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Research Article

The Effectiveness of Imitative and HMTM Methods on Pragmatic Skills in Autistic Childrens

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Abstract

Introduction: Human growth is dependent on social interactions. As a significant part of the human entity, language plays a crucial role in this regard. Humans communicate through verbal and nonverbal languages. Conversational skills are the most important pragmatics skills, and children with autism spectrum disorder suffer from significant deficits in pragmatics, and because of this they face successive communication failures due to impaired pragmatic and conversational skills. Thus, developing treatment methods that focus on improving the conversational skills of these children is especially important. The aim of the present study was to compare the effectiveness of Holistic Multidimensional Treatment Model (HMTM) with the interventional method of reciprocal imitation and evaluating the function of pragmatic skills and the severity of this disorder in 60 Persian speaking children with autism aged 4 - 10. The participants were randomly divided into two groups. The first group consisted of 30 autistic children who received the interventional method of reciprocal imitation and the second group encompassed 30 autistic children undergoing the effectiveness of the Holistic Multidimensional Treatment Model HMTM (Hojjati Model) - a cybernetic-based approach -on enhancing the speech of children with autism.

Awareness of how this approach works and its effectiveness on improving language and social skills can be a guide for therapeutic protocols to improve the development of theory of mind in children with a variety of language disorders.

Methods: The present study had a Quasi experimental design. The instrument used in this study was the Children's Communication Checklist, 2nd ed. to measure the pragmatic skills and the Childhood Autism Rating Scale-Second Edition (CARS-2). All of these children were also evaluated by a child psychiatrist and a child neurologist and investigation was based on autism criteria and the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V). Eventually, the data were analyzed by independent t-test in R environment.

Results: A significant difference was observed between autistic subjects and standard scores, i.e. there was a significant difference ($p < 0.001$) between the scores of autistic subjects receiving reciprocal imitation training and those undergoing HMTM intervention.

Conclusion: By and large, it can be concluded that undergoing HMTM treatment method, can be effective in treating language disorder in children with autism.

Keywords: *Reciprocal Imitation Training; HMTM Treatment Method; Pragmatics; Autism*

Introduction

Autism Spectrum Disorder (ASD) is an advanced cognitive - communication disorder [1-3] which is a type of developmental disability which comes under the Individuals with Disabilities Education Act (IDEA) [4], significantly affecting verbal and nonverbal communication

and social interactions [5-7]. Seemingly, autism is caused by growth factors affecting all or a large part of the brain's functional systems and alters the process of brain development [8]. Neuroanatomic studies strongly suggest that these growth changes generate pathological events in the brain that strongly affect the brain's environmental factors. Autism is a biological disorder, though its related genes are not fully understood yet [9-12]. Disorder in social skills is the most well-known and fundamental feature of the autism spectrum disorder and probably the most enduring feature of this disorder as it lasts from childhood to adulthood [13]. Various theories and hypotheses existed and were raised regarding the etiology of this disorder. One of the well-known theories for the behavior-brain relationship in children with autism, which has been the subject of recent studies by scientists, is the theory of executive function, mainly related to the function of the frontal lobe of the brain and the prefrontal cortex; the condition which involves disorder in many social skills [14,15]. Behavioral problems identified by the theory refer to dry and uniform behaviors, weaknesses in initiating a new action, and a tendency to continue the previous action [16,17]. Other evident symptoms of autism may include loneliness, lack of interest in social relation, inability to properly present appropriate gestures, growth retardation, repetition or echolalia, pronoun inversion (using the pronoun "you" instead of "I"), monotonous sound and speech, stereotyped behaviors, emotional and cognitive problems, stereotyped behavior patterns, attentional deficit, cognitive limitations (weak to severe), and deficits in the theory of mind development [18,19]. The theory of the mirror neuron system has been raised regarding the neurology of autism, according to which, disorder in the mirror neuron system leads to problems in the imitation ability and ultimately to the emergence of communication and social deficits [20,21]. Another finding obtained in the studies of autistic children's nervous system is related to the neural network communication involved in emotional and social processes. In this regard, the brain imaging of autistic patients showed a specific pattern of signals in the cingulate cortex, varying from the normal pattern of function of this segment of the cortex [22].

