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FACTORS INFLUENCING THE SOCIAL-EMOTIONAL BEHAVIOR OF CHILDREN WITH AUTISM: THE INFLUENCE OF PSYCHOMOTOR CLUMSINESS

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Abstract:
Children with autism manifest detection first, then parallel behavior, cooperation, autistic behavior, and communicate less with other children. Higher autism functioning was associated with probing, parallel, cooperative and partnering behavior and lower with autistic behavior. Children had more difficulty in tests where the children were stationary and the environment was changing, followed by tests where the children were moving, and better performance was observed in tests where the children were stationary, and the environment was stable. Psychomotor clumsiness produced negative effects on socio-emotional behavior, while physical activity within school and group play produced positive effects. Autism functionality emerged as a moderator in the relationship between psychomotor clumsiness and socioemotional behavior.

Keywords: psychomotor clumsiness, social-emotional behavior, autism functionality, influencing factors, regulator

1. Introduction

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by persistent challenges in social communication and restricted or repetitive patterns of behaviour, which can significantly affect the social-emotional development of these children (Blake *et al.*, 2003; Corbett *et al.*, 2014; Nathalie, 2011; Vogan *et al.*, 2018). Research studies show that children with ASD have deficits in motor skills (Courchesne *et al.*, 2011), visual motion recognition (Blake *et al.*, 2003), and emotion regulation (Diamond *et al.*, 1998), which affect their social, emotional and behavioural outcomes (Nathalie, 2011; Vogan *et al.*, 2018). Children with high-functioning ASD may show increased exploratory, parallel and cooperative behaviours (Bentenuto, De Falco & Venuti, 2016). Conversely, those who experience greater symptom severity, reduced social interest, and more behavioral problems generally demonstrate lower levels of

adaptability (Franchini *et al.*, 2018). Furthermore, research conducted by Andersen *et al.* (2017) revealed that autistic symptom severity and attention difficulties were predictors of emotional and behavioral challenges in children with high-functioning autism over a two-year period.

The challenges that children with ASD face in cooperative behavior are evident in their ability to recognize the needs of others, with maintaining attention being a challenge (Mundy, Sullivan, &Mastergeorg, 2009), which reduces the quality of their relationships with peers and teachers (O'Haire *et al.*, 2013). In addition, in children with ASD, their engagement with the environment is linked to motor skills. Those with higher functioning show better motor coordination, subsequently improving their social interactions (Gowen & Hamilton, 2012). Hirata *et al.* (2015) also found that the severity of social impairments was influenced by the motor skills of children with ASD.

Studies highlight that involvement in physical activity can lead to beneficial changes for children with ASD, making them less prone to stereotypical behaviors. As a result, such engagement promotes social skills and improves their motor coordination (Dadds *et al.*, 1988; Elliott, Dobbin Rose & Soper, 1994; Kern, Koegel& Dunlap, 1984; Rosenthal-Malek & Mitchell, 1997). As the prevalence of autism continues to increase, understanding the multifaceted factors that contribute to the social-emotional behaviors of children with ASD is becoming increasingly critical for researchers, educators and health professionals alike (Manzi *et al.*, 2020).

The aim of the present study is to investigate the factors that influence the socio-emotional behavior of children with autism by exploring the effect of psychomotor clumsiness, while examining the regulatory role of autism functioning. The research questions are:

1) What factors related to the characteristics of the child with autism affect their socioemotional behaviour?
2) What is the effect of psychomotor clumsiness on the socio-emotional behavior of children with autism?
3) Is autism functioning a moderator in the relationship between psychomotor clumsiness and socioemotional behavior of children with autism?

The significance of the research lies in the fact that it can provide valuable information for a deeper understanding of the behavior of children with autism, taking into account their motor characteristics. By exploring the impact of psychomotor clumsiness, the research provides information useful for developing more targeted interventions that take into account individual differences in psychomotor skills and socio-emotional functioning of children with ASD. A deeper understanding of these mechanisms can help both educators and health professionals design more effective educational and psychological interventions.

The novelty of the present study lies in the fact that, for the first time, the functionality of autism as a moderating factor in the relationship between psychomotor clumsiness and social-emotional behavior of children with ASD is investigated. Although

several studies focusing on the psychomotor development or social behavior of children with autism have been conducted (Andersen *et al.*, 2017; Bentenuto, De Falco & Venuti, 2016; Gkatzogia, 2018; Dadds *et al.*, 1988; Downs & Smith, 2004; Franchini *et al.*, 2018; Gowen & Hamilton, 2012; Hirata *et al.*, 2015; Kern, Koegel& Dunlap, 1984; Mundy, Sullivan, &Mastergeorge, 2009; O'Haire *et al.*, 2013) none so far have investigated this interaction in the way approached in this research. This innovation offers new perspectives for understanding the complexity of autism, as it takes into account individual differences in children's functioning and how these affect the relationships between their motor and emotional abilities. Thus, this study paves the way for new theoretical and practical approaches to support children with autism.

