohl et al., 2013).

Applying the previous categories and dimensions to code the targeted social behaviors and gestures (see Table 1) for our video-coding, we performed a systematic observation to obtain a code matrix. Two coders analyzed and coded the entire set of videos, using The Lince Software, a multiplatform analysis software (Gabin et al., 2012). In order to assure reliability between coders, 20% of videos were coded for this propose and coders were blind to the randomized session number (sessions #2 and #10) that they were assigned to code. Two blinded coders performed a training phase until reaching a moderate-to-high (76-89%) Cohen's Kappa (1988) agreement rate, prior to coding the videos that were then analyzed for this study.

The observational design was nomothetic (several participants were observed), included follow-up (an initial session and the program's last session), and multidimensional (several dimensions of the observation instrument were considered suitable) (N/F/M). As the therapeutic process extended to several sessions, the groups were considered as a plurality of units. We worked with two levels of response: verbal and non-verbal.

Procedures

All procedures were in accordance with the ethical standards of the institutional research committee and with the year 2000 Helsinki Declaration. Parents were invited to attend an informative session in which the study was presented. Afterwards, they provided signed consent and informed assent was obtained from each child. Included participants were invited to participate in a social skills intervention program with a total of 10 sessions, scheduled on a weekly basis. These sessions took place in a dedicated group-intervention room at the Child and Adolescents Mental Health Area (at Sant Joan de Déu Barcelona Children's Hospital) and had a length of 90 minutes per session. Before the intervention started, families came for an informative session, in which the therapists explained the schedule of the group intervention and questionnaires were distributed. One week before the intervention, children and their families came for one individual interview session. Individual goals, and personal preferences and rejections, were established in this session to meet the participants and record their characteristics and clinical needs.

As noted above, the study was conducted over three years (2017-2019). Each year of the study, two experimental groups (children, 8-12 years; and adolescents, 13-17 years) participated from January to April. During the experimental group intervention, the control group continued their treatment as usual (psychology and psychiatry). Afterwards, all control groups (children and adolescents) received the same intervention.

The social skills intervention program was based on a consented adaptation of the Social MINDS Skills Program of the UC Davis MIND Institute (Solomon, 2004). The original design contains more than 20 sessions, but in order to be feasible in a community-based service, we adapted the program to 10 sessions. We also adapted the content of the sessions, based not only on Solomon (2004), but also on other experts in social thinking and social cognition such as García-Winner (2000) (see general structure of the sessions in Table 2). Each session had the purpose of practicing different social competence skills that are typically affected in a young population with ASD (see session-specific contents in Table 3). The main goal of the program was to work with the patients using an *inside-out* approach, developing and role-playing social skills abilities such as empathy, recognition of emotions,

problem solving, and stress regulation, based on their motivations and internal driving preferences. All sessions started with a greeting and a little talk about the week. Afterwards, we left 15 minutes of free time to play, and then we introduced a didactic social lesson and a closing activity (therapists gave participants a task related to the topic discussed so they could practise at home) according to Solomon's clinical program design (see general structure in Table 2). Therapists were ASD experts trained in conducting social skills groups and in prior contact with the original program team (Solomon, 2004).

Data analysis

We used the Statistical Package for the Social Sciences (SPSS v23.0) for our statistical analyses. We conducted descriptive analyses to characterize our sample. To test our hypothesis regarding the effect on comorbid symptomatology, we calculated pre- and post-test mean differences and tested mean difference comparison between the experimental and control groups. To test our hypothesis regarding the effect on social behaviors coded through videos, we performed a mean comparison of behaviors coded in session #2 and those in session #10. We used ANOVA test for outcomes that met statistical assumptions for parametric test, and U Mann-Whitney non-parametric test for those that did not.

All statistical tests were performed with a bilateral contrast and the level of significance was set at 0.05, while marginally significant was understood to be below 0.10 and above 0.05, so AS to better understand our results and potential discussion. Based on the previous literature, we replicated the analyses described above stratifying by verbal IQ and age.

Results

Participant features

Participants included in the total sample (N=79) were 82.3% male (mean age: 11.92; mean verbal IQ: 105.73). Participants included in the sub-sample (n=39) were 84.16% male (mean age: 11.27; mean verbal IQ: 104.08). Normality and statistical tests were performed to assess whether there were differences between the participants who only had questionnaires as a

measure and those who had questionnaires and videos. There were no differences between groups. Descriptive results are shown in Table 4.

Effects on comorbid symptomatology

Results from the CBCL (Achenbach, 1992) showed a marginally significant change in the affective dimension ($z = 1.800, p = .072$), which includes problems such as fatigue, apathy, sadness, and inferiority complex, among others. The experimental group showed a decrease ($M_{pre} = 7.23, M_{post} = 6.31$) while the control group remained with a similar mean ($M_{pre} = 7.42, M_{post} = 7.62$). Other dimensions from the CBCL and from the Spence Children's Anxiety Scale (Spence, 1997) did not show any significant or marginal differences (see Table 5).

Effects on social behavior

Results show that *eye contact* did not increase significantly by the end of the treatment; however, the experimental group ($M_{Pre} = 1.81, M_{Post} = 3.12$) exhibited a marginally significant increase in eye contact ($z = -1.736, p = .087$) when compared with the control group ($M_{Pre} = 2.08, M_{Post} = 0.92$) (see Table 6).

Regarding *functional communication*, results showed a marginally significant increase in the experimental group ($M_{Pre} = 14.23, M_{Post} = 15.69; F(1, 38) = 3.785, p = .059$) compared with the control group ($M_{Pre} = 16.08; M_{Post} = 11.31$). This category includes verbal communication that is functional—for example, requesting something from someone, offer a play turn, or to talking about a game.

No significant differences were observed for the following behaviors (see Table 6): smile, proximity, looking without eye contact, verbal social communication, saying yes/no, functional play, offering a play turn, or talking about a game interaction, and overall low-level interaction, between the experimental group's second and last session.

Regarding the category of *Negative-level interaction*, coders did not observe behaviors included in this category; therefore data associated with this dimension were not included in the analyses.

Treatment response based on IQ and age

Based on the previous literature, we decided to analyse treatment response based on verbal IQ and age, replicating our analyses on the higher IQ subgroup and on the two age group participants, as higher IQ scores has been associated with a better treatment response (e.g. Solomon et al., 2004; Gates et al., 2018), and age related response is not well understood.

Of the total sample (N=79), 60 participants had an IQ>90 (experimental group=35, control group=25). Results showed a marginally significant result in the affective problem dimension ($F(1, 57) = 3.157; p = .081$) (see Table 7). The experimental group showed a tendency to change their affective problems ($M_{Pre} = 7.33, M_{Post} = 6.43$), compared with the control group ($M_{Pre} = 7.40, M_{Post} = 7.81$). Regarding age, a total of 36 children (experimental group=20, control group=16) showed a marginally significant result in the affective dimension ($F(1, 33) = 3.075, p = .089$) in the experimental group ($M_{Pre} = 5.21, M_{Post} = 3.84$) compared with the control group ($M_{Pre} = 6.50, M_{Post} = 6.75$). Internalizing problems showed a statistically significant change ($z=2.267; p=.022$), which included mood disturbance, anxiety, depression, and social withdrawal, showing a decrease in the experimental group ($M_{Pre} = 18.18, M_{Post} = 14.26$) compared to the control group ($M_{Pre} = 17.78, M_{Post} = 22.44$), with a moderate effect size ($r = 0.388$) (see Table 8).

Concerning adolescents (n=43; experimental group=22, control group=21), no significant results were observed in either study variable in the experimental group.

Discussion

The main purpose of this project was to evaluate the effect of the Social MINDS Skills Program (Solomon, 2004) after adapting it to a community-based setting (i.e., hospital setting with universal healthcare service through government funded health insurance).

Based on previous community research (e.g., Bryson & Ostmeier, 2014; Proctor et al., 2009), evidenced based intensive intervention programs have shown to challenge feasibility in community services with long waiting lists. Usually these turn out to community programs adapting their intensity to a fewer number of sessions per patient and/or group in order to support a higher number of participants in publicly available social skills programs.

In our program, we followed the above mentioned criteria of decreasing the number of sessions and simplifying the program in order to make it feasible to our hospital setting. After testing our adapted version, overall, our results showed a lack of statistically detectable positive results. There is a known controversy when publicly funded services try to make an evidence-based intervention available to a universal access, as ethical issues arise. This opens the discussion to how to fit feasibility and rigorous evidence-based interventions, as they often are hard to fit together.

Following this ethical rationale, community services should follow a threshold that guarantee community-adapted feasible programs continue to be clinically effective to the serving population, showing significant improvements in targeting behaviors and other indicators of patients quality of life, otherwise we will make feasible, but clinically ineffective programs, which ends up with a serious ethical issue.

We intended to assess the effectiveness of this adapted version with several indicators: Comorbid symptomatology present before and after the intervention, changes in social behavior observed at the initial and last sessions through video coding, and analysing treatment response by participants' IQ and age. Our study follows the line of two other studies that also described similar challenges in community settings such as determining the

properties of interventions suitable to implementing in the context or adapting a program to the financial resources of the hospital (Bryson & Ostmeier, 2014; Proctor et al., 2009). For instance, limited resources lead to the need for implementing low intensity programs (reduced number of sessions and limited duration), which allow access to a larger number of patients, responding to the hospital's ethics with a publicly funded service. However, literature has shown in different intervention programs, the need to perform a minimum number of sessions to generate change in participants.

In relation to the effect on comorbid symptomatology, our results did not reach any statistically significant differences among the groups in this area. However, we observed a marginally significant decrease in affective problems reported by parents, such as sadness, fatigue, and apathy after receiving the intervention, that approximated previous findings (Guivarch et al., 2017; Solomon et al., 2004). In the same line, another study that used the extended version of Solomon's program (included more sessions than in our program) (McMahon et al., 2013) found that questionnaires administered to parents showed that children exhibited a significant decrease of internalizing problems, which are related to anxiety and depressive problems. In contrast, we did not observe any change in affective problems in our sample of adolescents. Previous literature described a relationship between deficits in social behavior, anxiety, and behavioral problems (Paula, 2015; Bellini, 2006; Schohl et al., 2013). Our results show that anxiety tended to decrease after the intervention, but without reaching a statistically significant level. Some characteristics of participants such as age could be an important factor that interferes with the effectiveness of social skills interventions (Harrop et al., 2014; Hong et al., 2018) and some other specific characteristics from the program intervention could also interfere with it, such as the number of sessions.

It is a known fact that frequently clinically significant changes described by clinicians and family members are not reflected in questionnaires when we try to detect changes in a low intensity social skills program (Lerner & Mikami, 2012; Choque et al., 2016). Therefore, as a secondary goal, we quantitatively measured the amount of social behaviors in the second session and the last session, in order to obtain a more subtle and specific social behavior assessment. For this purpose, we used

observational methodology to observe and measure social behaviors in our participants. Our results did not show any statistically significant changes between the second and the last session when comparing the experimental group and the waiting list control group. However, two coded social behaviors (eye contact and functional communication) showed a marginally significant increase when comparing these two sessions in the experimental group, whereas the control group did not show this potential improvement. These results suggest that participants who received the intervention might end up using more *eye contact* in the last session than in the second. Our results point to other studies that did find a significant increase in eye contact after a social skills intervention (Bauminger, 2002). This intervention included different characteristics of ours. It was implemented over a longer period of time (7 months), and at school settings, involving children, teachers, parents, and peers. A higher intensity of the program (longer period and more sessions), implemented in a natural setting (school), where participants learn to interact with their peers, could help to generalize these behaviors out of the treatment sessions with perhaps a more significant social behavioral change. These two differences could also have an important impact in the effectiveness of the intervention program.

The *functional communication* (i.e., functional verbal communication, such as requesting something, offering to play turns, or talking about a game) popped-up as our second coded social behavior that could benefit from a social skills program. These results point to other studies that did find a positive and significant effect on functional communication (Bauminger, 2002; McMahon et al., 2013). Despite using the same intervention (Solomon et al., 2004) and intervention effect evaluation methodology as McMahon and colleagues (2013), we observed again that the intensity of the intervention was different (their program lasted 5.5 months; 1.5 hours/week over 22 weeks) from our intervention and included peers with typical development to provide additional opportunities of interaction. We assume that both the higher intensity (extended time and number of sessions (22 sessions) and the implementation context were factors that could provide more effectiveness in the intervention and therefore yield significant results.

The intensity and the inclusion of other agents in the intervention could be two important factors to obtain effect on the participants.

In relation to treatment response based on sample characteristics, we followed previous literature when designing our inclusion criteria, such as age and IQ (Harrop et al., 2014). A recent literature review (Gates et al., 2018) has shown that higher cognitive scores, especially in verbal abilities, are associated with a better treatment response in social skills programs. Therefore, we replicated our analyses for participants with a higher verbal IQ (> 90). We also considered that participants' age group could also affect our results (Harrop et al., 2014), and therefore we also replicated our analyses stratifying into two age groups (i.e., children and adolescence). In our study, the subgroup with verbal IQ superior to 90 obtained better results than the global sample. These results are coherent with previous findings (Solomon et al., 2004), that also observed an improvement in depressive symptomatology in the higher IQ children. Intellectual disability (ID) is characterized by below-average intellectual functioning (Intelligence Quotient (IQ) >70) simultaneously with social, cognitive, and adaptive skills deficits (Srivastava & Schwartz, 2014). Literature has shown that a higher cognitive capacity and good verbal ability allow participants to better understand all the skills taught and generalized to other contexts (Gates et al., 2018). Regarding age, we previously mentioned that our results showed a tendency to decrease in affective problems in children but not in adolescents. These results coincide with previous studies (Bauminger, 2002; Solomon et al., 2004). In our sample, we observed that children with a higher quotient had a tendency to a better treatment response. Social skills begin to develop in the early years. Children are expected to develop cooperation, assertive behavior, and self-control starting from late preschool years (Takashi et al., 2015). Research has observed that children tend to have fewer social competences compared to adolescents or adults, because the neural maturation and development of associated cognitive functions required to acquire social skills might not always be sufficiently developed in children (Choque et al., 2017). In our study, at the beginning of the intervention, most of the children started with very basic behaviors or did not relate directly, staying apart, reading, or playing games with practically no verbal communication. This could also lead social skills intervention to have a more detectable effect of observable behaviors in children. Although there is an important sensitive

window for social skills in adolescence associated with brain development, children might benefit from a more naïve social experience and a larger brain plasticity.

Finally, in terms of measurement, literature has demonstrated that questionnaires are useful to assess comorbid symptomatology in children and adolescents with ASD, obtaining positive results. However, other methodologies such as, observational methodology might be more appropriate to observe social behaviors during social skills intervention (Lopata et al., 2010). Natural and observational measures could increase the reliability and fidelity of results (Lerner & Mikami; Thoomer et al., 2016). Observational methodology allows the study of spontaneous behaviors and provides more detailed and accurate information about social behavior that might not be adequately captured by questionnaires (Solomon et al., 2004; McMahon et al., 2013; Mairena et al., 2019). Although the previous and initial positive results, published in observational methodology in the psychology field, weren't significant in our research. However, this methodology allowed us to observe little differences between sessions in specific behaviors (a marginally significant increase in eye contact and in functional communication). Observational methodology allows researchers to observe and understand interactions in a more complex way (Herrero, 2000). All the data that can be obtained from this methodology provide specific information that can be useful to family members and medical staff, as it provides information about what behaviors to expect. This knowledge could be useful to design precise interventions that could focus on individual interactions and specific difficulties that are present in autism. Observational methodology could be also an appropriate tool to observe and measure social competence (Lerner and Mikami, 2012), despite we did not find significant results in our sample. Further research with longer intervention time is needed.

All these factors, such as age, IQ and the different methods to assess comorbidities and social behaviors, are instructive for other researchers and clinicians that wish to implement social skills intervention groups in community-based hospital settings. Our results were not significant, compared to other low intensity social skills interventions that reach the significance level. As we mentioned during the discussion, many characteristics were probably involved and related to our results. Unifying the previous results, most of the low

intensity interventions included other agents such as parents (Deckers et al., 2016) or neurotypical peers (Barry et al., 2003). Another important different characteristic of these programs was the intensity of the intervention. Some of them performed interventions over a period of 5 weeks (1 month and a week) (Thomer et al., 2016) but with greater weekly intensity (i.e., 5 days a week). And finally, another important difference with some of these studies was the context and the location where the intervention was taking place. Our intervention was performed in a hospital, while other studies with similar characteristics and positive results were implemented in school classrooms (Lopata et al., 2010).

Some other investigations also failed to obtain significant results in questionnaires (Choque et al. 2016; Mikami & Lerner, 2012), but they did observe significant changes through observational methodology. The main difference between these investigations and ours was the inclusion of intervention sessions with parents. This is an important factor, which can contribute to the generalizability and maintenance of the social skills learned in the intervention groups. However, regarding subtle social behaviors, our study suggests that observational methodology can be implemented in community setting interventions to assess subtle changes in interaction. Therefore, observational methodology could be used in further research in order to evaluate changes in social behavior in longer interventions (e.g., 15 sessions) and including other agents (e.g., neurotypical peers or parents).

