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The Role of Sensory Integration in Developing Nonverbal Communication in Children with Autism Spectrum Disorder

A Quasi-Experimental Study on a Sample of Children Diagnosed with Autism Spectrum Disorder

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Abstract

This study aims to highlight the role of sensory integration in developing nonverbal communication skills among children with Autism Spectrum Disorder (ASD), particularly eye contact, gestures, and joint attention. The study sample consisted of 20 children aged between 5 and 7 years, divided into two groups (experimental and control) following a quasi-experimental approach. A sensory integration-based program was applied to the experimental group, while the control group followed traditional methods. A nonverbal communication scale was administered as a pre-test and a post-test, and the results were analyzed statistically. The findings revealed statistically significant differences at the level ($\alpha = 0.05$) in favor of the experimental group, confirming the effectiveness of sensory integration in improving nonverbal communication skills.

Keywords: Sensory Integration; Nonverbal Communication; Autism Spectrum Disorder.

1. Introduction

Nonverbal communication constitutes one of the essential components of a child's developmental growth, as it forms the primary foundation upon which the various forms of social interaction are built, and represents a fundamental means of expressing needs and emotions prior to the acquisition of spoken language. This type of communication is manifested through a set of organized behaviors such as eye contact, gestures, facial expressions, body postures, and joint attention, which enable the child to understand others and to respond within an integrated interactive context. The role of nonverbal communication is not limited to being an alternative to language; rather, it is a communicative system in its own right that contributes to organizing social relationships, building interaction, and exchanging roles, making it a cornerstone of social and emotional development.

However, children with Autism Spectrum Disorder exhibit a notable deficit in this domain, suffering from weak eye contact, limited use of gestures, difficulty in interpreting facial expressions, and the absence or delay of joint-attention skills — all core indicators of impaired social interaction. This deficit leads to difficulties in building relationships with others and to weak responsiveness to social stimuli, which limits the child's integration within the family and educational environment.

These difficulties cannot be interpreted within a narrow linguistic framework; rather, they should be viewed within a comprehensive neurodevelopmental context. Recent literature indicates that nonverbal communication is closely linked to the efficiency of sensory processing and neural regulation in the child. A considerable proportion of children with ASD exhibit sensory-processing disorders, manifested in a dysfunction in receiving, organizing, or interpreting sensory stimuli — whether visual, auditory, tactile, or motor. This dysfunction directly affects attention, concentration, and the ability to orient behavior toward others — all essential conditions for the emergence of communicative behavior.

As a result of this disorder, the child may exhibit behaviors such as gaze avoidance, weak responsiveness to being called, withdrawal from interaction, or preoccupation with irrelevant sensory stimuli, thereby hindering the

development of his nonverbal communication skills. Consequently, the absence of sensory regulation is reflected not only in the behavioral aspect but extends to the interactive structure of communication, rendering the child unable to perceive social cues or to respond to them appropriately. These observations underscore the importance of integrating the sensory dimension within the rehabilitation programs directed at this group, given its role in enhancing interactive readiness and improving communicative ability.

In this context, the theory of Sensory Integration, developed by Jean Ayres, emerged as one of the explanatory and applied frameworks aimed at understanding the relationship between sensory processing and adaptive behavior. This theory proceeds from the premise that the brain organizes and integrates the sensory information arriving from the various senses in order to produce appropriate and effective responses to the environment. This theoretical conception evolved into applied practices based on intervention programs employing organized sensorimotor activities, designed to improve sensory-neural regulation and to enhance the child's capacity for interaction, attention, and response.

2. Problem of the Study

Nonverbal communication is of paramount importance in the social and emotional development of the child, since it represents the first channel of interaction prior to the acquisition of spoken language. However, children with Autism Spectrum Disorder display a fundamental deficit in this aspect, manifested in weak eye contact, limited gestures, and the absence of joint attention, which impedes their social and educational integration.

Recent literature has shown that this deficit cannot be isolated from the sensory-processing disorders that are widespread among this group, since the regulation of sensory input is functionally and directly linked to readiness for interaction and communication. Nevertheless, most rehabilitation programs directed at this group — particularly in the Arab and Algerian context — still focus on the linguistic dimension and neglect the sensory dimension, while field studies that test the effectiveness of sensory-integration programs in developing nonverbal communication remain limited.

