TRAINING REFERENTIAL COMMUNICATIVE SKILLS TO INDIVIDUALS WITH AUTISTIC SPECTRUM DISORDER: A PILOT STUDY[1]

JOSÉ-SIXTO OLIVAR-PARRA AND MYRIAM DE-LA-IGLESIA-GUTIÉRREZ

Departamento de Psicología

Facultad de Educación y Trabajo Social

Universidad de Valladolid

MARIA FORNS

Departament de Personalitat, Avaluació i Tractament Psicològics

Institut de Recerca en Cognició, Conducta i Cervell

Universitat de Barcelona

[1]Address correspondence to José-Sixto Olivar Parra, Departamento de Psicología,Facultad de Educación y Trabajo Social, Universidad de Valladolid, Campus Miguel Delibes, Paseo de Belén 1; 47011 Valladolid, Spain or e-mail (jsolivar@psi.uva.es).

Training Communicative Skills to Adolescents With Autism

Summary.—The present study reports the effects of referential communication training in individuals formally diagnosed with autistic spectrum disorder (ASD). Participants were 20 children with ASD (*M* age = 14.3 yr., *SD* = 4.2; 6 girls, 14 boys) in the role of speakers and 20 control children, who acted as listeners. They were all enrolled in mainstream compulsory education. Inclusion/exclusion criteria were defined according to the clinical diagnosis of ASD, the presence or absence of additional or associated disability, previous training in referential communication, and any drug treatment. Speakers were randomly assigned to one of two groups (trained vs untrained). Linguistic age, cognitive level, and autistic symptoms were analyzed, respectively, with the Peabody Picture Vocabulary Test (PPVT), the Wechsler Intelligence Scale (WISC–R or WAIS–III) and the Autistic Behavior Checklist (ABC). Communicative abilities were analyzed through two indexes related to message complexity and self-regulation. The trained group was trained in referential communication tasks (task analysis, role taking, and task evaluation), while the untrained group took part in a communicative game but without any specific communicative training. The results showed that the complexity of emitted messages had improved statistically significantly in the trained group as an effect of training. Ecological referential communication is shown to be an appropriate paradigm for studying the communicative process and its products and could be used to develop and implement a training program focused on those skills in which individuals with ASD are most deficient.

Training Communicative Skills to Adolescents With Autism

Individuals with autistic spectrum disorder (ASD) are characterized by impairments in three domains: reciprocal social interaction, communication skills, and restricted repetitive and stereotyped patterns of behavior, interests, and activities (World Health Organization, 1990; American Psychiatric Association, 2002). The lack of varied, spontaneous social imitative play, appropriate to a given developmental level, the restricted patterns of interest, and the inflexibility in their behavior makes it difficult for individuals with ASD to learn and to generalize learning (Klin & Volkmar, 2000). Communicative theorists suggest that such difficulties may be related to deficits in executive functions (Ozonoff, 1995; Rajendran & Mitchell, 2006), in understanding mental states (Baron-Cohen, Leslie, & Frith, 1985), and in using knowledge in context (Frith, 2003).

While autistic children with speech may have adequate skills in relation to formal language components (phonology, morphology, syntax) and some semantic components, they often exhibit many difficulties in the use of social language (pragmatics). Indeed, in the areas of pragmatics and discourse, research has identified specific difficulties in referential communication skills, such as producing ambiguous messages, using a limited amount of self-regulation, and omitting certain elements of the message which, as relational terms, involve a greater cognitive challenge (Volden, Mulcahy, & Holdgrafer, 1997; Olivar & Belinchón, 1999). These difficulties could, potentially, be overcome through training (Asher & Wigfield, 1981). The present study aims to assess whether the paradigm of ecological referential communication (Lloyd, Boada, & Forns, 1992) is suitable for training certain specific communicative skills.

The referential communication paradigm considers communication as the ability to distinguish, in encoding and decoding, one particular referent from other non-referents. In addition to linguistic verbal abilities, research has identified (Sonnenschein & Whitehurst, 1984; Beal, 1987; Bonitatibus, 1988) three types of skills needed for effective communication: task analysis, role-taking, and task evaluation. Task analysis is regarded as a cognitive skill, since it requires an analysis of the task to be performed so as to identify the key attributes of the referents and to encode or decode them in a non-ambiguous message that enables the listener to distinguish the referent from other non-referents. Role-taking is considered a sociocognitive cooperation skill that consists in taking into account the perspective of the interlocutor and, therefore, in adapting the information to his needs. Task evaluation is considered to be a metacommunicative skill through which the subject evaluates the task in itself. Self-regulation skills and the use

of private speech are particularly relevant metacommunicative skills. The techniques that have been shown to be most effective in terms of training communicative skills are modeling, establishing social cognitive conflict, and providing visual and verbal feedback (Martínez, 1999).

Although there are many reports on teaching communicative skills to autistic children (Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011), very few of them have adopted the referential perspective (Dahlgren & Sandberg, 2008; Loveland, Tunalia, McEvoy, & Kelly, 2008; Nadig, Vivanti, & Ozonoff, 2009), and there are no training programs specifically aimed at improving these referential skills. However, there are several reasons why the referential communication model is useful for studying communication. First, verbal competence analyzed in a referential communicative situation is a prototypical example of what can be regarded as a "pragmatic skill or ability," in that the speaker must adjust the content and form of his messages to the listener's needs and capacities. This adjustment also requires comprehension of the mental state of the interlocutor. Second, the referential communicative situation can be applied to people with a wide range of disorders (e.g., dysphasia, Down syndrome, fragile X syndrome, blindness, Williams syndrome, schizophrenia, or autism, among others) as it provides an excellent basis on which to promote the communicative verbal exchange. Third, the referential design adapts well to children of different ages, and the flexibility of the model allows a wide variety of tasks to be used (Yule, 1997). Finally, the specific ecological referential paradigm, which includes the adult in the communicative exchange, provides an excellent learning situation as it depicts the school classroom situation in which a teacher guides, helps, and corrects the inaccuracies of the communicative exchange (Lloyd, *et al.*, 1992).