As in much community-based research, we recognize a number of limitations in our study (Tse et al., 2007). First, the small sample size we had for each group and subgroup, limiting our interpretations for a broader population, and constraining our statistical power in the effort to find significance in the tested hypothesis. Another important limitation was related to the intensity of our social skills intervention program, counting for the total number of sessions, frequency and/or total duration in time. There are many controversial ideas related to effectiveness and intensity in the literature. A recent systematic review (McMahon et al., 2013) showed that the majority of interventions extended to at least 1 or 2 hours a week during a whole academic year. Other research (Lopata et al., 2010; Thomeer et al., 2016) found effectiveness in short but more intensive interventions. In our study, we reduced the number of sessions to half of the original twenty in order to make it available to a larger

number of patients that met the initial inclusion criteria for the clinical program, and reduce as much as possible the waiting time to start in the program. Our hospital receives a high volume of patients and tries to adapt to the community needs with the available public resources provided, but some adaptations need to be considered, in order to not impact clinical effectiveness. Another limitation was that we could not carry out follow-up, and we know from previous studies (Solomon et al., 2004) that some effects might need more time to develop and be detectable as measurable behavior after the intervention. Finally, the quantity of data that we collected from the observational methodology was constrained by technological resources (e.g., recording angles) and other factors that limited our sample and the data collection itself, directly affecting our statistical power when analyzing the data. Observational methodology measures subtle behaviors and requires large samples to be sensitive enough for most of the statistical analyses, in comparison with other methodologies (Arias-Pujol & Anguera, 2004), as targeted behaviors are subtle and difficult to measure change.

Conclusions

Notwithstanding limitations of the study, there are some contributions we have made to future studies and clinical practice, based on what we have learned with these results. Community-based research is always difficult to perform and adapting evidence-based interventions programs that fit resources and reach the maximum number of children is highly challenging.

Clinicians participating in the study showed great satisfaction as the training does not require expensive materials nor specific equipment. Application of the inside-out approach was positively accepted by the participants and the therapist more widely than the previous outside-in paradigm. Free playtime was seen as highly motivating for the subjects, especially when they found common interests. Based on our results and previous literature, our community-adaptation (e.g., cutting the total number of sessions to 10) might impact the program's effectiveness, which should move clinicians to consider the minimum intensity needed to reach the wanted therapeutic treatment response. A possible minimum of sessions

to obtain effectiveness in our interventions, based on previous research, is around 20. Our participants reported that they were ending just when they had got to know each other and feel comfortable with their peers and the clinicians, especially in the adolescent groups. This could lead us to consider that a group based program starts to boost its therapeutic components after session 8-10. The inclusion of other agents such as neurotypical children or familiars, demonstrate in other researches to be an important factor to affect participants. In conclusion, evidence-based programs that might have been shown to be effective in high resources lab settings may not be effective unless diverse adaptations are made for community setting. That is why these adaptations need further testing to ensure that the publicly available treatments also meet evidence-based best practices.

We need to continue investigating which factors influence the effectiveness of social skills intervention treatment in hospital and community settings. Findings in this field would benefit a growing number of children with ASD who are attended in public mental health centers (Bryson & Ostmeier, 2014).

Acknowledgments

The authors would like to thank all the team at the Multidisciplinary Unit for Autism Spectrum Disorder (UnimTEA) at Sant Joan de Déu Barcelona Children's Hospital for their dedication and efforts in carrying out the social skills groups during the last 3 years. We also wish to thank all the families, children, and adolescents that participated and allowed us to achieve our community-research goals. The authors are also very grateful to the Social MINDS Skills Program developers and authors at UC Davis MIND Institute (Solomon and colleagues) for their generosity in sharing the program's therapeutic knowledge and didactic session structure with our team.

Conflict of interests

The authors declare that they have no actual or potential economic or personal conflict of interest.

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4.2. STUDY 2

Published in *Frontiers in Psychology*.

Mixed methods approach to describe social interaction during a group intervention for adolescents with Autism Spectrum Disorders.

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Abstract

Over the last twenty years, researchers have been mixing qualitative and quantitative approaches, but mixed methods research represents a new movement that arose in response to the currents of qualitative and quantitative research, considered separately. Little has been published on the use of polar coordinate analysis in psychotherapy. This type of analysis can provide detailed information and integrate the qualitative-quantitative analysis. Even less has been published on the analysis of ASD children's behavior. The main aim of this study was to implement this quali-quantitative methodology to analyze patterns of social behaviors in a group of adolescents with ASD during a group social competence intervention program. Moreover, we wanted to see whether an observational scale could be combined fruitfully with polar

coordinate analysis and to investigate whether typical ASD behaviors show similar interrelations (prospective and retrospective sequentialities) as behaviors observed in psychotherapy. We used an adaptation from the Social Skills Training Program (UC Davis, California). We observed that each participant took a unique course, increasing or decreasing the number and quality of their social behaviors. In accordance with previous literature, results suggest some increment in the amount of appropriate social conduct. We did not detect a generalized progress pattern but agreed that there were changes between the beginning and end of the intervention. Therefore, we consider that observational methodology is useful in the field of psychotherapy and ASD, offering detailed information about changes and development that cannot be obtained with other traditional measures, such as questionnaires. Key words: Qual-Quan Integration, Mixed Methods, Systematic observation, Polar Coordinate, Social Skills Interventions, ASD, group.

INTRODUCTION

Autism Spectrum Disorders (ASD) are serious neurodevelopmental disorders that involve impairments in reciprocal social interaction and social communication combined with restrictive interests, repetitive behaviors and sensory abnormalities, and a wide range of psychiatric and medical conditions (American Psychiatric Association, 2013). The estimated prevalence of ASD is about 1/160 (World Health Organization, 2017).

Regarding treatment, Social Skills Training Programs (SSTP) constitute an evidence-based therapeutic approach commonly used with high-functioning adolescents with ASD. Certain specific manualized programs have demonstrated positive results in improving social competence in adolescents with ASD (DeRosier et al., 2011; McMahon et al., 2013). However, it is difficult to adequately measure improvements in social skills. Most studies that evaluate the effectiveness of group therapies commonly use questionnaires or social cognitive assessments to measure social outcomes (Kasari et al., 2014) but these evaluations have been proven to be insufficiently sensitive and other methods of evaluating these outcomes are urgently required.

According to Sánchez-Algarra and Anguera (2013), systematic, objective, serious study of human conduct is highly complex due to the spontaneity of this behavior and the natural context of the situation. Considering this complexity, integration of qualitative methods, which provide a holistic view of the person, and quantitative methods, which offer more objective information (Lutz and Hill, 2009) has been proposed. It is for this reason that observational methodology is used in the field of psychology research. Observational methodology allows analysis of spontaneous behaviors that occur in the natural environment (Portell et al., 2015) and has been shown to be useful in studying changes that take place over the course of psychotherapy (Pascual-Leone et al., 2009). Moreover, this type of methodology can directly evaluate social performance and behaviors linked to the objectives of the intervention. For instance, McMahon et al. (2013) proposed the use of an observational scale (Bauminger, 2002) to evaluate the efficacy of a group-based intervention for children and adolescents with ASD.

Observational studies are a form of mixed methods research. After researchers had been more than twenty years mixing qualitative and quantitative approaches, mixed methods research is the response to the currents of qualitative and quantitative research, and represents a new movement that has arisen. Arias-Pujol and Anguera, 2017). The mixed methods approach involves the collection, analysis, and interpretation of qualitative and quantitative data for the same purpose and within the framework of the same study (Anguera et al., 2018). Studies that use observational methodology are considered to be mixed methods research studies, as they offer a great amount of data that can be analyzed in different ways. Data obtained from observational methodology are qualitative but can be transformed into quantitative data using different techniques, such as sequential analysis and polar coordinate analysis. These quantitative data can also be analyzed from a qualitative perspective. This integration of qualitative and quantitative methods is coherent with a mixed methods perspective (Anguera et al., 2017). In mixed methods studies we can perform various types of analysis. A study by Arias-Pujol et al (2015) used lag sequential analysis to identify patterns of interactive behaviors between children with ASD and their therapists during psychotherapy sessions. Results show how certain behaviors exhibited by the therapist stimulated the appearance of positive behaviors in the child.

The analysis of polar coordinates is distinct from other forms of sequential analysis. Polar coordinate analysis reveals the relationships established between a behavior considered as ‘focal’ and a number of conditional behaviors, with respect to prospective and retrospective sequentialities, and to describe different behavioral maps (Castellano and Hernández, 2003). This analysis provides information about activation or inhibition of the registered/observed behaviors through qualitative information transformed into quantitative data, allowing detailed observation of diverse behaviors.

Polar coordinate analysis is an elaborate data reduction technique that provides a vector image of the complex network of interrelationships between categories that make up the different dimensions of the observation instrument. The structure of polar coordinate analysis, which is a technique that complements prospective and retrospective sequential analysis (Bakeman, 1978), is based on complementarity between two analytical perspectives: prospective and retrospective. Therefore, this technique can detect changes in social competence behaviors in adolescents with ASD throughout therapy by combining data from prospective and retrospective viewpoints.

Little has been published on the use of polar coordinate analysis or similar analyses to examine the behavior of children (Espinosa et al., 2004; Herrero, 2000; Rodríguez-Medina et al., 2018). In ASD, the literature is even scarcer. Mixed methods analysis has been used to describe interactions in neurotypical-adolescent group therapy (Arias-Pujol and Anguera, 2017). In their study, Arias and Anguera used polar coordinate analysis to analyze conversation turn-taking between therapists and six adolescents over the course of a 24-session intervention. Results show that polar coordinate analysis can offer a new focus. It could be used to study the role of the therapist, her interaction style and the effects of her strategies on participants.

In this study, we used an adapted version of the social competence intervention program developed by the Solomon Lab at the UC MIND Institute (Solomon et al., 2004). The goal of the group therapy is to improve social skills and social competence. Therapists seek to

promote social interactions, such as conversation and cooperative play. Sessions include topics such as empathy, talking about feelings and resolving social conflicts.

The main aim of this study was to demonstrate how polar coordinate analysis can be useful in studying social behaviors in adolescents with ADS during an intervention. Moreover, we want to see whether Bauminger's scale could be combined fruitfully with polar coordinate analysis and to investigate whether typical ASD behaviors show similar interrelations (prospective and retrospective sequentialities) as behaviors observed in psychotherapy.

METHOD

Design

In this study, we applied systematic observation to analyze social behaviors in a group of adolescents with ASD. A total of ten sessions was conducted, although the first session was not included in the analysis as participants did not know each other and this could interfere in interactions. We only observed 15 minutes of each session (free play time). The observation of behavior was scientifically rigorous as the observers had a non-participatory role and only observable behavior was coded.

The observational design (Anguera et al., 2001) was nomothetic (several adolescents were observed), included follow-up (every session from the intervention was registered), and multidimensional (several dimensions of the observation instrument were considered suitable) (N/F/P). As the therapeutic process extended to several sessions, the group of adolescents was considered as a plurality of units. We worked with two levels of response: verbal and non-verbal.

Participants

Following approval from the Research Committee Review Board at Sant Joan de Déu Hospital (Barcelona) and the Ethical Committee for Clinical Research at Sant Joan de Déu Foundation (CEIC "Comitè d'Ética d'Investigació Clínica Fundació Sant Joan de Déu"), subjects were recruited by psychologists and psychiatrists from the Multidisciplinary Autism

Spectrum Disorder Unit (UnimTEA), Hospital Sant Joan de Déu (HSJD). All parents provided written, informed consent and informed assent was obtained from each child. Participants were informed about the location of the camera and the period of time that would be recorded.

Participants were selected through inclusion criteria based on an age range between 13 and 17 years old, diagnosed with Autism Spectrum Disorder according to DSM-5 criteria, and evaluated with the Autism Diagnostic Observational Schedule-2 (ADOS-2; Lord et al., 2000). Subjects were also required to have a level of Verbal Comprehension within the normal range according to standardized assessment. Participants with below average cognitive or language abilities ($IQ < 70$), severe behavioral problems, and/or other mental psychopathologies were excluded.

A total of eight adolescents were initially enrolled and participated in ten group sessions. However, the final sample consisted of five participants as three participants did not attend all sessions (mean age 14.6; 1 Girl/ 4 boys).

The group was led by a trained psychologist and assisted by co-therapists.

Table 1: *The characteristics of the five participants were as follows*

Participant	Age	Verbal comprehension	ADOS (severity)
P1	16	88	6
P2	15	105	7
P3	14	93	DS 15 (module 4)
P4	14	116	7
P5	14	Missing data	6

Intervention design

The intervention was based on a more extensive program developed by the Solomon Lab at the UC MIND Institute (Solomon et al., 2004). The main goal of the program was to develop and improve social competence skills, following an “inside-out” model, that is, trying to increase inner motivation to socialize. Each session consisted of separate parts: greeting time, 15 minutes of free play, didactic time, joke time and a take-home social experiment. Didactic time involved training abilities such as empathy, recognizing emotions, managing anxiety or anger, reciprocal conversation skills, theory of mind and problem-solving.

The adolescents included were invited to participate in a total of 10 sessions, scheduled on a weekly basis. These sessions took place in a large, especially adapted room at Sant Joan de Déu Hospital (Barcelona) and lasted for 90 minutes. Each session followed the same structure: introduction (open conversation), 15 minutes of free play, didactic time, jokes and ending. Free play time in all sessions was video-recorded.

Before the group sessions, all participant families attended an information session with therapists and general information about the study was provided. Afterwards, each participant had an individual meeting with his/her therapist to set his/her own personal goals. Participants agreed to participate in the program and informed consent was obtained from the parents of minors. All procedures were in accordance with the ethical standards of the institutional research committee and the 2000 Declaration of Helsinki.

Instruments

Diagnostic instruments

Diagnosis of Autism Spectrum Disorder was confirmed through clinical interview and the ADOS-2 (Lord et al., 2000), which was administered to the adolescents. Cognitive abilities were measured with the Wechsler intelligence scale for children and adolescents: Fourth edition (WISC-IV, 2007) or Fifth edition (Wechsler et al., 2014).

Recording instrument

Group sessions were recorded using two video cameras. In accordance with the principles of the Declaration of Helsinki, the Spanish Official College of Psychologists General Council's Ethical Code and the Ethical Committee for Clinical Research at Sant Joan de Déu Foundation, participants were informed that they were being filmed. They were shown the location of the video cameras, which were positioned discreetly to minimize reactivity bias. Lince software (Gabin et al., 2012) was used to codify behaviors.

Observation Instrument

The observation instrument used to code social behaviors was based on an adaptation of an observational scale (Bauminger, 2002) that had previously been used to evaluate social competence groups for adolescents with ASD (McMahon et al., 2013). We adapted the scale in order to make it more adjusted to our clinical reality. Each category was described in a more specific manner so that observers could understand them better and increase inter-observer reliability. We also eliminated the Negative Interaction dimension, because we rarely observed this type of behavior. Finally, we decided to add a dimension that was very interesting and a fundamental part of communication between our participants: gestures. It is worth noting that gestures are more varied and common in Mediterranean cultures than in northern Europe or the U.S.

Behavior was grouped into two categories: social initiation (the child/adolescent begins a new social sequence, distinguished from a previous sequence by a change in activity) and social response (the participant responds verbally and/or nonverbally to social stimuli directed toward him/her by peers). Subsequently, each category was organized into three dimensions, depending on the quality of social interaction: high-level positive interaction (HPI; the child exhibits verbal and nonverbal social behaviors that lead to an effective social process with peers and serves to start or maintain social interaction), low level interaction (LPI; the child exhibits behaviors that indicate social intention, but with minimal social enactment, such as close proximity to children without initiating a positive social interaction), and negative interaction (NSI).

These three dimensions involved specific conduct. High-level positive interactions included: eye contact, smiling, affection, sharing objects, sharing experience, verbal social communication, talk that reflects an interest in another child's hobbies and giving help. Low level interaction conduct included: looking, close proximity, “yes” and “no”, imitation, idiosyncratic language, repetitive behavior and functional communication.

As we observed that our sample never codified for negative interaction, we decided to remove this dimension.

Table 2: *Dimensions and category systems in the observation instrument for patients*

Response Levels	Dimensions	Category systems (codes)
<p>Social Initiation (IS): The child begins a new social sequence, distinguished from a previous sequence by a change in activity.</p>	<p>High Positive Interaction (HPI): The child exhibits verbal and nonverbal social behaviors that lead to effective social process with peers. Behaviors that serve to start or maintain social interaction.</p>	<p>Eye Contact (CO): The child looks into the eyes of another child. Smile (SON): The child smiles at other children. Affection (AFEC): The child expresses affection for another child, either verbally (e.g., “You’re nice,” “I like you”) or nonverbally (e.g., hugs, touches). Sharing objects (COMOBJ): The child offers his/her objects to another child or shares an object with another child. Sharing experience (COMEXP): The child tells peers about an experience or asks them about their experiences (e.g., “What did you do over the weekend?”). Verbal social communication (COSOVER): The child approaches another child with a social (rather than functional) intention (e.g., “Let’s play”). Talk that reflects an interest in another child (CMI): The child expresses an interest in another child’s hobbies (e.g., “What’s your favorite game/object?”), mood (e.g., “Are you sad?”), etc. Giving help (OFAY): The child offers help to another child.</p>
<p>Social Initiation</p> <p>Social Response</p>	<p>Low Level Interaction (LPI): The child exhibits behaviors</p>	<p>Looking: - At an action or person without eye contact (MIR): The child looks at the other child’s face or body, or child’s action, without establishing eye contact.</p>

<p>that indicate social intention, but with minimal social enactment, such as close proximity to children without initiating a positive social interaction. Also includes behaviors typical of the autistic syndrome (e.g., echolalia, idiosyncratic language).</p>	<p>- Looks to the side, avoiding eye contact (MOL). Close proximity (PX): The child stands in close proximity to another child (3 feet or less) but does not approach the peer. Yes and No (YES/NO): The child only nods his/her head for yes or shakes it for no. Imitation peer (IMIC) or therapist (IMIT): The child imitates the talk or activity of another child or the therapist. Idiosyncratic language (LID): The child uses utterances with no clear meaning. Repetitive behavior (COMREP): The child behaves in a repetitive manner with no clear communication intent, but in close proximity to another child. Functional communication (COMFU): The child approaches or responds to another child with an intention to fulfill his/her own needs, and with no social intention (e.g., “It’s my turn on the computer now”), or just to express something related to the game, without social intent.</p>
<p>Social Initiation</p> <p>Social Response</p>	<p>(GECONV): Greet, raise your hand, no / yes (with your head), come, shut up, ok, etc. (GESEN): Gestures that emphasize explanations or participants’ discourse, but that do not add any further meaning. (GEDES): Gestures that indicate the quantity, the size, the form ... they describe something. (GESEÑ): Point your hand, arm or finger at something to show it to another. (GEMO): Gestures that indicate an emotion (covering your mouth (surprise or laughter), covering your eyes (disbelief), raising your hands or arm (joy), etc.)</p>

Procedure

Data Quality Control Analysis: Inter-observer Agreement

From the qualitative research perspective, systematic observation was used to obtain data that we managed as a code matrix. Two observers analyzed and coded 14 minutes of nine

group sessions. The degree of inter-observer agreement, calculated with Cohen's Kappa (1988), ranged between 76 and 89%. To obtain this value, 20% of the material was coded and the Kappa coefficient of the A and B sessions (which were randomized) of P3, P5, P6 and P8 participants was calculated". Once we had confirmed the reliability of the data, we codified 14 minutes during the free play activity of each session to exhaustively record social behaviors throughout the sessions. Finally, we only codified the total material of the participants that appeared in all sessions. For each participant, the nine sessions were organized into three blocks (First block: 1-2-3, second block: 4-5-6 and third block: 7-8-9).