2. Methodology

2.1 Research Design

A primary, correlational, quantitative, quantitative, synchronic survey was conducted using weighted instruments. Quantitative research was chosen as the sub-study variables can be considered measurable (DeVellis, 2016). Specifically, psychomotor clumsiness using the Movement Assesment Battery tool (Henderson & Sugden, 1992) and socio-emotional behaviour using the UVA-APE (Sherrill, 2004). Primary synchronic research is useful as it enables the researcher to directly assess the views of participants over a specific time period (Cohen, Manion & Morrison, 2007). Quantitative research is used to explore interrelationships between dependent and independent variables using statistical techniques on numerical data (Muijs, 2011). The dependent variable is social-emotional behaviour, and the independent variable is psychomotor dexterity and characteristics of the child with autism. In addition, the regulatory role (Hayes, 2022) of autism functioning in the relationship between psychomotor clumsiness and socioemotional behavior was examined.

2.2 Data Collection Tool

The data collection tool includes the following 5 sections. The reliability of the scales was tested using Cronbach's internal consistency index Cronbach's Alpha (Galanis, 2013).

A. **Teacher demographic and occupational data:** 4 questions about gender, age, educational level, and area of residence and 5 questions about, school, sector and geographical area of work, years of experience, and involvement in special education were used.
B. **Child data:** 10 questions were used regarding gender, child's age, type of autism, availability of physical activity in and out of school, type of game preferred by the children, child's BMI, and weekly frequency of mild, moderate, and intense exercise.

C. **Psychomotor clumsiness:** the Movement Assesment Battery (Henderson &Sugden, 1992) was used as tool which includes 48 questions of Likert scale 0-3 (0 = Not at all, 1 = Fairly well, 2 = Quite well, 3 = Very well) and is the most valid and reliable instrument for measuring motor difficulties (Crawford, Wilson & Dewey, 2001; Chow & Henderson, 2003). The MAB displays conceptual construct validity, i.e., the existence of discrete factors in the instrument. The proof of the existence of factors lies in the Factor Analysis, which was confirmed by Gkatzogia (2018) in Greek:
   1) **Child Stationary/Environment Stable**: Includes low-difficulty activities (questions 1-12) where the child is stationary and the environment is stable, such as "Can he/she put on his/her own clothes?" and "Changing book pages and holding an A4 glue correctly". The reliability of the factor was excellent (α=0.922).
   2) **Child Moving/Environment Stable:** Includes activities of moderate difficulty (questions 13-24) where the child moves and the environment is stable, such as "Bouncing on each foot" and "Moving comfortably between obstacles". The reliability of the factor was excellent (α=0.919).
   3) **Child Stationary/Environment Changing:** Includes activities of moderate to high difficulty (questions 25-36) where the child is stationary and the environment is changing, such as "Stopping objects in motion before they reach their destination" and "Rolling the ball correctly so that the child in motion can catch it". The reliability of the factor was excellent (α=0.908).
   4) **Child Moving/Environment Changing:** Includes high-difficulty activities (questions 26-38) where the child is moving and the environment is changing, such as "Running to catch a ball" and "Running to kick a ball". The reliability of the factor was excellent (α=0.906).

A. **Socio-emotional behavior:** We used the UVA-APE questionnaire (Sherrill, 2004), which includes 35 Likert scale questions 1-4 (1=Seldom or never, 2=Sometimes, 3=Most of the time, 4=Always) that examine the behavior of a child on the autism spectrum. The validity of the instrument lies in its factor validity, which was demonstrated by the developers (Sherrill, 2004) and in Greece by Γκατζόγια (2018). The instrument includes the following 5 factors of social-emotional behavior (Horvat, Block & Kelly, 2007):
   1) Autistic behavior: 8 questions (1,2,5-10), e.g., "Moves around for no reason". The reliability of the factor was high (α=0.819).
   2) Exploratory behavior: 6 questions (3,4,11-14) e.g., "Explores objects". The reliability of the factor was acceptable (α=0.697).
   3) Parallel behavior: 5 questions, of which 3 related to the existence of concurrent behavior (15,16,18), e.g., "Playing together with peers." and 2 (17,19) concerning the absence of parallel behavior such as "He does not give his toys and plays

alone" which are reversed during the formation of the factor (1↔4, 2↔3). The reliability of the factor was acceptable (α=0.652).

4) Companionship behavior: 8 questions (20-27), e.g., "He wants to share his toys with other children." The reliability of the factor was excellent (α=0.902).
5) Cooperative behavior: 8 questions (28-35), e.g., "He recognizes the terms used to play a game." The reliability of the factor was excellent (α=0.913).