In light of the above, the aim of this study was to evaluate the effects which training in referential communication skills might have on individuals with ASD. Specifically, differences in speakers' performance were compared between a trained and an untrained group, all of whom had a clinical diagnosis of ASD. There were two working hypotheses. Firstly, speakers with ASD would improve their skills in relation to delivering messages and planning their own verbal productions as a result of specific training. This improvement would be greater than any shown by untrained speakers. Secondly, the improvement achieved by trained speakers would be maintained into a generalization stage.

Method

Participants

Participants were 40 Caucasian children with Spanish as their native tongue. They were all from middle-class backgrounds and were enrolled in mainstream primary and secondary compulsory education schools in Valladolid, Spain. These schools had an integrated education policy, and they all accepted children with disabilities. Informed consent was obtained from the parents or legal guardians of all the participating children.

Twenty of these children had a clinical diagnosis of autistic spectrum disorder according to either DSM-IV–TR (American Psychiatric Association, 2002) or ICD–10 (World Health Organization, 1990) criteria, the diagnosis being made by psychiatric clinicians in Valladolid. Any children who were under drug treatment for symptoms related to their disorder (e.g., with risperidone) or who had previously participated in communication skills training were excluded. Also excluded were children with a comorbid diagnosis, specifically those with comorbid intellectual disability. However, the low IQ displayed by some of the children in the sample was not attributable to intellectual disability. These 20 children were enrolled as participants and acted as speakers.

The other 20 children presented typical development and none of them were diagnosed as autistic or had any psychopathological disorder. They were recruited from the same schools and had an equivalent educational and socioeconomic level. These 20 children were enrolled as controls and acted as listeners.

The 20 speakers were randomly assigned to either a trained group (2 girls, 8 boys) or an untrained group (4 girls, 6 boys). Table 1 shows the data regarding chronological age, verbal mental age (Peabody Picture Vocabulary Test, PPVT–III; Dunn, Dunn, & Arribas, 2006), total intellectual quotient (WISC–R; Wechsler, 1993; or WAIS–III; Wechsler, 2001) and the number of autistic symptoms (Autism Behavior Checklist,ABC; Krug, Arick, & Almond, 1980) for each group. Each autistic speaker was paired with a control listener and matched for sex and verbal mental age. This yielded a total of 20 pairs.

Speakers in the two groups (trained and untrained) presented no significant differences in chronological age, level of receptive language, intellectual quotient, or number of autistic symptoms (Table 1). The effect sizes indicate an important overlap

between the two distributions, such that the two groups of speakers were almost equivalent at baseline.

Materials

Two kinds of materials were used. First, standardized tests to characterize the groups taking part, and second, materials used in the referential communication tasks to assess and train communication.

Tests used to characterize the groups.—The Peabody Picture Vocabulary Test (PPVT–III) adapted for a Spanish population by Dunn, *et al.* (2006), measures receptive vocabulary and provides a quick estimation of subjects' verbal ability or scholastic aptitude. It can be applied to individuals in the age range 2:6–90+, and yields reliability and validity coefficients around .91.

The Wechsler intelligence scales were used to assess the cognitive abilities of participants. The Wechsler Intelligence Scale for Children–Revised (1993) was used to assess children and adolescents younger than 18 years old, while the adult scale (WAIS–III; Wechsler, 2001) was used to assess adolescents aged over 18 years. In both cases, the corresponding Spanish adaptation of the scale was used, which has shown good validity and reliability. Total scale scores show a test-retest reliability between .89 and .94, according to age.

The Autism Behavior Checklist (Krug, *et al.*, 1980) is a screening checklist for non-adaptive autistic behaviors and is completed independently by parents or teachers. It was used in the present study to measure the total number of autistic symptoms presented by participants. The cutoff score was set at 49, with a sensitivity of 92.1% and specificity of 92.6% (Marteleto & Pedromônico, 2005), or at 45 (Juneja, Sharma, & Mukherjee, 2010) with a sensitivity of 98%.

Materials used in the training stages.—The referential communicative tasks used have their roots in the classic experiment by Krauss and Gluksberg (1969). This attempts to analyze the communicative skills of two partners who are exchanging information about a picture, and whose task is to construct two identical pictures. In the present study, the children were separated by an opaque screen to potentiate the verbal exchange. In the ecological referential communication paradigm (see Fig. 1), an adult, such as a teacher, was also present and participated in the communicative exchange in order to help children restore the flow of verbal communication when it broke down (San Martín, Boada, & Forns, 2009). Three set of drawings were used.

Comment [A2]: Fig. 1, Fig. 2

Picture A: Organization of a room (Boada & Forns, 1997). This task requires the use of two pictures (one for the speaker and another for the listener) and a set of movable objects (the referents) which the listener has to place in his/her picture according to the speaker's instructions (see Fig. 2). The speaker has to transmit precise verbal information about the characteristics of the objects and their placement in the picture so that the listener can identify them and put them unambiguously in the space that has been indicated. The listener can ask for further information if needed. The goal is to obtain two identical pictures. The adult's role is to prevent the breakdown of communication, guiding it if necessary but without participating in the exchange of substantive information.

Picture B: Organization of an old room (Olivar, 2004).

Picture C: Organization of a new room (Olivar, 2004).