Data Analysis

From the quantitative perspective, data were initially analyzed in a descriptive way, showing the corresponding frequencies of the group categories from the ISP and IBN dimensions in three consecutive group sessions through polar coordinate analysis, which is a technique that shows relationships between categories.

To carry out the prospective analysis, the first step is to define a behavior, known as the focal behavior, which, depending on the aims of the study, is believed to generate or trigger a series of connections with other categories, known as conditional behaviors. To detect significant behavioral patterns, it is necessary to compute lag sequential statistics with a focus on positive lags, i.e., events or behaviors that occur *after* the focal behavior. In the case of our study, positive lags identified "forward-occurring" discursive units used by the teachers.

The retrospective, or "backward" perspective, which incorporates what Anguera (1997) referred to as the concept of "genuine retrospectivity", reveals significant associations between the focal behavior and behaviors that occur *before* this behavior (i.e., negative lags). In this study, this retrospective analysis produced a "mirror-like" image of associations between discursive units that occurred before the focal behavior; the sequence followed was last, second-last, third-last, etc.

As mentioned above, polar coordinate analysis integrates both the prospective and retrospective perspectives, and provides interpretable data through the application of an

extremely powerful technique involving the calculation of the Z_{sum} statistic, described by Cochran (1954) and later proposed by Sackett (1980). This computation is possible, as both the frequency of the focal behavior (n) and the Z scores for each of the lags considered are known. These Z scores are independent of each other, as they are computed using the binomial test, which compares observed probabilities (corresponding to textual units derived from observation of the therapists' discourse) with expected probabilities (chance occurrences).

Prospective and retrospective Z_{sum} scores can have a positive or negative sign. Each conditional behavior is represented by a vector, which, in turn, is located in one of four quadrants (I, II, III, or IV) depending on the positive or negative sign of the prospective and retrospective Z_{sum} scores. These quadrants indicate whether the focal and conditional behaviors activate or inhibit each other, as follows:

- Quadrant I: Mutual excitation between focal and conditional behavior (prospective and retrospective activation).
- Quadrant II: Inhibitory focal behavior and excitatory conditional behavior (prospective inhibition and retrospective activation).
- Quadrant III: Mutual inhibition between focal and conditional behavior (prospective and retrospective inhibition).
- Quadrant IV: Excitatory focal behavior and inhibitory conditional behavior (prospective activation and retrospective inhibition).

With polar coordinate analysis technique, it is possible to generate vectors that show the relationship between the focal behavior and each of the conditional behaviors analyzed. Polar coordinate analysis thus constitutes a powerful statistical technique and a robust methodological tool for identifying all possible interrelationships between the variables of interest in a given study. In short, following a complex process of data reduction, polar coordinate analysis generates a highly informative map containing vectors showing the complex network of interrelationships between behaviors that play a central role (focal behaviors) and other, potentially related, behaviors of interest (conditional behaviors). The

corresponding calculations can currently be performed in HOISAN v.1.6.3 (Hernández-Mendo et al., 2012). The first step is to calculate the adjusted residual values for lags -5 to +5; these values are then standardized and combined with the Z_{sum} of the prospective (positive) lags and the retrospective (negative) lags to calculate the length and angle of each vector. The vectors connect the focal behavior with the conditional behaviors. Once the vector angles have been calculated, each vector is assigned to one of four quadrants that indicate the type of relationship between the focal and conditional behaviors. All vectors with a length of 1.96 were considered to be significant ($p < .05$).

In order to facilitate the analysis and obtain more data for each participant, the sessions were divided in three blocks: block 1 corresponded to sessions 1, 2 and 3; block 2 corresponded to sessions 4, 5 and 6 and block 3 corresponds to sessions 7, 8 and 9.

In our study, within the HPI (positive high-level interaction) dimension, polar coordinates were calculated for the three blocks of sessions considering the following categories as focal and conditional behaviors: eye contact (CO), sharing objects (COMOBJ), sharing experiences (COMEXP), verbal communication (COSOVER) and five types of gestures: conventional gestures (GECONV), emotional gestures (GEMO), emphatic gestures (GESEN), descriptive gestures (GEDES) and pointing gestures (GESEÑ). Within the LPI dimension, polar coordinates were calculated considering the following categories as focal and conditional behaviors: affirmation or denial gestures, functional communication, play and five types of gestures (as with HPI). No negative social interaction (NSI) was registered.

RESULTS

As previously explained, the final sample consisted of 5 participants with diagnosis of ASD. They all had an IQ within the normal range and presented significant difficulties in social communication and social interaction behaviors. However, the degree of impairment in social communication was distinct for each participant as they showed differences in the quality and frequency of social behaviors (Table 1). We also observed differences in their personal patterns. For instance, some participants exhibited more non-verbal communication

behaviors (e.g., eye contact, gestures) than verbal communication while other participants showed the opposite patterns (e.g., verbal communication without eye contact).

To describe relationships between social behaviors for each participant, we applied two types of analysis. We analyzed the number of social behaviors in each block of sessions (frequency) and additionally performed polar coordinate analysis. In general, all participants showed fewer low-level interactions (LPI) and high variability in high level positive interaction (HPI) behaviors. As described above, polar coordinate analysis offers information on the development of their interactive behaviors. There was no specific pattern that summarized the progress of all participants through the intervention, as each adolescent took a different course. In the sections below, we describe the development of social behaviors for each participant.

Focal behaviors for each participant were chosen according to the frequency with which they appeared in the sessions of each. For example, in Participant 1, functional communication (COMFU) was more frequent than other types of conduct. Therefore, this behavior was selected as focal. In contrast, conditional behaviors were those that appeared more sporadically or were less frequent in the interaction.

Participant 1

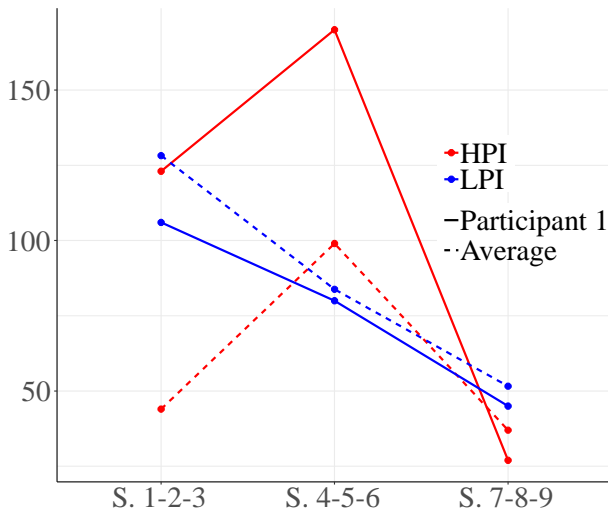


FIGURE 1. Development of high-level positive interaction (HPI) behaviors and low-level positive interaction (LPI) behaviors for participant 1. Session blocks 1-2-3 from left to right. As shown in Figure 1, participant 1 exhibited a high number of high-level positive interaction (HPI) behaviors within the first block of sessions (1-2-3). These behaviors increased during the second block, while low level interaction behaviors (LPI) decreased. By the end of the intervention, all types of social behaviors decreased.

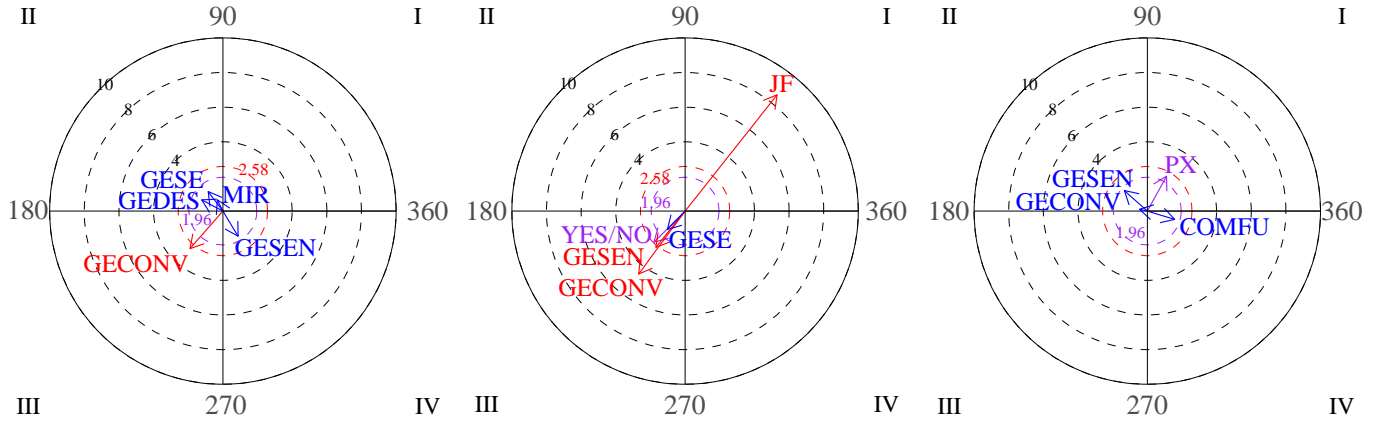


FIGURE 2. Graphs 1 and 2 represent vectors corresponding to functional communication (COMFU) as the focal behavior during the first and the second block of sessions and functional communication, gestures and functional play as conditional behaviors. Graph 3 represents gestures of nodding/shaking the head as focal behavior during the third block and proximity (PX) as conditional behavior.

Polar coordinate analysis was used to analyze relationships between social behaviors. The focal behavior was functional communication. The graphs in Figure 2 show the vectors for the different relationships distributed among the four quadrants through the three blocks of sessions (1-2-3, 4-5-6, 7-8-9). On examining the first block (sessions 1-2-3), it can be seen that functional communication does not stimulate any conduct (quadrant I is empty), whereas vectors located in quadrant IV indicate that functional communication and gestures are mutually inhibited. During sessions 4-5-6 (graph 2), functional communication and functional play activate each other (quadrant I). The third graph represents the gesture of nodding/shaking the head as focal behavior during the third block of sessions (7-8-9). Vectors in quadrant I indicate mutual activation between the gestures of nodding/shaking the head

and physical proximity. These results suggest positive development of interactive play during free playtime.

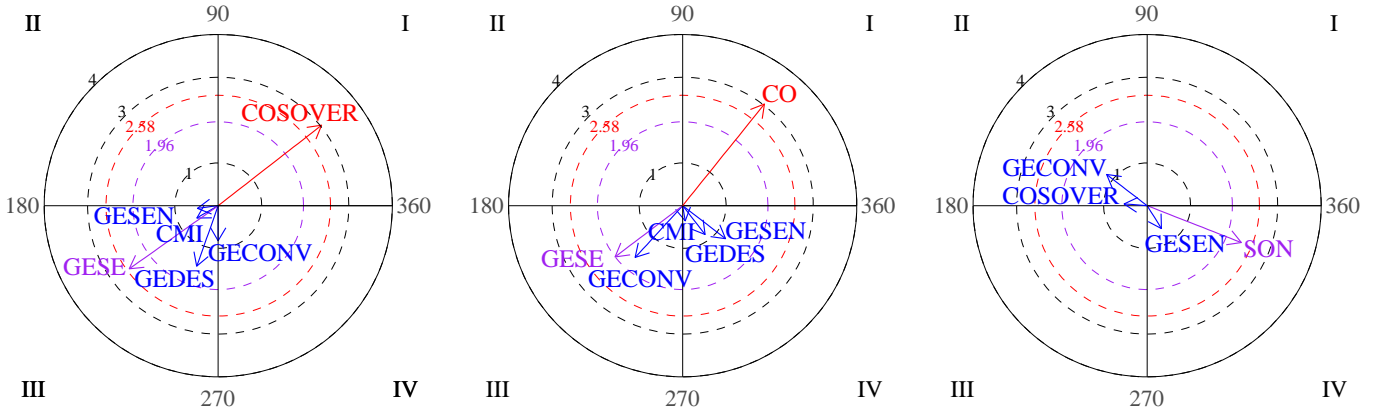


FIGURE 3. Graph 1 represents vectors corresponding to eye contact (CO) as focal behavior during first block of sessions, and verbal social communication (COSOVER) as conditional behavior. Graph 2 represents verbal social communication as the focal behavior during the first block of sessions. Graph 3 represents vectors corresponding to eye contact as focal behavior during the second and third block of sessions, and conventional gestures and social smile (SON) as conditional behaviors.

The graphs in Figure 3 show positive steps stimulated by eye contact (focal behavior). During the first block (sessions 1-2-3), vectors located in quadrant I indicate that eye contact (CO) and verbal social communication (COSOVER) were mutually activated, which indicates an appropriate strategy. In the second block (sessions 4-5-6), vectors located in the first quadrant indicate mutual activation between eye contact and conventional gestures. Finally, it can be seen that eye contact precedes social smile (SON; quadrant III).

Participant 2

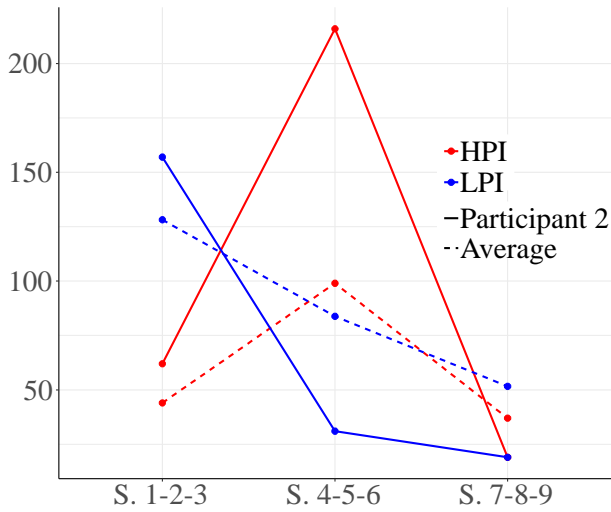


FIGURE 4. Development of high-level positive interaction (HPI) behaviors and low level positive interaction (LPI) behaviors for participant 2. Session blocks 1-2-3 from left to right. Figure 4 shows the progress of social interaction frequency through the intervention for participant 2. The figure shows that the number of positive interactions increases in the second block with respect to the first block of sessions, while the number of low-level interactions decreases. Both types of interaction decrease by the end of the intervention.

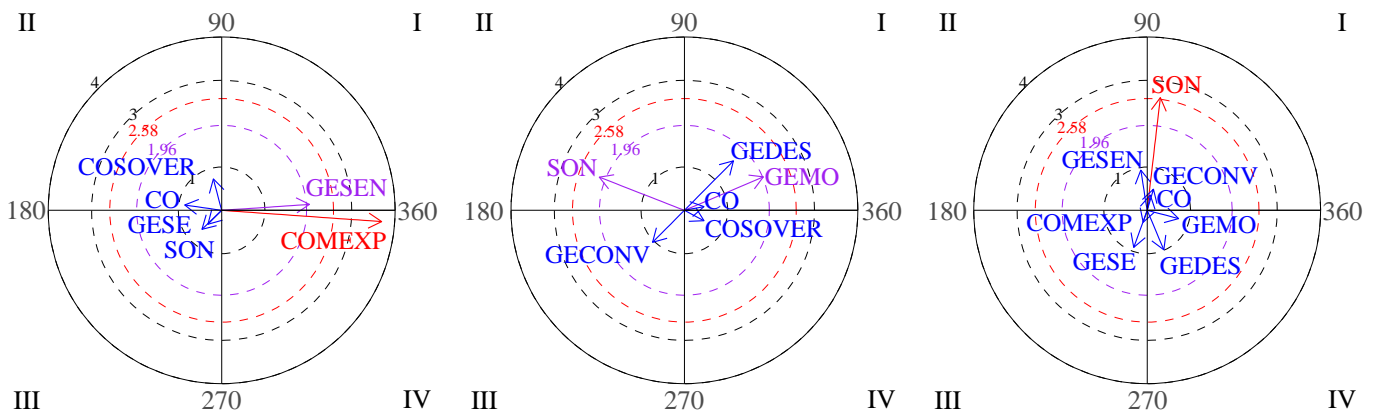


FIGURE 5. Vectors corresponding to the social behaviors of participant 2. Graphs 1 and 3 correspond to sessions 4-5-6 and the focal behaviors are GEMO and COSOVER. In Graph 2, the focal behavior is GESEN in sessions 1-2-3.