2.3 Participants

152 teachers participated in the survey, with an average age of 36.5 years, the majority of whom were female (90.13%, N=137), holding a postgraduate degree (69.54%, N=105), and residing in an urban centre (63.33%, N=95). Most of them are in the field of ECE (67.97%, N=104), have up to 15 years of experience (86.93%, N=133) and up to 10 years of involvement in special education (79.74%, N=122), while about half of them teach in primary schools (56.86%, N=87) and in Epirus (52.70%, N=78) **(Table 1).**

Regarding the characteristics of the child with autism, 65 (42.48%) are moderate functioning, 50 (32.68%) are high functioning, and 38 (24.84%) are low functioning. Most of the children are boys (73.86%, N=113), aged 8-14 years (60.13%, N=92), prefer individual play (79.08%, N=121), have normal BMI (63.40%, N=97), perform physical activity within (91, 50%, N=140) and outside (69.28%, N=106) school as well as intense (81.70%, N=125), moderate (71.83%, N=102) and mild (63.40%, N=97) exercise 1-2 times/week for more than 15 minutes **(Table 2).**

2.4 Data Collection Process and Ethics

The data collection process started after the approval of this research proposal by the Ethics Committee of the University of Ioannina on April 24, 2023. Data collection was conducted through cluster sampling, according to the type of school (Creswell, 2014), in special education schools from May 2023 to February 2024. Participating teachers were approached online by the researcher and completed the questionnaire through the google forms application. The researcher obtained information about teachers' personal emails from the special education school units. The teachers were informed about the purpose of the research and that this research is being conducted as part of a PhD thesis. In addition, they were informed that their participation in the survey would be anonymous and voluntary, that their responses would be used solely for research purposes, and that they would be deleted after the results were published. Furthermore, they were informed that they have the right to withdraw at any time if they so wish, without giving reasons. Finally, teachers' participation in the survey was based on their written consent (BPS, 2014).

2.5 Methods of Data Analysis

IBM SPSS 26 software was used for data analysis at a 5% significance level. Factor distributions were tested for the validity of normal distribution using Kolmogorov-

Smirnov test. The levels of psychomotor clumsiness factors were compared with each other using Repeated Measures ANOVA, while Friedman's test was used to compare the levels of socioemotional behavior factors. The relationship between psychomotor clumsiness and socioemotional behavior was investigated using Spearman's correlation coefficient. For the comparison of means of the factors of socioemotional behavior between 2 independent samples defined by the children's data, the Mann Whitney nonparametric test was used, and for 3 or more independent samples the Kruskal Wallis nonparametric test was used. Predictors of socioemotional behaviour were investigated using multiple linear regression models (Field, 2017). Hayes' model 1 was used to study whether autism functioning is a moderator in the relationship between psychomotor clumsiness and socioemotional behavior (Hayes, 2022).

3. Results

The validity of a normal distribution was confirmed for the psychomotor clumsiness factors *(p≥0.074)* and rejected for the socioemotional behavior factors *(p≤0.032)* **(Table 3).** Statistically significant differences were observed between the psychomotor clumsiness factors (*F (3,150)=20,689, p<0,001*). Lower levels of psychomotor clumsiness were observed in the factor"Child Stationary/Environmental Stable" (*M.O.=1,29*) compared to the "Child Moving/Environment Stable" (*M.O.=1,42, p=0,002*), "Child Stationary/Environment Changing" (*M.O.=1,62, p<0,001*) and "Child Moving/Environment Changing" (*M.O.=1,47, p<0,001*) factors. Furthermore, the factor"ChildStationary/EnvironmentChanging" (*M.O.=1,62*) was scored higher compared to the factors "Child Moving/Environment Stable" (*M.O.=1,42, p<0,001*) and "Child Moving/Environment Changing" (*M.O.= 1,47, p<0,001*) **(Table 4).**

Statistically significant differences were observed between the socioemotional behavior factors ($X^2(4)=91,361$, *p<0,001*). " Companionship behavior" *(AV=2.20)* scored lower compared to "Autistic behavior" (*M.O.=2,39, p<0,001*), "Cooperative behavior" (*M.O.=2,39, p<0,001*), "Parallel behavior" (*M.O.=2,45, p<0,001*) and"Exploratory behavior"(*M.O.=2,74, p<0,001*). In addition, "Exploratory behavior" scored higher compared to "Parallel behavior" (*M.O.=2,45, p<0,001*), "Autistic behavior" (*M.O.=2,39, p<0,001*), and "Cooperative behavior" (*M.O.=2,39, p<0,001*) **(Table 4).**

"Autistic behavior" was positively correlated with the psychomotor skill factors "Child Stationary/Environment Stable" (*rho(153)=0,322, p<0,001*), "Child Stationary/Environment Changing" (*rho (153)=0,240, p=0,003*), "Child Moving/Environment Changing" (*rho (153)=0,296, p<0,001*), negatively related to autism functionality (*rho(153)=-0,321, p<0,001*) and lower values were observed in children performing physical activity within the school (*AV=2,35*) compared to children who do not perform (*AV=2,76, Z=-2,591, p=0,010*), who prefer group play (*AV=2,14*) compared to children who prefer individual play (*AV=2,45, Z=-2,563, p=0,010*) and in children who are underweight or have normal BMI (*M.O.=2,32*) compared to children who are overweight

or obese (*AV=2,63, Z=-2,355, p=0,018*) **(Table 5).** Predictors were identified as in-school physical activity (*beta=-0,157, p<0,05*) and overweight/obese (*beta=0,187, p<0,05*). **(Table 10).**

