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COMPREHENSIVE PROGRAM FOR TEACHING SKILLS TO CHILDREN WITH AUTISM

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The purpose of this research was to test a comprehensive system for teaching skills to children diagnosed with autism. Three children received intensive teaching for approximately three months. Each child received a daily set of programs tailored to his/her functional level. These programs had been demonstrated as effective in previous studies for teaching children with learning difficulties. Other programs were derived from basic learning principles. We evaluated on a continual basis the effectiveness of each program with each child, so that the programs that were not effective were replaced by others with more effective procedures. The three children learned roughly one skill for every hour of teaching. They learned more skills per hour when the intervention was intensive; this outcome shows that an intensive program increases the effectiveness of the intervention. On the whole, this system was shown to be effective for teaching skills to children with autism. Thus, it served to increase the children's quality of life and that of their families. The present intervention can be applied to Special Education schools.
Key words: *autism, pervasive developmental delays, effective intervention, behaviour analysis, applied behaviour analysis*

Esta investigación tuvo el objetivo de probar un sistema integral para enseñar a niños con el diagnóstico de autismo. Tres niños recibieron enseñanza intensiva durante aproximadamente tres meses, con programas adaptados individualmente a su nivel funcional. Esos programas se habían demostrado eficaces, en investigaciones anteriores, para enseñar a niños con problemas de aprendizaje o se derivaron de principios básicos de aprendizaje. Evaluamos constantemente la eficacia de cada programa con cada niño, y sustituimos inmediatamente los programas menos efectivos por otros eficaces. Los tres niños aprendieron aproximadamente una habilidad por cada hora de enseñanza. Aprendieron más habilidades por hora cuando la intervención fue intensiva; esto muestra que un programa intensivo incrementa la efectividad de la intervención. En conjunto, este sistema se mostró efectivo para enseñar habilidades a niños con autismo, lo cuál supuso mejorar su calidad de vida y la de sus familiares. Este sistema puede ser aplicado en los colegios de educación especial.
Palabras clave: *autismo, trastornos generalizados del desarrollo, intervención efectiva, análisis de la conducta, análisis aplicado de la conducta.*

According to the *Diagnostic and statistical manual of mental disorders* [DSM-IV-TR] (American Psychiatric Association [A.P.A.], 2000/2002), autism is a generalized developmental disorder characterized by three types of symptom: qualitative alteration of social interaction, qualitative alteration of communication, and restricted, repetitive, and stereotyped patterns of behaviour, interests and activities. To be diagnosed as having an autistic disorder, a child should present at least two characteristics of the first type, one of the second, and one of the third. Alternatively, it is characterized by developmental delays or abnormal functioning, before age three, in social interaction, in language used or social communication, or in symbolic play. Despite such imprecision, the authors of the DSM-IV-TR have actually established a third diagnostic route, even less precise, based on differential diagnosis with similar disorders.

Genetic factors are involved in the origin of autism. This assertion is based on two types of observation: First, the probability of autism in the siblings of persons with autism is greater than the probability of autism in the general population. Second, autism is more probable in non-identical twins (dizygotic) than between siblings, and even more probable in identical twins (monozygotic) than between non-identical twins. On the other hand, the wide variability of phenotypical characteristics of persons with autism probably reflects the interaction of several genes, which may be different in each person with autism. Regions and/or genes that may be associated with autism have been found in chromosomes 1, 2, 3, 4, 5, 6, 7, 10, 13, 15, 16, 17, 19, 22, and X (Bespalova & Buxbaum, 2003; Muhle, Trentacoste & Rapin, 2004; Veenstra-VanderWeele & Cook, 2004). However, genetic factors may not be the only ones involved, since there exist identical twins in which one has autism and the other does not. This suggests the involvement of non-

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genetic agents in the physical environment that trigger autism; moreover, these agents may interact with genetic factors (Ruiz-Rubio, 2003). Some of the most relevant research on the non-genetic causes of autism suggests that certain chemical agents or inappropriate medicines may have an effect. For example, epidemiological analyses indicate a high prevalence of autism in cities with high pollution levels, such Brick, New Jersey (USA): 4 cases of autism per 1000 inhabitants (Kephart, 1999). Among the possible causes in relation to medicines, one of the most noteworthy cases is that of thalidomide (Rodier, 2000; Rodier, Ingram, Tisdale, Nelson & Romano, 1996).

In the developed countries, approximately 1 in 2000 people is diagnosed with autism (according to the DSM-IV-TR, APA, 2000/2002). The number tends to rise in some countries, such as the United States (1 in 625 people, according to Rodier, 2000). The disorder affects males more than females: one girl is diagnosed for every four boys. However, girls present more developmental delays and are more difficult to treat.

Currently, there is a long list of procedures whose advocates claim that they improve the symptoms of autism. The spectrum of treatments ranges from special diets (such as diets without casein), to blood transfusions, to treatment with secretin. In the majority of studies on such procedures there is a lack of rigorous assessment pre- and post-treatment. Moreover, those administering these treatments often make imprecise and subjective descriptions ("the child integrates more", "he seems more receptive", and so on). A study that did use rigorous methodology in assessing the effects of secretin found not only that its ingestion was ineffective for the treatment of autism and pervasive developmental disorder (PDD), but also that the autistic symptoms of the 28 children in the control group diminished significantly more than those of the 28 children who received secretin (Sandler et al., 1999). A comprehensive review of effective and ineffective treatments for autism has been carried out by González Menéndez, Williams, and Pérez-González (2003).

Given the state of biological research and the belief that autism may have a psychological etiology, a series of therapies of a psychological nature have been developed to try and improve the situation of children with autism. In this case, the range of therapies is also very wide. One category of therapies ranges from exposure of the child to dolphins or horses to "holding therapy". In all of these cases, we also find a lack of rigorous assessment of the effects of the treatment. In the majority of cases, the authors base their conclusions on anecdotal reports such as "the parents notice more receptivity in the child", which are purely subjective and, in any case, not indicative of an evident improvement in the child's language abilities or speed of learning (see the review on lack of rigour in these therapies in the article by Smith, 1996). This lack of rigour in assessment is due, in large part or indeed wholly, to the fact that such therapies do not actually produce clear changes in children with autism.