In order to determine the children's ability to generalize what has been learned the referential tasks, Pictures B and C were progressively more complex than Picture A, as suggested by Brown and Campione (1984). The use of different communication pictures for each of the training stages (see below) was also designed to avoid learning effects among the participants with ASD, not least because such individuals often have a very good visual-spatial memory.

All communicative utterances produced in the communicative exchange while performing the task were recorded on VHS tape and later transcribed and encoded using the coding system of Boada and Forns (1997). Cohen's kappa indexes were calculated for one-third of the speakers' productions by three experts in referential communication. The global index obtained indicated an acceptable level of inter-coder reliability (kappa = .76).

Procedure

Design of training stages.—The design had four stages: pre-training, training, post-training and generalization. In the pre-training stage (Picture A), the baseline level of communication skills was established. The training stage involved implementation of the Referential Communication Training Program (Olivar & De la Iglesia, 2007). This program consists of four weekly training sessions, each lasting 30 to 45 minutes. In the post-training stage, participants had to perform a new task (Picture B), and any changes produced by training were analyzed. The purpose of the final generalization stage (Picture C) was to analyze the extent to which communicative learning had been maintained. All four stages were conducted in appropriate rooms in the children's

school. The total design lasted 9 weeks, distributed as follows: pre-training stage, Week 1; training stage, Weeks 2–5; post-training stage, Week 6; and the generalization stage, Week 9.

Types of skills targeted by training.—The four sessions of the training stage were used to practice specific communication skills: Session 1, training in task analysis; Session 2, training in role-taking; Session 3, training in both task analysis and role-taking; and Session 4, training in task evaluation. Training was based on the following techniques: modeling with and without exchanging roles, creating a social cognitive conflict, and giving visual and verbal feedback. All training sessions were conducted in line with the ecological referential communication paradigm.

In the modeling technique, the trainer offers both the speaker and the listener a good model of how to send or receive information in a referential communication situation. In the role-taking technique, the partners switch roles between speaker and listener. The purpose of this switch is to increase their awareness of what and how they should give and receive the information about the objects, according to the role they occupy, in order to perform the task accurately.

In the social cognitive conflict technique, and as stated by Mugny and Doise (1983), participants are either confronted with their own responses through feedback from companions or the trainer, or confronted with a bad outcome (in this case, pictures that are not the same). If, when speakers compare their messages with the listeners' performance (and vice versa), they realize that the outcome is not good, then a social cognitive conflict is produced, since it becomes apparent that the messages given were ineffective, thereby raising questions about the role of the sender or the receiver in the poor outcomes. Depending on the extent to which this conflict is verbalized, participants become aware of the utterances that trigger an incorrect response and, consequently, are more able to improve their communication.

In the explicit verbal and visual feedback techniques, the trainer or the listener provides information to the speaker. This information is related, directly or indirectly, to the message given, and indicates via visual and/or verbal means the main aspects required for a good message and those that lead to an erroneous outcome (Sonnenschein & Whitehurst, 1984). The feedback may serve as approval or disapproval of the outcome (through positive or negative verbal reinforcement), to highlight the errors made or the good or bad communication strategies used (through communicative/verbal feedback), or to provide help by presenting pertinent visual elements or visual feedback.

For example, when using visual feedback to train participants in task analysis, the individual is given a set of cards, each one of which represents one of the attributes of the referent. Before formulating the message, the speaker has to place next to the referent all those cards that correspond to the referent's attributes, which means that he or she has to bear in mind the attributes reflected on the cards prior to emitting the message.

Verbal reinforcement sometimes goes beyond mere approval of a correct performance or disapproval of a mistake, and takes the form of an "explanation of strategies." This consists in training systematically what has to be done, when it has to be done and why it has to be done (evaluation strategies), based on the verbal productions from participants themselves. Table 2 shows an example of a training session in which all these techniques are combined.

Comment [A3]: Table 2

Dependent variables in the analysis of training effects.—The effects of training were analyzed using two measures taken from previously published observational guidelines and the assessment form for referential communicative exchange (Boada & Forns, 1997, 2004); these measures were message complexity and self-regulation.

Message complexity.—In order to produce an adequate message, speakers had to do three things: (1) analyze the attributes and location of the referent object; (2) compare and differentiate this referent from other non-referent objects; and (3) construct a precise, non-ambiguous message. This means they had to select the appropriate verbal utterances to identify and describe each object (naming the object and its attributes) and its corresponding determinants of relation and position. Each element of the messages produced by speakers was scored (from 0 to 2) according to the quantity and precision of the attributes and determinants contained therein. The more informative and precise the speaker's message was, the greater the number of points awarded, which in turn indicated higher communicative competence. Table 3 shows the coding system used to assess messages, along with some examples of coded messages.

Comment [A4]: Table 3

Self-regulation.—Self-regulation refers to the ability to monitor one's own comprehension and control one's own cognitive processes. In the referential communicative context, it refers to a set of behaviors that are used flexibly to guide, monitor, and direct the success of one's own communicative performance (Singer & Bashir, 1999). Two kinds of self-regulation were considered here: internal regulations and planning interventions. Internal regulations are audible verbal productions aimed at guiding or controlling one's own behavior, but without any communicative intention to

influence the interlocutor's behavior (San Martín, *et al.*, 2009). Planning interventions are utterances designed to organize one's own action and message: the speaker organizes the information and emits an audible message that contains verbal prompts addressed to him/herself as well as to the interlocutor. These planning interventions do not provide relevant information about the content of the message but rather express procedural information (see examples in Table 3). In the present study we calculated the ratio between the number of self-regulations (internal regulations and planning interventions) emitted by the speakers in order to complete the task and the total number of productions emitted by the interlocutors. The mean ratio for each group was then calculated.

