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Review articles

LEGO® therapy as an intervention in autism spectrum disorders: an integrative literature review

Náiade Cristina Pereira Ramalho[1]
https://orcid.org/0000-0003-4812-1576

Stella Maria de Sá Sarmento[1]
https://orcid.org/0000-0002-9960-0166

[1] Universidade Federal da Bahia – Instituto de Psicologia, Salvador, Bahia, Brasil.

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Corresponding address:
Náiade Cristina Pereira Ramalho
Rua Heráclito Pires de Carvalho, nº 10
Caminho de Areia
CEP: 40440-430 - Salvador, Bahia, Brasil
E-mail: naiade.fono@gmail.com

ABSTRACT

Objective: to analyze the effects of LEGO® therapy as an intervention for autism spectrum disorder through an integrative literature review.

Methods: the study included a search of electronic databases, and nine empirical studies and three books, detailing the intervention method, were selected.

Results: the studies identified quantifiable improvements in social behavior and language/communication after LEGO® therapy.

Conclusion: LEGO® therapy is an intervention that favors motivation, interaction, and teamwork using a material that allows a variety of strategies, which have shown proven positive effects on the development of children with ASD.

Keywords: Children's Language; Autism Spectrum Disorder, Neuropsychology; Social skills

INTRODUCTION

The term "autism" was introduced to the scientific community by Eugene Bleuler in 1911. The earliest research on autism can be traced to the studies of Leo Kanner[1-3] and Hans Asperger[1-3]. These authors described children who presented difficulties in forming and maintaining relationships, communicative commitment, intense interests, and motor skills, isolation, repetitive and stereotyped behavior, and delayed development[1-5].

Autism is currently recognized as a neurodevelopmental disorder affecting communication and social interaction and is characterized by patterns of restricted and repetitive behavior and interests[6]. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) unified most of the previously identified developmental disorders —childhood autism, Asperger's syndrome, childhood disintegrative disorder, atypical autism, and Rett's Syndrome — into a single diagnostic entity called autism spectrum disorder (ASD); Rett's Syndrome was excluded from ASD because Retts' syndrome was different from the other disorders included in ASD[6].

Whitman[5] specified that individuals with ASD present sensory processing disorders, with difficulties in gross and fine motor skills. They also present dyspraxia and difficulties in speech and language. Stereotyped movements and changes in cognitive and executive functions may also be present in these individuals[2,5].

According to Gonçalves and Castro[7], the language changes that can be perceived in the first years of life of individuals with ASD are as follows: reduced communicative interest, atypical vocalizations, difficulty imitating others, and failures in verbal and non-verbal communication. These changes indicate future linguistic deficits, mainly at the practical level — inability to maintain eye contact, verbal games, gestures and inadequate babbling[2,5,7-9]. These inadequacies may also be noted in the failure to understand the meaning of a message, irony, sarcasm, metaphors, and vocal intonation, thus, representing an impairment of the receptive language domain[2,5,7-9].

Gonçalves and Castro[7] reported that in ASD expressive language is impaired due to the lack of development of the morpho-syntactic features and that many individuals exhibit pronoun reversal and semantic alterations - problems related to the semantic and lexical field. Phonological alterations are also observed with omissions, subtractions and phonemic exchanges in verbal ASD children[7].

Interventions for individuals with ASD are extremely important to stimulate their general development, and specifically the development of the functions that are typically impaired by the disorder[7,10,11].

Most of the interventions directed at ASD are individual in character and focus on linguistic and communicative development. Baron-Cohen[12] reports that children diagnosed with ASD are attracted to predictable objects, resultingin motivation and engagement in systematic activities[12]. The use of these objects can promote not only the linguistic development, but also development of social skills, which are indispensable for human development.

There are many methods that enable children to improve communication, behavior and social interaction.