An important achievement in the treatment of children with autism came with the work of Ivar Lovaas. Lovaas (1987) studied the effect of a package of procedures based on behaviour analysis with 19 children with autism from a group that received 40 hours of individual treatment per week. Another 19 children from a control group received similar treatment, but for less than 10 hours a week, while a further 21 children from a second control group received another type of treatment. Lovaas found that after two years of treatment, 9 children from the experimental group (47%), whose treatment began prior to the age of 3.5 years, obtained normal IQ measures and passed first grade at school by the age of 7. Just one of the 40 children from the two control groups obtained a similar functional level. The 9 children who acquired a normal functional level were reassessed around age 13, in a follow-up study. This second study showed that the gains from the treatment had been maintained, and that cognitive, emotional, and social functioning continued to be normal (McEachin, Smith, & Lovaas, 1993).

Lovaas' treatment is still one of the most well-known, with adaptations and given the enormous amount of research carried out by Lovaas (see summaries in Lovaas, 1977, and in Lovaas et al., 1981). In relation to the purposes of the present study, it is pertinent to mention the following characteristics of Lovaas' treatment: (a) the treatment is a package made up of many procedures. It may be that many of these procedures are effective and others not so effective. Although Lovaas has studied the effectiveness of many procedures for teaching skills to children with developmental problems, he did not assess individually the effectiveness of each procedure in his package; (b) many procedures reported by other researchers that have proved effective for teaching specific skills to children with autism or with other developmental problems have not been incorporated in the package. The incorporation of these treatments would possibly increase the effectiveness for teaching children with autism. In this same line, recent years have

seen the development of a series of packages for the treatment of autism based on applied behaviour analysis, but which differ from Lovaas' package in the particular procedures they use, and which have also shown their effectiveness (e.g., Fenske, Zalenski, Krantz, & McClannahan, 1985; Green, Brennan, & Fein, 2002; Perry, Cohen, & DeCarlo, 1995; Sheinkopf & Siegel, 1998; Smith, Groen, & Wynn, 2000; Williams, 1998; see, for a review, Green, 1996; see the description by Maurice, 1993).

The present study falls within the framework of the procedures shown to be effective by the relevant scientific research, but it attempts to overcome the disadvantages of Lovaas' system referred to above. Its main objective was to assess the effectiveness of developing a set of procedures applied to children with autism with the following two characteristics: first, that the procedures involved are effective for teaching skills to children with autism; and second, that the effectiveness of each specific procedure in the learning context of children with autism can be rapidly assessed.

The appropriate framework for the present study is derived from the CABAS system (Comprehensive Application of Behavior Analysis to Schooling; e.g., Greer, 1991, 1996; Greer, McCorkle, & Williams, 1989; Lamm & Greer, 1991; Selinske, Greer, & Lodhi, 1991; Twyman, 1998). The CABAS system is characterized by involving a series of procedures whose essence lies in the method of working, based on applying the principles of behavioural science to all participants from a school. The system we have used has the following characteristics: (a) The objective of schooling is the acquisition of new skills. These skills should be assessed through rigorous and impartial observations. A curriculum is developed that focuses on the aim of teaching the skills a child lacks at a given time. As the child acquires skills, the new objective becomes the teaching of other, more complex skills, following approximately, and as far as possible, the developmental stages of children without learning problems. (b) Teaching is individualized, because each child learns at his/her own pace, and requires different procedures for learning. In the case of special education, it is necessary to design a curriculum for each child with procedures adapted to their needs. (c) Every intervention for teaching skills is continually assessed: children's responses should be recorded and the data plotted every day on a graph. The graphs indicate the ongoing progress of the child on each program. (d) When the child learns, the procedure continues to be used until the skill is consolidated. When the continual assessment shows that the child is not learning, the procedure is changed for another more appropriate one. It is the responsibility of teachers and program supervisors to find the most appropriate program for the child's learning. (e) The intervention methods are based on the principles of human learning, and preferentially on studies that show the effectiveness of the procedures with children in similar stages of development. No distinction is made between the relevant findings published in scientific journals based on theories defended by their authors. All the principles are applied as long as they demonstrate their usefulness for teaching a particular skill to a child.

This system permits assessment of the effectiveness of each procedure in particular. Moreover, the system we have used does not specify which procedures should be employed in teaching. In other words, researchers or professionals can freely test the effectiveness of any procedure they might consider, regardless of whether it has been used in other programs or not at all. The system is comprehensive in the sense that it covers all areas of child development, from motor functions to the most complex (cognitive) verbal skills.

An essential characteristic of the present intervention consists in placing emphasis on the teaching of language. With regard to language, there are marked differences among the strategies proposed by research groups. These differences include the following:

a) Some professionals propose teaching an alternative system of communication —sign language, for example, or communication with the aid of pictures, as in the TEACCH (cfr., Smith, 1996) or PECS system (Bondy & Frost, 1994). The alternative to this treatment is to teach vocal language. We believe it is more useful to teach the language everyone uses in everyday life because, first of all, it has not been demonstrated that alternative communication systems are effective for a child with autism to acquire normal language; second, the majority of children with autism have no motor or biological limitation that prevents them using the muscles necessary for speaking; and third, many children with autism have learned normal language with procedures similar to those we use (e.g., Lovaas, 1987; Maurice, 1993; McEachin, Smith & Lovaas, 1993).
b) There is a considerable difference between teaching language on the basis of linguistic analyses and teaching language on the basis of functional analyses (e.g., Catania, Matthews & Shimoff, 1982; Sundberg, 1990; Sundberg & Partington, 1998; Vargas, 1988).