Data Analysis

Baseline performance in communicative skills was analyzed by comparing group means (between-groups design: trained vs untrained subjects) using the Mann-Whitney *U* test, with Monte Carlo sampling when required. Cohen's *d* and the percentage of non-overlap between the trained and untrained groups were also calculated. The effect of training on message complexity and self-regulation, as well as the persistence of learning (within-group design across three stages: pre-training, post-training, and generalization) were analyzed by means of the Kruskal-Wallis test for related samples, using the Friedman index and Monte Carlo sampling. A *post hoc* Bonferroni analysis was conducted to identify the differences between training stages. The total and partial effects of training on message complexity and self-regulation were assessed by MANOVA, calculating the effect of groups (2) and training stage (3). The results obtained in this last analysis are only indicative, due to the small sample size. All statistical analyses were performed using SPSS (Version 15.0) for Windows.

Results

Communication Skills at Different Stages of the Design: Trained Versus Untrained Groups

Table 4 presents basic descriptive data regarding message complexity and self-regulation for the trained and untrained groups, and for each stage of the design. The complexity of messages formulated at the pre-training stage was equivalent in the two groups (Mann-Whitney $U = 41.50$, $p = .52$). However, in the post-training stage, the Trained group produced more complex messages than did the Untrained group ($U =$

14.00, p = .007, d = 1.55), and this statistically significant difference was maintained at the generalization stage (U = 10.50, p = .003, d = 1.52).

As regards self-regulations, there were no statistically significant differences between the Trained and Untrained groups at either the pre-training stage (U = 36.00, p = .267) or the post-training stage (U = 26.50, p = .06). By contrast, a statistically significant difference was observed in the generalization stage, with the Trained group producing more complex messages (U = 25.00; p = .05, d = .948). However, Cohen's index indicated that this difference was not relevant due to high overlap between the groups (46.7%).

Comment [A5]: Table 4

Communication Skills: Changes in the Trained Group Across Stages

In the Trained group, message complexity increased statistically significantly between the pre- and post-training stages (U = 19.50, p = .02, d = 1.14), but not between pre-training and the generalization stage (U = 30.00, p = .13), or between post-training and the generalization stage (U = 36.00, p = .29). The number of self-regulations showed no significant increase across the stages (Table 4).

These data confirm that the training produced an increase in the complexity of messages formulated. However, the greater ability to deliver more complex messages is not maintained in the generalization stage. Furthermore, the training produced no statistically significant change in the rate of self-regulations.

Communication Skills: Changes in the Untrained Group (UTG) Across Stages

As can be seen in Table 4, the Untrained group showed no statistically significant change in message complexity across the three stages analyzed (U = 42.50, p = .57 between pre- and post-training; U = 48.00, p = .88 between pre-training and generalization; and U = 37.00, p = .33 between post-training and generalization).

In terms of self-regulation skills, statistically significant differences were found between the pre-and post-training stages, but these were not relevant as the overlap between samples was about 46.7% (U = 26.00, p = .05, d = 0.95). There were no significant differences between pre-training and generalization (U = 27.00, p = .06), or between the post-training and generalization stages (U = 47.00, p = .79). Therefore, message complexity and self-regulation remained stable across the stages of training.

Communication Skills: Effects of Group and Task

The MANOVA analysis (3 task stages × 2 groups) showed that in relation to message complexity, only the total effect and the group effect were significant. There was no statistically significant effect in relation to self-regulation.

Discussion

The objective of this study was to evaluate the effects of training in referential communication skills. A communicative skills training program was implemented to a small group of individuals diagnosed with autistic spectrum disorder (ASD), the results being compared with those of another group of individuals with ASD who received no training. It was hypothesized that the trained speakers with ASD would show improved skills in terms of message delivery and planning their verbal intervention, and that these improvements would be greater than any shown by untrained speakers. It was also hypothesized that positive changes in these skills would be maintained in a generalization stage.

The results obtained were very modest. With respect to the effect of training on message complexity, the trained group showed a slight and significant increase in the complexity of the emitted message, compared with messages emitted by the untrained group. The message produced in the pre-training stage, by both the Trained and the Untrained groups, consisted basically in naming the referent object and in indicating a basic location (e.g., Speaker: “Put the skateboard under the bed”). In other words, they provide very basic information about the object, and they only described one relationship between the object and the immediate context. This kind of relationship has been referred to (Plumert, Ewert, & Spear, 1995) as a relation of “support” (e.g., “on” or “under”). By the post-training stage, the score awarded to messages produced by Trained speakers had increased by almost 2 points, indicating that the post-training messages included the expression of: (1) other kinds of relationships between objects, in addition to the expression of “support” (e.g., near/far, in the middle, between, next to, in front of; Speaker: “The skateboard is under the bed, near the pillow”); or (2) the expression of specific positions (e.g. Speaker: “The skateboard is under the bed with the wheels touching the floor”). Thus, the message has become more complex, although it does not provide all the information necessary to place the objects accurately (see Boada & Forns, 2004).

These results are partially in agreement with those obtained by Nadig, *et al.* (2009), who reported that individuals with ASD have difficulties providing adequately informative descriptions of objects, and that they are less likely than typically developed peers to modify their descriptions. Loveland, *et al.* (2008) also indicated that autistic individuals needed more help to convey the required information to a listener. However,

the present results are also partially in agreement with those obtained by Olivar and Belinchón (1999), who found that when individuals with autism have been practicing referential communication skills, they improve their ability to analyze and compare the attributes and location of referents, and thus show greater precision in naming objects and expressing their relationships in space, both of which are key elements with regard to greater effectiveness in speaking.

