*Original Article***Behavioral and Movement Characteristics of
Children With Autism or Attention Deficit
Hyperactive Disorder**

Yoshitaka KONNO

The present study attempted to identify behavioral and movement characteristics of children with autism or attention deficit/hyperactive disorder (ADHD), using factor analysis. Participants were 30 children with autism (26 boys and 4 girls; 5 years 7 months to 10 years 3 months; mean CA=6 : 2), and 22 children with ADHD (18 boys and 4 girls; 5 years 3 months to 9 years 11 months; mean CA=6 : 8). The mean IQ was 76 (range 71-89) for the children with autism, and 74 (range 71-83) for the children with ADHD. A behavior checklist (21 items) and a movement checklist (22 items) were administered. Factor analysis of the behavior checklist revealed 4 factors: "lack of active relating to others" (Factor I), "persistent interest in objects" (Factor II), "psychological tension and suppressed emotional expression" (Factor III), and "lack of sympathy with others" (Factor IV). The following factors were obtained from the movement checklist: "lack of active control of bodily movement" (Factor I), "insufficiency of movement skill and movement coordination" (Factor II), "impulsivity" (Factor III), and "hyper-excitability in mind and body" (Factor IV). For the children with autism, comparison of factor scores from the behavior checklist revealed that Factor I, Factor III, and Factor IV were their dominant characteristics, while comparison of the movement checklist factor scores indicated that Factor I was a salient characteristic for them.

Key Words: behavioral and movement characteristics, autism, ADHD

Introduction

Ever since Kanner (1943) first described the symptoms of children with autism, such as the inability to relate to people and situations in the way other children do (e.g., showing extreme aloofness and lack of affective contact with others), limitations in the variety of the spontaneous activity of children with autism, an anxious obsessive desire for sameness or perseveration of sameness, and an inability to use language for the purpose of communication, definitions of autism have listed those behaviors without referring to neurological symptoms. More recently, Creak (1963)

Y. Konno

described children with autism as having underdeveloped self-identification, abnormalities in perception, unreasonable anxiety, and distortion of movement patterns.

Abnormal postures such as toe walking, bizarre posturing of the trunk and extremities, arching of the back, and hyperextension of the neck, have been noted consistently in children with autism (American Psychiatric Association, 1994; Ornitz, 1973). Gillberg (1989) found that 83% of a group of children with Asperger syndrome whom he examined had “relatively poor motor skills.” He also noted that they “appeared to be generally clumsy,” had a “stiff or awkward way of walking (often without arm-swing,” and were “uncoordinated in posture and gesture.” Ghaziuddin and Butler (1998) noted that clumsiness in children with autism or Asperger syndrome has been described as relatively slow and inaccurate perceptual-motor skills and difficulty with the acquisition of skills such as constructing models, hopping, cycling, and throwing or catching a ball. According to Leary and Hill (1996), some individuals with autism have been described as having varied disturbances of movement, such as difficulty with motor planning and sequencing of movement, abnormality of gait and posture, difficulty in initiating or switching movements, stereotyped movements, disturbances in facial expression, abnormalities in muscle tone, loss of associated movements, clumsiness, catatonic phenomena, particularly excitement or posturing, and impaired imitation.

Green, Baird, Barnett, Henderson, Huber, and Henderson (2002) used the Movement Assessment Battery for Children (Movement ABC; Henderson & Sugden, 1992), which covers a fairly wide range of motor activities organized into three components, manual dexterity, ball skills, and balance, to assess the severity and nature of motor impairment in children with Asperger syndrome.

After Strauss and Lehtinen (1947) characterized hyperactive children as being hyperactive, distractible, uninhibited, and impulsive, and showing erratic and uncoordinated behavior, “hyperactivity” is the generalized term used to categorize individuals who exhibit a lack of control of spontaneous activity, specifically motor activities (Clements & Peters, 1962; Douglas, 1972; Kephart, 1971). Related to that, the diagnosis of attention deficit hyperactivity disorder (ADHD) is associated with an abnormally high level of motor activity, a short attention span, low tolerance of frustration, hyperexcitability, and an inability to control impulses (American Psychiatric Association, 1994).