The graphs in Figure 5 represent the development of interactions between social behaviors for participant 2 over the course of the intervention. As shown, gestures are very frequently used by this participant. Block 1 is characterized by mutual activation of emotional gestures and emphatic gestures (quadrant I).

For the second block (sessions 4-5-6), vectors located in quadrant I indicate that verbal social communication (COSOVER) and social smile (SON) were mutually activated. Again, mutual activation was observed between emotional gestures (GEMO) and emphatic gestures (GESEN). No significant result was observed during sessions 7-8-9.

Participant 3

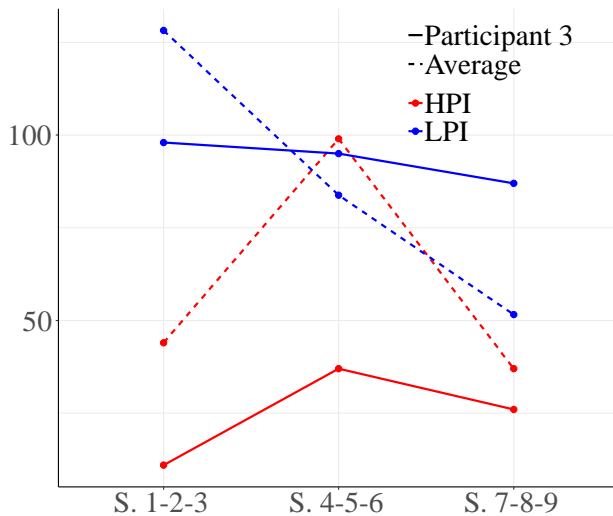


FIGURE 6. Development of high-level positive interaction (HPI) behaviors and low level positive interaction (LPI) behaviors for participant 3. Session blocks 1-2-3 from left to right. Participant 3 showed a different course to prior participants. As shown in Figure 6, he performed more low-level interaction behaviors than high level positive interaction behaviors. High level positive behaviors increased through the intervention, indicating that the quality of his interactions probably improved.

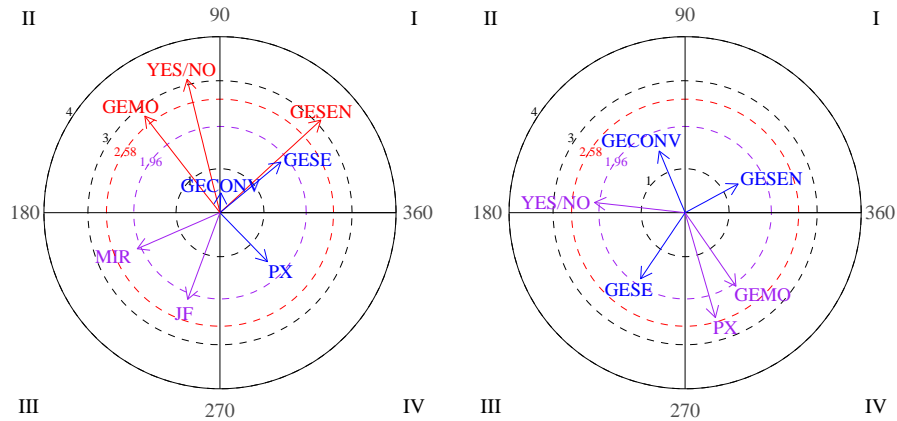


FIGURE 7. Vectors corresponding to functional communication (COMFU) as the focal behavior, with emphatic gestures, gestures of nodding/shaking the head, emotional gestures, looking at an object and functional play as conditional behaviors. Session blocks 1 and 3.

Figure 7 represents interactions between social behaviors for participant 3. The focal behavior was functional communication (COMFU). Significant results are observed for quadrants I and II in the first block of sessions (1-2-3). Vectors located in quadrant I reflect mutual activation between functional communication and emphatic gestures. Vectors situated in quadrant II indicate that functional communication inhibits the gesture of nodding/shaking the head (yes/no), while this gesture activates functional communication. The same pattern is observed with emotional gestures. We observe that looking at an object and functional play do not stimulate communication.

Vectors for the third block of sessions (sessions 7-8-9) show a change in the relationships between functional communication and other behaviors. In this case, the focal behavior (functional communication) stimulates physical proximity and emotional gestures, but not vice versa (quadrant IV). As in previous sessions, gestures of nodding/shaking the head activate functional communication.

Regarding high level positive behaviors, no significant result was observed in sessions 1-2-3 or 4-5-6. There were significant results in the final sessions (7-8-9). We observed that the social smile activates verbal social communication.

This participant showed frequent use of functional communication to initiate and respond in free play, exhibiting more low-level interaction behaviors than high level behaviors (Figure 7). We observed that during the first sessions his functional communication was more often accompanied by gestures. We observed a new component during final sessions: physical proximity to a partner or to a situation. By the end of the intervention, the amount of high-level interaction behaviors had increased.

Participant 4

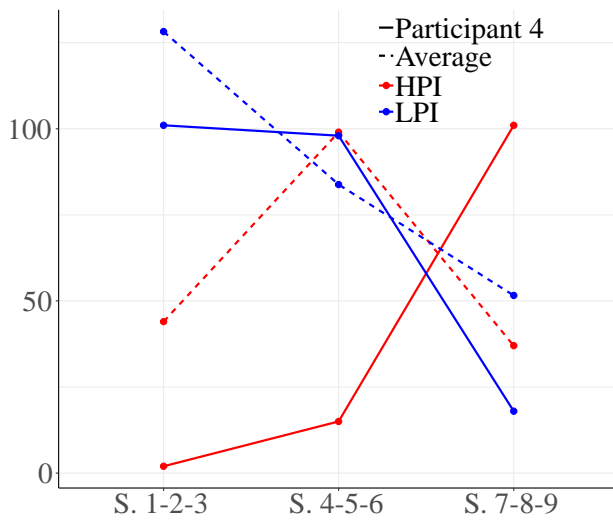


FIGURE 8. Development of high-level positive interaction (HPI) behaviors and low-level positive interaction (LPI) behaviors for participant 4. Session blocks 1-2-3 from left to right.

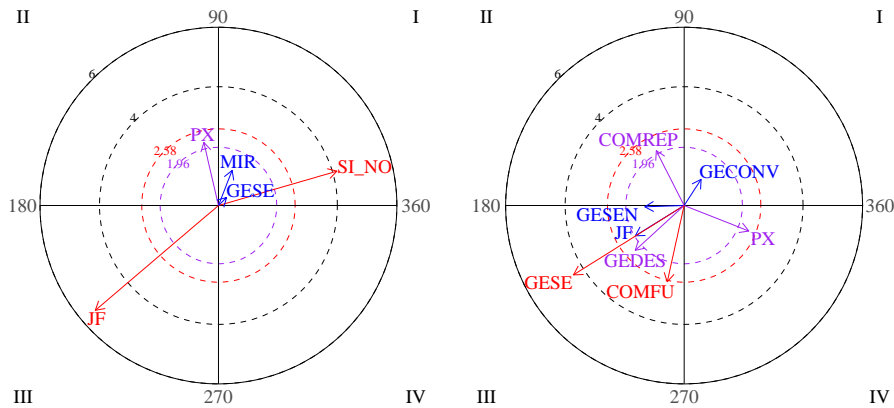


FIGURE 9. Graph 1 represents vectors corresponding to functional communication (COMFU) and the gestures of head nodding/shaking, physical proximity, functional communication and functional play as conditional behaviors during the first block of sessions (sessions 1-2-3). Graph 2 represents gestures of head nodding/shaking as focal behavior and physical proximity and repetitive behaviors as conditional behaviors during the second block of sessions (sessions 4-5-6).

Participant 4 exhibited changes in the use of high-level positive interaction behaviors and low-level behaviors over the course of therapy. Figure 8 shows that during the first block he manifested a high number of low-level interactions behaviors. However, the amount of high-level interaction behaviors increased in the second and third block.

Graph 1 in Figure 9 shows significant results for vectors located in quadrant I in block 1 (sessions 1-2-3). As can be seen, functional communication and head nodding/shaking (yes/no) gestures are mutually activated. Mutual activation is also observed between physical proximity and functional communication. These observations might offer information about the way this participant initially performs social initiations and social responses. Vectors located in quadrant IV indicate that functional play and functional communication are mutually inhibited.

Results for the second block show interactions among other behaviors (Figure 9, graph 2). Considering head nodding/shaking (yes/no) gestures as focal behavior, it was observed that this behavior activates physical proximity. Repetitive behaviors activate nodding/shaking head gestures.

Head nodding/shaking gestures do not activate emphatic gestures, descriptive gestures or functional communication.

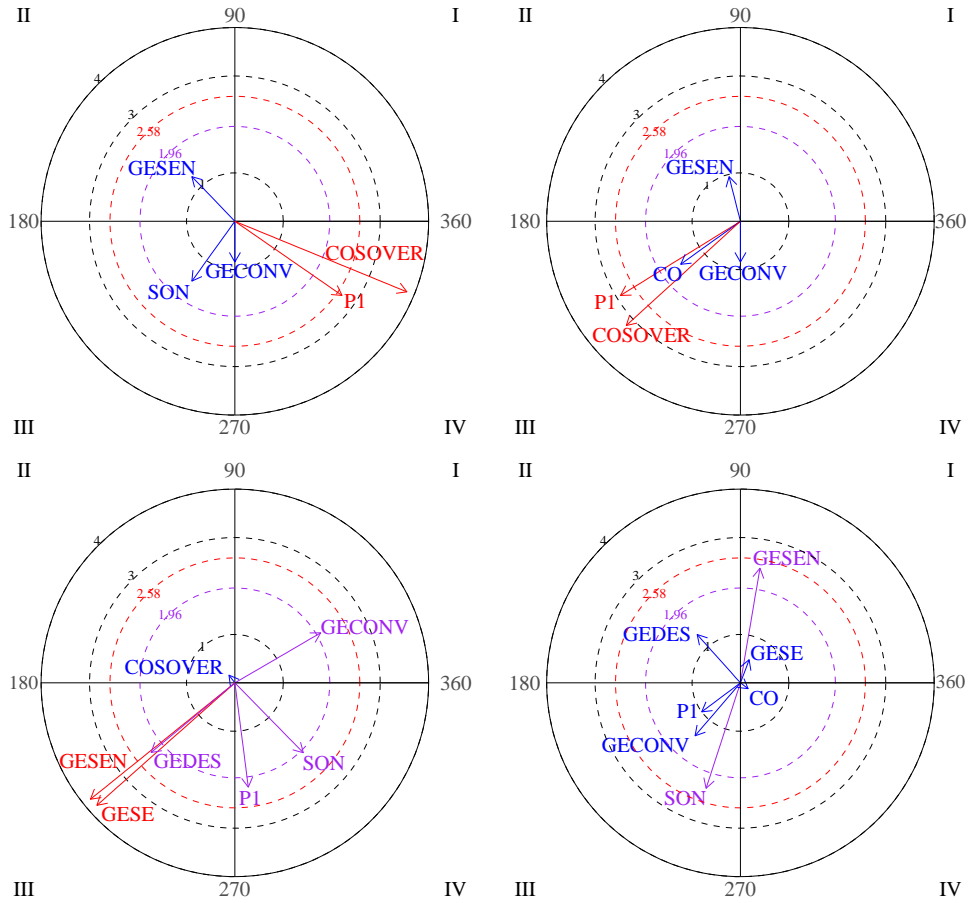


FIGURE 10. Graph 1 represents eye contact (CO) as focal behavior and verbal social communication (COSOVER) as conditional behavior during the second block of sessions (sessions 4-5-6). Graph 2 represents the social smile (SON) as focal behavior during the second block of sessions (sessions 4-5-6). Graph 3 represents eye contact as focal behavior and social smile, emphatic gestures, descriptive gestures and pointing as conditional behaviors during the third block of sessions (sessions 7-8-9). Graph 4 represents verbal social communication as focal behavior and emphatic gestures as conditional behavior.

Significant results for high level social behaviors are also observed during the second block of sessions (sessions 4-5-6). Considering eye contact as focal behavior, vectors located in quadrant II in the first graph (Figure 10) show that eye contact activates verbal social communication, which is expected in any social interaction. Finally, when the social smile is the focal behavior during this second block, verbal social communication and social smile are mutually inhibited (graph 2, quadrant III).

As can be seen in the third and fourth graphs in Figure 10, this participant shows significant positive results in the final sessions (7-8-9). For the third graph, the focal behavior was eye contact. Quadrant I indicate that eye contact and conventional gestures are mutually activated. Eye contact also activates social smile (graph 3, quadrant IV), which is important in social interactions. Other types of gestures (emphatic, descriptive or pointing gestures) and eye contact are mutually inhibited (graph 3, quadrant III).

The last graph in Figure 10 represents verbal social communication as focal behavior, which activates emphatic gestures.

In general, this participant showed high inhibition during early sessions and his interactions were mainly functional and not socially oriented. He demonstrated positive development and an improvement in the quality of his interactions, probably indicating more interest in social communication.

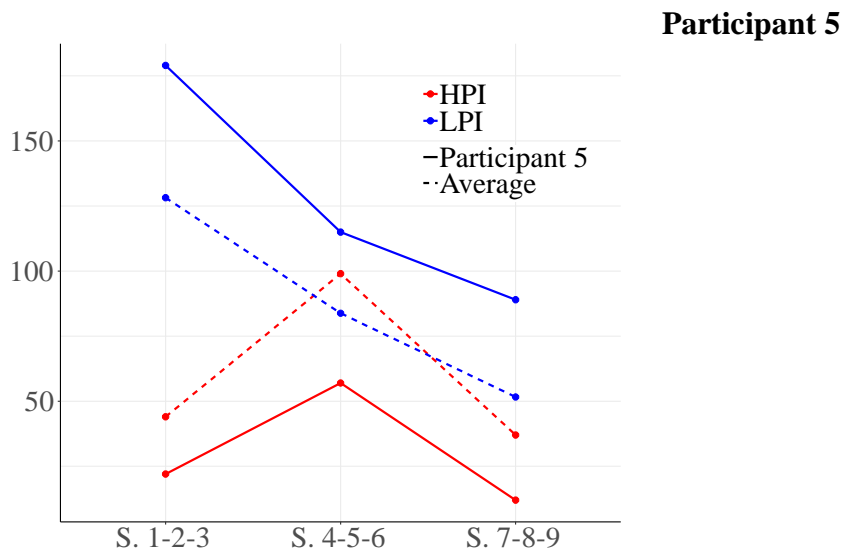


FIGURE 11. Development of high-level positive interaction (HPI) behaviors and low-level positive interaction (LPI) behaviors for participant 5. Session blocks 1-2-3 from left to right.

Results

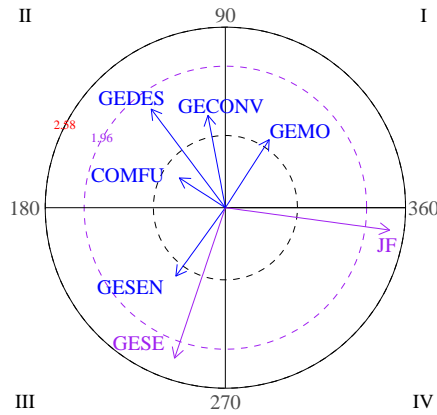


FIGURE 12. Vectors corresponding to head nodding/shaking (yes/no) gestures as focal behavior, and functional play and pointing as conditional behaviors during the first block of sessions (sessions 1-2-3).

Figure 12 represents vectors corresponding to head nodding/shaking (yes/no) gestures as focal behavior during the first block of sessions for participant 5. It can be seen that this type of gesture activates functional play (quadrant IV). Vectors located in quadrant III indicate mutual inhibition between head nodding/shaking gestures and pointing.

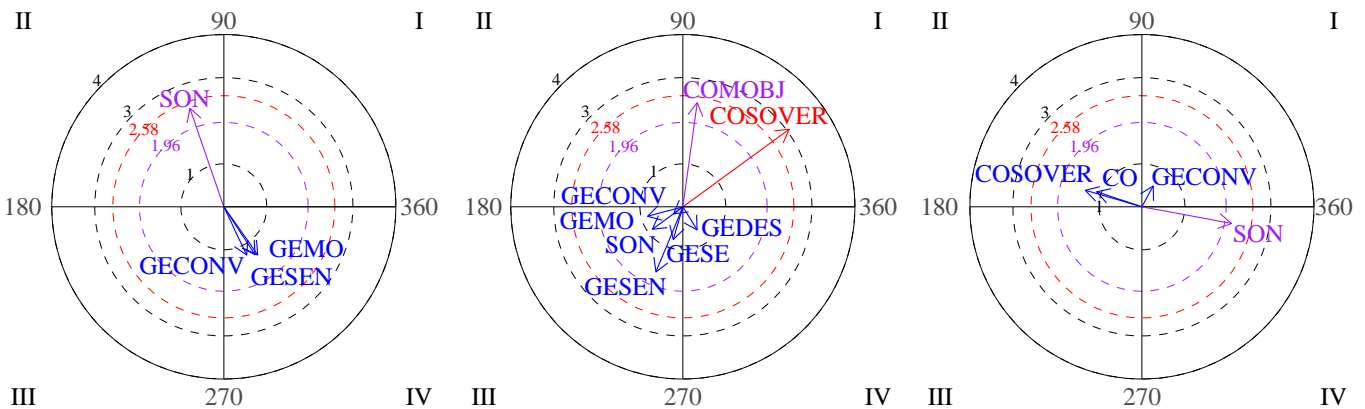


FIGURE 13. Vectors represent verbal social communication (COSOVER) as focal behavior and social smile as conditional behavior during the first block of sessions (sessions 1-2-3). Graph 2 represents eye contact (CO) as focal behavior and sharing objects and verbal social communication as conditional behaviors during the second block of sessions (sessions 4-5-6). Graph 3 represents emotional gestures as focal behavior and social smile as conditional behavior during the final block of sessions (sessions 7-8-9).