Using linguistic analyses as the basis, children are taught to emit words in various contexts. Procedures based on functional analyses, on the other hand, place high emphasis on the analysis of the conditions in which words are produced. Thus, for example, researchers who use this perspective teach children to ask for water in one condition, to name water in another condition and to respond to questions with the word water in a third condition. Thus, generalization is immediate to other contexts in which conditions are similar. Williams and Greer (1993) found that children learned more language, maintained it better, and generalized it more when they used procedures derived from the functional perspective than when they used more traditional procedures, such as that of Lovaas or that of Guess, Sailor, and Baer (1976). The research by Williams and Greer has given rise to the development of a curriculum of the teaching of functional language (Dorow, McCorkle, & Greer, 1987).

c) There is a considerable difference between teaching explicit language (for example, teaching the child what to say at each point) and teaching so that children produce language not explicitly taught. A characteristic of language is that we can generate new phrases in original situations and that we understand expressions heard for the first time. In recent years, a good deal of research has been carried out in this area, and all such initiatives have in common that they teach some skills to the children and test whether a new skill appears in the child that has not been taught explicitly. There have been three types of research: studies on the transference from some verbal skills to others, research on stimulus equivalence, and studies on stimulus relations. First, in the context of research on the transference of verbal behaviours, Lamarre and Holland (1985) taught children to ask the experimenters to put objects in certain positions or to describe that position, and found that the children only displayed the skill they had been taught. However, after showing the children several sets, they observed that they began to ask items even though they had only learned to describe them, and vice versa. Other studies in this line showed the emergence of verbal skills (e.g., Luciano, 1986; Partington & Bailey, 1993). These studies derive from the theoretical analyses on verbal behaviour by Michael (1984, 1993), Skinner (1957), and Sundberg and Partington (1998). Second, with regard to the context of research on stimulus equivalence, in the last twenty years there have been hundreds of studies on transference from some conditional discriminations to others. These studies showed that once a person learns two or more conditional discriminations with certain stimuli in common, other conditional discriminations emerge without explicit teaching (e.g., Sidman & Tailby, 1982; Sidman, 1994). Although the procedures have involved conditional discriminations with selection-based responses, the potential of this type of research for studying phenomena of transference of verbal behaviour, of phrase generation, and of comprehension of new expressions is enormous (e.g., de Rose, de Souza, & Hanna, 1996; Pérez-González, 1994; Pérez-González, Saunders, & Spradlin, 2000). And third, with respect to stimulus relations, Relational Frame Theory has stimulated a huge quantity of research on complex processes of transference of verbal behaviour showing the conditions in which new verbal expressions are generated and new phrases are understood, as well as many other verbal and cognitive processes (e.g., Hayes & Hayes, 1991, 1994; Hayes, Barnes-Holmes, & Roche, 2001; Hayes & Hayes, 1989). These studies on processes of verbal transference are especially pertinent for the present research, since we have laid great emphasis on teaching the pre-requisites for children with autism to acquire skills for generating language in new situations.

METHOD

Participants

The participants were three children with different levels of autism, whom we have given the pseudonyms of Dimas, Felisa, and Emilia. All three had been classified as children with autism by the Education Department of their Autonomous Region. Dimas was eight years and two months when the intervention began. His father was a manual worker and his mother worked at home and looked after the child. Felisa was five years and one month when the intervention began. Her parents were farm workers and lived in a small cottage. Emilia was seven years and eight months at the beginning of the intervention. Her father was unemployed at the time, and later started a manual job. Her mother worked at home and looked after the child.

Materials and procedures

Location

The intervention took place in the children's family

homes, at a school, and in other places suitable for the daily routine of the families concerned. Initially, the intervention lasted 4 hours per day. In a second phase the duration was 8 hours per day (see below). The intervention was conducted from June to August in the case of the two girls, and from July to August in the case of Dimas.

Persons involved in the treatment

The treatment was carried out by Psychology students, the children's mothers and other relatives (we shall henceforth refer to all of these people, including the mothers and relatives, as *teachers*), and the authors themselves. All the teachers were given specific theoretical and practical training by the researchers. The practical training consisted in showing them in real situations how to proceed with the child at each point in order to teach each skill with each procedure.

Initial assessment

The aim of the intervention was to assess and teach specific skills; consequently, we made an initial assessment of each child's skills. With Dimas, who had an incipient verbal repertoire, we used the Preschool Inventory of Repertoires for Kindergarten (P.I.R.K.®; Greer, McCorkle, & Twyman, 1996a). This test assesses the eventual acquisition of 267 skills grouped in five developmental areas: physical, emotional, social, communication (language), and cognitive. With Felisa and Emilia, who had no verbal behaviours, we used the Toddler Inventory of Behaviors (T.I.B.®; Greer, McCorkle, & Twyman, 1996b), which is a shorter version of the P.I.R.K. for children with less language repertoire.

Definition of skill and assessment of each skill

With the aim of being as objective as possible, we defined a skill as the existence of a behaviour in response to an antecedent stimulus or to a set of antecedent stimuli. Therefore, we did not assess solely the production of the behaviour, and we did not call these phenomena "behaviours". The most appropriate technical term is *operant*; however, given the context applied, we shall use the term *skill*, as defined above.

In order to assess each skill, we presented the antecedent stimulus or stimuli, we observed whether the child emitted an objectively defined behaviour within a reasonable extent and a predetermined time period, and recorded it. Each skill was assessed with a minimum of 10 trials. It was only considered that the child had acquired the skill if he or she responded correctly in at least 9 of these ten trials. The criterion varied across the skills, but was always 90% or above.

Design of the program curriculum

On the basis of the initial assessment, we developed a curriculum for each child, with a series of programs. For reasons of organization, not because there were any natural divisions among the repertoires, the programs were distributed in five areas, corresponding approximately to the areas assessed in the P.I.R.K.®: physical or motor, emotional, social, communication (language), and cognitive. Each program was aimed at teaching a skill to the child; we began by teaching the most basic skills, and continued with more complex ones. The programs were selected according to basic principles of learning (e.g., Pérez-González, 2001; Vives, Luciano, & Valero, 2002). Many programs we used can be found in González Menéndez, Williams, and Pérez-González (2003).

Form of implementing each program

In each program, the teacher sat opposite the child, waited for the right moment so that the child was prepared to receive the instruction, presented the stimuli, waited for the response, and presented the differential consequences. For example, in one of the most basic programs, the teacher said to the child "sit still", and waited for the child to sit properly, with feet on the ground and hands on the knees, head facing the teacher. If the child remained seated for one second (initially, because the time required was gradually extended) the teacher said "very good", or used some similar expression, and gave the child a particular item. If the child did not perform a behaviour in accordance with this stipulation, in less than around 5 seconds, the teacher waited about 10 seconds and moved on to the next trial. Each program was trained with a specific procedure.