Among these therapeutic methods, many have been created to favor the growth and development of subjects with ASD. It is, therefore, worth highlighting another method that is advantageous for patients with ASD and addresses the three pillars of autism: problems in social interactions, impaired communication, and stereotyped behavior.

LEGO®-based therapy is a treatment modality developed by Daniel LeGoff, a clinical neuropsychologist from Philadelphia (U.S.A.). This method stimulates social interactions and communication and was inspired by the clinical observation of his patients; he noticed that the building blocks attracted the attention of two children, who began to interact with each other.

This integrative literature review aimed to analyze the effects of LEGO® therapy as an intervention for patients with ASD by collecting information about its technical application, its effects on neurocognitive functions, and the potential benefits of this therapy in the future.

METHODS

An online search was performed on articles indexed in the following electronic databases: Scientific Electronic Library Online (SciELO), PubMed, PsycINFO, Latin American and Caribbean Health Science Literature (Lilacs) and Google Scholar.

The search included national and international publications and the keywords we chose, based on previously examined articles, were the following: "LEGO® Therapy", "LEGO®" and "Therapy", "Autism and LEGO® Therapy", "Speech Therapy and LEGO® Therapy".

In addition to the databases of scientific publications, the creator of the method, neuropsychologist,

Daniel LeGoff, and psychologist, Georgina Gomez De La Cuesta, who was trained in LEGO® therapy and evaluated the modality in her doctoral thesis, were consulted. Books recommended by these professionals, one of them being the manual of the method itself, were included as well.

The online search was performed between June 2015 and October 2016.

The following criteria for inclusion of the articles were considered: (1) discussion of the topic of LEGO® therapy; (2) empirical studies with quantitative and/or qualitative measures; (3) studies of children and adolescent population; (4) indefinite chronological time of publication.

Article abstracts were read to determine if they matched the inclusion criteria. After the selection, the articles were read in full, analyzed and classified by the same inclusion criteria.

Fifteen publications comprising thirteen papers and two doctoral theses were found. Six papers were excluded because they did not meet the inclusion criteria. Therefore, seven articles and two doctoral theses were used, as well as two chapters from different books and one book in its entirety.

LITERATURE REVIEW

LEGO® therapy is a therapeutic model created in the United States by Daniel LeGoff, a neuropsychologist, to promote social skills in individuals with ASD. Currently, this method is being disseminated in countries, including the United Kingdom, Canada, Australia, New Zealand, China, and India[13-15].

LEGO® therapy can be applied individually or in a group. The method prescribes specific rules and roles that are fundamental for the promotion of social interactions among the participants[13-17].

Role assignment allows the individuals to maintain the social interaction within a safe environment. LEGO® therapy aims to stimulate shared attention, dialogue exchange, problem solving, verbal and non-verbal communication, planning, motor skills, reasoning, attention and, above all, social skills[13-15].

LeGoff[16] and LeGoff and Sherman[17] observed in their research that the social norms and rules are learnt during the intervention. Building blocks are simple, promote tactile, visual, visuospatial and visuoconstructive sensory stimulation, and are easily accessible to therapists and parents[13-15].

The central objective of this intervention is to motivate the individuals to work together, in groups or in pairs, initially building models selected by the facilitator, who supervises the activity. In LEGO® therapy, there are specific functions for each member of the group, as well as for the overall construction project. The engineer is responsible for describing the instructions; the supplier is in charge of finding the right parts; and the builder places the parts in their correct places. The therapeutic process is initiated with this division of labor, where the individuals interact with each other, work together, activate functions, such as perception, attention, memory, language, and executive functions, and overallperform functions that are compromised in ASD[13-18].

Recipients of the LEGO® therapy initially participate in a series of individual interventions of 60 minutes per week, which were then increased to 90 minutes in a group setting, for 12 to 24 weeks[13-18].

In LEGO® therapy, there are certain rules to be followed in the intervention environment. These rules are the key to establishing self-regulation and self-control. Subjects who do not engage in verbal communication will not participate in groups until they have the ability to understand the rules and the appropriate behavior[13-18].