From this standpoint, the present study seeks to address this gap by examining the effect of a program based on sensory integration in developing nonverbal communication skills, which leads to the following main question:

Main question: Does a program based on sensory integration contribute to developing nonverbal communication skills in children with Autism Spectrum Disorder?

Sub-question: Are there statistically significant differences between the pre-test and post-test measurements in the level of nonverbal communication skills among children with ASD, in favor of the post-test?

General hypothesis: A program based on sensory integration contributes to developing nonverbal communication skills in children with Autism Spectrum Disorder.

Sub-hypothesis: There are statistically significant differences between the pre-test and post-test measurements in the level of nonverbal communication skills among children with ASD, in favor of the post-test.

3. Objectives of the Study

- To identify the effectiveness of a program based on sensory integration in developing nonverbal communication skills in children with Autism Spectrum Disorder.
- To reveal the significance of the differences between the pre-test and post-test measurements within the experimental group.
- To compare the experimental and control groups in the post-test in order to determine the effect of the program.
- To highlight the relationship between improving sensory processing and the development of eye contact, gestures, and joint attention.
- To provide applied recommendations for integrating sensory integration into speech-therapy and rehabilitation programs.

4. Importance of the Study

Theoretical importance: enriching the Arabic literature on the relationship between sensory processing and nonverbal communication, and highlighting the theory of sensory integration as an explanatory framework for the communicative deficit in children with Autism Spectrum Disorder.

Practical importance: providing practitioners with a scientifically grounded intervention program, orienting rehabilitation programs toward a holistic approach that goes beyond the linguistic aspect, and raising parents' awareness of the importance of sensory activities in care.

5. Previous Studies and Commentary

With respect to the previous studies that examined the relationship between sensory integration and communication in children with Autism Spectrum Disorder, much research points to the effectiveness of this approach in improving communicative performance. Ayres (1972), considered one of the foundational studies in the field of sensory integration, demonstrated that improving the organization of sensory input in children contributes to the development of adaptive responses, which constitute the basis for the emergence of communicative behavior, including its nonverbal forms. Schaaf and Mailloux (2015) found that programs based on sensory integration produce a notable improvement in social interaction and joint attention in children with ASD, which is positively reflected in their nonverbal communication skills. Moreover, several recent orientations

in the fields of speech therapy and psycho-educational rehabilitation emphasize the importance of integrating the sensory dimension within programs aimed at developing communication skills, especially in children with ASD, on the assumption that improving sensory regulation raises the level of interactive readiness, reduces interfering behaviors, and opens the way for the child to develop his communicative skills, particularly the nonverbal ones.

Commentary on the Previous Studies

A review of the previous studies reveals points of similarity with the present study, namely their shared adoption of sensory integration as an independent variable, their focus on the same population (children with ASD), and their conclusion that sensory-based programs are effective in improving social interaction and joint attention.

As for the points of difference, Ayres' study (1972) focused on the theoretical basis of adaptive behavior in general, without specifically addressing nonverbal communication, whereas the study by Schaaf and Mailloux (2015) was concerned with social interaction and joint attention without isolating the three manifestations of nonverbal communication. Furthermore, these studies were conducted in foreign settings, while the present study is distinguished by its application in the Algerian environment and by its operational focus on eye contact, gestures, and joint attention combined.

With regard to the extent of benefit, the present study drew upon the previous studies in constructing its theoretical framework, in formulating its hypotheses, and in selecting the quasi-experimental approach together with the pre-test/post-test measurement tools; it was likewise guided by their findings in designing the program's activities and in interpreting and discussing its own results.

6. Theoretical Framework

6.1 Sensory Integration Theory

Conceptual definition: Ayres defined sensory integration as the neural process by which the brain organizes the information received from the various senses and integrates it to produce an adaptive response appropriate to the environment (Ayres, 1972: 32).

Schaaf and Mailloux (2015) clarify that sensory integration refers to the ability of the central nervous system to process and organize sensory inputs in order to support functional performance and social participation. The Arabic literature, in turn, confirms that sensory integration represents the neural basis of adaptive behavior, and that any dysfunction in it may be reflected in learning and communication (Al-Rousan, 2019: 29).

Operational definition: in this study, sensory integration refers to the child's ability to organize and process the basic sensory inputs (touch, proprioception, and balance) in a way that translates into an increased readiness for social interaction and an improvement in the manifestations of verbal and nonverbal communication.