Denkla, Rudel, Chapman, and Krieger (1985) reported that children with ADHD show more qualitative signs of dysrhythmia or overflow while making repetitive and alternating movements than other children do. Szatmari, Bremner, and Nagy (1989) used Fog’s Test, in which children are asked to walk between two lines in several postures (e.g., heel-to-toe, on their heels, or with feet inverted) and overflow movements are scored, and found that severely impaired performance carried an increased risk of behavioral disturbances of all types, especially hyperactive behavior. Their most salient finding was that two of the four qualitative domains (dynamic balance, diadochokinesis, and manual dexterity) and the total qualitative score on this test at 5 to 6 years of age were predictive of a diagnosis of ADHD one year later.

Movement Characteristics of Children With Autism or ADHD

The studies mentioned above pointed out that in addition to extreme aloofness, perseveration of sameness, and lack of affective contact, disturbances of movement are important characteristic of autism. On the other hand, hyperactivity, distractibility, and impulsivity are considered to be the main characteristics of ADHD. There is now a general consensus that because the symptoms of autism and ADHD are caused by disorders of central nervous system, there are common behavior and movement characteristics among children with autism and children with ADHD. However, few statistical studies have demonstrated symptomatic differences between these populations. Therefore, the present study used factor analytic methods to identify characteristic symptoms of these populations.

Method

Participants

Participants were 30 children with autism (26 boys and 4 girls; 5 years 7 months to 10 years 3 months; mean CA = 6 : 2), and 22 children with ADHD (18 boys and 4 girls; 5 years 3 months to 9 years 11 months; mean CA = 6 : 8). The mean IQ as assessed using a variety of standard assessment instruments (WPSSI, WISC, WISC-III, and Tanaka-Binet) was 76 (range 71–89) for the children with autism, and 74 (range 71–83) for the children with ADHD. According to DSM-IV, their IQ's corresponded to borderline to dull normal levels. All participants who had autism or ADHD met the DSM-IV (American Psychiatric Association, 1994) criteria for infantile autism and attention deficit hyperactive disorder, respectively.

As described in DSM-IV, the children with autism showed marked impairment in the use of various nonverbal behaviors (e.g., eye-to-eye gaze, facial expression, body posture, and gestures) in regular social interaction and communication; a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., not showing or pointing out objects they find interesting); and a lack of social play or games, preferring solitary activities, or involving others in activities only as tools or “mechanical” aids. In addition to stereotyped body movements including hand movements, such as handclapping and finger flickering, and whole body movements, such as rocking, dipping, and swaying, they had postural abnormalities.

The children with ADHD showed the characteristics described in DSM-IV, such as fidgetiness or squirming in their seat, excessive running or climbing in situations where it was inappropriate, difficulty in engaging quietly in leisure activities, appearing as if “driven by a motor,” difficulty in delaying responses, blurting out answers before questions had been completed, and difficulty awaiting their turn.

The participants were recruited from children who visited the special education laboratory or the counseling room affiliated with the university where the author worked as a clinical developmental counselor for children with disabilities. All parents gave informed consent for the participation of their children in this study.

Y. Konno

Behavior Checklist

From a 46-item behavior checklist (Konno, 1987), 21 items were selected through factor analysis. These comprised categories such as motility, emotional expression, personal relations, verbal behavior, interest in objects, and perseveration of sameness. Each item was evaluated with a 5-point rating scale in which the frequency that a given behavioral characteristic appeared was rated from “never” to “very often,” and 1 to 5 points were assigned respectively. The higher the score, the greater was the behavior problem.

Behavioral observations were carried out individually in a small group play situation, in which 3 to 5 children with autism or ADHD participated with familiar staff members who engaged in group play therapy. Three examiners, including the present author, attended the playroom and assessed the children’s behavior using the behavior checklist. In addition to observations of behavior in the play room, information about the children’s daily activities at home or at day care were gathered from their mothers. Of the three examiners, two were clinical psychologists specializing in special education, and the other, a postgraduate student of clinical psychology.

Prior to the present study, with two participants’ cooperation, the examiners practiced rating with the behavior and movement checklists and achieved fairly good agreement among them. Based on a brief discussion about each test-item rating among the examiners, agreement or disagreement was determined. Across all test items, the ratio of agreement among the three examiners was calculated via the formula of total number of agreements of the three examiners divided by the total number of agreements plus the total number of disagreements, multiplied by 100. The range of interrater agreement was 87% (17 of 21 items) to 91% (19 of 21 items).