"Exploratory behavior" was negatively correlated with the psychomotor skill factors "Child Stationary/Environment Stable" (*rho (153)=-0,440, p<0,001*), "Child Moving/Environment Stable"(*rho (153)=-0,380, p<0,001*), "Child Stationary/Environment Changing" (*rho(153)=-0,254, p=0,002*), "Child Moving/Environment Changing" (*rho(153) =-0,359, p<0,001*) and positively with autism functionality (*rho (153)=0,241, p=0,003*) and with moderate exercise for more than 15 minutes (*rho(142)=0,210, p=0,012*) **(Table 6).** The factor "Child Stationary/Environment Stable" was found to be predictive (*beta=-0,269, p<0,05*). **(Table 10).**

"Parallel behavior" was negatively correlated with the psychomotor skill factors "Child Stationary/Environment Stable" (*rho (153)=-0,333, p<0,001*), "Child Moving/Environment Stable" (*rho (153) = -0,325, p<0,001*), "Child Stationary/Environment Changing" (*rho(153) = -0,342, p<0,001*), "Child Moving/Environment Changing" (*rho (153) = -0,400, p<0,001*) and positively with autism functionality (*rho (153) =0,269, p=0,001*) and with vigorous exercise for more than 15 minutes (*rho(153)=0,169, p=0,037*)and higher values were observed in children preferring group play (*AV=2,90*) compared to children who prefer individual play (*AV=2,34, Z=-4,624, p<0,001*) **(Table 7)**. A predictive factor emerged for "Group play" (*beta=0,225, p<0,001*) **(Table 10).**

"Companionship behavior" was negatively correlated with the psychomotor skill factors "Child Stationary/Environment Stable" (*rho(153)=-0,372, p<0,001*), "Child Moving/Environment Stable" (*rho(153) = -0,357, p<0,001*), "Child Stationary/Environment Changing" (*rho(153)=-0,463, p<0,001*), "Child Moving/Environment Changing" (*rho(153)=-0,538, p<0,001*) and positively with autism functionality (*rho(153)=0,293, p=0,001*) and with vigorous exercise for more than 15 minutes (*rho (153)=0,185, p=0,022*), and higher values were observed in children preferring group play (*AV=2,86*) compared to children who prefer individual play (*AV=2,02, Z=-5,434, p<0,001*) **(Table 8).** The factor "Child Moving/Environment Changing" (*beta=-0,333, p<0,05*) and "Group play" (*beta=0,294, p<0,001*) were found to be predictive **(Table 10).**

"Cooperative Behavior" was negatively correlated with the psychomotor skill factors "Child Stationary/Environment Stable" (*rho (153)=-0,493, p<0,001*), "Child Moving/Environment Stable" (*rho(153)=-0,492, p<0,001*), "Child Stationary/Environment Changing" (*rho(153)=-0,522, p<0,001*), "Child Moving/Environment Changing" (*rho(153)=-0,570, p<0,001*) and positively with autism functionality (*rho (153)=0,335, p=0,001*) and with vigorous exercise for more than 15 minutes (*rho(153)=0,198, p=0,014),* and higher values were observed in children preferring group play (*AV=2,97*) compared to children who prefer individual play(*AV=2,24, Z=-4,607, p<0,001*) **(Table 9).** A predictive factor emerged for "Group play" (*beta=0,217, p<0,01*) **(Table 10).**

"Autism Functionality" was a moderator in the relationships between "Autistic Behavior" and the factors "Child Stationary/Environment Changing" (*p=0,044*) and "Child

Moving/Environment Changing" (*p=0,022*) **(Table 11).** Notably, "Autistic Behavior" was positively correlated with the psychomotor clumsiness factors "Child Stationary/Environment Changing" (*rho(50)=0,536, p<0,001*) and "Child Moving/Environment Changing" (*rho(50)=0,463, p<0,01*) only for children with high-functioning autism **(Tables 12-14).**

"Autism Functionality" was a regulator in the relationships between "Exploratory Behavior" and the factors "Child Moving/Environment Stable" (*p=0,029*), "Child Stationary/Environment Changing" (*p=0,017*) and "Child Moving/Environment Changing" (*p=0,014*) **(Table 11).** Particularly, "Exploratory Behavior" was negatively and more strongly correlated with the psychomotor skill factors "Child Moving/Environment Stable" (*rho(38)=-0,513, p<0,01*), "Child Stationary/Environment Changing" (*rho(38)=-0,422, p<0,01*) and "Child Moving/Environment Changing" (*rho(38)=-0,648, p<0,001*) for children with low-functioning autism **(Tables 12-14).**

"Autism Functionality" was a moderator in the relationships between " Companionship Behavior" and the "Child Stationary/Environment Changing" factor(*p=0,018*) **(Table 11).** Specifically, " Companionship Behavior" was negatively and more strongly associated with the "Child Stationary/Environment Changing" factor (*rho (65)=-0,511, p<0,001*) for children with moderate-functioning autism **(Tables 12-14).**

4. Conclusions

4.1 Discussion

The current research studied the factors influencing the socio-emotional behavior of children with autism, investigating the effect of psychomotor clumsiness while examining the regulatory role of autism functionality.