In the present study, the progressive improvement in message formulation achieved by the post-training stage was not maintained in the generalization stage, even though these two stages were only separated by an interval of three weeks. This highlights the specific difficulties of generalizing learning in autism (Klin & Volkmar, 2000). However, the improvement in message formulation observed post-training does indicate that some message elements—such as object naming, expressing the main location, and the expression of relationships (support, specific relationship, and proximity) between objects—were able to be used in a more flexible way and could be applied to a new task, even though participants struggled to maintain the improvement in these skills.

According to referential communication studies conducted with typically developing children (Boada & Forns, 2004), the complexity of the messages produced by children with ASD at the pre-training stage would correspond to an age of around 4.5 yr. By the post-training stage, trained participants had reached a message complexity that corresponded to an age of around 6.5 yr., indicating that the improvement in message formulation linked to training was very small, although nonetheless relevant. Internal regulations and verbal planning interventions remained stable across the stages of training, indicating that the evaluative elements of communication and the executive function of planning and organizing one's own verbal behavior were difficult to train in individuals with ASD.

One of the most noteworthy findings is the low number of self-regulatory utterances used by participants with ASD, even after training. A longitudinal study of referential communication skills conducted with typically developed children (Martínez, Forns, & Boada, 1997) reported rates for different types of utterances. The authors found that speakers' self-regulations represented 3% of total utterances at the age of 4 years, 5% at the age of 6 years, and 6% at the age of 8 years. In the present study, the self-regulation of participants with ASD was well below these values; self-regulations did not exceed 4% at the pre-training stage, while after training and at the generalization

stage the rates were equivalent to those obtained by typically developed children ages 4–5 years. It can be concluded, therefore, that communicative exchange in speakers with ASD is characterized by a very limited use of self-regulation, and teaching such individuals how to use self-regulation would thus appear to be an intensive training objective in itself. Of course, one could argue that the self-regulations used by participants with ASD may have become internal and inaudible—as some theorists suggest—since most of them were teenagers. However, given that the messages produced correspond to a developmental age (between 4 and 6 years) at which regulations have yet to be internalized, it is unlikely that the lack of regulations is due to their internalization. Nonetheless, this could be a relevant topic for future research.

Limitations of the Study and Future Research Lines

The limited improvement in message complexity is one of the principal points of discussions in the present study. This could be attributed to the low number of training sessions, the lack of specific training in generalization, or the complexity of the generalization task. Therefore, new versions of the program, including more intensive and longer-lasting training, are now planned. These future versions will also include sessions that will be specific and adapted to medium- and long-term generalization tasks.

The research could also be improved by increasing the number of subjects in each group in order to analyze and generalize the results with greater confidence. It would also be necessary to select subjects who are more homogeneous in terms of educational level and chronological age, to avoid developmental effects. Indeed, the time which the children with ASD had spent in mainstream education, alongside typically developed peers, produces notable differences in their experience of talking with others, which is likely to influence the outcome of training.

Another weak point of the study concerns the wide range of verbal ages and cognitive levels among the children with ASD. However, this is a controversial issue and such heterogeneity in verbal ages and cognitive levels might be considered as a strong point. Indeed, in the forthcoming DSM–V (American Psychiatric Association, 2011) it is suggested that autistic disorder should become the only possible diagnosis for the Pervasive Developmental Disorder category, and should be called Autistic Spectrum Disorder (ASD), irrespective of cognitive level. Since the size of the group was small, it was not possible to explore the extent to which the progress made by participants was linked to cognitive, mnemonic, or spatial abilities.

Finally, a strong point of the study is that the ecological referential communication paradigm has been shown to be appropriate for exploring and studying the communication process and its products, enabling the implementation of a training program focused on those skills in which individuals with ASD show the greatest deficits. The system of analytic categories applied to the communicative exchange enabled a rigorous analysis of the skills that affect referential social and communicative competence, this being particularly worthy of observation in children with ASD. In conclusion, applying the ecological referential communication paradigm to teach communication skills to individuals with ASD is relevant not only clinically but also in social and educational terms, since it enables specific educational proposals to be developed and trained in a communicative context.

REFERENCES

American Psychiatric Association. (2002) *Manual diagnóstico y estadístico de los trastornos mentales. DSM-IV–TR. [Diagnostic and statistical manual of mental disorders, 4th Edition, Text revision (DSM-IVTR)]*. (Transl. by J. L. López-Ibor & M. Valdés) Barcelona, Spain: Masson.

American Psychiatric Association. (2011) *DSM–5 development.* Retrieved 2 March, 2011, from http://www.dsm5.org/Pages/Default.aspx.

Asher, S. R., & Wigfield, A. (1981) Training referential communication skills. In W.P. Dickson (Ed.), *Children's oral communication skills.* New York: Academic Press. Pp. 105-126.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985) Does autistic child have a "theory of mind"? *Cognition*, 21, 37-46.

Beal, C. R. (1987) Repairing the message: children's monitoring and revision skills. *Child Development*, 58, 401-408.

Boada, H., & Forns, M. (1997) Observational guidelines of communicative exchange: an ecological approach to referential communication. *Anuario de Psicología, 75,* 7-36.

Boada, H., & Forns, M. (2004) The cognitive complexity of the referent and self-regulation in children's messages. *Journal of Psycholinguistic Research, 33,* 3, 237-261.

Bonitatibus, G. (1988) Comprehension monitoring and apprehension of literal meaning. *Child Development, 59,* 60-70.

Brown, A. L., & Campione, J. C. (1984) Tree faces of transfer: implications for early competence, individual differences, and instruction. In M. Lamb, A. L. Brown, & B. Rogoff (Eds.), *Advances in development psychology.* Hillsdale, NJ: Erlbaum. Pp. 143-192.

Dahlgren, S., & Sandberg, A. D. (2008) Referential communication in children with autism spectrum disorders. *Autism*, 12, 335-348.