Each correctly presented trial, with its three components (antecedent stimulus, behaviour, and appropriate consequences), defines a *Learn Unit* (Greer & McDonough, 1999). A practical aspect deriving from using this term is that it distinguishes an incorrectly presented trial from a correctly presented one. After administering the consequence (reinforcers or time out), the teacher recorded whether the behaviour was correct or not, on a special sheet for each program, as explained below.

Reinforcers. After each correct response the teacher said something like "Right!", "Very good!" or "Excellent!", presented one or several items, such as a

ball, a toy with flashing lights or a jigsaw puzzle, and allowed the child to play with it for 15 or 20 seconds. In the context of this intervention, it was found that most of the time these items maintained or reinforced the children's behaviours, so that they met the definition of reinforcers. On some occasions, other items were tried that did not serve as reinforcers, and they were thus discarded. Given that these items and expressions were used over the course of many trials, the more they were used the less effective they became, due to a satiety effect (Skinner, 1953). This made it necessary to continually change the items. We sometimes used a system of reinforcement with tokens (e.g., Ayllon & Azrin, 1968).

Consequences for incorrect responses. Incorrect responses were followed by a period of around 10 seconds before presenting the following trial (technically, this is an extinction procedure). As a norm, no aversive consequences were applied after incorrect behaviours.

General tactics

Dividing into simpler skills. Many skills were broken down into simpler ones and each component taught separately. For example, for teaching how to cut out a circle, the child was first taught how to cut a short, thick straight line; then the line became longer and longer and thinner and thinner; eventually, the child was taught to cut out half a circle, and finally, a complete circle.

Use of prompts. In the majority of the motor-related programs, which often involved teaching behaviour topographies (forms), physical prompts were used. For starting to teach a skill, the child was presented with the stimulus (usually verbal) and, without waiting, the teacher took hold of the child's arm or other corresponding part of the body and made the gesture with it. In successive stages the help was gradually reduced. In other, non-motor-related programs similar prompts were used.

Changes in time criterion. In order to establish other skills, we set a criterion that was relatively easy to fulfil measured in terms of time. When a criterion of correct responses was met, the time was increased during which the child should be producing that behaviour. The procedure was similar to that described for Changing Criterion designs (e.g., Cooper, Heron, & Heward, 1987; Hartmann & Hall, 1976). For example, in the program designed to teach the child to look at people's eyes (eye contact program), the child was asked to look at the teacher's eyes for one second. Once the criterion had been met, the time was increased in one-second steps, up to a period of 10 seconds.

Changes of criterion based on quantities. These tactics were similar to the previous ones, but were based on number. For example, in the programs for teaching the skill of copying a model made up of pieces of various sizes, shapes and colours, two figures were used at first. Once the child showed that he or she could do the task correctly, another figure was added, until the child was working with designs of 10 figures or more.

Overview of the development of the curriculum

The researchers had a curriculum of reference they followed with each child in accordance with the child's characteristics. The skills corresponding to some areas could be taught in a parallel and independent fashion; for example, a child could learn many skills of a motor type regardless of his/her development in the language programs. However, in other cases some skills are necessary to be able to learn new ones – for instance, it is necessary to pronounce reasonably properly before counting aloud, and it is necessary to count before doing addition.

For teaching each skill we developed procedures taken from applied research or from research on general principles of human learning. The supervisors wrote each program on a sheet which was available to the teacher.

We taught all the skills in four steps: acquisition, maintenance, fluency, and generalization: first, the child was taught until he or she attained the criterion. Next, the programs continued, sometimes alternating between different skills, so that they were maintained. The programs were repeated until the child acquired the skill with fluency. By fluency we understand performing a skill correctly (without errors) and rapidly (often defined as a high rate of behaviours per minute). Nevertheless, we taught numerous cognitive and verbal skills with specific fluency programs, according to Johnson's (1993) teaching procedures. Finally, we gave specific instructions to the parents so that they could stimulate this skill in everyday life. Given that the language programs were especially designed to teach functional language, generalization occurred rapidly; therefore, it was not necessary to apply generalization programs.

Intervention on inappropriate behaviours

In the present intervention these behaviours were not dealt with in specific programs, for three reasons: the first reason was that the objective of the program was to teach new behavioural repertoires. The second reason was that these behaviours are important mainly insofar as they interfere with the performance of appropriate

behaviours or with the learning program; in other words, when these behaviours do not interfere with appropriate behaviours or with the child's learning, they can be left out. The third reason was that a study by Kelly (1994) showed that the inappropriate behaviours of children with learning problems decrease as learning opportunities increase and appropriate learning behaviours are reinforced. Thus, we expected inappropriate behaviours to decrease as the children learned more and more skills.

For these reasons, there were no specific programs for dealing with inappropriate behaviours. When, in the course of an intervention, there emerged an inappropriate behaviour that interfered with the development of a program, the teacher waited, trying to avoid doing anything that might serve as a reinforcer for that behaviour (technically, this is an extinction procedure). On some occasions, a time out was set until the behaviour decreased. The way the teachers worked was based on the studies by Kelly and Greer (1992), Mayer, Butterworth, Nafpaktitis, and Sulzer-Azaroff (1983), Polirstock and Greer (1977), and Porterfield, Herbert-Jackson, and Risley (1976).

Assessment of the effectiveness of each procedure

At the end of the day's work with the child, the teacher transferred the number of correct responses on each program to the corresponding graph. The graph allowed the daily monitoring of the child's progress on each program. In general, a rising trend on the graph indicated that the child was learning with that procedure, and the procedure continued to be employed. When the child attained a predetermined level —for example, a block of 10 correct responses or two consecutive blocks of 10 trials with 9 or more correct responses in each block—, then the teacher moved to a more sophisticated level or the program moved to the maintenance stage. A stable or falling trend on the graph indicated that the procedure had ceased to be effective at that time. In that case, the supervisor took a decision consisting in modifying some parameter or changing the procedure for another one aimed at teaching the skill in question.

