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## Original Article

# The effectiveness of Kephart's motor-perception skills training on executive functions of children with autism spectrum disorders

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## Abstract

One of the new treatment methods studied and applied by a majority of researchers of autism is body and movement centering methodology. The purpose of this study was to investigate the effectiveness of Kephart's motor-perception skills training on executive functioning of children with autism spectrum disorders. The research method was quasi-experimental with pre-test-post-test design applied on two experimental and control groups. The population consisted of all children aged 5-18 years old with autism in Arak city in 2019, 30 of whom were selected through the availability sampling. They were randomly assigned to experimental and control groups. The experimental group participated in Kephart's motor-perception skills training during twelve 12 (three sessions per week), each session for two hours, and no intervention was performed in the control group. The instrument was the Behavior Rating Inventory of Executive Function (BRIEF). The data were analyzed using covariance analysis by SPSS software. Testing the hypothesis of the research, the effectiveness of Kephart's motor-perception skills training on executive functioning of children with autism spectrum disorders showed that performing Kephart's training had a significant effect ($p < 0.05$) on improving the executive functions of children with autism spectrum dysfunction. Therefore, as the students in the upper grades are incompatible with aspects of emotional regulation, this interaction leads to a much greater impact on their emotional problems.

## Keywords

Autism spectrum disorders
Kephart's motor-perception skills training
Executive functioning

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## Introduction

Autism is known as a neuro-developmental disorder through which patients demonstrate a majority of deficits in social interactions and relationships as well as a pattern of behaviors, interests, repetitious activities, or clichés in one to two years (American Psychiatric Association, 2013). In 2010, the contagion of this disorder was estimated at around 0.76% of the public (Baxter et al., 2015). The findings illustrate the importance of early detection and intervention for improving medical resultant in children with autism (Woods & Wetherby, 2003). Recorded videos in early childhood (Baranek, 1999), parents' reports (Landa & Garrett-Mayer, 2006; Watson, Baranek, Crais, Reznick, Dykstra et al., 2007), and recent studies of these children's sibling(s) (Mitchell, Brian, Zwaigenbaum, Roberts, Szatmari et al., 2006) deployed aligned results in early disorder symptoms, appearing in the early second year of age. The most common symptom in the early stage reported by the parents was the delay in their child's speech development (De Giacomo & Fombonne, 1998). The more comprehensive researches, however, indicated that the delay in non-verbal interactions and relationship development before the delay in speech development, leading to disorder detection, is recognizable. This disorder encompasses a pile of extensive properties in different areas such as behavior and activity, skills, social interactions and relationships, and development (Richler, Huerta, Bishop, & Lord, 2010). Furthermore, the behavioral properties which clearly can distinguish autistic children and developmental delay from normal children involved the mutual attention and emotional-sentimental interaction (Osterling & Dawson, 1994; Wetherby, Woods, Allen, Cleary, Dickinson & Lord, 2004). The other properties embraced repetitious behaviors and clichés involving a wide range of certain behaviors and gestures, even behavioral traits determined

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by the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Richler et al., 2010). Another deficit in this disorder was considered to be the deficit in social interactions, including disability in friendship, romance, daily living, and career and academic success (Barnhill, 2007). Finally, the third and last range of deficits in this disorder involved disability in communication skills, mainly encompassing deficits in joint attention and social interaction, attention to spoken language symptoms, and poor skills in non-verbal communication such as lack of eye contact, gestures, and meaningful facial expressions (Kasari, Brady, Lord, & Tager-Flusberg, 2013; Ross & Kasper, 2013). All of these components caused impairment in the individual's performance during educational processes, lack of communication and, consequently, social isolation as well as a higher level of family stress; providing therapeutic solutions and eliminating destructive factors, therefore, can be essential (Eldevik, Hastings, Hughes, Jahr, Eikeseth & Cross 2009).