It is evident from the preceding definitions that they converge in regarding sensory integration as an organizing neural process that extends beyond the mere reception of stimuli to their integration and the production of an adaptive response. What concerns the present study in this conception is the shift from the neural-theoretical dimension emphasized by Ayres to the social-functional dimension highlighted by Schaaf and Mailloux; for the researchers adopt the view that improving sensory regulation is not an end in itself, but rather a means of raising the autistic child's readiness for interaction — which makes sensory integration a foundational gateway to developing nonverbal communication rather than a parallel variable.

6.2 Nonverbal Communication

Conceptual definition: nonverbal communication is defined as all forms of conveying messages and meanings that do not rely on spoken words, including facial expressions, eye contact, gestures, body postures, and interpersonal distance; it is an essential element in social interaction and in understanding communicative intentions (Knapp, Hall, & Horgan, 2014: 74).

In the Arabic literature, Abdel-Rahman explains that nonverbal communication is part of social communication skills, consisting of the child's ability to use signals and expressions as alternatives to, or accompaniments of, spoken language in order to achieve mutual understanding (Abdel-Rahman, 2019: 38). Al-Khatib likewise notes that weak gestures and eye contact are among the most prominent manifestations of communicative deficit in children with neurodevelopmental disorders, directly affecting their interaction with the surrounding environment (Al-Khatib, 2018: 27).

Operational definition: in this study, nonverbal communication refers to the child's ability to use, or to respond to, nonverbal cues during interaction — such as eye contact, pointing, facial expressions, motor imitation, and joint attention — measured through a pre-/post observation grid.

It becomes clear from the foregoing that nonverbal communication represents a communicative system in its own right and not merely an accompaniment to spoken language, and that the Arabic references (Abdel-Rahman, Al-Khatib) converge with the foreign ones (Knapp and colleagues) in regarding eye contact and gestures as essential indicators of it. The researchers proceed from this convergence to focus, in their study, on three operationally observable and measurable manifestations — eye contact, gestures, and joint attention — as the manifestations most sensitive to deficit in children with ASD and the most amenable to improvement through sensory intervention.

6.3 Autism Spectrum Disorder

Conceptual definition: Autism Spectrum Disorder is defined as a neurodevelopmental disorder characterized by persistent deficits in communication and social interaction across multiple contexts, in addition to restricted and repetitive patterns of behavior and interests, with the severity of symptoms varying among individuals (American Psychiatric Association, 2022: 32).

In the Arabic reference, Al-Rousan defines Autism Spectrum Disorder as a developmental disorder that appears in early childhood, characterized by weak social interaction, a deficit in communication, and the presence of repetitive stereotyped behaviors that affect the child's general adaptation (Al-Rousan, 2019: 36). Al-Zureikat further explains that children with ASD suffer from difficulties in verbal and nonverbal communication, and that these difficulties are among the characteristics that most affect their learning and social integration (Al-Zureikat, 2020: 43).

Operational definition: in this study, children with Autism Spectrum Disorder refers to children who have a formal diagnosis of ASD according to the DSM-5-TR criteria, who suffer from a deficit in verbal and nonverbal communication skills, and who are included in the sample in accordance with the study's conditions.

It can be inferred from the definitions presented that the deficit in communication, whether verbal or nonverbal, constitutes the central symptom of Autism Spectrum Disorder by the consensus of the medical references (DSM-5-TR) and the Arabic ones (Al-Rousan, Al-Zureikat). Here the perspective of the present study is determined: it does not treat this deficit as an isolated communicative dysfunction, but as an outcome linked to the sensory-processing disorder — the very link that justifies the selection of sensory integration as the independent variable for addressing this deficit.

7. Methodology of the Study

This study adopted the quasi-experimental approach, regarded as one of the most suitable approaches for studying the effect of intervention programs in the educational and therapeutic field, since it allows the relationship to be uncovered between the independent variable — represented by the program based on sensory integration — and the dependent variable — represented by the nonverbal communication skills of children with Autism Spectrum Disorder.

An experimental design based on pre-test and post-test measurement was employed for two groups: an experimental group subjected to the application of the program, and a control group that did not receive the same intervention, with the aim of comparing the changes occurring in the level of nonverbal communication skills before and after the application of the program, as well as determining its effectiveness.