The graphs in figure 13 show the vectors for the different relationships between social behaviors through the three blocks of sessions for participant 5. During early sessions (graph 1), vectors located in quadrant I indicate that social smile activates verbal social communication retrospectively.

Graph 2 represents eye contact as focal behavior during the second block of sessions (sessions 4-5-6). Vectors situated in quadrant I show mutual activation between eye contact and sharing objects, and between eye contact and verbal social communication. These relationships reflect appropriate use of social communication. Finally, graph 3 shows that emotional gesture activates social smile (quadrant IV).

Participant 5 shows high variability in the use of types of social interactions. He uses both high- and low-level social behaviors at the beginning and end of the intervention. It can be observed that this participant is able to use high level positive interaction behaviors, integrating conduct such as the social smile, sharing objects, eye contact, social communication and emotional gestures. Therefore, although the use of high-level interactions is variable, this participant shows good abilities in high level social interaction behaviors.

The results show that there is considerable variability between participants, showing different courses through the sessions, improving or decreasing the number and the quality of their social behaviors. In addition, we observed that the average of HPI in the first block of sessions (1-2-3) was very low, in the second block (sessions 4-5-6) increase the number of HPI behaviors increased, and finally we observed another decrease (sessions 7-8-9).

DISCUSSION

The main goal of this study was to analyze patterns of social behaviors in a group of adolescents with ASD that participated in a group social-competence intervention program. To evaluate these patterns, we adapted a previously used observation instrument and used polar coordinate analysis, based on an integrative qualitative-quantitative perspective.

The observation instrument presented could be considered as a new tool for coding and analyzing social behaviors. Our final instrument was an adaptation of an observation scale developed by Bauminger (2002), which had already proved its utility in analysis of social behaviors through social-competence group interventions (McMahon et al, 2013). With this study, we also observed that this instrument could be useful for polar coordinate analysis. The reliability results in the data quality control analysis support the adequacy of the data obtained. This observation instrument might have future applications in the field of psychotherapy.

Regarding polar coordinate analysis, we show the potential of the application of this observational methodology in analyzing behaviors in a group of adolescents with ASD. As has already been noted, Portell et al. (2015) described observational methodology as the type of evaluation that allows analysis of spontaneous behaviors in psychotherapy. Our results show that participants exhibited highly variable patterns of social behavior and different courses of development. Therefore, it is not possible to summarize their behaviors in one single pattern that represents the whole group of adolescents. Nevertheless, we were able to observe spontaneous behavior in a semi-structured social environment, which allowed us to observe variation in behaviors for each participant.

In common with Anguera et al. (2018), we established that the use of observational methodology offers the opportunity to obtain a large amount of data that can be analyzed with different techniques. These data offer a great variety of options when analyzing behaviors in a more sensitive and detailed manner, offering information to which questionnaires are not sensitive (Kasari et al., 2014).

Similarly, Castellano and Hernández (2003) suggest that polar coordinate analysis offers the chance to observe unique qualitative details which can be subsequently transformed into quantitative data to be interpreted in a more global manner. In our study, this type of analysis offered information about bidirectional relationships that appear between the behaviors of each participant. In the field of ASD, obtaining detailed information about behaviors would be very useful for therapists, as it can provide information on the way one type of behavior

might activate or inhibit another. In our study, we obtained information on how one behavior activated or inhibited another in the same person. Another type of analysis could examine interactions among different participants. For example, how a therapist activates or inhibits other participants' behaviors could be explored (Arias-Pujol and Anguera, 2017).

It is also valuable to know the type of behaviors that a person tends to exhibit. For instance, knowing whether a participant tends to display more low- or high-level behaviors could be important. Therapists may be interested in observing whether this tendency changes through the course of their interventions.

Similar observational methodology and polar coordinate analysis has been used to analyze behaviors in sports competitions, such as soccer (Maneiro and Jiménez, 2018) and handball (Morillo et al., 2017). These studies support the numerous possible applications of this type of methodology.

CONCLUSIONS AND FUTURE LINES OF RESEARCH WORK

We observed that each participant took a unique course, increasing or decreasing the number and quality of their social behaviors. In accordance with the literature, we observed some increment in the amount of appropriate social conduct. We cannot generalize to a pattern of progress but can say that there were changes and differences between the beginning and the end of the intervention. Therefore, we consider that observational methodology might be useful in the field of psychotherapy and ASD, offering information about changes and development that cannot be obtained with other traditional measures, such as questionnaires. For future lines of research, it would be interesting to correlate the different variables of the initial evaluation (i.e., ADOS2, WISC-V) with data obtained from polar coordinate analysis. This would provide more information about the possible changes in the degree of severity or difficulties related to ASD. Furthermore, studies with a greater number of sessions are needed to obtain more data that support these findings. In addition, it is vital to conduct more studies that include observational methodology and mixed methods analysis to obtain more evidence on the real utility of this methodology. It is important to obtain reliable data that support this

type of analysis, which would, in turn, allow researchers to obtain detailed information on spontaneous behaviors and then transform this information into quantitative data. Professionals in the field of ASD need new methods to evaluate their interventions and the changes in their patients. Each little change might be important in a child's development.

AUTHOR CONTRIBUTIONS

MAM and CA developed the project; codifying the videos, running the group therapy and writing the article.

EA contributed to documenting, drafting and writing the manuscript and gave her approval to the final version to be published.

MTA wrote the methods section and performed the polar coordinate analysis.

All the team at the Multidisciplinary Autism Spectrum Disorders Unit at Sant Joan de Déu Hospital contributed to the development of the group therapy. MM, NE, MD, GB and JRM also contributed to documenting, drafting and writing the manuscript.

ACKNOWLEDGMENTS

We thank all the team at the Multidisciplinary Autism Spectrum Disorders Unit at Sant Joan de Déu Hospital, Barcelona, Spain, who so willingly helped to make this study possible, as well as all the adolescents and families who participated.

We thank Stephen Kelly for help with English editing.

This study was supported by the Catalan government under Grant number 2017 SGR 876 for the project *Grup de Recerca de Parella i Família* (GRPF) and Grant number 2017 SGR 1405 for the project *Tecnologia i aplicació multimedia i digital als dissenys observacionals* (GRID).

We also gratefully acknowledge the support of the Spanish government (Ministerio de Economía y Competitividad) within the Projects *Avances metodológicos y tecnológicos en el estudio observacional del comportamiento deportivo* [Grant PSI2015-71947-REDT; MINECO/FEDER, UE] (2015-2017), and *La actividad física y el deporte como potenciadores del estilo de vida saludable: evaluación del comportamiento deportivo desde metodologías no intrusivas* [Grant DEP2015-66069-P; MINECO/FEDER, UE] (2016-2018). Lastly, we also acknowledge the support of Ramon Llull University (PGRiD of FPCEE Blanquerna) and University of Barcelona (Vice-Chancellorship of Doctorate and Research Promotion).

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4.3. STUDY 3

Social Skills Intervention in Children with Autism Spectrum Disorders: Polar Coordinate Analysis

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Abstract

The demand of social skills interventions for people with ASD has grown in recent years. The main goal of this research was to study social skills: "responding to interaction" and "initiating interaction", and to capture whether there were differences between an initial and a final session in a program for children with ASD. Additionally, we aimed to compare social skills patterns according to the IQ level. The sample (N = 20) was divided into 2 subgroups depending on whether the VQI was > 90 or < 90. We employed a mixed methods approach based on a systematic observation of social behaviors. The observational design was nomothetic, follow-up, and multidimensional. Once we confirmed inter-observer reliability for the ad hoc observational instrument we performed descriptive statistics and polar coordinate analysis using LINCE software. The results show high intragroup and intergroup variability. The polar coordinate technique was useful for detecting significant relationships between autism's social micro-behaviors. Results and information obtained through observational methodology could allow professionals to understand communication and interaction of participants.

Keywords: *Polar Coordinate Analysis, Autism Spectrum Disorders, Social Skills*

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by alteration in social communication and social interaction, along with restricted and repetitive patterns, behaviors, interests and activities. Impairment in social competence may cause significant problems in daily life, such as difficulties in social reciprocity, abnormality in eye contact and alteration in nonverbal communication (American Psychiatric Association, 2013). Another characteristic of children with ASD is the difference in the quantity and quality of gestures and facial expressions, compared to neurotypical children (Attwood et al., 1988). Social skills deficits may include the following difficulties: challenges with entering, sustaining and exiting interactions; difficulty attending to, understanding, and using nonverbal and verbal social cues (eye contact, facial expressions and gestures); difficulty in understanding the social rules of their context; not understanding the other's intentions, perspective and to interpret the beliefs of others; difficulty in problem solving and problems with participating in leisure activities and in free time play with others (Hyman et al., 2020). Therefore, the difficulties in social interactions may interfere in their relations. McMahon (2013) commented that social response is a difficult skill due to the need to be conscious of the other's speech and thoughts in order to be connected to the conversation.

Social impairments in youth with ASD do not tend to improve merely with development, but rather may become more pronounced during adolescence when the social demands exceed the social skills (Gates et al., 2017).

Besides, psychological comorbidities are frequent in ASD (Muratori et al., 2019), including symptoms related to anxiety and depression, being sometimes present in school-aged children (Llanes et al., 2018). Sometimes, sleep disorders and food refusal are also common in diagnosis of ASD (Hyman et al., 2020). Another frequent comorbidity is attention deficit and hyperactivity disorder (ADHD; Guerrero et al., 2019), which might interfere with social competence because of inattention of social cues and impulsivity (Sinzig et al, 2008; Hyman et al., 2020). However, this relationship has not been confirmed by other studies (Şahin et al., 2018).

Research suggests that specific factors, such as age, intelligence quotient (IQ) or gender, could interfere with the presence of comorbidities (Guerrera et al., 2019). Regarding age, adolescents present more difficulties related to anxiety or depression compared with children in the spectrum (Mensi et al., 2013). In relation to IQ, certain studies report a relationship between IQ and comorbidity (Bölte et al., 1999) but other researches do not confirm this finding (Avni et al., 2018). In terms of gender and comorbidity in ASD, no relationship has been found in recent studies (Margari et al., 2019) but further research is needed.

Intervention Programs

Social skills interventions have demonstrated to be useful to improve social competence and might consequently improve comorbid affective symptomatology (Gates et al., 2018). Commonly, programs include domains of verbal and nonverbal communication, social interaction and problem-solving strategies. There are several recommended social skills interventions. The most common is social skills groups, that tend to be used in school-aged children and adolescents (Chester et al., 2019). Peer mentoring/training, is one of the most effective interventions in social skills and is regularly applied in preschool and school-age children in classrooms (Bohlaner et al., 2012). Video modeling has been shown to be effective to improve social and communication skills in child and adolescents with ASD (Buggey, 2009). Like peer mentoring, video modeling has proved that skills tend to be generalized and maintained (Tierney et al., 2014). Social narrative, social stories and picture books are widely used as tools to complement social skills training (Reichow et al., 2010; Golzari et al., 2015).

There are many published social skills programs, such as Think Social! (Crook and Winner, 2010, 2017), Social STAR (Vernoso et al., 2016), Navigating the Social World (McAfee, 2013), KONTAKT (Choque et al., 2016), PEERS (Laugeson, 2012, Schohl, 2012) and Social Adjustment Enhancement Intervention (Salomon, 2004). After all, it is unclear whether these programs promote generalization and maintenance over time (Moody et al., 2020).

Research has analyzed the effect of certain factors that could interfere with the effectiveness of social competence interventions, such as age (Hong et al., 2018), sex (McVey et al., 2017),

severity, comorbidity or IQ. However, these results are not yet consistent (McMahon, Lerner, et al., 2013). For instance, whereas some studies have found higher effectiveness in participants with a normal range of IQ, other studies do not confirm this relationship (Gates et al., 2018).

Literature has also described changes in comorbid symptomatology after participating in social skills interventions, as decrease in depression symptoms (Solomon et al., 2004), general anxiety (Guivarch et al., 2017) and social anxiety symptomatology (Schohl et al., 2013).

In terms of methodology, there is a lack of objective measures that reflect the real progress of social skills abilities. The majority of studies use questionnaires to assess the evolution of participants, but these methods tend to be subjective and incomplete (McMahon, Lerner, et al., 2013; Moody et al., 2020). Therefore, additional methodologies that complement questionnaires have been proposed, such as social cognitive assessments and behavioral observations (Author et al., 2019; Solomon et al., 2004). These methodologies have demonstrated to be effective in assessing evolution and changes in social behaviors, including micro-conducts like gestures. In addition, they provide greater knowledge and specificity about social behaviors, which can offer information for professionals to improve their interventions and focus them on their participants (Author et al., 2019).

Mixed Methods Perspective

In the last twenty years, and with the expansion of the *mixed methods methodology*, various proposals have been made regarding the integration of qualitative and quantitative elements, not without controversy. This new vision implies the integration of different types of data, which includes the transformation of quantitative data into qualitative data (Sandelowski et al., 2009), of qualitative data into quantitative data (Author, 2017, 2020), or any other type of information (Onwuegbuzie & Teddlie, 2003) in a comprehensive way ("crossover", according to Onwuegbuzie & Dickinson, 2008).

Our proposal is based on a phrase from Creswell and Plano Clark (2011, p. 7) that we especially value: "There are three ways in which mixing occurs: merging or converging the two datasets by actually bringing them together, connecting the two datasets by having one build on the other, or embedding one dataset within the other so that one type of data provides a supportive role for the other dataset". This mixing, applied from a literal and, broader perspective, constitutes a central point of support for rethinking the *quantitizing*. On one hand, from literality, "connecting the two datasets by having one build on the other" will imply that one database - which is qualitative in nature, in our paper social skills group sessions - can give rise to another through its transformation. This transformation must ensure the maintenance of its informative quality, although the appearance is modified. On the other hand, from a broader perspective, the *connecting* allows the alternation of QUAL-QUAN-QUAL stages, which legitimizes the generic approach of mixed *methods*, while a total integration between qualitative and quantitative elements is achieved (Anguera et al., 2020). With this rethinking we can ensure an idoneous way to materialize in this paper.

In this work, focused on procedural aspects, we propose an observational methodology considered itself as a mixed method (Anguera et al., 2017; Anguera & Hernández-Mendo, 2016), that implies integration ways (quantitizing) between qualitative and quantitative elements. The proposal of quantizing begins with a systematic observation of ASD children, and implies qualitative records (QUAL step); from theoretical framework and empirical expertise we built an observation instrument with a specific structure that allows to record from sequence parameter, and following a matrix codes format, that we will analyze quantitatively (QUAN step); the results will interpret coming back to initial problem (QUAL step) (Anguera et al., 2020).

Specifically, it has been suggested that observational methodology can complement other methodologies, allowing to analyze spontaneous conducts that take place in natural situations (Anguera, 2003; Portell et al., 2015) and behaviors in psychotherapy settings (Author., 2015; Author, 2017; 2020; Bartholomew & Lockard, 2018; Del Giacco et al., 2019). This methodology also allows to detect patterns in co-therapy work with a group of siblings of

children with autism (Venturella et al., 2019), to analyze evolution of parenting skills during a behavior parent training with ASD children (Parladé et al., 2019).

Considering all previous literature, the main objective of this research is to provide more scientific evidence about new mixed methodologies, measuring possible changes in social behavior in children with autism. Specifically, this research aims to a) observe changes between the second and the last session of a social skills intervention program for children with ASD, through Polar Coordinate Analysis; b) detect if there exist differences in children regarding comorbidities and the intelligence quotient. We hypothesized that results from Polar Coordinate Analysis would be different in session 2 and session 10, showing differences in children without comorbidities and high IQ.

Our Intervention Program

The intervention that we applied was an adaptation of the Social Skills program of the UC Davis MIND Institute (Solomon et al., 2004). This intervention has shown positive results, including an increase in responses and interaction between peers and a decrease in other vocalizations, such as talking alone (McMahon, Vismara, et al., 2013). The main objective of the intervention group was to work with patients from an inside-out perspective, developing and practicing the abilities of empathy, recognition of their own and others' emotions and problem resolution, conversational skills or stress regulation, among others.

Considering our community hospital context and the high demand of intervention in social skills, we adapted the original program to a brief intervention of 10 sessions (Solomon et al., 2004) with two purposes: one objective was to be able to reach all patients in the ASD unit who needed this type of intervention, offering a lower waiting list and a brief intervention, compatible with the public resources of the hospital. Another purpose was to observe whether a brief intervention program (adapted to our community context) could cause initial and little changes in social behavior (Lerner & Mikami, 2012; Matthews et al., 2019).