The rules are explained to the individuals upon first contact with the mediator and the materials. They should be displayed in the intervention room, so that if a rule is broken, the participants themselves can monitor each other and inform the mediator, who can then reanalyze the subject who failed to comply (Figure 1)[13-18].

1. Build together!
2. If you break something, you have to fix it or ask for help to fix it.
3. If someone is using something, do not grab it, ask first.
4. Speak quietly and do not scream.
5. Keep your hands and feet close to your body.
6. Use kind words.
7. Clean the materials and place them where they were.
8. Do not put the pieces in your mouth.

Figure 1. Rules of LEGO® therapy

LEGO® therapy has five sequential levels, each of which aims to improve specific skills as a prerequisite for participation. Each level involves the stimulation of such skills in each individual, and the transition from one level to the next is based onmastering these skills. Thus, the application of LEGO® therapy requires compliance with the hierarchical and sequential nature of the intervention levels[13-18].

During this study, a total of fifteen publications were found, consisting in thirteen papers and two doctoral theses. After the selection and inclusion analysis, six papers were excluded because they did not meet the criteria defined for this integrative literature review, and nine publications were selected —seven papers and two doctoral theses. We also used three books proposed by the creator of the method and by a professional trained in LEGO® therapy.

The pilot study on LEGO® therapy[16] was performed on a group of 47 participants, divided by gender, with ages between 6 and 16 years. For this study, three scales were used to measure social interaction (see Appendix). All the subjects showed improvementin the three scales after 12 weeks of treatment, and such improvements were maintained or increased after 24 weeks. The improvements concerned communication and social adaptation.

This pilot study confirmed that the interaction between two patients that took place in the clinic of the method's creator, using the building blocks, was effective for the development of social skills[16]. In the study by LeGoff[16], the social communication skills evolved, but also joint attention, problem solving, and verbal and non-verbal communication and collaboration improved[14-17]. Such improvements can be demonstrated in studies adopting a structured methodology to promote positive responses related to social skills. Wood et al.[19] reported that the systematic stimulation of social skills in groups favors the reduction of nonfunctional responses related to this ability, favoring a change of rudimentary behaviors, facilitating the learning and generalization of adaptive behaviors, reducing anxiety and improving motivation for interpersonal contact[19]. Gutstein and Whitney[20] show that the behavioral stimulation required to improve social skills must be motivated with playful strategies and positive reinforcement, to induce the generalization of the behavior[20]. Therefore, LEGO® therapy covers all aspects needed to promote adequate stimulation of social skills.

In the second publication on LEGO® therapy, the creator of the method attempted to expand the relevant data by extending his first study to 36months. LeGoffand Sherman[17] continued to refine the method and selected only subjects with high-functioning ASD. They used 3 instruments to obtain reliable data (see Appendix).

In comparison with the first study by LeGoff[16], in this second study verbal and non-verbal communication, shared attention, concentration, and collaboration for problem-solving and dialogical exchanges emerge as important factors in the longer term. A reduction of stereotypies and an increase in social interaction were observed compared to the first study.

The instruments used in the 36-month study showed significant gains compared with the control group that did not receive the same intervention. The group receiving LEGO® therapy showed better social skills, reduced maladaptive behavior, improved verbal and non-verbal language and communication.

Owens et al.[18] compared LEGO® therapy with the program *Social Use of Language Programme* (SULP), also using quantitative measures to evaluate the effects (see Appendix). LEGO® therapy enabled a decrease of interactional difficulties, with improvement in eye

contact, shared attention, problem solving, dialogical exchange and communication skills, which could not be matched by6 months of SULP intervention. Both methods achieved similar results, but LEGO® therapy was significantly more effective on the scale concerned with communication difficulties. In both methods, the subjects showed reduced maladaptive behavior.