This design makes it possible to control some of the influencing variables and to observe the differences between the two groups, which enhances the credibility of the results obtained and contributes to interpreting the effect of the program in a precise scientific manner.

8. Control of the Study Variables

In order to ensure the accuracy of the results and to control the factors influencing the study, a set of variables related to the research topic were controlled, as follows:

Independent variable: the program based on sensory integration, which comprises a set of organized sensorimotor activities aimed at improving sensory regulation in the children.

Dependent variable: the nonverbal communication skills of children with Autism Spectrum Disorder, which include eye contact, gestures, and joint attention.

Extraneous (mediating) variables: certain variables that might affect the study's results were controlled by ensuring the homogeneity of the sample in terms of chronological age, ASD diagnosis, and initial level of performance in nonverbal communication skills, in addition to standardizing the conditions of program application in terms of time, place, and number of sessions, and applying the same measurement tools to all members of the sample. This control reduces the influence of external factors, thereby allowing the differences in the results to be attributed to the effect of the program based on sensory integration.

9. Stages of the Quasi-Experimental Study

This study was carried out according to a set of organized stages falling within the framework of the quasi-experimental approach, as follows:

Preliminary stage: the study sample of children with ASD was selected, ensuring their homogeneity in terms of age and level of performance, and a pre-test was administered using the nonverbal communication skills scale in order to determine the initial level of each child.

Program-application stage: the program based on sensory integration was applied to the members of the experimental group through a set of organized sensorimotor activities, while the control group continued to receive the traditional methods in use, without any additional intervention.

Post-test stage: after completing the application of the program, a post-test was administered to the members of both groups using the same measurement tool, in order to monitor the changes occurring in the level of nonverbal communication skills.

Results-analysis stage: the data obtained were processed using the appropriate statistical methods in order to compare the results of the pre-test and post-test, and to compare the performance of the experimental and control groups, with the aim of verifying the hypotheses and determining the effectiveness of the program.

10. Delimitations of the Study

Human delimitations: the study was confined to a sample of children with Autism Spectrum Disorder aged between 5 and 7 years, who pursue their education or rehabilitation in specialized educational institutions.

Spatial delimitations: the study was conducted at certain schools and centers specialized in the care of children with ASD, in the municipalities of Ouled Fayet, Bni Aknoun, and Hydra.

Temporal delimitations: the study was conducted over a defined period during which the program based on sensory integration was applied and the pre-test and post-test were administered.

Objective delimitations: the study was confined to uncovering the effect of the program based on sensory integration in developing nonverbal communication skills — represented by eye contact, gestures, and joint attention — without addressing other aspects such as verbal communication or academic aspects.

11. Study Sample and Its Characteristics

The study sample consisted of a group of children with Autism Spectrum Disorder, numbering 20 children aged between 5 and 7 years, selected purposively from certain specialized educational institutions. The sample members were divided into two equivalent groups: an experimental group of 10 children that underwent the application of the program based on sensory integration, and a control group of 10 children that did not undergo this program but continued to receive the traditional educational methods.

In selecting the sample, a set of conditions was observed, namely the homogeneity of the children in terms of chronological age and ASD diagnosis, in addition to the proximity of their initial levels in nonverbal communication skills, with the aim of ensuring the equivalence of the two groups before applying the program — which allows the potential differences in the results to be attributed to the effect of the independent variable.

School / Center	Case	Gender	Age	Grade	Severity
Ouled Fayet	Case 1	Male	5	Primary	Mild
Ouled Fayet	Case 2	Male	7	Primary	Moderate
Ouled Fayet	Case 3	Female	5	Primary	Moderate
Ouled Fayet	Case 4	Female	6	Primary	Moderate
Ouled Fayet	Case 5	Female	5	Primary	Mild
Ouled Fayet	Case 6	Male	7	Primary	Mild
Hydra	Case 7	Male	6	Primary	Moderate
Hydra	Case 8	Male	5	Primary	Mild
Hydra	Case 9	Male	7	Primary	Mild
Hydra	Case 10	Male	7	Primary	Moderate
Hydra	Case 11	Male	6	Primary	Moderate
Hydra	Case 12	Male	7	Primary	Mild
Bni Aknoun	Case 13	Female	5	Primary	Moderate
Bni Aknoun	Case 14	Female	5	Primary	Mild
Bni Aknoun	Case 15	Female	6	Primary	Moderate
Bni Aknoun	Case 16	Male	5	Primary	Mild
Bni Aknoun	Case 17	Female	7	Primary	Moderate
Bni Aknoun	Case 18	Male	5	Primary	Mild
Bni Aknoun	Case 19	Female	5	Primary	Mild
Bni Aknoun	Case 20	Female	7	Primary	Moderate