Dunn, L. M., Dunn, L. M., & Arribas, D. (2006) *Test de vocabulario en imágenes. Peabody [Peabody picture vocabulary test: PPVT–III]*. Madrid, Spain: TEA.

Frith, U. (2003) *Autism: explaining the enigma.* (2nd ed.). Oxford, UK: Blackwell.

Juneja, M., Sharma, S., & Mukherjee, S. B. (2010) Sensitivity of the autism behavior checklist in Indian autistic children. *Journal of Developmental & Behavioral Pediatrics*, 31, 1, 48-49.

Klin, A., & Volkmar, F. R. (2000) Treatment and intervention guidelines for individuals with Asperger syndrome. In A. Klin, F. R. Volkmar, & S. S. Sparrow, (Eds.), *Asperger syndrome.* New York: Guilford. Pp. 340-366.

Krauss, R. M., & Glusckbeg, S. (1969) The development of communication competence as a function of age. *Child Development*, 40, 255-266.

Krug, D. A., Arick, J. R., & Almond, P. J. (1980) *Autism screening instrument for educational planning.* Portland, OR: ASIEP Educational.

Lloyd, P., Boada, H., & Forns, M. (1992) New directions in referential communication research. *British Journal of Developmental Psychology*, 10, 385-403.

Loveland, K. A., Tunalia, B., McEvoy, R. E., & Kelly, M. L. (2008) Referential communication and response adequacy in autism and Down's syndrome. *Applied Psycholinguistics*, 10, 301-313.

Marteleto M. R., & Pedromônico, M. R. (2005) Validity of autism behavior checklist (ABC): preliminary study. *Revista Brasileña de Psiquiatría*, 27, 295-301.

Martínez, M. (1999) Incidencia del entrenamiento en la competencia comunicativa: una perspectiva referencial-ecológica. [Incidence of training on communicative competence: an ecological-referential perspective]. *Anuario de Psicología*, 30, 35-58.

Martínez, M., Forns, M., & Boada, H. (1997) Estudio longitudinal de la comunicación referencial en niños de 4 a 8 años [Longitudinal study of referential communication in children 4–8 year old]. *Anuario de Psicología*, 75, 37-58.

Mugny, G., & Doise, W. (1983) *La construcción social de la inteligencia [The construction of social intelligence]*. Mexico City: Trillas.

Nadig, A., Vivanti, G., & Ozonoff, S. (2009) Adaptation of object description to a partner under increasing communicative demands: a comparison of children with and without autism. *Autism Research*, 2, 334-347.

Olivar, J. S. (2004) *Láminas de tareas de comunicación referencial* [*Drawings for referential communication task*]. Tech. Rep. No. VA-152-04- 00/2004/7621. Valladolid, Spain: Junta de Castilla y León.

Olivar, J. S., & Belinchón, M. (1999) *Comunicación y trastornos del desarrollo* [*Communication and developmental disease*]. Valladolid, Spain: Servicio de Publicaciones de la Universidad de Valladolid.

Olivar, J. S., & De la Iglesia, M. (2007) *Intervención psicoeducativa en personas con autismo y síndrome de Asperger* [*Psychoeducational intervention in people with autism and asperger syndrome*]. Madrid, Spain: CEPE.

Ozonoff, S. (1995) Executive functions in autism. In E. Schopler & G. B. Mesibov (Eds.), *Learning and cognition in autism: current issues in autism.* New York: Plenum. Pp. 199-219.

Plumert, J. M., Ewert, K., & Spear, S. J. (1995) The early developmental of children's communication about nested spatial relations. *Child Development*, 66, 959-969.

Rajendran, G., & Mitchel, P. (2006) Text chat as a tool for referential questioning in Asperger syndrome. *Journal of Speech, Language, and Hearing Research*, 49, 102-112.

San Martín, C., Boada, H., & Forns, M. (2009) Private speech in the framework of referential communication. In A. Winsler, C. Fernyhough, & I. Montero (Eds.), *Private speech, executive functioning, and the development of verbal self-regulation*. Cambridge, UK: Cambridge Univer. Press.

Shillingsburg, M. A., Valentino, A. L., Bowen, C. N., Bradley, D., & Zavatkay, D. (2011) Teaching children with autism to request information. *Research in Autism Spectrum Disorders*, 5, 670-679.

Singer, B. D., & Bashir, A. S. (1999). What are executive functions and self-regulation and what do they have to do with language-learning disorders? *Language, Speech, and Hearing Services in Schools*, 30, 265-273.

Sonnenschein, S., & Whitehurst, G. J. (1984) Developing referential communication skills: the interaction of role-switching and difference rule training. *Journal of Experimental Child Psychology*, 38, 191-207.

Volden, J., Mulcahy, R. F., & Holdgrafer, G. (1997) Pragmatic language disorder and perspective taking in autistic speakers. *Applied Psycholinguistics*, 18, 181-198.

Wechsler, D. (1993) *Escala de Inteligencia de Wechsler para niños, revisada, WISC–R.* (Spanish version by M. V. De la Cruz & A. Cordero) Madrid, Spain: TEA.

Wechsler, D. (2001) *WAIS–III. Escala de inteligencia de Wechsler para adultos.* (Spanish version by N. Seisdedos, S. Corral, A. Cordero, M. V. De la Cruz, M.V. Hernández, & J. Pereña) Madrid, Spain: TEA

World Health Organization. (1990) *CIE–10. Trastornos mentales y del comportamiento. Descripciones clínicas y pautas para el diagnóstico ICD-10. [International statistical classification of diseases and related health problems]*. Madrid, Spain: Meditor.

Yule, G. (1997) *Referential communication task*. Mahwah, NJ: Erlbaum.

Accepted November 21, 2011.