Concerning psychomotor clumsiness, children had more difficulty in tests where they were stationary and the environment was changing, followed by tests where children were moving (in a changing and stable environment), and improved performance (less psychomotor clumsiness) was observed in tests where children were stationary, and the environment was stable. One of the common problems of children with autism is the development of motor skills. The brain and spinal cord work in harmony to coordinate the planning and execution of movements, from simple to complex, involving every aspect (Courchesne *et al.*, 2011; Sarris *et al.*, 2024). Children with autism, particularly those with Asperger syndrome, show differences in symptom severity and developmental functioning compared to those with other pervasive developmental disorders (Starr *et al.*, 2003; Charmpatsis *et al.*, 2024a/b). Their performance on standardized tests may be affected by their motivation and attention, suggesting the need for adapted testing conditions (Koegel *et al.*, 1997). These children may experience difficulties in organizing their behavior in extended temporal situations (Diamond *et al.*, 1998; Katsarou *et al.*, 2024) and may also have difficulty with visual motion recognition (Blake *et al.*, 2003).

Regarding social-emotional behavior, substudy children on the autism spectrum use detection first, then parallel behavior (peer play), cooperation-obedience to rules and autistic behaviour (stereotypical behaviors, need to be motivated to play, moving without reason), and they interact less with other children and seem to trust them.

Kanner (1943, cited in Manzi *et al.*, 2020) was one of the first to observe that, despite differences and limitations, children with ASD show a special interest in objects and their exploration. In fact, children with ASD show similar or greater interest in exploring objects compared to typical children (Jacques *et al.*, 2018; Zaragas *et al.*, 2023). In fact, Manzi *et al.* (2020) identified that children with ASD's interest in exploring objects acts as a mediator in their interactions with adults. Corbett *et al.* (2014) noted that during interactions with peers, children with ASD engage less in verbal communication and more in self-play compared to typically developing children.

In the behavior of autistic individuals, there is evidence of a preference for parallel play. In particular, children who show a strong liking for "Fair" parallel play show improved Parallel Behavior in contrast to those who do not (Gkatzogia, 2018). Assessing how individuals react to social cues can be an important benchmark for performance in social situations. Nevertheless, these social cues can act as barriers for people with autism that impede the ability to express themselves freely or seek reconciliation with like-minded peers. It appears that reluctance toward social interaction is further intensified when an autistic subject is expected to accept a stranger into group activities, as it is perceived as a threatening change. Cooperative behavior involves people, and the biggest challenge is to understand that an autistic person lacks a sense of the concept of "otherness". Also, individuals with autism face challenges in self-regulation and attention, and this makes it difficult for them not only to follow an activity but also to cooperate with another person (Mundy *et al.*, 2009 Sarris *et al.*, 2020b).

The greatest autism functionality was associated with exploratory, parallel, cooperative, and companionship behavior, and the weakest with autistic behavior. Research shows that children with autism spectrum disorder (ASD) exhibit different levels of adaptive functionality and social behavior according to the severity of their symptoms. Children with ASD with high functionality may demonstrate more exploratory, parallel, and cooperative behaviors (Bentenuto, De Falco & Venuti, 2016; Sofologi *et al.*, 2023; Sarris *et al.*, 2023a/b).

The results indicated that psychomotor clumsiness in low-difficulty psychomotor tests, where the child is stationary, and the environment is stable, is expected to reduce the detection ability of children with autism. However, for children with low-functioning autism, psychomotor clumsiness on higher difficulty psychomotor tests where the child is moving, or the environment is changing is anticipated to reduce their detection ability to a greater extent than other children of medium or high functioning. Autistic children face marginalisation from early childhood. This exclusion, at times, escalates into what can be termed social racism - an act that is mainly fuelled by the behavior of their peers in the school environment. Children are often characterized as 'special' based on

idiosyncratic physical characteristics such as abnormalities in gait or appearance based on Carmody & Lewis' (2012) study, and when faced with consistent failure, they develop feelings of inferiority leading to behavioural dysfunction (Makri-Botsari, 2001; Vrakas *et al.*, 2022). Children with low autism functionality have higher symptom severity, reduced social interest and more behavioural problems and tend to have lower adaptive functions (Franchini *et al.*, 2018).

Furthermore, it was demonstrated that in children with high-functioning autism, psychomotor clumsiness on high-difficulty tests in a changing environment is expected to increase their autistic behavior to a greater extent than in children with low or medium functioning. Autism symptom severity and attention problems were found to predict emotional and behavioral problems in children with high-functioning autism over a two-year period (Andersen *et al.*, 2017; Sarris *et al.*, 2020a).

In addition, psychomotor clumsiness in high-difficulty psychomotor tests, where the child is moving and the environment is changing, is expected to reduce the sociability of children with autism. In children diagnosed with ASD, motor skills are associated with their interaction with the environment. This relationship affects their perception of the environment, their communication with others, and their ability to develop language skills (Gowen&Hamilton, 2012; Christopoulou *et al.*, 2023).

Moreover, in children of intermediate functionality, psychomotor clumsiness on high-difficulty psychomotor tests in a changing environment where the child is stationary is expected to reduce children's companionship behavior to a greater extent than in low- or high-functioning children. Solitary Probing Behavior, identified as incident Solitary Probing Response (SPR), was found to be linearly related to motor difficulties experienced by individuals in the Level 3 domain ("Autistic person stable/environmental changes"). The severity of deficits at Level 3 for individuals with autism typically involves a change for the worse in terms of verbal communication and social interaction, as well as rigidity in terms of adaptive behavior (Gkatzogia, 2018).