Gonçalves and Castro[7] reported that several therapeutic methods are used on individuals with ASD. These methods should be constantly studied and assessed for use on each individual[20]. LeGoffet al.[15] indicated that LEGO® therapy requires pre-established application steps. It stimulates, in a playful way, the development of language, with positive results, as shown in the study by Owens et al.[18], who performed a veritable clinical trial to compare the results of two therapeutic interventions. The effectiveness of the intervention was proved because the comparison of the two intervention methods showed that LEGO® therapy leads to significant improvements in social skills and in fine motor skills, language, shared attention, dialogical exchange, and problem solving[13-18].

In the case study published by Pang[21] an individual, diagnosed with mild ASD, performed LEGO® therapy in a school setting. After 3 months of intervention the subject acquired new communicative skills and vocabulary repertoire, and began to produce simple phrases. In addition to language, advances in fine motor skills were observed after the intervention, enabling the subject to trace the letters of the alphabet, draw and color, control the fingers and properly pick up a pencil. Social behavior also evolved, where the subject achieved an understanding of the interactivity of the social environment, thus organizing its emotional aspects.

In the survey conducted by Andras[22], a significant improvement in social skills could be obtained after 12 weeks of intervention. She observed phenomena shared by the groups, and in particular the imitation of behaviors among members during the intervention, which favored the engagement of participants who did not yetmaster verbal communication. Andras[22] also noted that social gains appeared only in the last three weeks of the intervention. The greatest gains were in verbal interactions, where increased communication could be observed after the intervention with LEGO® therapy. Specifically, an increase in verbal communication and a simultaneous decrease in the use of gestural communication wereobserved after the therapeutic process.

Despite the positive results shown, the study of Andras[22] had limitations related to the technique of therapeutic intervention, which may have influenced the data. According to Andras[22], the main limitations of the study were the lack of session duration records, the fact that the intervention mediator was not the same throughout the process, and, as the research was carried out in schools, the interruptions caused by school holidays: all these limitations contributed to inadequate data, as did the small number of participants.

The research by Brett[23] was divided into two studies, one using quantitative scales (see Appendix) and the other using only semi-structured interviews. In the first study, the results of the scales, after the intervention of LEGO® therapy, were significant for the development of social skills and general communication, as found by LeGoff & Sherman[17].

When analyzing the qualitative outcomes of LEGO® therapy, ascertained from interviews, Brett[23] reported that both parents and educators had detected advances in social and communication skills among the participants.

The results of these two combined collection approaches were positive for what concerns improving social skills and increasing social interaction, as well as encouraging individuals to learn social problem-solving, engage in activities, and increase their interest in interactions.

Boyne[24] conducted a study on social and communication competences using LEGO® therapy. In this study, two participants achieved peer-to-peer communication, one was able to initiate a dialogical exchange, four were able to respond to the intervention adequately and two achieved functional communication. Only one participant failed to communicate effectively or show adequate social interaction, due to the seriousness of the subject's condition. The results of this study showed that the quantitative scales used (see Appendix) met with a positive response from guardians and teachers, and improvementswere noted in the development of social communication, social skills, and language in 6 months of intervention.

Nascimento et al.[25] reported in their study that the therapeutic strategies used in a school context benefit children with ASD, since they promote the possibility of communication, interaction and learning in a mediated way[25]. In her study, Brett[23] reports about the use of LEGO® therapy in a school environment, with teacher mediation, as it allows the collection of relevant data on

the evolution of the diagnostic picture presented by the research participants[23].

All four studies obtained significant results in social skills, but there were limitations. Comparing Andras' study[22] with the LEGO® therapy intervention manual[13], all the therapeutic limits of her study emerge in a negative light, since the appropriation of the LEGO® therapy-method by professionals is fundamental to obtain the results[13,22]. The study by Cardoso and Montenegro[11] highlights that continuity of the therapist improves the results obtained in the intervention of individuals with ASD[14]. It must be noted that in Andras' research[22] the mediator was changed several times, which could have negatively affectedthe intended gains of social skills.