Movement Checklist

From a 27-item movement checklist (Konno, 1984), 22 items comprising characteristic movements of the arm, grasping objects, throwing or catching a ball, walking (gait) and standing posture, keeping one’s balance, and bodily tension, were used. Each item was evaluated with a 5-point rating scale in which the frequency that a given movement characteristic appeared was rated from “never” to “very often,” and 1 to 5 points were assigned respectively. The higher the score was, the greater the difficulty of movement.

Participants were required to perform several movement tasks following movement models performed by a familiar staff member who engaged in group play therapy. Movement tasks included walking, standing on one leg, using a pencil, catching and throwing a plastic ball, jumping, and skipping, and were assessed on the spot without video recording. In addition to the observations of the performance of the movement tasks, information about movement characteristics at home or day care were gathered from their mothers. Verbal instructions were kept to minimum and phrased as simply as possible. In instances where the participant was temporarily inattentive, the experimenter simply waited until the child was again oriented to the task requirements. All participants were rewarded with verbal praise for participa-

Movement Characteristics of Children With Autism or ADHD

tion. Interrater agreement obtained by the same formula as for the behavior assessments was 82% (18 of 22 items) to 91% (20 of 22 items).

Results

Factor Analysis of the Behavior Checklist Data

As shown in Table 1, factor analysis using principal method with varimax rotation revealed four factors. Each factor was interpreted from items that had a factor loading score above 0.40. Representative items for Factor I were “no interest in other children,” “leading adults by the hand when wanting to do something,” “no eye contact with others,” “no response to call as if no hearing,” “no resistance to bullying,” and “rejects physical contact with others.” These items denote extreme difficulties in actively relating to others, so that Factor I was named “lack of active relating to others.” Factor II comprised “interest in handling machinery,” “interest in a particular letter or pattern,” “interest in a particular toy,” “persistence in a particular manner or ritualistic manner,” “repetitive singing of a song or reading of a particular book,” and “saying something inappropriate for the occasion.” Factor II was named “persistent interest in objects,” because most of the items represent a persistent interest in particular objects or activities.

The items that contribute to Factor III are “strained and nervous looks,” “grimaces or blinks like a tic,” “awkwardness in gait or running,” “rejection of any changing of clothes or rearranging of furniture,” and “lack of a distinctive facial expression.” Because these items represent difficulty in controlling psychophysiological tension and suppressed expression of emotional experiences, Factor III was named “psychological tension and suppressed emotional expression.” Factor IV consists of “smiling without sympathetic feeling,” “no spontaneous speech,” “no interest in TV programs for children,” and “no interest in toys.” These items indicate a lack of affective/sympathetic contact with others. Therefore, Factor IV was named “lack of sympathy with others.”

Comparison of Behavior Characteristics Between the Children With Autism and Those With ADHD

Figure 1 shows the comparison of mean scores for each group for each factor. The mean scores on Factor I were 4.68 for the children with autism and 2.96 for the children with ADHD; t-test revealed a significant difference between the two groups, $t(50)=5.843$, $p<.001$. The mean scores on Factor III were 4.07 for the children with autism and 2.87 for the children with ADHD; there was a significant difference between the two groups, $t(50)=5.316$, $p<.001$. The mean scores on Factor IV were 4.61 for the children with autism and 2.81 for the children with ADHD, and that difference too was significant, $t(50)=2.737$, $p<.01$. However, the mean scores on Factor II were 4.13 for the children with autism and 4.62 for the children with ADHD, and t-test revealed a non significant difference between two groups, $t(50)=1.334$, $p>.05$.