Definition of goal

Given that each program was divided into subprograms (because it was divided into simpler tasks or because the criterion changed as the child learned), it was considered that every time the child attained a criterion a goal was fulfilled in the program. Thus, a goal is defined as the achievement of an objective within a program. The concept is useful because it is usual that each day the children attain several goals, and this aids the observation of daily progress, as well as serving as a substantial factor in maintaining teachers' motivation. In many cases, the attainment of several goals one after the other implies that the child has learned a skill. In other cases, one goal implies that the child has acquired a skill.

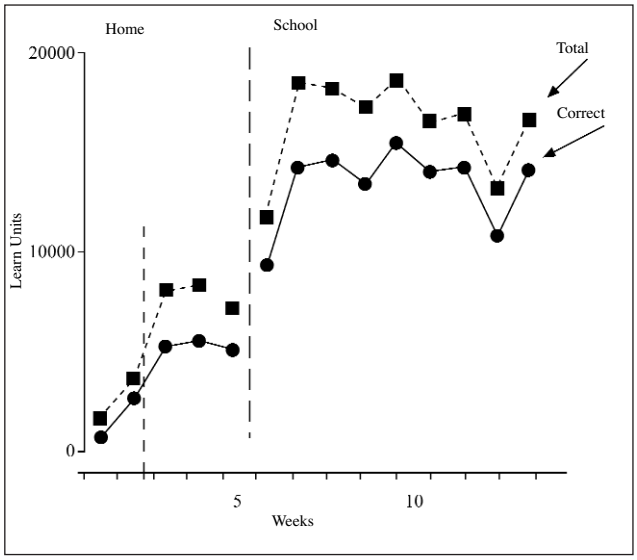
Global analysis of the effectiveness of the intervention

The data on the programs, together with the record of the starting and finishing times of the day's activity, permitted a series of calculations in relation to the child's learning and learning speed. To this end, teachers and supervisors recorded each day the effective time of intervention, the number of learn units and the number

Table 1
Time of intervention received by the children, measured in minutes and hours (in brackets), learn units, goals achieved and goals per hour. Individual data and global figures are shown

		Learn Units		Learning rate (responses/minute)			
	Time in minutes (hours)	Correct	Total	Correct	Total	Goals	Goals/hour
Dimas	12.195 (203)	20.704	26.067	1,70	2,14	209	1,03
Felisa	25.570 (426)	63.333	82.011	2,48	3,21	470	1,10
Emilia	26.009 (433)	55.529	68.200	2,13	2,62	282	0,65
Total	63.774 (1062)	119.000	146.411	2,19	2,76	961	0,90

Figure 1
Correct and total learn units presented to the three children by weeks. Learn units are shown when the program was implemented exclusively at home and when it was implemented at home and at school



of goals attained on the programs. With these data, a series of calculations were made that allowed a global assessment of the intervention.

Results

Quantitative analysis

The global figures give a clear idea of the overall effectiveness of the intervention. Table 1 shows the number of hours of intervention received by each child, the learn units they received, the goals they attained, and the proportion of goals per hour. As it can be seen, the pace was approximately 2-3 learn units per minute. At this rate and with the procedures we used, the children attained one goal for each hour of work on average.

Figure 1 shows the correct and total learn units for the three children by weeks. More learn units were presented when the program was implemented in a more intensive way, combining intervention at school and in the children's own homes.

Table 2 shows the summary of the skills achieved. In the 9 weeks that Dimas was on the program, he learned a total of 209 skills. In 14 weeks of intensive training, Felisa learned a total of 470 skills and Emilia a total of 280 skills. Figure 2 shows the verbal and non-verbal skills the three children learned each week. This figure provides data complementary to those offered in Table 2. It can be seen that approximately a third of the total skills that the children learned in the final weeks were language skills.

Figure 3 shows the skills acquired per 1000 learn units by the three children, each week. It can be seen that the children gradually learned more and more skills during the early weeks. When the program was implemented intensively at the school, the skills they learned per learn unit were maintained basically constant.

Figure 4 is a combined graphic representation of hours of learning and the skills learned by each child. This figure was drawn up to allow comparison of these two parameters. It can be seen that the skills these children learned basically correspond to the number of hours of learning. Even so, this general trend changes in the three children at various points, and the more intensive the

Figure 2
Verbal and non-verbal skills learned by the three children each week. Learn units are shown when the program was implemented exclusively at home and when it was implemented at home and at school