Based on studies, several disorders influence inflammatory and immune-inflammatory factors in ASD. Decreased cytotoxic activity and increased levels of specific inflammatory cytokines produced by mononuclear blood cells play a role in disrupting the progress of neuronal development [23]. Some of the inflammatory molecules in the brain and cerebrospinal fluid in individuals with ASD is increased, including CCL8, MCP-1, TNF, IL-6, IL-1β (IL-8). It is proven that increased plasma level of IL-6, IL-8, and IL1β in autistic children is associated with abnormal behaviors and social disorders [24,25].

Neurobiological studies investigating the pathways involved in neuronal evolution, flexibility or synaptic plasticity, brain structural abnormalities, cognition and behavior indicated that studies have shown that social interactions as well as isolation are due to social brain activity [26]. The social brain consists of a network of brain areas including the amygdala, orbitofrontal cortex, the superior temporal gyrus, the medial prefrontal cortex, the anterior cingulate cortex, the temporoparietal cortex, the inferior frontal gyrus, the anterior insula, the hippocampus, and anterior temporal lobes and fusiform gyrus. The amygdala neurons are abnormally small in autistic subjects, and the effect of this is proven to be particularly prevalent in the amygdale [27]. Since the amygdala is recognized as a key element involved in socio-emotional behaviors, it is therefore a key and potential neuronal area in the pathophysiology of autism. Increased frontal growth as well as the presence of narrow and small columns in the frontal and temporal cortex are important in the pathogenesis of ASD [28,29]. MRI biomarkers in ASD indicate an increase in overall brain size, abnormalities such as an increase in white and gray matter in the frontal, temporal and cingulate areas, an increase in extra-axial brain fluid, amygdala enlargement, cortical thinning in the frontal and temporal lobe which are present in the brain system of autistic people [30,31].

Based on the research, the cries and phonemes produced by stimulation of the various nuclei of the limbic system, through after cingulate, the amygdala is the most active part of the limbic system in the production of sound, which has a special disorder in people with autism. According to the Diagnostic and Statistical Manual of Mental Disorders-5th edition (DSM-V), 50% of these children either fail to speak or have limited abilities in this regard [32,33]. Moreover, research suggests that a large number of emotional sounds in humans occur due to amygdala stimulation. The amygdala is also able to provide immediate responses because it is closely related to other auditory areas such as the thalamus and vestibular nuclei [34]. In humans, because the destruction of the right amygdala disrupts the ability to express rhythm, it can even disrupt the ability to understand and respond to social sounds [34,35]. Meanwhile, the abnormal electrophysiology

of people with autism is also associated with the cortical areas of the brain that handle auditory word processing. Over the past few decades, studies have indicated that in one-third of autistic patients, Serotonin levels of plasma increase with an upward trend. In addition, an increase in homovanillic acid and dopamine in cerebrospinal fluid is also associated with isolation and stereotyped behaviors [36,37].

Based on our studies, 25% of these children suffer language problems and furthermore boys are 4 to 5 times more likely to suffer from them than girls. Defect in speech perception, auditory agnosia, inability in decoding the speech of others, inability to express thoughts verbally, defect in using correct and efficient vocabulary in conversations, weaknesses in nonverbal cognitive abilities, and word finding skills and expressive language are among the most important defects [38,39].

The brain's motor mechanisms-speech relationship is one of the most fundamental issues regarding language and its external manifestation, namely speech. The fact that a child can pronounce words correctly or knows adequate vocabulary, does not mean that they are able to correctly use the language, because they will have problems communicating with others if they do not know the pragmatics i.e. the rules of social use of language. Conversational skills are one of the most important pragmatic skills of language. Many children with autism display deficits in conversational skills, and these significant deficiencies in verbal and nonverbal communication lead to problems in social participation and maintenance of social relationships. According to studies, electroencephalogram oscillations at the frequency of 8 - 13 Hz (alpha waves) in the sensory-motor cortex of the brain reflect the function of mirror neurons, which is clearly evident in autistic patients [40-46].