There was no single definition of executive functions that have been accepted by all researchers, but there was an agreement that executive functions encompassed all processes involved in decision making (Lezak, Howieson, Loring, & Fischer, 2004). The executive functions are a set of cognitive processes that play an important role in cognitive-behavioral control, selection, and optimal management of behaviors to achieve a goal, and basic cognitive processes such as attention control, cognitive inhibition, inhibition control, working memory, and cognitive flexibility (Malenka, Nestler, & Hyman, 2009). These executive functions changed and developed over the individual's life, which was capable of being improved at any time of life, being influenced by all the factors affecting the individual (Diamond, 2013). Inhibition control and working memory, as the basic and key executive functions, provided the chance of developing more complex executive processes such as problem-solving (Senn, Espy, & Kaufmann, 2004 ). These two functions were of the earliest executive functions that appeared in early manifestations of the infant aged around 7 to 12 months, furthermore, a mutation was observed in their performance in preschool age, i.e. 3 to 5 years old (Best, Miller, & Jones, 2009 ). During this age and simultaneously with this mutation, cognitive flexibility, purposeful behaviors and planning also begin to develop (De Luca & Leventer, 2010). There are comprehensive debates about the nature of executive functions in autism spectrum disorder. Studies have demonstrated that during the autism spectrum disorder, there was the probability of normal and abnormal developments of executive functions (Luna, Doll, Hegedus, Minshew, & Sweeney, 2007). The executive functional disorders of individuals with autism spectrum disorder would consistently appear in their school period, adolescence, and adulthood, and are accounted for being of the most important aspects of this disorder (Ozonoff, Pennington, & Rogers, 1991). Recent structural and functional imaging along with neuropsychological and psychopathological studies have provided decisive and strong empirical supports for implying the participation of the frontal cortex in autism disorder (Ozonoff et al., 2004). Studies comparing children with autism spectrum disorder (autism and Asperger syndrome) with age- and IQ-matched control groups demonstrated some deficits in executive functioning in autistic children (Happé, Booth, Charlton, & Hughes, 2006). Also, inspecting the studies of explicit evaluating of executive skills such as planning, mental flexibility, inhibition, fertility, and self-assessment in autistic children compared to the same control group or the standardized test data indicated deficit in all of the stated areas in affected individuals (Hill, 2004).

Kephart's view of perceptual-motor development was based on a precise analysis of perceptual development and the structuring of learning (Neeman, 1973). This view had two fundamental principles, firstly, if the visual-motor abilities don' become the most essential basis in cognitive development, they won't play, at least, a very significant role; and secondly, the visual-perceptual-motor processes can be taught and transferred to the children (Goodman & Hammill, 1973). Kephart has adjusted his view in such a way that its activities and processes can be used to modify some deficits and disorders. Kephart believed that children need more extensive communications and relationships between perceptual and motor information and that many children at their early ages do not properly pass this process (Seif Naraghi & Naderi, 2006). Furthermore, in a research, it has been shown that physical exercise is related to the reverse recall of active memory compounds and can explain 30% of the variance changes in active memory. Also, based on the results of this research, physical exercise improves children's ability in executive functions such as planning and organization, concentration and attention (Dahlin, 2019). Also, Evans and colleagues (2018) showed that motor skills training reduces hyperactivity disorder and improves psychological, physical, and emotional well-being.

## Method

### *Participants*

This research was applied, semi-experimental study research involving a pre-test-post-test design with the control group. The statistical population included all children and teenagers with autism spectrum disorder referred to the Rezvan Autism Charity Center of Markazi province in 2019. This study aimed to investigate the effectiveness of Kephart's perceptual-motor training exercises on executive functions of children with an autism spectrum disorder. After the diagnostic interview and considering the minimum size of the experimental and control groups in the semi-experimental research (Isaac & Michael, 1995), 30 clients with entry criteria, volunteering to participate in the study, were randomly assigned into two groups (15 as experimental group and 15 as Control group). The inclusion criteria were: Autism diagnostic scale based on DSM-5, aged around 5-18 years, and consent form filled in by parents. Exclusion criteria, besides, included the comorbidity of other physical and mental disorders, and child or the parents not participating and co-operating in the rest of the treatment.

## Instrument

### *The Behavior Rating Inventory of Executive Function (BRIEF) (the parent form):*

It was developed by Gioia, Isquith, Guy, and Kenworthy (2000). The questionnaire had two forms for teachers and parents, including 86 questions designed to behaviorally interpret the children's and teenagers' (5 to 18 years old) executive functions, and scaled from 1 to 3 based on the children sever conditions labeled as 'never', 'sometimes', and 'always' respectively; parents examined the child's behaviors the school or home to answer the questions. It took around 10 to 15 minutes to complete this form. The target population includes neurodevelopmental disorders (Attention deficit hyperactivity disorder (ADHD), autism spectrum disorder, reading disorder, Tourette's syndrome, mental retardation, and brain injury). The questionnaire was scored on a Likert scale. This questionnaire was a valid and reliable test, assessing the executive functions and, among other questionnaires related to executive performance, was highly valuable as it measures people's behavior in real-life (Memisevic & Sinanovic, 2013). Each question was related to one of the questionnaire's subsets which were classified into two main behavioral regulatory skills and metacognitive skills categories, as follows:

A. Behavioral regulatory skills: inhibition, shift, emotional control

B. Metacognitive skills: planning, organization of materials, monitoring, working memory, initiating

The validity coefficient of this questionnaire for clinical cases in the parents' form was 0.82-0.98, and when the questionnaire was used for normal population evaluation, it was calculated to be 0.80-0.97. Questionnaire validity and reliability were examined in this study, and consequently, the stability coefficient of subscales test-retest of a behavioral rating scale for each executive function was determined as follows: inhibition 0.90, orientation 0.81, emotional control 0.91, initiation 0.80, active memory 0.71, planning 0.81, organization of materials 0.79, monitoring 0.78, behavioral regulation index 0.90, metacognition index 0.87; additionally, the overall executive functions score was 0.89. The internal consistency coefficient of this questionnaire was ranged from 0.87 to 0.94, indicating high internal consistency for all subscales of the questionnaire (Nodei, Sarami, & Keramati, 2016).

### *Procedure*

This study aimed to investigate the effectiveness of Kephart's perceptual-motor training exercises on executive functions of children with an autism spectrum disorder. At the pre-test stage, the participants' initial states and behaviors were, primarily, observed, assessed, and evaluated, therefore, the questionnaires were completed. Secondly, the intervention process was carried out weekly; the participants' behavior in each group was, finally, reviewed and analyzed, followed by completion of the questionnaires.

The training sessions were set up over 12 weeks (two sessions per week) and each session lasted for 2 hours (Table 1). During the first two sessions, intensive interaction was used to communicate children and make them calm. Furthermore, after adjusting the programs, the Kephart method was implemented as implied in Table 1. The central theme of this theory was that normal perceptual-motor development can help the child perceive a stable and reliable concept of the world he or she was living in. The ANCOVA (analysis of covariance) test, along with omitting pre-test effects, was used for observing the groups. Before this test, the assumptions of the score distribution normality were performed using the Kolmogorov–Smirnov test, with a probability value greater than 0.05, indicating the normality of the data. Also, to investigate the homogeneity of the regression line slope, the distribution graph indicated no interaction between the covariate variation and intervention as well as the same slope for the two lines; the probability value was determined greater than 0.05 in the Levene's test, representing the equal variances. Implementing the covariance analysis test was permissible due to the non-violation of the stated assumptions. The data were, finally, analyzed through the covariance analysis method using SPSS software at a significant level of 0.05. Also, the principles of professional ethics, patient's consent, the confidentiality of the information and willing participation were respected. Participation in this research was completely voluntary and participants were informed about the objectives of this research and their consent was obtained using a consent form.

**Kephart's session's description**

| Sessions | Description |
|---|---|
| First: Gross motor skills | Make the child move toward a certain target through a direct or curved path. |
| | He or she moves back through the same path. |
| | Cross crawl; the child moves forward by putting his or her foot next to the opposite hand, orienting his or her eyes and head in the hand direction. |
| | Draw curved, edged, or maze lines on the floor. Have the child move along these lines. |
| | Hopping; ask the child was asked to take off on one foot and change the foot after several jumps. |
| | Hoop rolling; it is done using multi-sized hoops. |