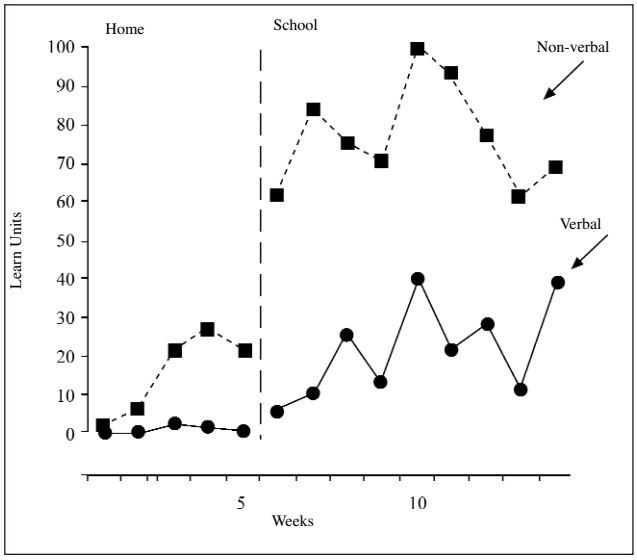


Table 2
Verbal and non-verbal skills learned by each child each week

	EMILIA					FELISA					DIMAS					ALL		
	Verbal		Non-verbal			Verbal		Non-verbal			Verbal		Non-verbal					
Week	School	Home	School	Home	Total	School	Home	School	Home	Total	School	Home	School	Home	Total	Verbal	Non-verbal	Total
1	0	0	0	1	1	0	0	0	1	1						0	2	2
2	0	0	0	0	0	0	0	0	6	6						0	6	6
3	0	1	0	6	7	0	1	0	15	16						2	21	23
4	0	1	0	6	7	0	0	0	20	20						1	26	27
5	0	0	0	4	4	0	0	3	14	17						0	21	21
6	2	1	9	4	16	1	1	29	17	48	0	0	2	0	2	5	61	66
7	1	1	10	12	24	1	0	22	25	48	7	0	15	0	22	10	84	94
8	2	3	12	11	28	1	0	19	17	37	19	0	16	0	35	25	75	100
9	1	3	10	10	24	3	1	27	4	35	5	0	19	0	24	13	70	83
10	2	5	10	16	33	7	4	34	17	62	22	0	23	0	45	40	100	140
11	1	3	23	13	40	3	11	25	20	59	3	0	12	0	15	21	93	114
12	4	4	16	18	42	5	8	19	9	41	7	0	15	0	22	28	77	105
13	0	1	10	5	16	3	0	19	16	38	7	0	11	0	18	11	61	72
14	0	20	10	10	40	2	2	21	17	42	15	0	11	0	26	39	69	108
Total	**13**	**43**	**110**	**116**	**282**	**26**	**28**	**218**	**198**	**470**	**85**	**0**	**124**	**0**	**209**	**95**	**650**	**845**

program (in the periods that they received more hours per week), the more skills they learned per hour.

Qualitative analysis

Dimas

During the initial assessment, Dimas displayed the ability to repeat phrases and sentences, though with many difficulties of articulation. When asked a question, he repeated the final part of it or said something totally incoherent. He made no reply to questions as simple as "What's your name?" or "How old are you?" He did not know how to ask for things, and displayed a non-functional use of language, that is, he did not use his language for communicating. He could not follow simple instructions such as "Give me the pencil" or "Close the door", he could not identify parts of the body and he could not sit still. He had many stereotypies, such as screaming out loudly, which annoyed the rest of the people around him, or touching the back of his neck with rapid movements of the hand as he walked. He showed a knowledge of numbers and letters and was able to perform simple addition, subtraction and multiplication, though sometimes with errors.

After 9 weeks of intervention, Dimas learned, from the skills in the *social area,* to sit still with his hands on his knees and his feet together. He learned to reply to greetings and to say "Goodbye" using people's names, when they greeted him or took their leave of him. He learned to follow orders such as "Clap", "Touch the chair", "Touch the table", "Touch the floor", "Sit down", "Stand up", "Close the door", "Open the door", "Feet together", "Walk", "Throw this away in the rubbish", "Hands up", "Turn round", "Give me a kiss", "Give me a hug", and "Clap your knees". He learned to imitate several broadly defined movements, one by one, and then combine them, up to 4 successive combinations. He learned to stand still for 4 seconds on the order "stand still". He learned to say "Thank you (name of the person)" when someone gave him something he had asked for.

Of the skills in the emotional area, there was a considerable reduction in the inappropriate behaviour of screaming out loudly for no apparent reason.

As regards the skills in the cognitive area, Dimas learned to copy horizontal and vertical lines and circles on the blackboard. He also learned to point to specific drawings on a sheet with 20 different images, to count up to specific numbers and to count objects as he put them into a box.

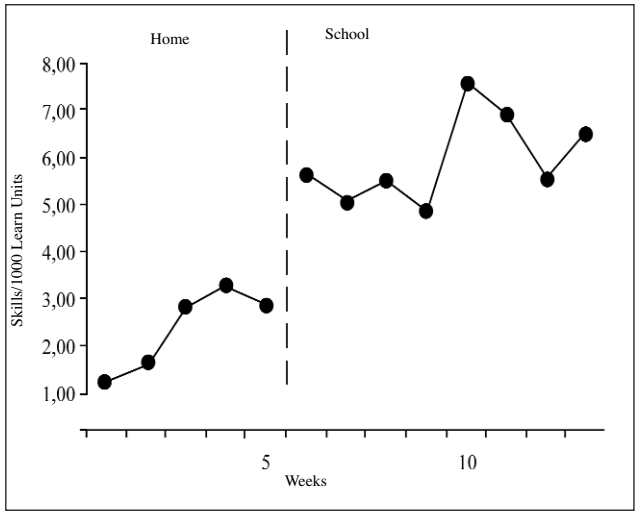
With regard to the skills in the motor area, he learned to jump on the spot, on the instruction "Jump". He learned to walk along a straight line without straying off it and to throw and catch a ball.

As far as skills in the language area are concerned, he learned to ask for things with complete sentences, such as "Paula, may I go to the toilet?", "Mum, give me the book, please", or "Dad, I want to go to the beach". He learned to respond to basic questions such as "What's your name", "How old are you?", "When is your birthday?", "Who is he?", "Who is she?", or "How are you?". He learned to say what things are for: the telephone, the chair, the keys, the hair-dryer. He also learned to answer the question "What colour is this?". He learned to respond appropriately when someone called his name and to say that he was coming. He learned to describe what another person was doing, using the following expressions: kicking the ball, writing, reading a book, talking on the telephone, drinking water, looking outside, walking, and closing the door. He learned to say "Yes" and "No" appropriately, in response to a request to do something. Finally, he learned to respond to orders with possessives in reference to touching parts of the body, as in "Touch my nose" or "Touch your nose".