It is difficult to assess the pragmatic ability for a number of reasons, one because pragmatics and behavior depend on the context [47]. Since language development varies across cultures [48], one needs to be aware of the natural developmental process in the same language in order to accurately and fully assess children [46-48].

The question now arises as to what the pragmatic ability of these children is? And is there a difference between the speech of autistic children who received the interventional method of reciprocal imitation and the second group encompassed 30 autistic children undergoing the effectiveness of the Holistic Multidimensional Treatment Model HMTM (Hojjati Model)? In addition, does the HMTM approach affect the speech recovery process in autistic children?

Since most pragmatic studies have focused on English children with autism [45-47], the need for studies that investigate the use of pragmatics in children with different cultural and linguistic backgrounds is important [47] because the use of pragmatics is affected by linguistic and cultural factors of the community and the place where the study is being conducted [48].

What led to the effectuation of the present study was the absence of a specific interventional research on pragmatic skills in Persian-speaking children, which is the difference of this study from previous studies.

Considering the above, the present study investigates the pragmatic skills of 60 autistic children aged 4 - 10 compared to 30 normal children.

Materials and Methods

Study design and population

This one-stage research was a cross-sectional comparative study, and over a period of 3-months, the pragmatic ability was assessed in two groups, namely children with autism. The subjects of the present study were 30 girls with autism and 30 boys of Noore hedayat school of Mashhad.

The autistic subjects all underwent language training based on HMTM and imitation method.

Methods

Overall, 60 autistic children met the inclusion criteria for entering the study, and they were randomly selected from Noor-e Hedayat training center in Mashhad, Iran.

The inclusion criteria were:

- Being aged 4 - 10 years old,
- Suffering from autism,
- Having the ability to generate sentences,
- Having a normal hearing threshold (based on the results of the audiometric test), and
- Having sufficient visibility (based on an optometrist's opinion).

Measuring tools: Laboratory measurements

With respect to these criteria, various physicians, including a pediatric psychiatrist and pediatric neurologist, selected children diagnosed with autism and then the autism criteria were investigated based on the Diagnostic and Statistical Manual of Mental Disorders-5th Edition (DSM-V) by observing the child and interviewing parents and then finally children with inclusion criteria were selected considering the results [49].

Inclusion and exclusion criteria

To better understand the disorders of each of the autistic subjects, the assessment test of CARS-2 [50] was first administered and then to assess the disorder in each skill based on the Children's Communication Checklist, 2nd Ed [51]. Values less than 0.001 were considered significant.

Children's communication checklist, 2nd Edition

It was designed by Bishop in 1998 and its validity and reliability were confirmed in Farsi [51,52]. The checklist consists of 70 questions that should be completed by the child's instructor or parent in 15 - 20 minutes and includes 10 sub-categories of semantics, syntax, speech, coherence, inappropriate initiation, use of context, stereotyped language, nonverbal communication, social relation, and interests to investigate the pragmatic skills in the age group 4 - 16 who can make sentences. Each question has a positive or negative load in terms of linguistic and social abilities. Each of the sub-category questions has 4 options for answering, and considering the frequency of questioned behavior observed in the child, the question sheet was filled in by the parent or the child's instructor [53,54].

Since most pragmatic studies have focused on English children with autism [45-47], the need for studies that investigate the use of pragmatics in children with different cultural and linguistic backgrounds is important [47] because the use of pragmatics is affected by linguistic and cultural factors of the community and the place where the study is being conducted [48].

What led to the effectuation of the present study was the absence of a specific interventional research on pragmatic skills in Persian-speaking children, which is the difference of this study from previous studies. In accessing interventions focusing on these skills within the framework of cognitive model, it is expected that communication failures in autistic children also decrease [55,56]. Thus, the present study aims at evaluating the effectiveness of a treatment focused on pragmatic and conversational skills in 4 - 10 year old girls with autism.