The main goal of this research was to study social skills ("responding to interaction" and "initiating interaction") and to capture whether there were differences between an initial and

a final session in a program for children with ASD. Additionally, we aimed to compare social skills patterns according to the IQ level and we were interested in measuring changes using observational methodology.

Method

Design

The design of our research was N/F/M, nomothetic (N) because several participants were observed, it consisted of follow-up (F) because an initial session (session 2) and the last session from the intervention were registered, and it was multidimensional (M) because several dimensions of the observation instrument were considered suitable (Anguera, 2011; Sánchez-Algarra & Anguera, 2013).

Participants

According to the approval to the standard of the institutional Research Committee review board, the Ethical Committee for Clinical Research (Intern Code: PIC-04-17), and following the 2000 Helsinki declaration, participants were recruited by psychologists and psychiatrists from the Multidisciplinary Autism Spectrum Disorder Unit. All parents provided written and informed consent and informed assent were obtained from each child. Participants were informed about the location of the camera and the period of time that would be recorded.

Participants were selected through the inclusion criteria: 8-12 years old, diagnosis of Autism Spectrum Disorder verified with the Autism Diagnostic Observational Schedule-2 (ADOS-2, Lord et al., 2000), and normal range of level of Verbal Comprehension (Verbal IQ) according to standardized assessment (WISC-IV or V, Wechsler & Kaplan, 2015). Participants with severe behavioral problems, other several mental psychopathologies such as schizophrenia, or with intellectual functioning below 70, were excluded.

During two years (2018,2019), a total of 36 children were recruited to participate in the intervention sessions. Each year we recruited 18 children and randomized them between two groups, considering their age, gender and IQ. Each group was formed by 7, 8 or 9 participants

and conducted by a clinical psychologist, a psychiatrist, a nurse and 2 master's psychologists. A total of 4 groups received the same intervention with similar conditions.

In order to code observational data, we only included 21 children (3 females and 18 males) from the total sample. This selection was based on the fact that participants of this subgroup had attended all the sessions and it was possible to codify their social behaviors through the video records. The rest of the participants (n=15) did not attend all sessions and observational data was missing. From the final sample (n=20), 11 participants had received the intervention in 2019 (5 children of one group; 6 of another group) and 10 participants had attended the sessions in 2018 (5 children of each group). To perform polar coordinate analyses, we included 20 participants from the sample, because data from VIQ from one participant was missing.

Instruments

Diagnostic Instruments

In order to confirm the diagnoses of autism, a clinical interview based on DSM 5 criteria (APA, 2013) was done. Additionally, the ADOS-2 (Lord et al., 2000) was administered to all participants. To assess the Verbal Comprehension, cognitive abilities were measured using the Wechsler intelligence scale for children and adolescents (Wechsler, 2007; Wechsler & Kaplan, 2015).

Recording Instrument

Sessions were recorded with two different cameras located at different angles. Cameras were positioned discreetly to avoid inconvenience to participants and followed all the ethics aspects.

Observational Instrument

To codify all the social behaviors, we reorganized and evolved an observational instrument (Author et al., 2019) which had been inspired by an original observational instrument of Bauminger (2002) and by the approach of social difficulties by the authors of ADOS-2 and

Autism Diagnostic Interview-Revised (Lord et al., 2000; Rutter et al., 2003). Certain behaviors were not included in the analysis because the observation frequency was very low such as proximity, sharing objects, affection, talk that reflects an interest in another child's hobbies, giving help, peer or therapist imitation, idiosyncratic language and repetitive behavior. We reorganized the observational instrument in order to adjust it to the behavior of our participants (see Table 1). The final instrument had 6 dimensions. For each dimension, we built a category system, following the requirements of exhaustivity and mutual exclusivity. Dimensions and categories are shown in Table 1.

Table 1: *Dimensions and Category Systems of the Social Behavior Observational Instrument for Participant*

Dimensions Categories (CODES)	Description	Examples
Interaction type		
Low-level interaction (LLI)	The child exhibits behaviors that indicate social intention, but with minimal social enactment.	Interactions between different participants: “It is your turn”.
High level interaction (HLI)	The child exhibits verbal and nonverbal social behaviors that lead to an effective social process with peers. Behaviors that serve to start or maintain social interaction.	“I like your t-shirt”.
Negative level interaction (NLI)	Participant exhibits rude and unpleasant social behaviors that stop or decrease the possibility of developing appropriate social interaction.	“You are a dumb”
Social behavior		
Responses to an interaction (RES)	The child responds verbally and/or nonverbally to social stimuli directed toward him/her by peers.	“Which game do you want to play? Response: I want to play Uno”.

Initiations of interaction (IN)	The child begins a new social sequence, distinguished from a continuation of a previous sequence by a change in activity.	“Do you want to play with me?”
Evitations (EV)	The child avoids any type of interaction or communication that is addressed to him/her.	When someone asks to play or share something, the participant ignores or avoids the question/demand.
Functional Play (FP)	The child play with another participant without talking.	Two participants who play 'three in line' without speaking.
Verbal communication		
Functional communication (FUNC)	The child approaches or responds to another child with an intention to fulfill his/her own needs, and with no social intention. ;	“It’s my turn on the computer now”.
Social verbal communication (SOVERC)	The child approaches another child with a social (rather than functional) intention	“Let’s play”.
Sharing experiences (SHAREXP)	The child tells about an experience to peers or asks them about their experiences	“What did you do over the weekend?”.
Sharing object (OBJ)	The participant shares an object or game with another participant	The participants give a doll to another one, spontaneously or by request.
Non-functional communication (NONFUNC)	Sounds, words and phrases that are understandable or not addressed to anyone.	Sounds made during a play game but not addressed to any other participant (sing).
Verbal aggressive communication (VAGC)	The participant behaves intrusively and negatively towards his peers.	“I do not want to play with you (screaming)”.
Facial expression		
Smile (SMIL)	Participant smiles to another in an interaction	When two participants are talking, in a social conversation or during a game, one participant smile as an answer (combined or not with word).

Looking

Not looking (NOLOOK)	Looking to another side, avoiding eye contact	When someone talks to the participant, he/she is looking to another side, avoiding eye contact.
Eye contact (EC)	The child looks into the eyes of another child.	When someone talks to the participant, he/she is looking at the eyes.
Looking without eye contact (NOEC)	The child looks at the other child's face or body, or child's action, without establishing eye contact.	When someone talks to the participant, he/she is looking to the other person but not to the eyes.
		When a participant is talking, he/she is looking at the person but not to the eyes.

Gestures

Pointing gestures (POINTG)	Point your hand, arm or finger at anything to show it to another.	“Move your piece here (pointing to the place)”
Emotional gestures (EMOG)	Gesture that indicates an emotion.	Covering your mouth (surprise or laughter).
Conventional gestures (CONVG)	General and universal gestures, used in everyday life.	Greet, raise the hand, no / yes (with your head), come, shut up, ok, etc.
Affirmation or denial gestures (AFFDEN)	The child only nods his/her head for yes or shakes it for no.	The participant answers a question without words, only using the head to say yes or no.
Descriptive gestures (DESCG)	Gesture that is made with the arms and hands and gives us specific information and description about something.	The gesture indicates the quantity, the size, the form, the length of things.
Proximity (PX)	The child is near other children or game but does not play or do another activity. There is no eye contact or verbal communication.	Participant reads a book and sits near two other participants that are playing cards.

Procedure

For the purpose of this study, data was collected during the free playtime group of each session (14 minutes) through the different instruments. We performed the analysis through two levels of response: initiation and response.

Implementation of the program

As aforementioned, our program was an adaptation of the Social Skills program of the UC Davis Mind Institute (Solomon et al., 2004). We implemented 10 sessions of 1:30 hours each. Solomon's program is less structured than most traditional programs. It includes semi-structured instructions, positive reinforcement, motivation for social interactions, and free-time play as an opportunity to practice. Regarding the intervention, the structure of each session was: salutation with a little talk about the week and introduction of the topic (allowing participants to talk and share thoughts or problems), free time to play (14 minutes were children play games in an unstructured time-lapse), didactic activity (structured part where pedagogic information and activities of social competence are performed) and closing (structured part that include joke-telling time and the optional homework, called "social experiment for the week"). The specific contents of each didactic session are detailed in Table 1. Clinicians developed strategies and activities based on theory of mind and social competence (Winner, 2000) in order to practice the didactic components.

Table 2: *Specific didactic topics of each session. Adapted from Solomon et al (2004).*

Session	Didactic topic
Session 1	Presentation and empathy. We start playing different games to know each other. We introduce the concept of "empathy" and the steps, through a role playing.
Session 2	Practice empathy through role playing invented situations and examples of their real situations.
Session 3	Recognizing our own and others' emotions. Explain the concept and perform different games to understand and interiorized the emotions.
Session 4	Practice emotional recognition.

- Session 5 Strategies to manage stress, anxiety and anger.
- Session 6 Practice strategies to manage stress, anxiety and anger, through role playing of real situations.
- Session 7 Interests and group reciprocal conversation. Talk about personal interests that have in common and differences between the group. Practice of having a conversation of topics that are not interesting.
- Session 8 Nonverbal communication and reciprocal conversation. Practice through role playing.
- Session 9 Solving social problems. Expose different real situations of problems, talk about the different solutions and possibilities to manage them. Practice through role playing.
- Session 10 Closing group: feelings and thoughts about the intervention group.
-

After obtaining approval from the authors (Solomon and colleagues), our clinicians were trained in the program. In order to ensure fidelity of implementation of the intervention, clinicians followed indications provided by a member who had previously collaborated with the developing team of the program at the UC MIND Institute. Fidelity checking was performed after the sessions.

Data Quality Control Analysis: Inter-observer Agreement

From the qualitative research perspective, a systematic observation was used to obtain data that we managed as a code matrix. Two observers analyzed and coded data. The degree of interobserver agreement calculated with Cohen's Kappa (1960, 1968) ranged between 0.76 and 0.89. To obtain this value, 20% of the material was coded and the Kappa coefficient of the 2 and 10 sessions (which were randomized) was obtained of the 10% of the participants. Once we had confirmed the reliability of the data, in order to exhaustively collect social behaviors throughout the sessions, we codified 14 minutes during the free play activity of each session and participant. Finally, we codified session 2 (as a pre-evaluation) and 10 (as a post-evaluation) of the participants that participated in all sessions and appeared in all videos, to observe differences between sessions.

Data Analysis

The software LINCE (Gabin et al., 2012) was used to codify social behaviors during the free time of the selected sessions. After the codification, the analysis strategy was developed in two stages.

First, in a descriptive level, the absolute frequencies of each of the behaviors recorded were analyzed and compared according to the groups of participants and the session (2 and 10 session).

In the second stage, the polar coordinate technique (Cochran, 1954) was applied to compare the social interactions generated in both sessions. This technique, applied by Sackett (1980) and further optimized with the genuine retrospective technique proposed by Anguera (1997), allows the reduction of data by using the Zsum statistic ($Z_{sum} = \sum Z / \sqrt{n}$), where Z represents the independent values obtained from the adjusted residuals found for the respective delays of - 5 to - 1 and 1 to 5, and n represents the number of delays considered. Thus, the Zsum values allow us to estimate the type of relationships established between the selected focal behavior and the other behaviors (conditioned behaviors) that constitute the instrument of observation. The type of relationship between focal and conditioned behaviors is shown qualitatively (Quadrant I, II, III or IV) and quantitatively (vector length).

Results

Descriptive Statistics of Participants

The mean age of the participants was 9.52 y.o. (median = 10, PC25 = 8.5 and PC75 = 10.5) and the mean of Verbal Comprehension Index from the WISC-IV or V scale (Wechsler, 2007) was 103.8 (median = 105, PC25 = 89 and PC75 = 117).

A total of 1631 behaviors in session 2 and a total of 1393 behaviors in session 10 were analyzed in 21 participants (85.7% male). In general, in session 2 (initial session), the average frequency of positive social interactions (HLI) ($M = 1.14$, $SD = 1.39$, range [0 - 4]) was lower

than the average frequency of low intensity interactions (LLI) ($M = 20.24$, $SD = 6.74$, range [7- 30]).

A general decrease in the number of social behaviors was observed in session 10, even so, an increase in the number of behaviors related to ASD nuclear difficulties such as positive social interaction (HLI; $S2 = 5.65\%$; $S10 = 12.67\%$) ($M = 2.2$, $SD = 3$, range [0 - 11]), verbal social communication, eye contact or emotional gestures was observed, as well as a decrease of the low-level interactions (LLI) ($M = 14.7$, $SD = 5.1$, range [3 - 23]). Finally, negative level interaction (NLI) was registered in session 10 ($M = 0.4$, $SD = 0.7$, range [0 - 2]).

Outcomes results

Results of Polar Coordinate Analysis

To perform these analyses, we included 20 participants from the sample, because data from VIQ from one participant was missing. Coordinate analyses were performed in two subgroups: Verbal IQ (VIQ) > 90 ($n = 14$) and VIQ < 90 ($n = 6$).

Focal behavior: Response to an interaction

In session 2 (see Table 3 and Figure 1), a significant activation relationship was observed between focal behavior response to an interaction and low-level interaction conditioned behavior, in 9 of the 14 participants with VIQ > 90. Simultaneously, low-level interaction (LLI) inhibited the response to interactions, since the vector with a significant radius representing LLI is located in quadrant IV (Quadrant IV, radius = 2.29, $SD_{radius} = .59$, angle = 346° , $SD_{angle} = 8.91$, $p < .05$). On the other hand, for the rest of the participants with VIQ > 90 (5/14), there was a relationship of mutual activation between response and low-level interaction (LLI), but it was not statistically significant (Quadrant I, radius = 1.69, $p > .05$). In two of these participants, functional communication (FUNC) significantly activated the response to interactions (participant 13, Quadrant I, radius = 2.29, $p < .05$; participant 1, Quadrant II, radius = 2, $p < .05$). However, while for the first participant, the response to interactions in turn activated functional communication, for the second, these responses

inhibited functional communication. Finally, we observed again in one participant from VIQ > 90 group that high-level interaction (HLI) activated the response to interactions (participant 21, Quadrant II, radius = 2.05, $p < .05$) and initiations of interaction (IN) inhibited the appearance of new social responses for another (participant 13, Quadrant III, radius = 2.5, $p < .05$).

Coinciding with the other group, we observed that low-level interaction (LLI) inhibited the response to interactions observed in 5 of the 6 participants with VIQ < 90 (Quadrant IV, radius = 2.34, $SD_{radius} = .19$, angle = 340° , $SD_{angle} = 8.98$, $p < .05$). Other findings obtained in the VIQ > 90 were not observed in this group, but a significant relationship of mutual activation between look without eye contact (NOEC) and response to interactions in one of the members of this group was found (participant 15, Quadrant I, radius = 2.34, $p < .05$).

In session 10, we observed again, in fewer participants, the previous relationship of significant activation between focal behavior response to an interaction and conditioned behavior low-level interaction (5 of the 14 participants with VIQ > 90) (Figure 1) (Quadrant IV, radius = 2.58, $SD_{radius} = .47$, angle = 345.73° , $SD_{angle} = 8.18$, $p < .01$; in 2 of the 6 participants with VIQ < 90 (Quadrant IV, radius = 2.47, $SD_{radius} = .66$, angle = 355.8° , $SD_{angle} = .23$, $p < .05$).

In session 10, regarding to the VIQ < 90 group, we observed in one participant how conventional gestures (CONVG) activated responses to interactions while they inhibited these types of gestures (participant 18, Quadrant II, radius = 2.28, angle = 131.72° , $p < .05$). No other significant relationships between behaviors were observed in this subgroup.