12. Tools of the Study

This study relied on two main tools employed in accordance with the nature and objectives of the research. The first tool was a scale of nonverbal communication skills for children with Autism Spectrum Disorder, constructed in the light of the theoretical literature and previous studies. It comprises a set of items distributed across three main dimensions: eye contact, gestures, and joint attention. A graded (Likert) rating scale was adopted, allowing the child's level of performance to be determined precisely.

This scale was applied individually to each child under appropriate, distraction-free conditions, taking into account the behavioral and attentional characteristics of this group, through observing the child's behavior during guided interactive situations (such as responding to being called, gaze following, and pointing to objects). The application was carried out in two phases: a pre-test before applying the program and a post-test after its completion, in order to monitor the change in the level of nonverbal communication skills.

As for scoring the scale, a system was adopted that assigns scores to each response according to a defined gradient (for example: 0 = behavior not displayed, 1 = displayed sometimes, 2 = displayed often, 3 = displayed always), whereby the total score for each dimension is computed separately and then the overall score is derived to reflect the child's level of nonverbal communication. The higher the score, the better the level of performance. The results were entered into dedicated tables and processed statistically to compare the pre-test and post-test.

The second tool was a training program based on sensory integration, designed according to scientific foundations that take into account the characteristics of children with ASD. It included a set of organized sensorimotor activities targeting the activation of the various sensory systems (tactile, vestibular, and proprioceptive), through balance exercises, tactile-stimulation activities, interactive games, and motor-coordination exercises.

The program was applied to the members of the experimental group within an organized environment, according to a defined time plan (at a rate of two to three sessions per week, each session lasting from 30 to 45 minutes), with attention to a gradual presentation of activities, control of the application conditions, and consideration of individual differences among the children, with the aim of improving sensory regulation and enhancing attention and interaction — which is positively reflected in the development of their nonverbal communication skills.

13. Statistical Methods

The data obtained in this study were processed using a set of statistical methods suited to the nature of the quasi-experimental approach, relying on the appropriate statistical-analysis software. Descriptive statistics were used by computing the arithmetic means and standard deviations to describe the performance of the sample members in the pre-test and post-test of nonverbal communication skills in children with ASD.

Inferential statistics were also used through the paired-samples t-test to detect the differences between the pre-test and post-test within the same group, in addition to the independent-samples t-test to compare the mean scores of the experimental and control groups in the post-test, in order to verify the effect of the program based on sensory integration.

The significance level ($\alpha = 0.05$) was adopted for judging the significance of the differences, whereby the differences are considered statistically significant if the significance value is below this level — which makes it possible to confirm or reject the hypotheses posed in the study.

14. Field Observation

Through the field observation of the sample members of children with ASD, a clear weakness in nonverbal communication skills was noted during the pre-test phase, especially with regard to eye contact and joint attention, as most children avoided direct gaze and showed difficulty in following cues or interacting with others.

During the application of the program based on sensory integration, a gradual improvement was recorded in the responses of some children, through an increase in the duration of attention and in their participation in the proposed activities, with the beginning of the emergence of some forms of nonverbal interaction.

In the post-test phase, a relative improvement was observed in some indicators of nonverbal communication, especially eye contact and responsiveness to gestures, which reflects the effect of the program in developing this skill.

15. Presentation of the Study Results

After applying the program based on sensory integration to the members of the experimental group and processing the data obtained from the pre-test and post-test of nonverbal communication skills in children with ASD, the results yielded the following:

The pre-test results showed a convergence in the level of nonverbal communication skills between the members of the experimental and control groups, with the arithmetic mean of the experimental group reaching 12.40 against 12.10 for the control group, indicating the equivalence of the two groups before applying the program.

In the post-test, the experimental group recorded a marked improvement, with its arithmetic mean rising to 20.30, whereas the mean of the control group reached 13.20 — a slight improvement compared with the experimental group.