Ethical consideration

The Legal and Intellectual Property Affairs Committee of the Ministry of Culture and Islamic Guidance approved the HMTM Model (Holistic Multidimensional Treatment Model) and it was registered by number 17505.

Treatment

Holistic multidimensional treatment model (HMTM) (Hojjati Model) [55-58]

This new approach called the holistic and multi-dimensional approach inspired by holistic philosophy in the 8 principles in the treatment of disorders in the autism spectrum. This approach has 8 elements: (1) Emphasis on the holistic view to the child (the holistic principle), (2) emphasis on the part-whole relationship and its inseparable mutual effect (the interaction principle), (3) emphasis on the principle of energy exchange and deep communication and emotional security and unconditional acceptance of children by the family, instructors and therapists (field principle), (4) emphasis on child physiology (physiology principle), (5) emphasis on movement and perception, (6) emphasis on speech and language, (7) emphasis on the emotional, communicative, and game dimensions, (8) emphasis on the use of educational techniques and content based on the growth evolution process in group and in parallel.

According to the cybernetic approach governing the HMTM model, this model is based on the premise that all aspects of human existence are interdependent and indivisible, and that the child should be considered as a whole with various aspects such as: Physical, emotional and cognitive aspects which should be addressed in parallel and simultaneously. According to this philosophy and approach, each cell alone has a thought that can only function in the form of one organ, and ultimately one body, while, its existence depends on the whole body or organ.

Based on the HMTM view, the purpose of speech is not merely to express words or sentences or to make a child speak. Speech is not just the expression of words, it is the most important way of communicating with the outside world and the social environment and cybernetic information lies in the whole sentence and the interaction between words.

Since after passing through the domain of sense, every message must move into the domain of perception and then into the domain of cognition, this approach is based on the principle that the real learning will not be formed until complete understanding is achieved. Since improving and correcting movements will directly affect the domain of perception and brain processing and its speed, hence correct and semantic perception of messages delivered to the brain will ultimately improve brain processing and cognition.

In HMTM, it is believed that because human beings are naturally social beings, then the child with a disorder has the ability to perceive, learn, consolidate, and generalize what is learned in the social environment and from their peers, and what, in this model, contributes to the success and closeness of these children to the normal spectrum is how to plan, spend time, and parallelize with respect to all the needs of an autistic child. Thus, this method has taken into account to practice and reinforce the various lessons learned in the group and apply the services individually only in specific treatments such as speech therapy, occupational therapy or individual training.

In the Holistic Multidimensional Treatment Model (HMTM/ Hojjati Model), the child is examined in basic cognitive concepts, and after cognitive and clinical assessments, based on the severity of the level of disorder, the child is placed individually or in groups of two, three, four, five or six people. The time spent on each child in the institute is also 5 hours and the length of attending individual programs varies from several days to weeks or months [55-58].

Imitation training

The reciprocal imitation training is a naturalistic method which its main emphasis is put on the social role of imitation in classical behaviors as well as other educational programs. In reciprocal imitation training, the overall interaction with the therapist or the child's

parents increases. Toys are also selected based on the child's interest which are placed in a periodic cycle every 20 minutes or more. The basics of reciprocal imitation training method rely on that the therapist imitates all of the child's gestures, words, and actions using his/her toys [59].

Imitation of the child is considered as a major task for reciprocal imitation training. The studies conducted on reciprocal imitation training reveal that this method increases such social and communication skills as social interaction, language, pretend play and use of body movements [60,61].

Data analysis

This Quasi experimental study was conducted on 60 children aged 4 - 10 with a mean age of 6.2% (30 boys and 30 girls). The participants were randomly divided into two groups. The first group consisted of 30 autistic children who received the interventional method of reciprocal imitation and the second group encompassed 30 autistic children undergoing HMTM treatment. As seen in the following tables, there was a significant difference between the scores of HMTM intervention (Table 2) and imitation subjects (Table 4) ($p < 0.001$).