Y. Konno

TABLE 1 Behavior Checklist

	Factor I	Factor II	Factor III	Factor IV	h^2
Factor I: Lack of active relating to others					
1. no interest in other children	0.67	-0.01	0.01	0.32	0.65
2. leading adults by the hand when wanting to do something	0.66	0.21	0.09	0.18	0.62
3. no eye contact with others	0.60	0.13	0.17	0.06	0.62
4. no response to call as if no hearing	0.51	-0.06	-0.04	0.22	0.76
5. no resistance to bullying	0.49	0.01	0.01	0.01	0.54
6. rejects physical contact with others	0.42	0.08	-0.01	0.06	0.43
Factor II: Persistent interest in objects					
7. interest in handling machinery	-0.01	0.84	0.04	-0.14	0.71
8. interest in a particular letter or pattern	0.06	0.82	-0.08	-0.07	0.64
9. interest in a particular toy	0.01	0.56	-0.11	0.01	0.46
10. persistence in a particular manner or ritualistic manner	0.16	0.53	0.11	-0.24	0.64
11. repetitive singing of a song or reading of a particular book	-0.07	0.40	0.13	0.06	0.41
12. saying something inappropriate for the occasion	0.18	0.40	0.2	0.1	0.48
Factor III: Psychological tension and suppressed emotional tension					
13. strained and nervous looks	-0.03	-0.14	0.69	0.22	0.54
14. grimaces or blinks like a tic	0.09	-0.08	0.65	-0.15	0.54
15. awkwardness in a gait or running	0.29	0.02	0.55	0.28	0.62
16. rejection of any changing of clothes or rearranging of furniture	-0.01	-0.01	0.48	-0.01	0.48
17. lack of a distinctive facial expression	-0.02	0.16	0.44	0.19	0.47
Factor IV: Lack of sympathy with others					
18. smiling without sympathetic feeling	-0.01	0.06	-0.16	0.52	0.52
19. no spontaneous speech	0.17	0.13	-0.06	0.41	0.41
20. no interest in TV programs for children	0.23	-0.14	0.23	0.42	0.42
21. no interest in toys	0.12	0.17	0.25	0.40	0.40
Eigen value	14.38	7.66	3.65	1.87	
Variance	35.4%	15.2%	8.2%	5.7%	

Movement Characteristics of Children With Autism or ADHD

Factor Analysis of the Movement Checklist Data

Table 2 shows the result of factor analysis using principal method with varimax rotation. Four factors were extracted, and each factor was interpreted from items that had a factor loading score above 0.40. Factor I comprised the following 9 items: “bends the elbow and twists the wrist inward,” “makes restricted hand flapping while waving good-bye,” “does not modify a movement when given verbal instruction or gesture model,” “grasps or reaches an object without paying attention to it,” “throws a ball with the palm upward,” “throws a ball to other people without paying attention to the other person,” “catches a ball thrown by other people without paying attention to the ball or the other person,” “does not imitate a simple movement,” and “makes repetitive and stereotyped movements.” These items denote extreme difficulties in actively relating to one’s own body movement. Therefore, Factor I was named “lack of active control of bodily movement.” Factor II consisted of following 8 items: “brings a pencil while twisting the wrist inward or outward,” “does not bring a pencil with three-point (precision) grasping,” “does not throw a ball in the correct direction,” “does not jump on one leg,” “does not pay attention to the feet while walking on a balance beam,” “does not make a forward spin on the ground,” “does not skip,” and “does not swing the arms alternately while walking.” Factor II was named “insufficiency of movement skill and movement coordination.”

Factor III consisted of three items: “raises the arm without paying attention to it,” “does not keep a static posture,” and “makes impulsive movements.” Because

FIG. 1 Comparison of Behavior Characteristics Between Children With Autism and With ADHD

Factor I: “lack of active relating to others,” Factor II: “persistent interest in objects,” Factor III: “psychological tension and suppressed emotional expression,” Factor IV: “lack of sympathy with others.” (*= $p < .001$)

Y. Konno

TABLE 2 Movement Checklist

	Factor I	Factor II	Factor III	Factor IV	h^2
Factor I: Lack of active control of bodily movement					
1. bends the elbow and twists the wrist inward	0.55	0.32	0.16	0.09	0.47
2. makes restricted hand flapping while waving good-bye	0.67	0.43	0.12	0.1	0.66
3. does not modify a movement when given verbal instruction or gesture model	0.55	0.32	0.32	-0.25	0.66
4. grasps or reaches an object without paying attention to it	0.66	0.14	0.07	0.16	0.61
5. throws a ball with the palm upward	0.78	0.21	0.18	-0.05	0.68
6. throws a ball to other people without paying attention to the other person	0.76	0.31	-0.02	0.06	0.71
7. catches a ball thrown by other people without paying attention to the ball or the other person	0.76	0.32	0.06	0.01	0.69
8. does not imitate a simple movement	0.78	0.11	0.22	-0.7	0.69
9. makes repetitive and stereotyped movements	0.78	0.17	0.23	0.21	0.72
Factor II: Insufficiency of movement skill and movement coordination					
10. brings a pencil while twisting the wrist inward or outward	0.35	0.64	-0.22	0.02	0.67
11. does not bring a pencil with three-point (precision) grasping	0.29	0.77	-0.09	0.1	0.69
12. does not throw a ball in the correct direction	0.22	0.71	0.26	0.03	0.63
13. does not jump on one leg	0.2	0.73	0.28	0.17	0.69
14. does not pay attention to the feet while walking on a balance beam	0.13	0.73	0.21	0.16	0.63
15. does not make a forward spin on the ground	0.26	0.50	0.25	-0.18	0.49
16. does not skip	0.11	0.53	0.35	-0.09	0.42
17. does not swing the arms alternately while walking	0.31	0.47	0.33	0.13	0.44