The results of the paired-samples t-test showed statistically significant differences between the pre-test and post-test of the experimental group at the significance level of 0.05, in favor of the post-test, indicating an improvement in nonverbal communication skills after applying the program.

Regarding the comparison between the two groups, the results of the independent-samples t-test showed statistically significant differences in the post-test between the experimental and control groups, in favor of the experimental group, indicating the effectiveness of the program based on sensory integration in improving nonverbal communication skills.

On the basis of these results, it may be stated that the intervention program contributed to developing some indicators of nonverbal communication, especially eye contact, gestures, and joint attention, which confirms the validity of the hypotheses from which the study set out.

Group	Measurement	Mean	Std. Deviation	t-value	Significance
Experimental	Pre-test	12.40	2.15	6.45	Significant at 0.05
Experimental	Post-test	20.30	2.80		
Control	Pre-test	12.10	2.05	1.25	Not significant
Control	Post-test	13.20	2.30		

16. Analysis and Discussion of the Results

16.1 Presentation of the Results

After applying the program based on sensory integration to the members of the experimental group, and conducting the pre-test and post-test of nonverbal communication skills (eye contact, gestures, and joint attention), the following results were obtained: a notable improvement was found in the mean scores of the experimental group in the post-test compared with the pre-test; by contrast, the control group recorded no significant changes between the two measurements; and the results further showed statistically significant differences at the level ($\alpha = 0.05$) between the two groups in the post-test, in favor of the experimental group. This indicates, in preliminary terms, the effectiveness of the program based on sensory integration in improving nonverbal communication skills in children with ASD.

16.2 Analysis of the Results

These results can be interpreted in the light of the nature of the program based on sensory integration, which relies on organizing sensory inputs (tactile, motor, and vestibular), improving attention and concentration, and enhancing responsiveness to social stimuli. The improvement recorded in the experimental group is attributed to the fact that the sensorimotor activities helped raise the children's level of sensory-neural regulation; this regulation, in turn, increased their readiness for social interaction, and consequently the indicators of nonverbal communication — namely eye contact, gestures, and joint attention — improved. Moreover, the absence of such improvement in the control group reinforces the conclusion that the change resulted from the program rather than from random factors.

16.3 Discussion of the Results

The results of this study are consistent with many theoretical orientations and previous studies that affirm the close relationship between sensory integration and nonverbal communication. The literature indicates that sensory-processing disorders directly affect attention and social interaction, and that improving sensory regulation contributes to facilitating the emergence of communicative behavior. These results may also be interpreted within the framework of Ayres' theory of sensory integration, which holds that when the brain organizes sensory information effectively, the individual becomes more capable of producing appropriate adaptive responses. This was indeed manifested in the improvement of the children's ability to direct their attention toward others and in their increased use of nonverbal cues during interaction.

16.4 Linking to the Previous Studies

The results reached in this study are in line with what many previous studies have confirmed regarding the close relationship between sensory integration and the development of nonverbal communication skills in children with Autism Spectrum Disorder.

The foundational study of Ayres (1972) indicates that the effective organization of sensory input is an essential condition for the emergence of adaptive behavior, which in turn forms a basis for the development of the various forms of interaction and communication, especially the nonverbal ones; the better the child's ability to process and organize sensory stimuli, the greater his ability to respond appropriately to the social environment.

These results also support the findings of Schaaf and Mailloux (2015), who confirmed the effectiveness of programs based on sensory integration in improving social interaction and joint attention in children with ASD — skills that are directly related to the manifestations of nonverbal communication.

Accordingly, the convergence between the results of this study and those of the previous studies enhances the credibility of the findings reached and supports the view that sensory integration should be incorporated within the rehabilitation programs directed at developing communication skills in this group.

17. General Interpretation of the Results

Based on the foregoing, it can be stated that sensory integration does not affect the sensory aspect alone, but rather extends to encompass the cognitive, behavioral, and communicative aspects, since it constitutes an essential basis for the emergence of interactive behavior in the child. Consequently, improving sensory processing entails improving the capacity for nonverbal communication.

18. Summary of the Discussion of Results

In the light of the results obtained, it can be affirmed that the program based on sensory integration proved its effectiveness in developing nonverbal communication skills; that the general hypothesis of the study was verified; and that the sub-hypothesis concerning the existence of statistically significant differences in favor of the post-test was likewise verified.