| | |
|---|---|
| | Rope activities; ask the child to wrap his or her different limbs or other objects in a rope. |
| Second: Fine motor skills | Throwing and catching exercises: Throwing objects by the trainer and the child, and catching merely by the child. |
| | Exercises for consistency among eyes and hands: Trace drawing; the child is asked to draw pictures, drawings, numbers, and sentences through air or ground tracing lines. Cutting by scissor; handworks; the child is required to draw geometric shapes on paper, wood, or cardboard and cut them. Playing with puppets; copying the drawings. |
| | Exercises on a blackboard: Dot activity; the child should connect the dots on the board by lines. Drawing circles, geometric shapes, letters, and numbers; the child tries witting letters and numbers on the board. |
| | Eye movement exercises: Retraining the eye-tracking; the child should track the moving objects with the eyes. Finger and flashlight; ask the child to follow the light by eye and finger. Moving ball; have the child pay attention to a circling ball. |
| | Training with fine motor skills developing tools: Stringing beads; cutting by scissor; playing with dough; coloring; buttoning and unbuttoning; zipping and unzipping; stringing a needle; painting; drawing; etc. |
| Third: Visual-motor consistency | The child is asked to frequently hit the ground with a ball by his or her hand, or a racket without losing the ball. |
| | Playing with sand; splashing water on the face; unloading. |
| | Construction games |
| | Stringing needles; stringing and threading beads. |
| | Cutting and gluing different shapes |
| | Playing games with hands and fingers while singing a song. |
| Forth: Body balance | Increasing and improving centers of gravity in the body (such as lifting arms, etc.) |
| | Increasing bearing period (such as standing on feet by 20 seconds) |
| | Decreasing visual control (i.e. eyes to be closed while exercising body balance) |
| | Doing head movements and exercises |
| | Diversifying various bearing planes (such as standing on different planes) |
| | Jogging |
| | Slow-walking |
| | Catching ball |
| Fifth: Breathing exercises | The child should lie down on back and breath, at the same time s/he must put her or his hands on the chest to feel its contraction and retraction. |
| | Repeating these exercises while sitting and standing. |
| | Have the child Expel the air from the lungs through his or her mouth; it is recommended to provide the child with a mirror so s/he can see the fog. |
| | Blowing |
| | Blowing a balloon up |
| | Whistling |
| | Playing harmonica |
| Sixth: Body design | The parts of the body are names and touched. |
| | Imitating the act of washing hands and face |
| | Playing statues: Strike different poses and stay frozen. |
| | Massaging one hand with another |
| | Bending the knees |
| | Striking different poses |
| | Drawing the body parts and naming them |
| | Recognizing different parts of the body |
| Seventh: Lateral preference | Teach the child to align, see, and write from right to left. |
| | Ask the child to put one hand on the table and put another hand on it. |
| | Throwing a ball |
| | Toothbrushing |
| | Placing matchsticks inside a matchbox |
| | Shooting a ball by merely one foot |
| | Jumping by one foot |
| | Going up on a chair |
| | Ask the child to close one eye. |
| | Ask the child to look at a landscape through a rounded paper with 2 cm diameters and 30 cm length. |
| Eighth | Repeating these activities in further sessions |

## Results

The Table 1 represents the statistical description of standard deviation and mean for executive functions scores in two measuring stages (pre-test and post-test) separately for both control and experimental groups. As indicated, the mean scores in the control group in pre-test and post-test stages implied no significant change although, in the post-test, more increase in scores is observed compared to the previous stage. To investigate the effectiveness of Kephart's perceptual-motor on autistic children's executive functions, a multivariate covariance analysis (MANCOVA) test was implemented. Before this test, the statistical assumptions for scores distribution normality were evaluated by Kolmogorov–Smirnov test, homogeneity of covariances matrix by the Box test, and homogeneity of variances by the Levene's test. It is advisable to use multivariate covariance analysis since the stated assumptions were not violated.

**Table 1.** The statistical description of executive functions scores in two measuring stages separately for both control and experimental groups

| | | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| **Group** | Variable | Mean | Standard deviation | Mean | Standard deviation |
| **Control** | Inhibition | 18.021 | 3.0984 | 18.467 | 3.1728 |
| | Shift | 16.267 | 2.8999 | 16.733 | 2.5275 |
| | Emotional control | 19.333 | 3.4614 | 19.833 | 2.8814 |
| | Planning | 20.217 | 2.6150 | 20.750 | 2.2615 |
| | Organization of materials | 19.760 | 6.6311 | 20.360 | 6.1085 |
| | Monitoring | 22.167 | 3.6227 | 22.833 | 3.3566 |
| | Working memory | 14.063 | 2.5964 | 14.883 | 2.7115 |
| | Initiating | 15.517 | 3.8999 | 16.583 | 3.5790 |
| **Experiment** | Inhibition | 19.533 | 3.0394 | 21.773 | 3.2616 |
| | Shift | 16.467 | 3.7161 | 18.920 | 4.1869 |
| | Emotional control | 18.873 | 4.4169 | 21.073 | 4.1694 |
| | Planning | 20.617 | 2.5486 | 23.083 | 3.1861 |
| | Organization of materials | 21.960 | 4.9019 | 23.553 | 4.4080 |
| | Monitoring | 22.633 | 3.1773 | 25.513 | 2.9437 |
| | Working memory | 13.483 | 2.5598 | 15.883 | 3.0925 |
| | Initiating | 15.917 | 4.7759 | 18.690 | 4.4729 |

As indicated in table 2, the significant level for Box's test is 0.415. Since this value is greater than the significance level (0.05) needed to reject the null hypothesis, our null hypothesis, which is based on the homogeneity of the covariances matrix, is confirmed.