Notably, in the selected articles the sample size varied from case studies with only one participant[21] to interventions with 60 individuals[15]. The number of sessions required for meaningful results was not always recorded[17], which may have had a negative influence on the data obtained[2,17].

In the study by Barakova et al.[26] a robot was used. It produced a synthetic voice, which could be manipulated by a mediator, explaining the operation of the LEGO® therapy. After the completion of the learning process the roles were distributed to each child (constructor, supplier and engineer). The mediator's role was transferred to the robot, which was outside the intervention environment. The central objective of Barakova et al.[26] was a brief, robot-mediated intervention based on LEGO® therapy.

According to Barakova et al.[26], no significant results were obtained in this study, especially regarding LEGO® therapy.

A second study was carried out by Huskenset al.[27], where again a robot was used as the mediator. Despite the language articulation capabilities of this robot, there were difficultiesrelated to the vocal emissions by the mediator, because besides the robotic nature of the speech, there were also imperfections in the words uttered. The subjects of the study interacted with the robot, trying to touch it and talk to it. LEGO® therapy was introduced as the intervention and, as in the first study, the robot was used for mediation and the explanation of the procedure, including the rules. In this study the authors explored the benefits of using robots for social interaction with children with ASD, but did not report positive results associated to the use of LEGO® therapy. Huskenset al.[27] indicated that the method only served to increase the contact between the subjects and the robot, but that other neurocognitive aspects did not improve.

The study performed by Barakova et al.[26], showed a method of intervention with important differenceswith the original LEGO® therapy, since it does not significantly favor social skills. Indeed the two studies[26,27] proposed an intervention using robots on subjects with a diagnosis of ASD: Such an intervention would not be effective in improving social sharing and interaction with the environment, since it would be the robots which would mediate group and/or individual work[26,27]. The aim of all therapeutic strategies is to enable individuals with ASD to interact in pairs, improving social interaction, eye contact and dialogical exchanges. These two studies neglected these aspects, since children and adolescents will not interact with robots, but with people;this is a negative aspect of these studies. The use of robotics with LEGO® therapy according to Huskens et al.[27] presents limitations that reduce its validity[27]. Further research was proposed, still based on LEGO® therapy,about the use of robotics with an increased number and duration of sessions. It is evident that the inappropriate use of the LEGO® therapy led to the negative results reported in the studies.

CONCLUSION

After this literature review, it was possible to analyze the effects of another intervention method that stimulates and improves the functions related to the three pillars of ASD.

The aim of this article was to analyze the effects of LEGO® therapy in individuals with ASD. This objective was achieved by proving the effectiveness of the method, and by emphasizing its importance in stimulating neurocognitive aspects.

LEGO® therapy has been widely disseminated, but there are few published studies on it. This was a problematic aspect of this study, as it prevented a more comprehensive discussion of the subject.

It is important to emphasize that despite the availability of a method that favors the stimulation of neuropsychological functions, classic therapies should continue to be performed. LEGO® therapy should be combined with the classic therapies, as it can help to improve the clinical outcome of individuals with ASD.

Therefore, it is necessary to further pursue the investigation of this method, and to allow it to be disseminated and understood, thus providing access to another effective intervention method.