19. General Conclusion

In the light of the theoretical framework from which the study set out, and the field results reached through the quasi-experimental application, it can be affirmed that sensory integration represents an effective gateway to developing nonverbal communication skills in children with Autism Spectrum Disorder.

The results revealed statistically significant differences between the pre-test and post-test in favor of the experimental group, reflecting the positive effect of the program based on sensorimotor activities in improving the manifestations of nonverbal communication, particularly eye contact, gestures, and joint attention. This is explained by the capacity of these activities to enhance sensory-neural regulation, thereby raising the child's level of readiness to interact with his social environment.

These results also confirm that the deficit in nonverbal communication in children with ASD cannot be separated from sensory-processing disorders, but is functionally and directly linked to them — which makes interventions based on sensory integration a therapeutic and educational option of great importance. Consequently, improving sensory performance constitutes a fundamental gateway to improving social interaction and communicative behavior.

These results are consistent with the previous literature: Ayres' study (1972) confirmed that sensory regulation forms the basis of adaptive behavior, while the study by Schaaf and Mailloux (2015) highlighted the effectiveness of programs based on sensory integration in improving social interaction and joint attention in children with ASD — which supports the findings reached in this study.

This study has thus contributed to highlighting the importance of integrating the sensory dimension within the rehabilitation programs directed at this group, and of moving from traditional approaches that focus solely on the linguistic aspect to holistic approaches that take into account the nature of the disorder in its neural, sensory, and communicative dimensions. Finally, these results open the way for further studies that explore the effectiveness of diverse intervention programs based on sensory integration, with larger samples and multiple application settings, thereby contributing to the generalization of the results and the strengthening of evidence-based practices in the field of speech therapy and psycho-educational rehabilitation.

Conclusion

In concluding this study, it becomes clear that the topic of sensory integration constitutes one of the fundamental axes in understanding and interpreting the communicative difficulties of children with Autism Spectrum Disorder, especially in their nonverbal aspect, which is the first building block in the construction of social interaction. This study sought to explore the extent of the effectiveness of a program based on sensory integration in developing nonverbal communication skills, through a quasi-experimental approach that takes into account the developmental characteristics of this group.

The results obtained showed that intervention based on organized sensorimotor activities contributes tangibly to improving the indicators of nonverbal communication, confirming that the development of this type of communication cannot be achieved in isolation from improving the child's sensory regulation. Communication, in this context, is understood not merely as a process of symbolic exchange but as the product of a functional integration among neural, sensory, and behavioral processes.

The study also highlighted the importance of adopting holistic approaches in the care of children with ASD — approaches that take into account the overlap of the sensory, cognitive, and communicative dimensions and move away from the reductionism that confines the difficulty to its linguistic dimension alone. This calls for reconsidering the nature of the rehabilitation programs in use and orienting them toward strategies that are more integrated and more closely connected to the neural foundations of development.

From this standpoint, integrating sensory integration into speech-therapy and educational practices is not a supplementary option but a scientific and applied necessity dictated by the nature of the disorder and the specificity of this group. The results reached also open promising horizons for further scientific research, whether in developing more specialized intervention programs or in expanding the fields of application to include diverse educational and therapeutic contexts. This study thus remains an attempt to contribute to enriching scientific knowledge in the field of psycho-educational rehabilitation, and an affirmation that a deep understanding of the child begins with grasping how he interacts with the world sensorially, before seeking to develop the tools of communication with him.

Recommendations

- The necessity of integrating sensory-integration programs within the educational and rehabilitation plans directed at children with ASD, given their proven effect in improving interactive and communicative readiness.

- Working to educate and train specialists in speech therapy and special education to apply sensory-integration strategies in a scientific and systematic manner.
- Encouraging early intervention with children, since intervention in the first years of life contributes more substantially to improving the chances of developing communication skills.
- Strengthening integration among the various disciplines (speech therapy, psychology, occupational therapy) so as to ensure a holistic approach that takes into account the different dimensions of the disorder.
- Raising parents' awareness of the importance of sensory activities in daily life and involving them in the rehabilitation programs to ensure the continuity of intervention beyond the therapeutic setting.
- Conducting further studies that address sensory integration with larger samples and in different settings, focusing on other variables such as language and social interaction.

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