**Table 2.** The (Box) test results for homogeneity of covariances matrix

| Box's | F | df1 | df2 | Significant level |
|---|---|---|---|---|
| 54.139 | 1.033 | 36 | 2638.045 | 0.415 |

*Note. 'df' is degree of freedom*

As demonstrated in table 3, the Levene's test results were not significant for any variables. Therefore, our null hypothesis based on the homogeneity of variances can be confirmed.

**Table 3.** The Levene's test results for investigating homogeneity of variances

| Variable | F | df1 | df2 | Significant level |
|---|---|---|---|---|
| Inhibition | 0.399 | 1 | 28 | 0.533 |
| Shift | 0.438 | 1 | 28 | 0.514 |
| Emotional control | 0.449 | 1 | 28 | 0.508 |
| Planning | 0.720 | 1 | 28 | 0.403 |
| Organization of materials | 0.225 | 1 | 28 | 0.639 |
| Monitoring | 1.055 | 1 | 28 | 0.313 |
| Working memory | 2.644 | 1 | 28 | 0.115 |
| Initiating | 0.915 | 1 | 28 | 0.347 |

*Note. 'df' is degree of freedom.*

As indicated, the significance level of all four relevant multivariate statistics, i.e. Pillais trace, Wilks' Lambda, Hotelling effect, and Roy's Largest Root, was less than 0.05 ($p < 0.05$). Hence, the statistical null hypothesis was rejected and it showed a significant difference between the executive functions of both experimental and control groups in the post-test. Therefore, it can be stated that Kephart's perceptual-motor training has been effective in autistic children's executive functions. To examine the differences between the experimental and control groups in terms of their executive functions, the between-subject effects test was used; the results are presented below.

**Table 4.** The multivariate covariance analysis results for executive functions comparison between control and experimental groups

| *effect* | tests | Values | F | effect df | error df | Significant level | Effect size |
|---|---|---|---|---|---|---|---|
| *group* | Pillais trace | 0.653 | 3.064 | 8 | 13 | 0.036 | 0.653 |
| | Wilks' Lambda | 0.347 | 3.064 | 8 | 13 | 0.036 | 0.653 |
| | Hotelling effect | 1.886 | 3.064 | 8 | 13 | 0.036 | 0.653 |
| | Roy's Largest Root | 1.886 | 3.064 | 8 | 13 | 0.036 | 0.653 |

*Note. 'df' is degree of freedom*

Table 5 presents the results of the between-subject effects test to compare the executive functions' components for both experimental and control groups in the post-test stage. According to the results provided in table 5, the calculated values of F were significant for all components at an alpha level of 0.05 ($p < 0.05$). Therefore, the null hypothesis was rejected and the research hypothesis can be confirmed. Regarding the higher mean scores for the experimental group in the post-test compared to the control group, it was concluded that Kephart's perceptual-motor training was effective and improved the executive functions of children with an autism spectrum disorder.

**Table 5.** Between-subject effects test for comparing executive functions' components of the experimental and control groups in post-test