TABLE 1

Means, Medians, Standard Deviations, Ranges, Mann-Whitney *U* Tests For Differences Between Groups, Cohen's *d*, and Percentage of Nonoverlap Between Group For Chronological Age, Verbal Mental Age, Full Intelligence Score, and Number of Autistic Symptoms For the Autistic Speakers in the Trained and Untrained Groups

ASD Speakers	Trained Group (*n*=10)	Untrained Group (*n*=10)	Mann-Whitney *U*	*p*	Cohen's *d*	Percentage of Non-Overlap
Chronological age, yr.			34.00	.23	0.55	33.0
M	15.40	13.11				
Mdn	13.50	12.50				
SD	4.55	3.73				
Range	9–23	8–19				
Verbal mental age (PPVT)*			48.50	.91	0.06	7.7
M	10.23	9.96				
Mdn	8.55	9.05				
SD	4.79	4.12				
Range	4.01–18.02	6.09–18.02				
Full intelligence score†			41.00	.50	0.25	14.7
M	79.10	86.80				
Mdn	65.00	87.00				
SD	31.50	29.82				
Range	48–130	40–130				
Autistic symptoms‡			48.00	.88	0.11	7.7
M	56.90	54.00				
Mdn	48.00	46.00				
SD	27.54	23.62				
Range	29–115	30–104				

*PPVT–III: Peabody Picture Vocabulary Test (Dunn, *et al*., 2006). †FSS: Full Scale Score, Wechsler Intelligence Scale (WISC–R, Wechsler, 1993; or WAIS–III, Wechsler, 2001; according to speaker's age). ‡Number of autistic symptoms: Autism Behavior Checklist (ABC) (Krug, *et al.*, 1980).

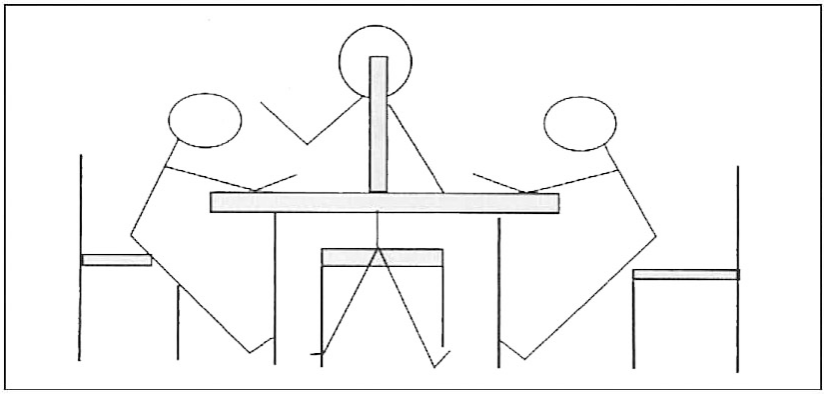

FIG. 1. Position adopted by the three participants in the ecological referential communication paradigm: ASD speaker, adult, screen, typically-developed listener.

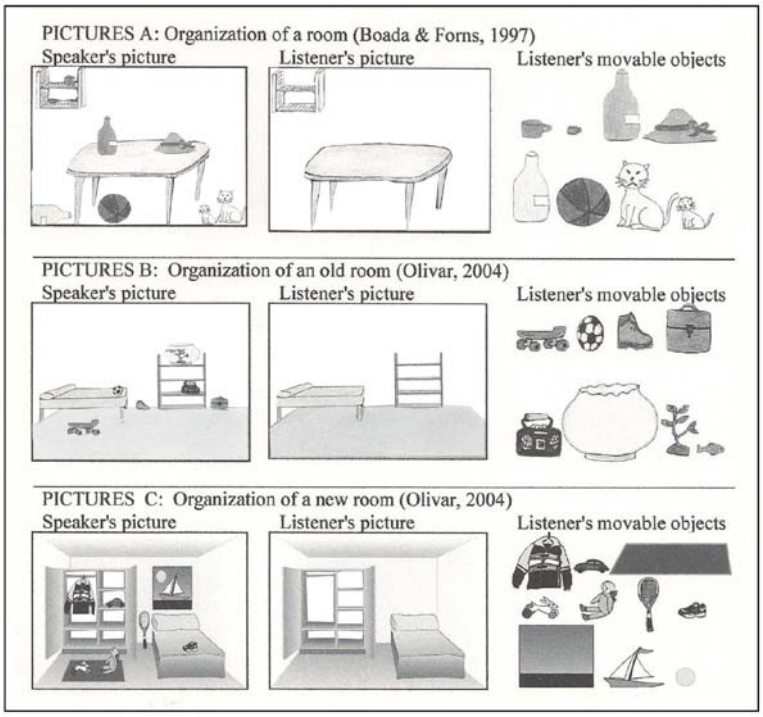

Fig. 2. Pictures A, B, and C used in the ecological referential communication task.

TABLE 2

Comment [A6]: Remove box

Example of a Fourth Training Session, in Which Different Types of Communicative Techniques Are Combined

Fourth Training Session

The trainer stands between the two participants to be trained. The screen is not used at this point. The trainer performs the task and produces complete messages about all the referents: '*Notice that when you describe how and where an object should be placed you need to be very clear, giving the name of the object, indicating where it is and how to position it, for example like this…'* (he/she produces a complete message). The two participants then arrange the referents **(Technique of modeling without exchanging roles: training the speaker's role)**.

The trainer then says: "*When I have to arrange the objects I'll need to ask for details about what the object is (is it large or small, red or blue, etc.). Also, I'll have to ask about where they are (are they in the top or bottom part of the picture, above or below other things, near or far from other objects, etc.), and how to organize them (are they to the right or left, top or bottom), etc."* The trainer then produces several sample questions about each referent: e.g., "*Where is the bottle?*", "*Which objects are close to one another?"* **(Technique of modeling without exchanging roles: training the listener's role)**. Having received this modeling, trainees then perform a trial with the screen between them. In the trial each participant takes first one role and then the other (**Technique of modeling with exchanging roles**).