Autistic Children	Mean	SD
Semantics section	0.10	0.08
Syntax section	0.10	0.10
Speech section	0.14	0.10
Inadequate section	0.15	0.10
Echolalia section	0.20	0.10
Unclassified section	0.20	0.10
Use of context section	0.10	0.10
Nonverbal communication section	0.22	0.11
social relation section	0.17	0.11
Interests section	0.18	0.11

Table 1: *Examination of the function children with autism- HMTM Method (pre test).*

Autistic Children	Mean	SD	t-test	P-value
Semantics section	0.60	0.11	2.750	0.005
Syntax section	0.75	0.13	2.974	0.001
Speech section	0.50	0.12	0.995	0.005
Inadequate section	0.67	0.13	0.516	0.001
Echolalia section	0.63	0.11	2.767	0.003
Unclassified section	0.75	0.9	2.140	0.005
Use of context section	0.63	0.14	1.266	0.002
Nonverbal communication section	0.50	0.11	1.876	0.001
Social relation section	0.50	0.10	1.481	0.004
Interests section	0.57	0.17	1.654	0.005

Table 2*: Examination of the function of children with autism- HMTM Method (post test).*

Autistic Children	Mean	SD
Semantics section	0.10	0.09
Syntax section	0.10	0.10
Speech section	0.15	0.11
Inadequate section	0.21	0.11
Echolalia section	0.20	0.10
Unclassified section	0.19	0.11
Use of context section	0.25	0.10
Nonverbal communication section	0.18	0.10
social relation section	0.17	0.10
Interests section	1.00	0.11

Table 3: *Examination of the function of children with autism-imitative method (pre test).*

Autistic Children	Mean	SD	t-test	P-value
Semantics section	0.43	0.9	3.570	0.02
Syntax section	0.65	12	1.174	0.01
Speech section	0.48	0.11	0.991	0.05
Inadequate section	0.65	0.12	0.615	0.03
Echolalia section	0.63	0.11	2.676	0.03
Unclassified section	0.50	0.11	1.620	0.02
Use of context section	0.36	0.14	1.662	0.02
Nonverbal communication section	0.40	0.11	1.786	0.01
Social relation section	0.23	0.10	1.381	0.04
Interests section	0.47	0.11	0.15	0.05

Table 4: *Examination of the function of children with autism-imitative method (post test).*

Results

There is a difference between the mean scores of pragmatic subscales in the Children's Communication Checklist, 2nd ed. and the subjects' scores ($p < 0.001$). The results also indicated that the subjects' language development improved gradually and during treatment. Research findings suggest that interventional exercises for autistic children with serious weakness in pragmatic skills can be effective in improving their speech. According to the statistical tests and test scores in different groups, it can be said that the interventional periods and the length of the HMTM intervention period lead to growth changes that lead to the increase of abilities over time, and have a particular effect on the research findings.

Accordingly, the charts recorded in this study (Figure 1-10) indicate the effectiveness of the above method in the research subjects and may confirm the need for a greater emphasis on the desirable effectiveness of the HMTM approach on improving language comprehension and production in autistic children.