Movement Characteristics of Children With Autism or ADHD

TABLE 2 Continued

	Factor I	Factor II	Factor III	Factor IV	h^2
Factor III: Impulsivity					
18. raises the arm without paying attention to it	0.31	0.38	0.48	-0.33	0.68
19. does not keep a static posture	0.15	0.14	0.77	-0.08	0.65
20. makes impulsive movements	0.29	0.03	0.74	0.19	0.37
Factor IV: Hyperexcitability in mind and body					
21. stiffens body in an unfamiliar or strange situation	0.29	0.25		0.54	0.53
22. increases bodily tension when excited	-0.03	0.08		0.61	0.51
Eigen value	12.33	4.23	1.98	1.26	
Variance	39.2%	10.5%	8.2%	7.3%	

these items represent difficulties in keeping a static posture and in controlling movements smoothly, Factor III was named “impulsivity.” Factor IV comprised two items, “stiffens body in an unfamiliar or strange situation” and “increases bodily tension when excited,” and was named “hyperexcitability in mind and body.”

FIG. 2 Comparison of Movement Characteristics Between Children With Autism and With ADHD

Factor I: “lack of active control of bodily movement,” Factor II: “insufficiency of movement skill and movement coordination,” Factor III: “impulsivity,” Factor IV: “hyperexcitability in mind and body.” (* = $p < .001$)

Y. Konno

TABLE 3 Coefficient Correlation Between Behavior and Movement Characteristics in the Children With Autism

	Factor I Lack of active control of bodily movement	Factor II Insufficiency of motor skill and movement coordination	Factor III Impulsivity	Factor IV Hyperexcitability of mind and body
Factor I: Lack of active relating to others	0.561	0.386	0.437	0.152
Factor II: Persistent interest in objects	0.247	-0.021	0.181	0.032
Factor III: Psychological tension and suppressed emotional expression	-0.115	0.023	0.036	0.445
Factor IV: Lack of sympathy with others	0.279	-0.131	-0.045	0.083

TABLE 4 Coefficient Correlation Between Behavior and Movement Characteristics in the Children With ADHD

	Factor I Lack of active control of bodily movement	Factor II Insufficiency of motor skill and movement coordination	Factor III Impulsivity	Factor IV Hyperexcitability of mind and body
Factor I: Lack of active relating to others	0.232	0.265	0.236	0.189
Factor II: Persistent interest in objects	-0.157	0.043	0.396	-0.125
Factor III: Psychological tension and suppressed emotional expression	0.243	0.326	0.135	0.427
Factor IV: Lack of sympathy with others	-0.112	-0.124	0.694	-283

Comparison of Movement Characteristics Between the Children With Autism and Those With ADHD

Figure 2 shows the comparison of mean scores for each group for each factor. The mean scores on Factor I were 4.18 for the children with autism and 2.64 for the children with ADHD. T-test revealed a significant difference between the two groups, $t(50)=11.724$, $p<.001$. The mean scores on Factor II were 4.23 for the children with autism and 3.72 for the children with ADHD. There was no significant difference,

Movement Characteristics of Children With Autism or ADHD

$t(50)=1.332$, $p>.05$. The mean scores on Factor III were 4.01 for the children with autism and 3.81 for the children with ADHD, and there was no significant difference, $t(50)=1.576$, $p>.05$. The mean scores on Factor IV were 3.97 for the children with autism and 4.3 for the children with ADHD. T-test revealed a non significant difference between two groups, $t(50)=1.035$, $p>.05$.