Felisa

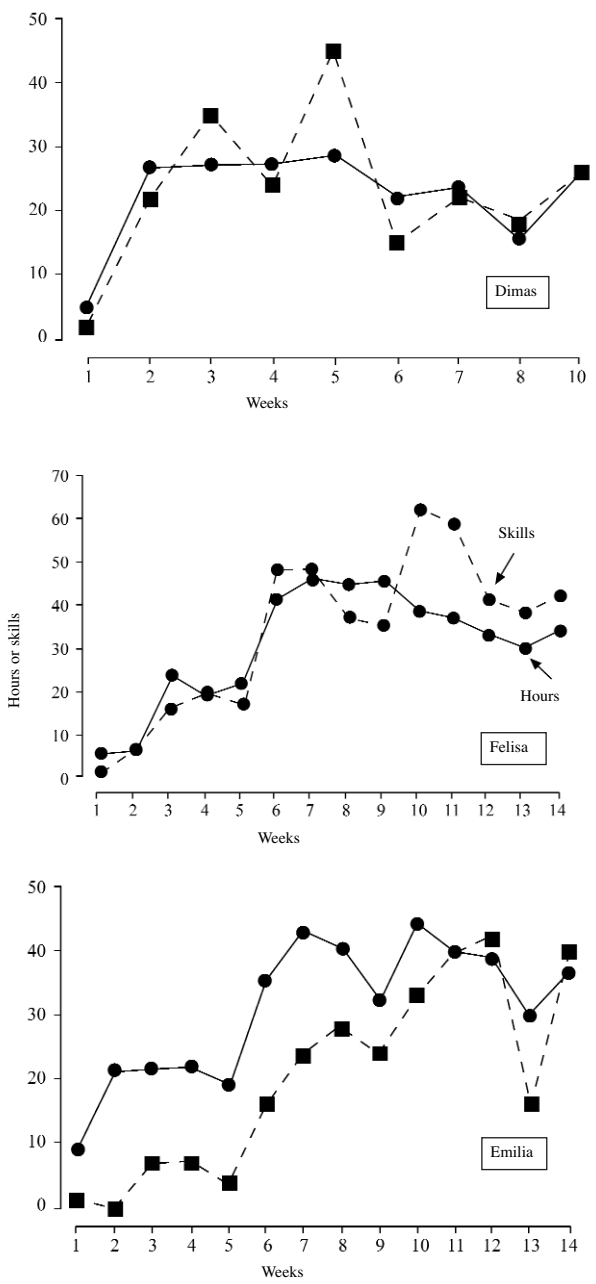
During the initial assessment, Felisa displayed the following deficiencies: inability to follow simple instructions (e.g., "Clap"), to identify body parts (e.g., "Touch your nose"), to sit still, to look at the teacher, to imitate general and specific movements on the instruction "Do

Figure 3
Weekly skills acquired by the three children per 1000 learn units. Learn units are shown when the program was implemented exclusively at home and when it was implemented at home and at school



this", or to imitate simple sounds such as "Ah" on request. She cried and threw tantrums every time she was made to sit so as to continue the assessment, which took place over two sessions. Felisa produced no sounds (however, as shown in an assessment carried out five months before this intervention, Felisa could produce four sounds: she used "ca" to ask for "Cola Cao" [a chocolate brand] and "ta" to ask for a biscuit [*galleta*], as well as repeating "mamá" and "papá"). Instead, she used two gestures to ask for various things. Also, Felisa learned to touch her head after several repetitions by her mother of "Touch your head" and got up from her chair after several repetitions of "Get up".

Figure 4
Hours of learning (continuous lines) and skills (dotted lines) learned by each child, each week. The ordinate scale is the same for hours and for skills (e.g., a point of continuous lines indicates hours and a point of dotted lines indicates skills, always on the scale of the ordinate axis)



The assessment after three and a half months of intervention showed that, in the area of language, Felisa learned to imitate the sounds: "a", "aa", "u", "i", "m…", "ba", "ma", "te-te-te", "u", "hola", "patata", "su", and "mamá." She learned to imitate certain words making an approximation to the sound –for example, *juguete* ("toy") by saying "etete" or *chorizo* (a kind of spicy sausage) by saying "oiso". She also learned to respond to her mother's question "Who am I?" with "mamá", and to request her mother's attention: when she wanted something from her, she went to her, tugged at her, and said "mamá". Finally, she learned to identify the following parts of the body: nose, teeth, foot, head, mouth, tongue, eyes, eras, arm, and waist.

With regard to skills in the social area, she learned to sit still and look at the teacher when the latter told her to do so. She learned to turn her head and look at the person who called her name "Felisa" and to say "Hello". She learned to imitate general movements from her teacher, up to the point where she could imitate 4 successive movements. She also learned to follow instructions: stand up, clap, touch the table, touch the floor, walk, give me a kiss, blow, close the door, throw this away in the rubbish, clap your knees, give me a hug, and say goodbye (she waved her hand as she did so).

With regard to the skills in the emotional area, she learned prerequisites for learning play imitations, such as imitating play actions with a doll.

With regard to the skills in the cognitive area, she learned to copy horizontal and vertical lines and circles on the blackboard. She also learned to copy combinations of line and circle, forming different figures every time. She learned to circle figures on the blackboard, to copy block designs with 4 blocks, one by one, and to line up as many as 15 letters on the table.

With regard to the skills in the motor area, she learned pre-requisites for beginning to colour in drawings such as choosing the colour and colouring in with movements from left to right or up and down, for a period of 8 seconds. She learned to use a pencil and chalk to copy lines and circles on paper and blackboard. She learned to jump on the spot, and later to jump one or two obstacles,

on the instruction "jump the obstacles". She learned to stand still for 8 seconds. She also learned to catch the ball when it was thrown to her, to pick it up when it was rolling on the floor, and to follow the instruction to give the ball to a specific person. Finally, she learned to follow the rhythm of a tambourine, tapping her feet.

Emilia

At the beginning of the program Emilia did not possess the skill to imitate any sound, nor to imitate broadly defined or specific movements or follow orders; she could not label any part of the body, she did not play with the ball, she did not ride a bicycle, had no graphomotor skills, and did not discriminate objects. She could ask for water with a gesture, and for food with another gesture. She followed the instruction to sit down, and for brief periods seemed to be listening to instructions. She displayed stereotypes with finger movements, and aggressive behaviours such as scratching her face, spitting, and throwing things.

During the 14 weeks of intensive training, and in relation to language skills, Emilia learned to imitate the following sounds: "a", "a-a", "m…", "ba", "baba", "ma", "mama", "Emilia", "u", and "a-m". She learned to use different combinations of these sounds to ask for things. She learned to imitate movements with her tongue. She learned to produce new sounds within a program of differential reinforcement. She learned to repeat the word "water" when she wanted water, to respond to the question "What's your name?" with the syllables of her name, and to identify the following body parts: nose, head, leg, shoulders, arm, belly, eyes, and elbow.

With regard to skills in the motor area, she learned to blow on request, to imitate movements with the tongue upwards, downwards, and to the sides, and to open and close her mouth. She also learned to jump on the spot, and to jump one, two and three obstacles on the instruction "Jump the obstacles". She learned to stand still for 4 seconds and to ride a bicycle on her own. She learned to throw the ball into a basket, and to play throw and catch with the ball. She learned to use colouring pencils properly and to colour a drawing on her own for 3 seconds.