Figure 1: *The procedure of semantic skills growth.*

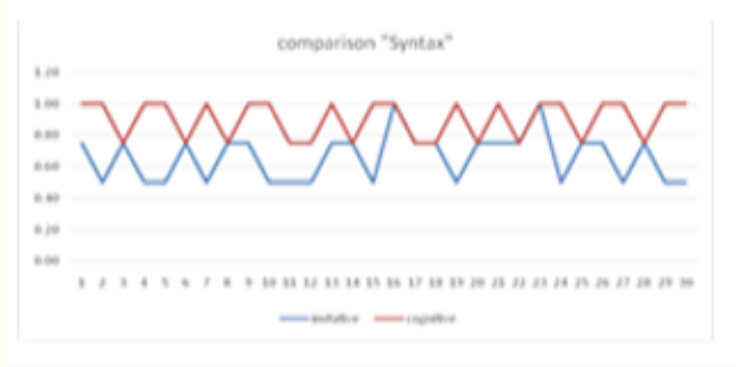

Figure 2: *The procedure of syntax skills growth.*

Figure 3: *The procedure of speech skills growth.*

Figure 4: *The procedure of unclassified skills growth.*

Figure 5: *The procedure of echolalia skills growth.*

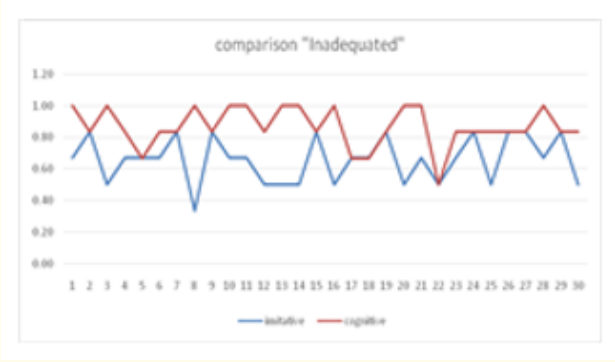

Figure 6: *The procedure of inadequated skills growth.*

Figure 7: *The procedure of use of context skills growth.*

Figure 8: *The procedure of nonverbal communication skills growth.*

Figure 9: *The procedure of social relations skills growth.*

Figure 10: *The procedure of interests skills growth.*

Discussion

The findings of the present study acknowledge that previous studies in the field of autistic children's brains suggest that motor and gesture imaging exercises can be helpful in improving the functions of the mirror neuron system. This can facilitate verbal, speech, production and pragmatic skills in autistic children [19-22].

Consistent with previous studies in other languages, the findings of the present study indicate a significant disorder in the pragmatic and social skills of autistic children and child communication could be improved by providing focused therapies within the cognitive approach. Their performance in the field of structure (syntax, semantics and speech) is quite similar to that of normal children. In the field of semantics, these children are able to correctly classify objects and animals into semantic groups, but have difficulty understanding and perceiving abstract and cognitive vocabulary. Also, these children experienced difficulties in constructs related to the questions with question word, reciprocal pronouns, passive constructs, tense, mood and aspect. The significant difference between the two groups of autistic and normal children in this study is also consistent with the previous research [62,63]. Children with autism also suffer from profound disorders in terms of pragmatics, i.e. appropriate language use in social and communication contexts [64,65]. Difficulties in communicating and practicing language are among the disorders that occur in all children with autism spectrum [66,67]. According to the research, these children have a major problem in the field of pragmatism which is related to the violation of presupposition, violation of the Grice principles, including Maxim of Quantity, Maxim of quality, Maxim of Relevance, and Maxim of Manner. These children do not observe speech acts such as asking, ordering or informing. In addition, these children also have difficulty adhering to the Conversational Principle and initiating a conversation. They also fail to participate in a conversation initiated by someone else. Problems seen in these children include lack of politeness, lack of continuing the subject matter, and lack of turn taking in conversation. These people do not adhere to the Grice' s Cooperative Principle and ignore the principle of quantity in conversation. These cases make the speech of these children seem vague and irrelevant to others in a linguistic context [68-70].

Awareness of how this approach works and its effectiveness on improving language and social skills can be a guide for therapeutic protocols to improve the development of theory of mind in children with a variety of language disorders.

Conclusion

Accordingly, the tables recorded in this study indicate the effectiveness of the above method in the research subjects and may confirm the need for a greater emphasis on the desirable effectiveness of the HMTM approach on improving language comprehension and production in autistic children.

Considering the previous research and the cognitive theory, the findings support the relationship between limb movement, particularly the use of gestures to improve verbal information retrieval. Speech is also the most important means of communicating with the outside world and the social environment, supports cybernetic information and that the whole sentence lies in the interaction between words, and thus is consistent with previous research findings. Based on the findings of the present study, autistic children suffer significant weaknesses in nonverbal and gestural skills and received and expressive verbal skills and that interventional experiences parallel to the HMTM model can be effective in improving the speech of such people. Therefore, it can be said that the HMTM approach can be an appropriate applied approach in treating these children.

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