Table 3: *Polar Coordinate Analysis Results Corresponding to Response to Interaction as the Focal Behavior*

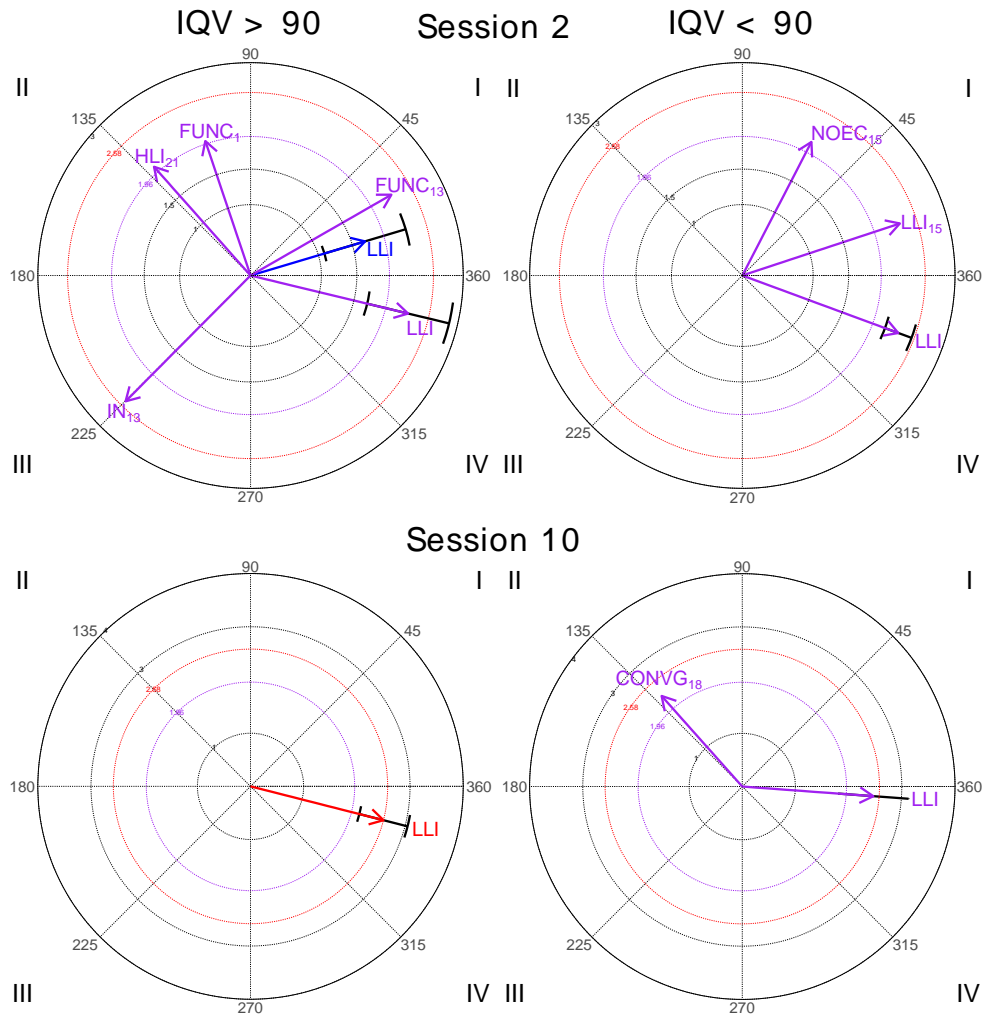
Session 2								
IQV > 90								
Code	Quadrant	Ratio	Radius	Angle	SD radius	SD angle	Angle range	n° participants

Results

LLI	IV	-.44	2.29	346.46	.59	8.91	334.16	357.84	9
LLI	I	.09	1.69	16.60	.60	21.75	.11	52.63	5
FUNC ₁₃	I	.50	2.29	29.81	-	-	-	-	1
FUNC ₁	II	.95	2.00	108.58	-	-	-	-	1
HLL ₂₁	II	.75	2.05	131.60	-	-	-	-	1
IN ₁₃	III	-.71	2.50	225.17	-	-	-	-	1
IQV < 90									
LLI	IV	-.29	2.34	339.78	.20	8.98	328.71	352.55	5
LLI ₁₅	I	.31	2.34	18.25	-	-	-	-	1
NOEC ₁₅	I	.89	2.12	62.62	-	-	-	-	1
Session 10									
IQV > 90									
LLI	IV	-.43	2.58	345.73	.47	8.18	334.43	356.59	5
IQV < 90									
LLI	IV	-.08	2.47	355.81	.66	.23	355.64	355.81	2
CONVG ₁₈	II	.75	2.28	131.72	-	-	-	-	1

Note. LLI = low-level interaction; FUNC = functional communication; HLLI = high level interaction; IN = initiations of interaction; NOEC = looking without eye contact; CONVG = conventional gestures

Figure 1: Polar coordinate results in Response to interaction as a focal behavior in sessions 2 and 10 in participants with $VIQ > 90$ and $VIQ < 90$.



Focal behavior: *Initiation of interaction*

The set of associated behaviors was significantly greater for this focal behavior than for the response to interaction.

In session 2 (see Table 4 and Figure 2), the group of participants with $VIQ > 90$ had a greater initiation of interactions (11 of 14 participants initiated social interactions in the initial session ($M = 5.64$, $SD = 3.58$, Range [1-12]), compared to the other group (only 3 of 6 participants, $M = 2.67$, $SD = 2.08$, Range [1-5]). In two of the participants in this group, there

was a significant relationship of mutual activation between high level interaction (HLI) and focal behavior (initiation of interaction) (Quadrant I, radius = 3.90, $SD_{radius} = 1.39$, angle = 10.11° , $SD_{angle} = 5.18$, $p < .01$). Also, we observed a relationship of mutual inhibition between focal behavior (initiation of interaction) and deictic gesture behavior (POINTG) in 4 of the participants (Quadrant III, radius = 2.12, $SD_{radius} = .15$, angle = 227.98° , $SD_{angle} = 8.09$, $p < .05$). Mutual activation relationships between focal behavior (initiation of interaction) and verbal social communication (SOVERC) were also observed in 2 participants (participants 3 and 13: Quadrant I, radius = 3.20, $SD_{radius} = .04$, angle = 24.37° , $SD_{angle} = 3.94$, $p < .01$) and activation of eye contact (EC) by focal behavior (initiation of interaction) (participant 3, Quadrant IV, radius = 4.57, angle = 354.75° , $p < .01$) (participant 13, Quadrant I, radius = 3.2, angle = 48.59° , $p < .01$).

In the group of participants with $VIQ < 90$, only 3 of the 6 participants-initiated interactions in session 2 ($M = 2.67$, $SD = 2.08$, Range [1-5]). As it can be seen in Figure 2, results show a significant relationship between deictic gestures (POINTG) that activated focal behavior (initiation of interaction) in 2 of the 6 participants (participant 15, Quadrant I, radius = 2.77, angle = 56.59° , $p < .01$) (participant 10, Quadrant II, radius = 2.68, angle = 97.39° , $p < .01$).

In session 10 a lower number of significant relationships was compared to session 2 and in a smaller number of participants in both groups (Figure 2). However, both eye contact (EC) (Quadrant II, radius = 3.55, $SD_{radius} = .19$, angle = 95.41° , $SD_{angle} = 1.94$, $p < .01$) and smile (SMIL) (Quadrant II, radius = 3.04, $SD_{radius} = .93$, angle = 96.87° , $SD_{angle} = 4.06$, $p < .01$) activated the initiation of social interactions in two participants from the $VIQ > 90$ group (participants 3 and 13). This type of relationship did not occur among participants in the $VIQ < 90$ group.

Table 4: Polar Coordinate Analysis Results Corresponding to Initiation of Interaction as the Focal Behavior

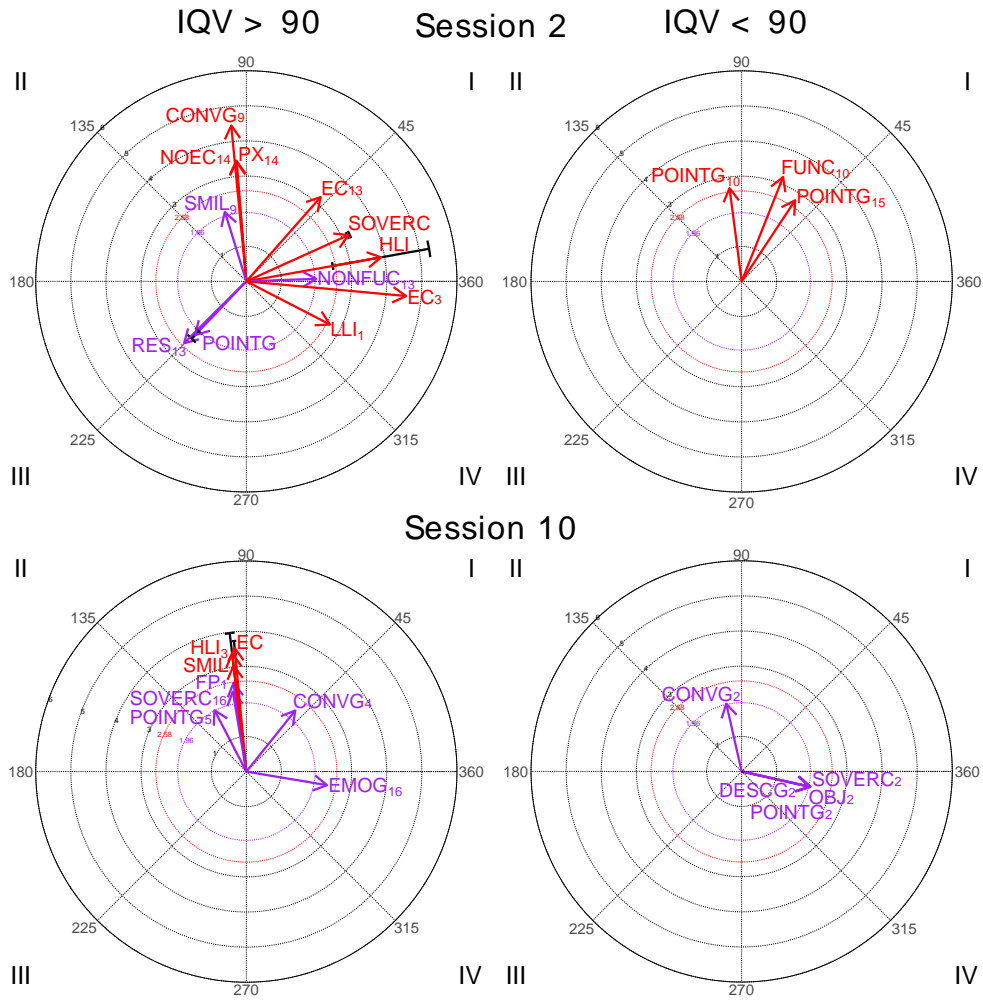
Session 2									
IQV > 90									
Code	Quadrant	Ratio	Radius	Angle	SD radius	SD angle	Angle range		n° participants
POINTG	III	-.71	2.12	227.98	.15	8.09	218.35 237.60		4
HLI	I	.24	3.90	10.11	1.39	5.18	6.44 13.77		2
SOVERC	I	.37	3.20	24.37	.04	3.94	21.58 27.15		2
EC ₃	IV	-.09	4.57	354.75	-	-	- -		1
EC ₁₃	I	.75	3.20	48.59	-	-	- -		1
CONVG ₉	II	1.00	4.46	95.53	-	-	- -		1
LLI ₁	IV	-.46	2.68	332.69	-	-	- -		1
NOEC ₁₄	II	1.00	3.45	94.69	-	-	- -		1
NONFUC ₁₃	I	.04	1.99	2.06	-	-	- -		1
PX ₁₄	II	1.00	3.42	94.73	-	-	- -		1
RES ₁₃	III	-.70	2.50	224.83	-	-	- -		1
SMIL ₉	II	.96	2.07	107.16	-	-	- -		1
IQV < 90									
FUNC ₁₀	I	.93	3.20	68.33	-	-	- -		1
POINTG ₁₀	II	.99	2.68	97.39	-	-	- -		1
POINTG ₁₅	I	.83	2.77	56.59	-	-	- -		1
Session 10									
IQV > 90									
EC	II	1.00	3.55	95.41	.19	1.94	94.03 96.78		2
FP ₁	II	.99	2.55	98.29	-	-	- -		1
SMIL	II	1.00	3.04	96.87	.93	4.06	94.00 99.74		2
HLI ₃	II	.99	3.38	96.83	-	-	- -		1
CONVG ₄	I	.78	2.23	51.28	-	-	- -		1
POINTG ₅	II	.89	1.97	117.47	-	-	- -		1
SOVERC ₁₆	II	.99	2.31	99.61	-	-	- -		1
EMOG ₁₆	IV	-.17	2.33	350.47	-	-	- -		1
IQV < 90									
SOVERC ₂	IV	-.22	2.00	347.34	-	-	- -		1
CONVG ₂	II	.98	1.98	102.79	-	-	- -		1

Results

DESCG ₂	IV	-.22	1.98	347.21	-	-	-	-	1
POINTG ₂	IV	-.22	1.99	347.28	-	-	-	-	1
OBJ ₂	IV	-.22	2.01	347.40	-	-	-	-	1

Note. POINTG = pointing gestures; HLI = high level interaction; SOVERC = social verbal communication; EC = eye contact; CONVG = conventional gestures; LLI = low-level interaction; NOEC = looking without eye contact; NONFUC = non-functional communication; PX = proximity; RES = responses to an interaction; SMIL = smile; FUNC = functional communication; FP = functional play; EMOG = emotional gestures; DESCG = descriptive gesture; OBJ = sharing object.

Figure 2: Polar coordinate results in Initiation of interaction as a focal behavior in sessions 2 and 10 in participants with VIQ > 90 and VIQ < 90.



Finally, regarding comorbidities, we observed that significant (positive or negative) results were more frequent in participants without ADHD symptomatology. Only one participant with ADHD (participant 3) obtained positive significant results in the initiations of interaction.

Discussion and Conclusions

The main purpose of this study was to study social skills ("responding to interaction" and "initiating interaction") and provide data quality about the possible changes in social behaviors in children with ASD who participated in an adapted social skills training program. We were interested in observing changes between the second and the last session of a social

skills intervention program for children with ASD, through Polar Coordinate Analysis. Additionally, we aimed to evaluate differences in children according to their intelligence quotient. Regarding treatment, our purpose was to observe whether a brief intervention program could cause initial and little changes in social behavior adapted to our community context (Lerner & Mikami, 2012; Matthews et al., 2019).

Results show that, in general, our social skills intervention improved the quality of interactions but not the quantity, observing a diminution in the quantity of social behaviors in session 10 but improving the quality (more positive behaviors than in session 2).

Regarding relationship with verbal intelligence quotient (IQ), we found differences between sessions 2 and 10, both in responses and initiations.

In our sample, we observe controversial but interesting results. Initiations of interactions were more complex and included more social components in participants with VIQ>90 before and after intervention (initiations with social communication, eye contact, smile and use of gestures). Instead, group with lower VIQ, showed less patterns and low quality at the beginning. Regarding the response to an interaction, participants with VIQ<90 showed a better improvement, specifically an activation of responses was observed through the behavior of looking without eye contact, indicating a low-quality level of interaction. According to Lebarton and Iverson research (2016), new significant pattern in these participants was observed, indicating an activation of the responses through conventional gestures. The results are highly variable, observing improvements in different areas in both groups; according with McMahon, Lerner et al. (2013) that did not find a relationship between effectiveness of social skills training and IQ. However, other studies obtained better results in people with autism spectrum disorder and normal IQ rating (Gates et al., 2018). Children with higher intelligence coefficient have more social skills than children with lower VIQ, but this does not imply that their evolution is more positive or ones take more benefit than others.

Regarding comorbidities, one research has excluded children with comorbidities such as ADHD, because they considered that difficulties related to attention deficit or hyperactivity

can affect the effectiveness of the group and could not be appropriate for these children (Antshel et al., 2011). Other study did not observe it (Deckers et al., 2016). In our study, we observed that there were certain differences between participants with ASD and participants with ASD and ADHD comorbidity: one participant with comorbid ADHD and VIQ>90 used higher quality patterns, such as verbal social communication in both sessions. These results differ from data reported by other studies, which show unfavorable development of social competence, specifically in ToM, in children with ASD and ADHD symptoms (Sinzig et al., 2008).

In relation to sex, we observed that two out of three females showed more patterns of responses to an interaction. There are many controversial aspects regarding this subject. Choque et al. (2017) observed more improvements in females than males. Our results did not include a significative number of both sexes, so we cannot affirm that girls perform better quality and quantity patterns than boys. Coinciding with another observational research, females performed more social interactions than males (McMahon, Lerner, et al., 2013).

Concerning the methodology, results provide information on the quality of the interactions established between the participants and also the existence or not of relational patterns. These micro-conducts and specific information were obtained through the rigorous observation in natural situations (Anguera, 2003; Portell et al., 2015) of the interactions during a spontaneous time-play (Deckers et al., 2016; McMahon, Vismara, et al., 2013). According to several investigations (Koenig et al., 2010; Lerner & Mikami, 2012), questionnaires cannot provide that type of information, and this specific and detailed information can contribute to develop more specific interventions to improve social skills in children with autism. Many researches with brief interventions, expose that existed difficulties to conclude if their groups' interventions were effective (Lerner & Mikami, 2012). With observational methodology, in our research, and inside *mixed methods* perspective, we could observe the micro-conducts that were at the beginning of the intervention and at the end, exposing the little differences before and after the intervention and getting more specificity in the process and evolution of each participant.

Generally, we observed a better baseline of social responses in participants with higher VIQ. However, we observed new quantity and quality patterns after the intervention in participants with lower VIQ. With this research, we cannot conclude whether there are similar or common social behavior patterns between children with autism, but we could better understand our participants, supporting and adapting our intervention with specific objectives to improve their impairments in social competence.

This knowledge could allow professionals to understand better the deficits and difficulties in communication and interaction that our participants tend to present and adapt their interventions, making it more efficient and beneficial for the patients.

Limitations

There are many limitations that should be considered for future researchers. Firstly, the most important limitation was the number of observations registered and codified. More observations are needed during the group and post-treatment to measure the effectiveness of the intervention. Having several observations during different times (at the beginning, in the middle, at the end and post-treatment) could contribute to have information about the evolution of the micro-conduct during the intervention (Author et al., 2019). Secondly, the sample size was small and this could interfere with finding significant and generalizable results. However, it is important to consider that studies that involve observational methodology tend to include smaller samples than studies that use quantitative methodology. Another limitation was that observers who coded the data were not blind to the study goals. Finally, no control (waiting-list or traditional SSI; Lerner & Mikami, 2012; Marro et al., 2019) group was used, limiting interpretability of effects. We are a community hospital and we were limited by the clinical demand. However, we plan to perform further research with a control group (waiting list).

Implications

Our findings show that mixed methodologies allowed us to observe patterns of micro-conducts that participants exhibited. This information obtained through observational methodology could allow professionals to understand communication and interaction of participants. Therefore, this type of measures could complement data obtained from other traditional methods, such as questionnaires.

Moreover, based on the findings of this research, it is recommended to design social skills intervention groups for patients with ASD in community hospitals taking in account their IQ level. We observed that both groups of patients (higher and lower IQ) could learn and develop different social competences such as, eye contact, gestures or social communication. In fact, each group could have different needs and trajectory. We have to consider the development of specific interventions based on the line-based difficulties of each group (higher and lower IQ) in order to obtain the maximum profit of the intervention.