Correlation Between Behavior and Movement Characteristics

Tables 3 and 4 show the matrices of Pearson's coefficient of correlation between the behavior factors and the movement factors for the children with autism and the children with ADHD, respectively. There were significant correlations between "lack of active relating to others" (Factor I) and "lack of active control of bodily movement" (Factor I), and "impulsivity" (Factor III) (see Table 3). There was a significant correlation between "psychological tension and suppressed emotional expression" (Factor III) and "hyperexcitability in mind and body" (Factor IV). There were significant correlations between "persistent interest in objects" (Factor II) and "impulsivity" (Factor III), between "psychological tension and suppressed emotional expression" (Factor III) and "hyperexcitability in mind and body" (Factor IV) (see Table 4). Also, a significant correlation was obtained between "lack of sympathy with others" (Factor IV) and "impulsivity" (Factor III).

Discussion

The factor analysis in the present study revealed four factors for behavior characteristics (Factor I: "lack of active relating to others," Factor II: "persistent interest in objects," Factor III: "psychological tension and suppressed emotional expression," and Factor IV: "lack of sympathy with others"), and four factors for movement characteristics (Factor I: "lack of active control of bodily movement," Factor II: "insufficiency of movement skill and movement coordination," Factor III: "impulsivity," and Factor IV: "hyperexcitability in mind and body").

Comparison of the factor scores of behavior characteristics between the children with autism and those with ADHD revealed that these factors except for Factor II, were salient features of children with autism. Therefore, "lack of active relating to others," "psychological tension and suppressed emotional expression," "lack of sympathy with others" are important behavioral indices for separating children with autism from those with ADHD.

Kanner (1943) held that perseveration or persistent interest in objects was one of the most characteristic symptoms of children with autism. However, in the present study, there was no significant difference in factor scores on Factor II ("persistent interest in objects") between children with autism and those with ADHD. This is probably due to the fact that Factor II included few items concerning an obsessive desire for sameness. Rather, this factor represented aspects of voluntarily relating to objects, although the manner of those activities contained impulsive and uncoordinated features. Therefore, this factor may reflect the behavioral characteristics of

Y. Konno

children with ADHD as well.

Examination of developmental changes (Konno, 1987) has indicated that children with autism show an increase in scores for Factor III (“psychological tension and suppressed emotional expression”) as they grow older. Similar results were also reported in previous studies (Kobayashi, 1976; Konno & Ohno, 1981).

According to Bettelheim (1967), children with autism cover their ears or eyes with their hands in order to exclude external stimuli because they are overly sensitive to those stimuli and cannot tolerate them. Kobayashi (1976) reported that children with autism showed increased frequency of stereotyped movements when they were confronted with psychological difficulties. That suggests that children with autism try to reduce their psychological tension through these avoidance behaviors. These studies suggest that their suppressed emotional expression reflects learned avoidance of the psychological difficulties of adapting to their internal or external environment. Eventually, they fail to establish the schemata necessary for actively relating to their environment and themselves in an ordinary way.

When factor scores on movement characteristics were compared, a significant difference was found in Factor I (“lack of active control of bodily movement”), indicating that this factor was the most salient movement characteristic in the children with autism. In contrast, Factor II (“insufficiency of movement skill and movement coordination”), Factor III (“impulsivity”), and Factor IV: (“hyperexcitability in mind and body”) were commonly observed movement characteristics in both the children with autism and the children with ADHD.

However, as indicated in DSM-IV (American Psychiatric Association, 1994), the increased motor activity that may occur in ADHD must be distinguished from the repetitive motor behavior that characterizes stereotypic movement disorder. In stereotypic movement disorder, the motor behavior is generally focused and fixed (e.g., body rocking or self-biting), whereas the fidgetiness and restlessness shown by children with ADHD are more typically generalized. Piek, Pitcher, and Hay (1999) administered the Movement Assessment Battery for Children (comprising manual dexterity, ball skills, and static and dynamic balance) to children with ADHD, and an everyday-functioning parent/teacher report checklist to their parents and teachers. They found that in fine motor skills such as handwriting, children with ADHD commonly show deficits. They also suggested that children with either predominantly inattentive-type or combined-type ADHD were at risk for motor coordination difficulties, and that children with ADHD-predominantly inattentive (ADHD-PI) were more likely to have manual-dexterity difficulties, whereas children with ADHD-combined (ADHD-C) were more likely to have difficulties with balance. However, in the present study, most of the participants exhibited features of ADHD-combined, so that a relationship between movement characteristics and type of ADHD could not be evaluated.