With regard to skills in the social area, she learned to sit still for 2 seconds when the teacher said "Sit still". She learned to imitate the teacher's broadly defined movements, managing to imitate 4 successive movements. She also learned to follow simple instructions: touch the floor, touch the window, touch the table, walk, open/close the door, get up, come here, give me hug, hands up, throw that away in the rubbish, and hands in pockets.

With regard to skills in the emotional area, she learned pre-requisites for learning play imitations, such as imitating play with dolls. Her inappropriate behaviour of throwing objects onto the floor decreased considerably. She also learned to do puzzles with 4 to 6 figures independently.

With regard to skills in the cognitive area, she learned to copy horizontal and vertical lines and circles on the blackboard and to circle figures on the blackboard. She learned to copy designs with up to 5 wooden blocks and to link up identical drawings with a line, up to 5 pairs of drawings per sheet. She also learned to line up as many as 15 letters on the table and to link the numbers 1, 2, and 3 to their respective points.

DISCUSSION

The present study has shown that this system has worked for teaching a considerable number of skills to children with autism. With this program they basically learned one skill, or a component of it, for each hour of intervention. We believe that this learning was due to three main factors: the first factor is that we selected the procedures very carefully, from basic and applied research. The second is the speed of learning, since the teachers presented two to three learn units per minute. And the third is the application of a system that permitted continual assessment of the child's development and the continuous adaptation of each program to each child.

An important result was that the children learned more skills the more hours of learning they received. This corroborates the assumptions that the more intensive the program, the more effective it is. In fact, many programs that have proved effective for teaching children with autism have been intensive programs (e.g., Lovaas, 1987; Smith, Groen, & Wynn, 2000; Williams, 1998). Furthermore, this result contradicts the intuitive assertion that the child can "get tired" after several hours of learning in a day. The results of the present study show very clearly that the effect is the opposite: not only do children receiving effective treatment not learn less, but they indeed learn more skills per hour of work.

Neither of the two girls had acquired relevant skills in the years immediately preceding the application of our program. They lacked skills as basic as imitation. Both had received training in gestures because educators had given up trying to teach them language. The boy had learned to make sounds and to repeat short phrases, to recite numbers and the alphabet, and to add, subtract and

multiply with some errors. We believed that the boy had progressed in the previous years. But his language was barely functional. During the present intervention, however, the three children learned a total of 845 language and other skills. Each one of the children learned more than 25 skills per week during the two months in which they received the most effective treatment. In the final weeks, Emilia and Felisa learned over 35 skills per week. At this pace, the two girls could acquire skills corresponding to a level of 6 years of age in some three years. Felisa could integrate fully with normal children of her age in some three years; if she were to receive 50 hours per week, she could integrate in two years. Dimas, who had a much higher level of language than the girls and learns faster, could integrate fully with children of his age in some two years.

Behavioural interventions have proved to be effective for teaching children with autism (e.g., Fenske, Zalenski, Krantz, & McClannahan, 1985; Green, Brennan, & Fein, 2002; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Perry, Cohen, & DeCarlo, 1995; Sheinkopf & Siegel, 1998; Smith, Groen, & Wynn, 2000; Williams, 1998). In the context of such interventions, the intervention reported here involves a replication that increases the validity of the studies. It has been shown that a variety of interventions, with the principal characteristic of being based on behaviour analysis (e.g., Fuentes Ortega & Quiroga Romero, 2004) and which teach vocal language, are effective for teaching children with autism and for bringing a proportion of these children up to "normal" levels for their age.

The interventions of each research group mentioned in the previous paragraph differ from one another. They differ, for example, in the packages of procedures they use. This suggests that many specific procedures can serve for teaching children with autism. In other words, there is no package of procedures that has shown itself to be the only effective one. The present intervention has some characteristics which, with the exception of the intervention by Williams (1998), have not been reported in previous projects that have proved effective for teaching children with autism. These characteristics have to do with the methodology; more specifically, with the fact of analyzing the effects of each intervention daily and taking decisions on improvements in techniques on an ongoing basis.

The purpose of the present study was to assess the effectiveness of a series of procedures with this system of continual assessment. The purpose was not to compare the effectiveness of this system with those of other interventions. Thus, we cannot draw conclusions about the greater effectiveness of one type of behavioural intervention over another. The characteristics of the system we describe in the present work, however, can serve to help other researchers and professionals perfect the packages of treatments they offer to each child.

A study carried out in Special Schools in New York revealed that teachers presented some 12 opportunities per hour to each child; this results in some 10,800 opportunities per year. As regards the quality of the intervention, the study showed that the teacher did not present the instruction correctly, or wrongly presented the reinforcer and other consequences (Williams, 1988). Roughly the same occurs in Spain, in part because the educational model is based on the model of the United States. In contrast, in the present study we have presented an average of 165 learning opportunities per hour (a rate 13.8 times higher than that found in a Special Needs school). In the three months that the present project lasted, we presented a total of 176,278 learn units. We presented to each child the opportunities that 16 children receive in a year in a Special Needs school. Moreover, in the present study the quality was much higher than in Special Needs schools, since the learning opportunities were presented correctly (given that the majority of the instructions and consequences were appropriate) and the programs were continually adapted to each child.

We believe that the improvements the children achieved are much greater than those normally achieved by such children in specialized schools. We consider the degree of improvement to be comparable to that of children from the United States, Ireland, Britain, and other countries that use a similar system to the one employed here, but we feel that the children could progress even more quickly if they were taught in a more regular fashion, with more stable teaching staff and with more involvement from parents, implementing learning programs in their homes.

The program we have used has demonstrated its effectiveness for teaching children with autism. To this purpose, we used a large quantity of procedures, applied with a highly specific assessment system, and which proved effective for teaching specific skills to children with autism. All the procedures were based on studies of the experimental analysis and applied analysis of behaviour. Many of them were in fact based on theoretical analyses derived from the work of Skinner (1957), and on applied research based on these analyses. We consider a curriculum based on teaching functional language to be more effective than traditional curricula based on for-

mal analysis of language. This system can be employed for intensive teaching of children with autism and with other special educational needs.

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