| *Variable* | Source | Total sum of squares | df | Mean sum of squares | F | Significant level | Effect size |
|---|---|---|---|---|---|---|---|
| *Inhibition* | Between-group | 17.866 | 1 | 17.866 | 7.472 | 0.013 | 0.272 |
| | Within-group | 47.822 | 20 | 2.391 | | | |
| *Shift* | Between-group | 18.323 | 1 | 18.323 | 10.489 | 0.004 | 0.344 |
| | Within-group | 34.937 | 20 | 1.747 | | | |
| *Emotional control* | Between-group | 8.348 | 1 | 8.348 | 8.121 | 0.010 | 0.289 |
| | Within-group | 20.560 | 20 | 1.028 | | | |
| *Planning* | Between-group | 24.942 | 1 | 24.942 | 11.576 | 0.003 | 0.367 |
| | Within-group | 43.091 | 20 | 2.155 | | | |
| *Organization of materials* | Between-group | 6.439 | 1 | 6.439 | 9.142 | 0.007 | 0.314 |
| | Within-group | 14.086 | 20 | 0.704 | | | |
| *Monitoring* | Between-group | 24.077 | 1 | 24.077 | 5.226 | 0.033 | 0.207 |
| | Within-group | 92.143 | 20 | 4.607 | | | |
| *Working memory* | Between-group | 17.182 | 1 | 17.182 | 5.358 | 0.031 | 0.211 |
| | Within-group | 64.134 | 20 | 3.207 | | | |
| *Initiating* | Between-group | 26.219 | 1 | 26.219 | 13.383 | 0.002 | 0.401 |
| | Within-group | 39.183 | 20 | 1.959 | | | |

*Note. 'df' is degree of freedom*

## Discussion

This study aimed to investigate the effectiveness of Kephart's motor perception skills training on executive functions of children with Autism spectrum disorders. The findings indicated that performing Kephart's perceptual-motor activities positively affected the executive functions of children with autism. Our results are consistent with the findings of Soltani Kouhbanani, Arabi, Zarenezhad and Khosrorad (2020) as well as Moradi, Movahedi and Arabi (2020). One of the cognitive aspects of executive functions is the theory of mind. The autistic children have been suffering from insufficiencies in areas of cognitive-social changes, such as the theory of mind, since the birth (Burnside, Wright, & Poulin-Dubois, 2017). There are some shreds of evidence, suggesting the effectiveness of Kephart's perceptual-motor methods on the theory of mind in children with an autism spectrum disorder. The instance for these pieces of evidence is the researches from neuroscience, demonstrating that one's mirror neurons will activate while performing these activities or observing the individuals performing (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). Activation of these neurons in such a way will lead to a better understanding of the individual as well as a more efficient interpretation of others' behavior and brain states.

Another key component of the executive function was emotion. The results were in line with the findings of Gutman, Raphael, Ceder, Khan, Timp, and Salvant (2010). These studies showed that motor training and the application of motor-based interventions can affect autistic children's social skills and emotions. For researchers to implement the study, the participants gained a greater ability to use facial and body language and, thus, to shift their emotions and feelings, and became more skilled in identifying specific motor behaviors that conveyed emotions to others. As an explanation, it can be said that the perceptual-motor interventions, based on the child's tendencies and his/her emotions, can arouse positive emotions and facilitate communication.

The results were also consistent with the findings of Hartshorn, Olds, Field, Delage, Cullen, and Escalona (2001), which showed that motor-based treatments can reduce negative responses to touching, decrease inappropriate behaviors, and increase the awareness of behaviors. For an explanation, performing slow and knowledge-based motors can point to the reason a child can recognize and acquire the knowledge of these motors. A motor is a tool for improving, sustaining human life and organizing the brain.

The results were in line with the research of Hilton, Cumpata, Klohr, Gaetka, Artner, Johnson, and Dobbs (2014). According to their research, using exergame, a device based on doing exercises at home, can improve working memory, reaction speed, metacognition, and motor and skill domains. In other words, physical training, disregarding nurturing the mind and keeping it away from stress, can increase the brain's performance and efficiency, resulting in increased efficiency and rate in daily activities and training.

These exercises should be performed optionally, regardless of gender, following the level of abilities and cognitive and motor function of the child. Families should also be familiar with these perceptual-motor exercises, and to be more productive and to have a wider impact, besides, they should be assigned to in-house exercises and be used as part of their child's treatment.

## Conclusion

The results indicated that Kephart's motor perception skills training positively affected different aspects of autistic children's executive functions such as attention control, cognitive inhibition, inhibition control, working memory, cognitive flexibility, etc. These training can also play as applied interventions along with other interventions. The present study had a number of limitations that should be noted. Among them, we could refer to differences between participants related to their economic and social conditions and lack of awareness from their mental conditions. Accordingly, we suggest future studies to use of better tools and larger sample size to be able to compare results. Also, it is suggested that future studies assess the neural aspect of perceptual motor training effect like brain event-related potentials on executive functions of children with Autism disorders.

## Disclosure Statement

The authors declare that there was no commercial or financial relationship that could be construed as a potential conflict of interest in their research.

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