Bonnet and Gao (1996) estimated that 80% of children with Asperger syndrome display motor dyspraxia or clumsiness. Asperger’s original description of the syndrome included a description of motor abnormalities. Szatmari et al. (1989) described

Movement Characteristics of Children With Autism or ADHD

the inadequacies of motor coordination among children with Asperger syndrome qualitatively as “appeared to be generally clumsy and a stiff or awkward way of walking (often without arm-swing), or were uncoordinated in posture and gesture.” Similar movement characteristics such as poor manual dexterity, ball skills, and balance skill, have been described by others (e.g., Maurer & Damasio, 1982; Miyahara, Tuji, Hori, Nakanishi, Kageyama, & Sugiyama, 1997). In terms of the basic mechanisms underlying the movement disturbance, Weimer, Schatz, Lincoln, Ballantyne, and Trauer (2001) reported that children with Asperger syndrome showed deficits on tests of apraxia, especially whole body posturing; tandem gait, and one-leg balance, particularly when their eyes were closed, and also on repetitive finger-thumb apposition. Based on these observations, Weimer et al. (2001) suggested that a proprioceptive deficit may underlie the poor coordination observed in children with Asperger syndrome, and that those children may be over-reliant on visual input for maintaining balance and position in space.

Concerning special difficulties with ball skills, Tantam (1991) explained that children with autistic tendencies have particular difficulty in copying movements that others make. An alternative explanation was a deficit of motor planning proposed by Jones and Prior (1985). They indicated that children with autism were not only inaccurate in the imitation of static postures and dynamic sequences of movements, but they also showed many soft neurological signs. Although children with Asperger syndrome were not included in the present study, these explanations are suggestive to consider movement characteristics observed in the children with autism in the present study.

Another possible explanation, derived from clinical findings through the Dohsa-method, proposes that symptoms of movement disturbance can affect people's experience of life and how they may be perceived by others (Konno, 1990, 1992). Individuals who experience movement disturbance report difficulties in controlling perception, attention, consciousness, motivation, and cognition (Konno, 1990, 1992). This may be true in children with autism and those with ADHD. Dohsa-method focuses on viewing the clinical problems of children with autism and ADHD from a movement disturbance perspective. Especially, from a Dohsa-method point of view, children with autism fail to establish a well-functioning self-image because of distorted body image. Therefore, they need to reestablish a well-functioning self-image or activity based on experiencing harmonious mind-body relations. On the other hand, the central disturbance of children with ADHD is thought to be a dysfunction or difficulty in controlling both behavioral and motor impulses, so that they need to acquire skills needed for controlling impulsivity by having experiences of mind-body relaxation and intentional control of bodily movement.

The present study aimed at identifying behavioral and movement characteristics of children with autism and children with ADHD. However, the IQ's of the children in the present study fell in the borderline to dull normal level. Thus, the results of this study might be confounded with effects of lower mental functioning. Therefore, a further study is needed in which children with borderline IQ's but neither autism nor

Y. Konno

ADHD are included as a comparison group.