Additionally, physical activity in school is expected to reduce children's levels of autistic behavior, which is also observed more in children who are overweight or obese. Moderate physical exercise for more than 15 minutes was associated with exploratory behavior, while vigorous exercise was associated with parallel, companionship and cooperative behavior. In Gkatzogia's (2018) study, a statistically significant linear positive relationship has been reported between physical activity and social behavior (Gkatzogia, 2018). Sam *et al.* (2015) and Yekini & Ademakin (2017) both have found that exercise interventions can improve exercise capacity, physical fitness and social ability in these children. Celiberti *et al.* (1997) further showed that different types of exercise can have different effects on self-stimulatory behaviour, with jogging being particularly effective. Memari *et al.* (2017) also added that the frequency and intensity of exercise can affect cognitive and social functions in children with autism. Research shows that children who participate in enjoyable and well-organized activities, either at school or in other contexts, are less likely to exhibit stereotyped behaviors, which often stem from anxiety or lack of

stimulation. Consequently, this engagement promotes social skills and enhances their motor coordination (Kern, Koegel& Dunlap, 1984). Research also shows that children with ASD can experience positive changes from engaging in physical activity. According to Rosenthal-Malek & Mitchell (1997), moderate-intensity aerobic exercise was associated with improvements in attention and positive attitudes among children with ADHD. In addition, programs that focus on physical activity have been shown to be effective in addressing various inappropriate behaviors associated with autism (Elliott, Dobbin Rose & Soper 1994).

The benefits of group play were highlighted as children who preferred it showed higher scores in parallel, companionship, and cooperative behaviour. A strong correlation appears to exist between liking cooperative play and possession of social skills. Individuals with autism, whether children or adults, who demonstrate a preference ranging from moderate to considerable cooperative play tend to exhibit improved social behavior in contrast to those who do not gravitate towards this form of play (Gkatzogia, 2018). Dadds *et al.* (1988) observed that higher levels of interpersonal contact were associated with increased play engagement and decreased stereotypical behavior and disengagement. High-functioning children with autism who engage in group play demonstrate cooperative social behaviors and advanced theory of mind skills, performing similarly to typically developing children in the cooperative context (Downs & Smith, 2004).

The results refer to boys with autism, aged 8-14 years, who are physically active in and out of school, have normal weight, and exercise for more than 15 minutes 1-2 times a week. Furthermore, the results were not obtained from an experimental procedure in order to safely establish cause-effect relationships. It is suggested that future researchers should conduct experimental studies examining the levels of socioemotional behavior prior to and following the training of individuals with autism in psychomotor clumsiness exercises as well as their effects on socioemotional behavior pre- and post-intervention (Kirk, 2013).

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Appendix

Table 1: Demographic and Professional Data of Teachers

Categorical Variable	**Category**	**N**	**%**
Gender	Male	15	9.87
	Female	137	90.13
Educational Level	University Degree (AEI/TEI)	36	23.84
	Second University Degree (AEI/TEI)	3	1.99
	Master's Degree	105	69.54
	PhD	7	4.64
Residence Area	Metropolitan Center	12	8.00
	Urban Center	95	63.33
	Small Town	27	18.00
	Rural Area	13	8.67
	Island	3	2.00
Special Education Sector	No	49	32.03
	Yes	104	67.97
School of Employment	Kindergarten	15	9.80
	Primary School	87	56.86
	Middle/High School	2	1.31
	Special Needs School (SMEAE)	27	17.65
	Special Vocational Education Center (EEE.E.E.K.)	16	10.46
	Special Vocational Integration (EN.E.E.GY.L/KEDASY)	6	3.92
Work Region	Epirus	78	52.70
	Macedonia	29	19.59
	Central Greece/Peloponnese	19	12.84
	Ionian/Aegean Islands	15	10.14
	Crete	7	4.73
Years of Experience	0-5 years	62	40.52
	6-10 years	36	23.53
	11-15 years	35	22.88
	16-20 years	7	4.58
	21-25 years	8	5.23
	26+ years	5	3.27
Years in Special Education	0-5 years	87	56.86
	6-10 years	35	22.88
	11-15 years	21	13.73
	16-20 years	5	3.27
	21-25 years	3	1.96
	26+ years	2	1.31
Quantitative Variable	Minimum-Maximum	Average	SD
Age	21-59	36.56	8.67