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5. DISCUSSION

The conclusions related to objectives and hypothesis of each study, as well as theoretical and practical discussion of each study, are presented in the following section:

Study 1: The first study aimed to evaluate the effect of a community adaptation of a social skills training program developed by Solomon et al. (2004) on a sample group of children and adolescents with ASD through specific indicators and to assess whether there was a better response to treatment in participants with a Verbal Intelligence Quotient (VIQ) higher than 90 and in relation to age. We hypothesized that *regarding comorbidity, anxiety and mood difficulties would decrease after the intervention. It was also hypothesized that the amount of social behaviors would be higher at the end of intervention, and finally, we hypothesized that age and range of VIQ would be factors of influence in the evolution and improvements* (Study 1).

Our empirical findings showed a marginally significant change in affective symptoms assessed by the CBCL questionnaire administered to parents, with a decrease in symptoms such as fatigue, apathy, sadness, and inferiority complex. These results are consistent with previous literature that reported the relationship between social deficits and affective comorbidity and behavior problems (Bellini, 2006; Paula, 2015; Schohl et al., 2013). Coinciding with another study, the decrease in affective symptoms observed in our sample was more significant in the children's group (McMahon et al., 2013). Our children also showed a significant decrease in internalizing problems (including anxiety and depressive problems). This improvement was not seen in the adolescent group. According to the results obtained and the previously cited literature, social skills interventions seem useful to decrease comorbid symptomatology that may be present. The decrease in social anxiety could also lend support to the ability and motivation to relate with others socialize (Duvekot et al., 2017; Pickard et al., 2017).

Regarding social behaviors, we observed a marginally increase after intervention in specific social conducts: eye contact and functional communication. Functional

communication refers to the verbal communication that has a functional objective, for example, requesting something or offering a play turn. These results were in the same line as Bauminger (2002), where experimental group showed a significant increase in eye contact, while the control group did not. In relation to functional communication, we again observed a marginally significant increase in the experimental group compared to the control group (Lerner & Mikami, 2012). Despite these results, we did not observe marginal or significant changes in other social behaviors that were observed and coded: smile, proximity, looking without eye contact, verbal social communication, saying yes/no and functional play, overall high positive interaction, and overall low-level interaction.

In relation to age and VIQ factors, we observed that comorbid symptomatology tended to improve in all participants (children and adolescents). However, the decrease in comorbid symptoms was greater in participants with higher intelligent quotient and in the group of children. These results were concordant with other research (Solomon et al., 2004). Literature highlight that a higher cognitive capacity allows participants to better understand all the skills taught and generalized to other contexts (Gates et al., 2018). In spite of these results and the previous literature, more research is needed to obtain conclusive results regarding age and the VIQ in social skills interventions for people with ASD. In the same line, we observed that age have been an important factor. We observe results in children that were not seen in adolescents. Conceding with these results, researches have exposed that during the first years, cooperation, assertive behavior and self-control are developed (Takashi et al., 2015). However, other researches exposed that children do not have enough neural maturation and cognitive function required to socialization, so they have more difficulties to interact or demonstrate their abilities (Choque et al., 2017). To better understand all these results, it is important to be aware of the background of each participant and their own social deficits. The same researchers, reported that children tend to show fewer social competences compared to adolescents or adults. Most of the children started the intervention with basic social competence or without any relationship at all. Even so, we also observed important difficulties at the beginning of group intervention in adolescents, who showed similar deficits to children. For this reason, evolution and progress are individualized. In conclusion, age and

VIQ could be important factors that positively or negatively affect progress and improvement in the intervention (Harrop et al., 2004; Hong et al., 2018).

In relation to the program of the UC Davis MIND Institute developed by Solomon (2004) we concluded that it proved effective in the reduction of comorbidities present in ASD, but not significant results in the assessment of social behaviors. However, the program allowed clinicians and researches to observe and assess of social behaviors, by proposing free playtime as an unstructured and natural context. In spite of the advantages, we observed that the community-based adaptation that we applied did not have the clinical effect that has been expected.

With regard to observational methodology, we agree with other recent studies that this method could be appropriate to measure changes in social behavior in children and adolescents with ASD (Bauminger, 2002; McMahon et al., 2013; Mairena et al., 2019). We conclude that it might be also useful to assess changes in social conduct frequency, providing information about the quantity and quality of social behaviors before and after, and as a consequence, contributing to assessment of whether intervention was useful for the group. Observational methodology has demonstrated that it is useful to provide different information related to human behavior through different analysis. This pragmatic information could be of practical use for clinicians and researchers to design more precise interventions for people with ASD, focusing on the difficulties that are present at the moment.

Despite the marginal results obtain in this study, our assessment in social behaviors were not significant, compared to other low intensity social skills interventions. We conclude that many important characteristics were involved and related to our results. Other factors such as, the inclusion of different agents (parents (Deckers et al., 2016), neurotypical peers (Barry et al., 2003), teachers...), the intervention duration (Thomer et al., 2016) and the context and location where the intervention was performed (school classrooms (Lopata et al., 2010)).

Studies 2 and 3: The second study aimed to demonstrate how polar coordinate analysis can be useful in studying social behaviors in adolescents with ASD during a group social skills intervention and to investigate whether typical ASD behaviors show interrelations (prospective and retrospective sequences) similar to behaviors observed in psychotherapy. We hypothesized that *polar coordinate analysis would provide specific and detailed information about social behaviors in adolescents with ASD during an intervention of social skills. Furthermore, similar social behaviors would be detected during the psychotherapy* (Study 2). In the same line, the third study aimed to identify changes in social behaviors through analysis of relationships established between behaviors in children with ASD who participated in a social competence intervention program and to determine whether there were differences in behaviors relationships in children regarding comorbidities and IQ. We hypothesized that *the relationships established between the selected focal behavior and the other behaviors would be different between an initial session and the last session, and that specifically we would observe improvements in the quality of the relationships established between the selected focal behavior and the other behaviors in children without comorbidities and high VIQ* (Study 3).

Following the objectives and hypothesis of **study 2** and **study 3**, and in accordance with study 1, we confirmed that the observation instrument is a new tool for coding and analyzing social behaviors in social skills interventions for ASD children and adolescents. Our final instrument was an adaptation of an observation scale developed by Bauminger (2002), and we observed that this instrument could also be useful for polar coordinate analysis. The reliability results in the data quality control analysis supported the adequacy of the data obtained.

Regarding the polar coordinate analysis applied in both studies, our results were highly variable. Participants showed different courses of development.

In the adolescent sample, some participants started with a high number of interactions and during the course of the intervention the number of interactions decreased. Other participants increased the number of interactions by the end of the program. And others

increased their number or quality of interactions in the middle of the intervention program (session 5) and then decreased at the end. Differences were observed not only in the quantity, but also in the quality.

For the sample of children, we observed high variability in social behaviors. However, in general, for the total sample we observed a decrease in the number of interactions (initiations and responses) and an increase in the quality (interactions were negative or low-level at the beginning and at the end more high-level). Furthermore, significant behavior relationships in session 2 and 10 were observed in relation to responses and low-level interactions.

In relation to VIQ, we observed that children with higher VIQ ($VIQ > 90$) had initiation behaviors of higher quality. These included behaviors such as eye contact and social verbal communication. However, the quantity decreased. In the group of children with $VIQ < 90$, we observed a decrease in the quantity in responses and initiation. However, new functional behavior relationships appeared after intervention in responses: children with lower VIQ used more gestures to communicate, specifically with the pointing gesture. In relation to initiations to interactions, behaviors disappeared after intervention. In conclusion, in our sample children with higher VIQ presented more social behaviors, specifically in initiations, than children with lower VIQ.

On the one hand, *initiations* tend to be more difficult to perform and less present in people with ASD, because this social interaction requires greater social skills and interest in sociability (interest in starting a conversation). It also implies the need for communication with the other, proposing topics of conversation or games. Difficulties in initiations are also related to social anxiety or to the fear of being rejected, present in this population (Paula, 2015; Fagan, 2017). On the other hand, *responses* are easier to perform, because the person does not need to start the conversation or think about what he or she can say, so consequently the fear of being rejected by the other person decreases.

In general, in both samples (study 2 and study 3), participants tended to use social behaviors of low-level interactions such as functional communication or looking without eye contact. However, throughout the intervention program, and certainly by the middle sessions or the last sessions, the quality of their interactions increased, demonstrating more high-level interactions (eye contact, smile, or social verbal communication).

Due to this variability, it is not possible to summarize their behaviors in one single pattern that represents the whole group of adolescents or children, and therefore we cannot confirm common behavior relationships in patients with ASD. Nevertheless, we may state that our observations might allow clinicians and professionals to identify and analyze behaviors in a group of adolescents and group of children with ASD and spontaneous behavior in a semi-structured social environment through observational methodology.

Other studies have used the same analysis, confirming that polar coordinates can offer the opportunity to observe unique qualitative details which can subsequently be transformed into quantitative data to be interpreted in a more global manner (Castellano and Hernández, 2003). This type of analysis offers information about bidirectional relationships that appear among behaviors of each participant. Following the same line, another research study used observational methodology and performed specific analysis to assess how a therapist, in a group, could activate or inhibit participants' behavior (Arias-Pujol and Anguera, 2017).

Interestingly, this type of methodology and similar analysis have been performed not only in psychology, but also in other fields. Two studies used this methodology to observe and analyze behaviors in sports competitions, such as soccer and handball (Marinello & Jiménez, 2018; Morillo et al., 2017).

Regarding our intervention in the field of ASD, obtaining this detailed information about social relationships established between behaviors of each participant could allow clinicians and therapists to better understand the behavior of their patients. We obtained information about how some behaviors activated or inhibited other behaviors, and with this information, we can better understand and offer guidance as to what the patient needs. This

is powerful information for professionals, because it allows them to develop better interventions more focused on the needs and specific difficulties of each patient. It also allows one to transform and modify interventions such as didactic lessons and materials, adapting them to the process and evolution that the patient demonstrates.

According to Anguera et al. (2018), we recognize that observational methodology offers the opportunity to better our understanding of human behavior, adding more detail and sensitivity. In the same line, it allows researchers from different fields and disciplines to perform diverse analyses to uncover many aspects of communications and relationships.

Until now, little research in observational methodology in autism has been performed. Most of the studies in the literature have used questionnaires to observe changes in social behavior, but we know that the information derived from these measures is not sensitive enough to allow us to assess interactions (Kasari et al., 2014).

6. CONCLUSIONS AND LIMITATIONS

Conclusions drawn from the research are presented here. These conclusions can contribute to future research, adding more significant results and suggesting new lines of investigation.

1. Results obtained in this research add significant and quality data to research in social skills interventions. Our results provide more evidence about how social skills interventions can be useful to decrease comorbid symptomatology such as anxiety and depression, thereby decreasing symptomatology that can be present in children and adolescents with ASD.
2. There are many influencing factors in social skills interventions for ASD. Two of these important factors are age and VIQ. Despite our favorable results in the sample of children and participants with $VIQ > 90$, researchers need to continue investigating regarding which characteristics of the sample may positively or negatively influence the evolution of social skills in this population. This awareness will allow experts to develop more specific interventions.
3. The observational instrument has demonstrated the possibility of capturing social behaviors in greater detail, even in a sample of ASD, who often perform social interactions that are unclear or confusing. This observational instrument might have future applications in the field of psychotherapy, and not only in the field of ASD.
4. Observational methodology has turned out to be very useful in the field of psychology, specifically assessing social behaviors in children and adolescents with ASD. The literature highlights the difficulties that exist in measuring improvements in social knowledge and social competence in this population. Through this methodology, researchers, clinicians and professionals will be able to obtain more specific information about the difficulties and evolution of each patient.
5. To date, a large number of studies have assessed the effectiveness of social skills interventions programs. In relation to the importance of observational methodology, we may state that this method might provide more sensitive and specific information about patients or participants, contributing to the development of more appropriate and accurate interventions, taking into account the needs and difficulties that are

present before and during the intervention. These possibilities would allow professionals to modify the course of their interventions in order to obtain better results.

6. Finally, over the years many intervention programs have been developed and validated through research. The program of the UC Davis MIND Institute developed by Solomon (2004) has proved to be effective in reducing ASD symptomatology, specifically anxiety and depression, and has also demonstrated the possibility of measuring and assessing social behavior through alternative new methodologies that are both more specific and more detailed. Despite all these qualities, more research is needed to prove the effectiveness of this program in the improvements in social skills in autism children and adolescents.
7. Community-based research is always difficult to perform, and adapting evidence-based interventions programs that fit resources and reach the maximum number of children is very challenging. The number of sessions should be considered with a minimum to obtain effectiveness.

We recognize many limitations in our studies in common with other research (Bonete, et al., 2016; Dolan, et al. 2016; Jonsson, et al., 2018). First of all, one limitation present in all three studies is the sample size. The small sample limits generalization of the results obtained and also precluded performing more specific sub-analysis that would have been of interest, although observational methodology does not require large samples. Secondly, the duration of the intervention (number of sessions) was too short. The number of sessions was halved because of the high volume of patients that the hospital receives (approximately 300 patients with ASD per year). The UnimTEA was interested in providing a social skills training group to most of the patients that needed the intervention, without increasing the waiting time and with the public resources provided. By reducing the number of sessions, the UnimTEA was able to offer the intervention to a larger number of patients. However, it is important to consider that the majority of interventions normally extend to 1 or 2 hours a week during the academic year (McMahon et al., 2013). Notwithstanding this, there are some controversial results in the duration of intervention (Matthews et al., 2019), some researches performed short but intensive interventions (one or two months, but more than one session and one hour

a week). These researchers also found effectiveness (Lopata et al., 2010; Thomeer et al., 2016). Thirdly, the quantity of data collected was not sufficient to permit us to observe many significant changes or generalized the results. We would have needed to collect more data from each participant (at the beginning of the intervention, during the intervention, and at the end). Coding and analyzing more sessions would have allowed us to have more consistent results (Arias-Pujol & Anguera, 2004). In relation to the analysis and techniques applied, other techniques such as pattern analysis, can be applied in future researches to assess different aspects of social communication and social interaction. Finally, we did not measure follow up-treatment, either with questionnaires or observational methodology. This measure would have allowed us to achieve greater reliability in the significant results, by assessing the generalization and maintenance of the improvements.

All these limitations should be considered in future research, so as to improve the quality, quantity, and generalizability of the results, and to contribute in a positive and useful way to the sample studied. Clinicians and researches should continue investigating which factors are influencing the effectiveness of the interventions in treatments of social skills, specifically in hospital context and community settings, were the volume of patients are higher. All these researches would improve the care provide in public mental health centers (Bryson & Ostmeier, 2014).

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8. APPENDIX

8.1. CEIC Certificate

	Informe Dictamen Favorable Projecte Investigació Biomèdica
	C.I. PIC 04-17
	30 de enero de 2017
CEIC Fundació Sant Joan de Déu	
Dr. Pau Ferrer Salvans Secretario del CEIC Fundació Sant Joan de Déu	
CERTIFICA	
1º. Que el CEIC Fundació Sant Joan de Déu en su reunión del día 26/01/2017, ha evaluado la propuesta del promotor referida al estudio:	
Título: "Valoración de la efectividad de un Programa manualizado de intervención grupal en habilidades sociales para niños/as y adolescentes con trastorno del espectro autista (TEA)"	
Código Interno: PIC-04-17	
IP: Sra. Ma Ángeles Mairena García de la Torre	
Considera que:	
<ul style="list-style-type: none">- El proyecto se plantea siguiendo los requisitos de la Ley 14/2007, de 3 de julio, de Investigación Biomédica y su realización es pertinente.- Se cumplen los requisitos necesarios de idoneidad del protocolo en relación con los objetivos del estudio y están justificados los riesgos y molestias previsibles para el sujeto.- Son adecuados tanto el procedimiento para obtener el consentimiento informado como la compensación prevista para los sujetos por daños que pudieran derivarse de su participación en el estudio.- El alcance de las compensaciones económicas previstas no interfiere con el respeto a los postulados éticos.- La capacidad de los Investigadores y los medios disponibles son apropiados para llevar a cabo el estudio.	
2º. Por lo que este CEIC emite un DICTAMEN FAVORABLE .	
3º. Este CEIC acepta que dicho estudio sea realizado en los siguientes CEIC/Centros por los Investigadores:	
• HOSPITAL SANT JOAN DE DEU. Ma Ángeles Mairena García de la Torre.	
Lo que firmo en Espugues de Llobregat, a 30 de enero de 2017	
Fdo:	
Dr. Pau Ferrer Salvans Secretario del CEIC Fundació Sant Joan de Déu	
<small>Edifici Hospital Sant Joan de Déu - C. Santa Rosa, 89-97, 08938 Espugues de Llobregat / Barcelona Telèfon: +34 93 600 92 50 - Fax: +34 93 600 92 71 - e-mail: info@fjd.org - web: www.fjd.org</small>	

8. 2. Research Comission Certficate



La Comissió de Recerca del Parc Sanitari Sant Joan de Déu, ha revisat i aprovat el projecte titulat "Valoración de la efectividad de un programa de intervención grupal en habilidades sociales para niños/as y adolescentes con trastorno de espectro autista" Dra. Mairena.

El projecte té el recolzament de la Comissió de Recerca. El tema es pertinent dintre de les línies de recerca de la Institució i el protocol es pot realitzar als termes proposats. El nivell de formació, experiència i dedicació dels Investigadors garanteixen a la nostra opinió el desenvolupament del projecte.

Sant Boi de Llobregat, 13 de desembre de 2016

Signat: Josep Maria Haro Abad
President Comissió Recerca