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APPENDIX

Results from papers on LEGO® therapy						
Reference	**Type**	**Country**	**Sample**	**Instruments Used**	**Time of Intervention**	**Results**
LeGoff (2004)	Paper	USA	47 individuals divided into 5 groups of 7 and 2 groups of 6. 34 were male and 13 were female, with ages ranging from 6 to 16 years.	Gilliam Autism Rating Scale (GARS-SI); Vineland Adaptive Behavior Scale (VABS); Wechsler Intelligence Scale for Children – Third Edition (WISC-III).	60 minutes of individual therapy and 90 minutes of group therapy weekly for 12 or 24 weeks.	Improvement in social competence, social contact, duration of social interaction, social behavior, social cognition and verbal and nonverbal language.
LeGoff and Sherman (2006)	Paper	USA	60 subjects received individual and group intervention of LEGO® therapy and 57 subjects received only classic therapy. All individuals had been diagnosed with ASD.	Vineland Adaptive Behavior Scales (VABS); Wechsler Preschool and Primary Scale of Intelligence – Revised (WPPSI-R); Wechsler Intelligence Scale for Children – Third Edition (WISC-III); Gilliam Autism Rating Scale (GARS).	60 minutes of individual therapy and 90 minutes of group therapy weekly for 36 months.	The group that received LEGO® therapy showed improvements in social skills, reduction of maladaptive behavior, improved communication, and improved verbal and non-verbal language in the 36-month period. The group that did not receive LEGO® therapy did not show alterations.
Owens et al., (2008)	Paper	United Kingdom	47 children divided into groups, 16 received LEGO® therapy, 15 received SULP training and 16 formed a control group. All with diagnosis of ASD.	Vineland Adaptive Behavior Scales (VABS); Wechler Abbreviated Scales of Intelligence; Gilliam Autism Rating Scale (GARS); Spence Children's Anxiety Scale; Child Behavior Checklist; Conner's ADHD index	60 minutes of weekly intervention for 18 weeks.	LEGO® therapy: improvement in interaction, socialization and communication. SULP (Social Use of Language Programme): decrease of maladaptive behavior.
Pang (2010)	Paper	USA	Oneindividual diagnosed with ASD.	Unspecified	3 months of intervention in the school environment with teachers and therapists.	Increase of the semantic/ lexical repertoire, communicative/ pragmatic skills, construction of simple phrases, improvements in morphosyntax, fine motor skills and social behavior.
Andras (2012)	Paper	United Kingdom	8 individuals divided into 4 typical children and 4 with diagnosis of ASD, with ages ranging from 8 to 11 years.	Unspecified	45 minutes per week, for 10 weeks.	Improvement in social behavior, increased verbal communication, decreased copying of inappropriate behaviors.

Results from papers on LEGO® therapy						
Reference	**Type**	**Country**	**Sample**	**Instruments Used**	**Time of Intervention**	**Results**
Brett (2013)	PhD Dissertation Thesis	United Kingdom	14 participants, 13 male and 1 female, with diagnosis of ASD, with ages ranging from 6 to 11 years.	Gilliam Autism Rating Scale (GARS-SI); Vineland Adaptive Behavior Scales: Socialization Domain (VABS-SD) and Communication Domain (VABS-CD);Social Communication Questionnaire.	45 minutes per week, for 10 weeks.	In both studies positive aspects were observed in the increase of adaptive socialization, motivation, engagement and modeling of social skills.
Barakova et al. (2014)	Paper	The Netherlands	6 children divided into pairs, a typical child and another with a diagnosis of ASD. 4 were male and 2 were female, aged 5 to 13 years.	Unspecified	5 sessions lasting 30 minutes per week.	There were no significant results when the intervention of LEGO® therapy was mediated by a robot.
Huskens et al., (2014)	Paper	The Netherlands	6 male subjects with a diagnosis of ASD divided into pairs, aged 8 to 16 years.	Unspecified	30 minutes per weekly session, lasting 4 weeks.	There were no significant results when the LEGO® therapy intervention was mediated by robot. Only increased contact between the robot and participants was observed
Boyne (2014)	PhD Dissertation Thesis	United Kingdom	6 children diagnosed with ASD, aged 5 to 11 years.	Single Case Experimental Design (SCED); The Social Competence Inventory; The Belonging Scale.	6 weeks of intervention, with 30 minutes per week.	Positive effect in improving social skills and general communication.