Table 2: Data on Children on the Autism Spectrum

Data	Category	N	%
Gender	Male	113	73.86
	Female	40	26.14
Age	3-7 years	36	23.53
	8-14 years	92	60.13
	15-18 years	16	10.46
	19-22 years	7	4.58
	22+ years	2	1.31
Autism Functionality	Low	38	24.84
	Medium	65	42.48
	High	50	32.68
Physical Activity in School	No	13	8.50
	Yes	140	91.50
Physical Activity Outside School	No	47	30.72
	Yes	106	69.28
Play Preference	Individual	121	79.08
	Group	32	20.92
BMI	Underweight	22	14.38
	Normal	97	63.40
	Overweight	32	20.92
	Obese	2	1.31
Vigorous Exercise (more than 15 minutes)	1-2 times per week	125	81.70
	3-4 times per week	22	14.38
	More than 4 times per week	6	3.92
Moderate Exercise (more than 15 minutes)	1-2 times per week	102	71.83
	3-4 times per week	34	23.94
	More than 4 times per week	6	4.23
Light Exercise (more than 15 minutes)	1-2 times per week	97	63.40
	3-4 times per week	37	24.18
	More than 4 times per week	19	12.42

Table 3: Normality Test

Factors	D (153)	p-value
Child Stationary / Environment Stable	0.066	0.097
Child Moving / Environment Stable	0.058	0.200*
Child Stationary / Environment Changing	0.050	0.200*
Child Moving / Environment Changing	0.069	0.074
Autistic Behavior	0.085	0.008
Exploratory Behavior	0.115	<0.001
Parallel Behavior	0.106	<0.001
Companionship Behavior	0.121	<0.001
Cooperative Behavior	0.118	<0.001
Self-esteem	0.076	0.032

Table 4: Descriptive Statistics of Factors

Factors	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary / Environment Stable	1.29	0.64	F (3,150) = 20.689	<0.001
Child Moving / Environment Stable	1.42	0.60		
Child Stationary / Environment Changing	1.62	0.58		
Child Moving / Environment Changing	1.47	0.61		
Autistic behaviour	2.39	0.59	$X^2(4) = 91.361$	<0.001
Exploratory behaviour	2.74	0.52		
Parallel behaviour	2.45	0.64		
Companionship behaviour	2.20	0.74		
Cooperative behaviour	2.39	0.75		

Table 5: Statistically Significant Effects on "Autistic Behaviour"

Variable	Category	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary / Environment Stable	-	-	-	rho (153) = 0.322	<0.001
Child Stationary / Environment Changing	-	-	-	rho (153) = 0.240	0.003
Child Moving / Environment Changing	-	-	-	rho (153) = 0.296	<0.001
Autism Functionality	Low	2.67	0.59		<0.001
	Medium	2.40	0.52		
	High	2.16	0.58		
Physical Activity in School	No	2.76	0.56	Z = -2.591	0.010
	Yes	2.35	0.58		
Play Preference	Individual	2.45	0.54	Z = -2.563	0.010
	Group	2.14	0.70		
BMI	Underweight / Normal	2.32	0.57	Z = -2.355	0.018
	Overweight / Obese	2.63	0.59		

Table 6: Statistically Significant Effects on "Exploratory Behaviour"

Variable	Category	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary / Environment Stable	-	-	-	rho (153) = -0.440	<0.001
Child Moving / Environment Stable	-	-	-	rho (153) = -0.380	<0.001
Child Stationary / Environment Changing	-	-	-	rho (153) = -0.254	0.002
Child Moving / Environment Changing	-	-	-	rho (153) = -0.359	<0.001
Autism Functionality	Low	2.54	0.60		0.003
	Medium	2.77	0.43		
	High	2.87	0.52		
Moderate Exercise (more than 15 minutes)	1-2 times per week	2.67	0.55	rho (142) = 0.210	0.012
	3-4 times per week	2.95	0.36		
	More than 4 times per week	2.83	0.47		

Table 7: Statistically Significant Effects on "Parallel Behaviour"

Variable	Category	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary / Environment Stable	-	-	-	rho (153) = -0.333	<0.001
Child Moving / Environment Stable	-	-	-	rho (153) = -0.325	<0.001
Child Stationary / Environment Changing	-	-	-	rho (153) = -0.342	<0.001
Child Moving / Environment Changing	-	-	-	rho (153) = -0.400	<0.001
Autism Functionality	Low	2.13	0.67		0.001
	Medium	2.50	0.50		
	High	2.64	0.70		
Play Preference	Individual	2.34	0.62	Z = -4.624	<0.001
	Group	2.90	0.52		
Vigorous Exercise (more than 15 minutes)	1-2 times per week	2.40	0.63	rho (153) = 0.169	0.037
	3-4 times per week	2.65	0.72		
	More than 4 times per week	2.77	0.41		

Table 8: Statistically Significant Effects on "Companionship Behaviour"

Variable	Category	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary / Environment Stable	-	-	-	rho (153) = -0.372	<0.001
Child Moving / Environment Stable	-	-	-	rho (153) = -0.357	<0.001
Child Stationary / Environment Changing	-	-	-	rho (153) = -0.463	<0.001
Child Moving / Environment Changing	-	-	-	rho (153) = -0.538	<0.001
Autism Functionality	Low	1.91	0.85		0.001
	Medium	2.20	0.66		
	High	2.42	0.68		
Play Preference	Individual	2.02	0.66	Z = -5.434	<0.001
	Group	2.86	0.67		
Vigorous Exercise (more than 15 minutes)	1-2 times per week	2.13	0.70	rho (153) = 0.185	0.022
	3-4 times per week	2.38	0.91		
	More than 4 times per week	2.92	0.46		