References

- American Psychiatric Association (1994) *Diagnostic and statistical manual of mental disorders* (4th ed.). Author, Washington, DC.
- Bettelheim, B. (1967) *The empty fortress: Infantile autism and the birth of self*. Free Press, New York.
- Bonnet, K. A. & Gao, X. K. (1996) Asperger syndrome in neurologic perspective. *Journal of Child Neurology*, 11, 482-489.
- Clements, S. D. & Peters, J. E. (1962) Minimal brain dysfunctions in the school-age child. *Archives of General Psychiatry*, 6, 185-197.
- Creak, E. M. (1963) Childhood psychosis: A review of 100 cases. *British Journal of Psychiatry*, 109, 84-89.
- Denkla, M. B., Rudel, R. G., Chapman, C., & Krieger, J. (1985) Motor proficiency in dyslexic children with and without attentional disorders. *Archives of Neurology*, 42, 228-231.
- Douglas, V. I. (1972) Stop, look and listen: The problem of sustained attention and impulse control in hyperactive and normal children. *Canadian Journal of Behavior Science*, 4, 259-282.
- Ghaziuddin, M. & Butler, E. (1998) Clumsiness in autism and Asperger syndrome: A further report. *Journal of Intellectual Disability Research*, 42, 43-48.
- Gillberg, C. (1989) Asperger syndrome in 23 Swedish children. *Developmental Medicine and Child Neurology*, 31, 520-531.
- Green, D., Baird, G., Barnett, A. L., Henderson, L., Huber, J., & Henderson, S. E. (2002) The severity and nature of motor impairment in Asperger's syndrome: A comparison with specific developmental disorder of motor function. *Journal of Child Psychology and Psychiatry*, 43, 655-668.
- Henderson, S. E. & Sugden, D. (1992) *The Movement Assessment Battery for Children*. Psychological Corporation, London.
- Jones, V. & Prior, M. (1985) Motor imitation abilities and neurological signs in autistic children. *Journal of Autism and Developmental Disorders*, 15, 37-46.
- Kanner, L. (1943) Autistic disturbances of affective contact. *Nervous Child*, 2, 217-250.
- Kephart, N. C. (1971) *The slow learner in the classroom* (2nd ed.). Charles E. Merrill Publishing Company, Columbus, Ohio.
- Kobayashi, S. (1976) Consideration on establishing of syndrome in the autistic children. *Faculty of Education, Tokyo University of Education*, 22, 145-151. (in Japanese with English abstract)
- Konno, Y. (1984) Consideration on the motor characteristics among children with autism, children with ADHD and learning disabled children. *Proceedings of the 26th annual meeting of the Japanese Association of Educational Psychology*, 876-877. (in Japanese).
- Konno, Y. (1987) A comparison of the behavioral characteristics among autistic, hyperactive and learning disabled children. *Annual Report of the Faculty of Education, Bunkyo University*, 21, 59-70.
- Konno, Y. (1990) *Dohsa method for children with developmental disturbance*. Gakusha, Tokyo

Movement Characteristics of Children With Autism or ADHD

(in Japanese).

- Konno, Y. (1992) Principles and practice of the Dousa-hou for autistic children. *Journal of Rehabilitation Psychology*, 17•18•19, 97-102.
- Konno, Y. & Ohno, K. (1981) A comparative study of hyperactivity and its related symptoms in autistic and hyperactive children. *Japanese Journal of Special Education*, 19(1), 37-47. (in Japanese with English abstract)
- Leary, M. & Hill, D. (1996) Moving on: Autism and movement disturbance. *Mental Retardation*, 34, 39-53.
- Maurer, R. G. & Damasio, A. G. (1982) Childhood autism from the point of view of behavioral neurology. *Journal of Autism and Developmental Disorders*, 12, 195-205.
- Miyahara, M., Tuji, M., Hori, M., Nakanishi, K., Kageyama, H., & Sugiyama, T. (1997) Brief report: Motor incoordination in children with Asperger syndrome and learning disabilities. *Journal of Autism and Developmental Disorders*, 27, 595-603.
- Ornitz, E. M. (1973) Childhood autism: A review of the clinical and experimental literature. *California Medicine*, 118, 21-47.
- Piek, J. P., Pitcher, T. M., & Hay, D. A. (1999) Motor coordination and kinaesthesia in boys with attention deficit-hyperactivity disorder. *Developmental Medicine and Child Neurology*, 41, 159-165.
- Strauss, A. A., & Lehtinen, L. E. (1947) *Psychopathology and education of the brain-injured child*. Grune & Stratton, New York.
- Szatmari, P., Bremner, R., & Nagy, J. (1989) Asperger's syndrome: A review of clinical features. *Canadian Journal of Psychiatry*, 34, 554-560.
- Tantam, D. (1991) Asperger's syndrome in adulthood. In U. Frith (Ed.), *Autism and Asperger's syndrome*. Cambridge, UK: Cambridge University Press.
- Weimer, A. M., Schatz, A. M., Lincoln, A., Ballantyne, A. O., & Trauer, D. A. (2001) "Motor" impairment in Asperger syndrome: Evidence for a deficit in proprioception. *Journal of Developmental and Behavioral Pediatrics*, 22, 92-101.

—Received September 30, 2004; Accepted February 5, 2005—