When each task is finished the screen that separates speaker and listener is removed, and both the speaker's picture and the listener's proposed picture are placed side by side so that trainees can compare them. Each participant therefore sees both his/her own production and that of the partner. The trainer helps the children to analyze the differences and to question themselves about who has said or done something wrong (*Whose fault is it?*). The speaker may then be aware that if he/she does not communicate the elements of the message correctly, the referent might be arranged in a different way; similarly, the listener may become aware of the results which might be obtained if he/she does not ask

suitable questions **(Technique of triggering a social cognitive conflict)**. The trainer and the two participants then arrange each referent in its correct place**.** The trainer helps in this process by making participants aware of their mistakes, e.g., emphasizing those referents that are placed in the wrong position; showing the speaker's picture, which is used as a model; and placing the referent correctly while he/she indicates the origin of the communicative failure **(Technique of giving explicit verbal feedback)**.

In the next trial, new material is used and participants are provided with some appropriate cards representing the referent's features. Before producing the message the speaker must place next to the referent all those cards that represent its features, so that he/she will take into account all these cards when producing the message **(Technique of providing visual feedback)**.

TABLE 3

Comment [A7]: Remove box

Assessment of Skills in Relation to Message Formulation and Self-regulation: Scoring System and Examples

Assessment of message complexity

Scoring	Correct/Precise	Ambiguous	Omitted and/or Erroneous
Naming the referent objects (name and attributes)	2 points	1 point	0 point
Giving the location determinants:			
Basic relation	2 points	1 point	0 point
First relation	2 points	1 points	0 point
Second relation/position	2 points	1 points	0 point

Examples for Pictures B: Organization of an old room (Olivar, 2004).

Message: "Put the radio on the shelf below the fish bowl, to the right"

Score:

- The object to be placed ("*radio*") is clearly identified …….. 2 points
- The basic location is clearly identified ("*on the shelf*") ……..…… 2 points
- The first relation with other objects ("*the fish bowl*") is clearly expressed ("*below*") ……..…..…….. 2 points
- The second relation with the object ("*the fish bowl*") is clearly expressed ("*to the right*") ……..…… 2 points

Total message = 8 points.

Message: "The radio goes on the shelf near the fish bowl"

Score:

- The object to be placed ("*radio*") is clearly identified……..…….. 2 points
- The basic location ("*on the shelf*") is clearly identified……..…… 2 points
- The first relation (i.e., below or under) with other objects ("*the fish bowl*") is ambiguously expressed ("*near*")…..……..….. 1 point
- The second relation with the object (i.e., "*on the second shelf*") is omitted……..… 0 points

Total message = 5 points.

Message: "The thing that makes music, put it at the top"

Score:

- The object to be placed ("*radio*")

is ambiguously identified (*"The thing that makes music"*) ……..……. 1 points

- The basic location (*"on the shelf"*) is omitted……..…..…..…. 0 points
- The first relation with other objects is ambiguously expressed (*"at the top"*)……..…..……..…..….. 1 point
- The second relation with other objects is omitted……..…..… 0 points

Total message = 2 points

Assessment of self-regulation (internal regulation and planning interventions)

Examples:

Self-regulation: speaking in a low voice, with a reflexive tone, and thus using private speech.

- Speaker: "Um, let me see… what can I tell you now?"
- Speaker: "Wait… I'll put it like this, like this".
- Speaker: " Now I've finished"

Planning interventions: speaking out loud, but for him/herself, and planning own behavior.

- Speaker: "Now I'm going to speak…about something else"…
  "The ball… wait, wait… I'd better say the cassette player and we finish with the bookshelf."

Score: The ratio between the number of self-regulations (internal regulations and planning interventions) emitted by the speakers in order to complete the task and the total number of productions emitted by the interlocutors was calculated. The mean ratio for each group was then calculated.

TABLE 4

Means, Standard Deviations, Medians, and Ranges Regarding Message Complexity and Self-regulation For the Trained and Untrained Groups in the Three Experimental Training Stages

	Pre-training	Post-training	Generali-zation	Kruskal-Wallis Friedman, with Monte Carlo	*p*	MANOVA 2 Groups × 3 Task Stages
Message complexity						Total effect:
Trained Group				11.54	.001	$F = 4.77$
M	4.59	6.02	5.56			$p = .001$
SD	1.49	.96	.99			$\eta^2 = 0.31$
Mdn	4.46	5.70	5.89			Task effect:
Range	2.21–7.00	4.63–7.30	4.27–7.17			$F = 2.97$
Untrained Group				4.20	.13	$p = .06$
M	4.31	4.55	4.15			$\eta^2 = 0.10$
SD	1.14	.94	.86			Group effect:
Mdn	4.00	4.35	4.07			$F = 14.13$
Range	2.75–7.13	3.21–6.08	2.80–5.83			$p < .001$
						$\eta^2 = 0.21$
Self-regulation						
Trained Group				2.77	.27	Total effect:
M	.02	.03	.04			$F = 1.78$
SD	.02	.03	.04			$p = .13$
Mdn	.00	.03	.04			$\eta^2 = 0.15$
Range	.00–.06	.00–.09	.00–.09			Task effect:
						$F = .022$
Untrained Group				0	.90	$p = .978$
M	.01	.01	.01			$\eta^2 = 0.001$
SD	.02	.03	.02			Group effect:
Mdn	.00	.00	.00			$F = 2.87$
Range	.00–.05	.00–.10	.00–.05			$p < .10$
						$\eta^2 = 0.05$