Table 9: Statistically Significant Effects on "Collaborative Behaviour"

Variable	Category	Mean (M)	Standard Deviation (SD)	Statistic	p-value
Child Stationary/ Stable Environment	-	-	-	rho (153) = -0.493	<0.001
Child Moving/ Stable Environment	-	-	-	rho (153) = -0.492	<0.001
Child Stationary/ Changing Environment	-	-	-	rho (153) = -0.522	<0.001
Child Moving/ Changing Environment	-	-	-	rho (153) = -0.570	<0.001
Autism Functionality	Low	2.11	0.79	rho (153) = 0.335	0.001
	Moderate	2.31	0.67		
	High	2.72	0.72		
Preference for Play	Individual	2.24	0.68	Z = -4.607	<0.001
	Group	2.97	0.75		
Intense Exercise for more than 15 minutes	1-2 times per week	2.33	0.74	rho (153) = 0.198	0.014
	3-4 times per week	2.63	0.77		
	More than 4 times per week	2.92	0.65		

Table 10: Multiple Linear Regression Models

Factors	1. Autistic	2. Exploratory	3. Parallel	4. Companionable	5. Collaborative
Child Stationary/ Stable Environment	0.119	-0.269*	-0.128	-0.064	-0.134
Child Moving/ Stable Environment	-	-0.213	0.097	0.137	-0.029
Child Stationary/ Changing Environment	0.050	0.324	0.035	-0.125	-0.190
Child Moving/ Changing Environment	0.086	-0.203	-0.280	-0.333*	-0.168
Autism Functionality	-0.132	0.055	0.128	0.051	0.072
Physical Activity within School	-0.157*	-	-	-	-
Group Play	-0.101	-	0.225**	0.294***	0.217**
Overweight/Obese	0.187*	-	-	-	-
Moderate Exercise	-	0.133	-	-	-
Intense Exercise	-	-	0.090	0.124	0.094

*p<0.05, **p<0.01, ***p<0.001
1: $F(7,145) = 5.887$, $p<0.001$, $R^2=22.1\%$
2: $F(6,135) = 6.703$, $p<0.001$, $R^2=23\%$
3: $F(7,145) = 7.047$, $p<0.001$, $R^2=25.4\%$
4: $F(7,145) = 12.755$, $p<0.001$, $R^2=38.1\%$
5: $F(7,145) = 13.933$, $p<0.001$, $R^2=40.2\%$

Table 11: The Moderating Role of Autism Functionality in the Relationship between Motor Impairment and Socio-emotional Behaviour

Interaction	Autistic	Exploratory	Parallel	Companionable	Collaborative
Child Stationary/ Stable Environment X Functionality	P=0.282	P=0.455	P=0.601	P=0.243	P=0.660
Child Moving/ Stable Environment X Functionality	P=0.139	P=0.029	P=0.846	P=0.075	P=0.606
Child Stationary/ Changing Environment X Functionality	P=0.044	P=0.017	P=0.456	P=0.018	P=0.223
Child Moving/ Changing Environment X Functionality	P=0.022	P=0.014	P=0.573	P=0.086	P=0.549

Table 12: Correlations between Motor Impairment and Socio-emotional Behaviour Factors for Children with Low Functionality

Motor Impairment	Autistic	Exploratory	Parallel	Companionable	Collaborative
Child Stationary/ Stable Environment	0.038	-0.475**	-0.329*	-0.307	-0.384*
Child Moving/ Stable Environment	0.027	-0.513**	-0.316	-0.413*	-0.473**
Child Stationary/ Changing Environment	0.073	-0.422**	-0.430**	-0.429**	-0.511**
Child Moving/ Changing Environment	0.008	-0.648***	-0.498**	-0.512**	-0.531**

*p<0.05, **p<0.01, ***p<0.001

Table 13: Correlations between Motor Impairment and Socio-emotional Behaviour Factors for Children with Moderate Functionality

Psychomotor Impairment	Autistic	Exploratory	Parallel	Companionable	Collaborative
Child Stationary/ Stable Environment	0.128	-0.278*	-0.215	-0.299*	-0.459***
Child Moving/ Stable Environment	-0.157	-0.219	-0.119	-0.271*	-0.390**
Child Stationary/ Changing Environment	0.031	-0.078	-0.231	-0.511***	-0.500***
Child Moving/ Changing Environment	0.185	-0.100	-0.245*	-0.555***	-0.531***

*p<0.05, **p<0.01, ***p<0.001

Table 14: Correlations between Motor Impairment and Socio-emotional Behaviour Factors for Children with High Functionality

Motor Impairment	Autistic	Exploratory	Parallel	Companionable	Collaborative
Child Stationary/ Stable Environment	0.363**	-0.472**	-0.293*	-0.264	-0.325*
Child Moving/ Stable Environment	0.311*	-0.311*	-0.360*	-0.177	-0.381**
Child Stationary/ Changing Environment	0.536***	-0.130	-0.303*	-0.217	-0.340*
Child Moving/ Changing Environment	0.463**	-0.272	-0.349*	-0.254	-0.271

*p<0.05, **p<0.01, ***p<0.001