Robot motion tracking analysis in Attention-Deficit/Hyperactivity Disorder

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Objectives

Attention-Deficit / Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by hyperactivity , inattention and impulsivity . Prior to 1980, the disease was named Attention-Deficit Disorder (ADD) and then changed to ADHD with an emphasis on the importance of hyperactive symptoms. Nonetheless, there are limits to measuring objective activity since the assessments are largely based on observations of therapists and caregivers. The current research attempts to mitigate these limits through objective measures.

Methods

The participants evaluated in this study were 35 children diagnosed with ADHD and 50 typically developing children within the age range of 5 to 12 years old. The purpose of this study was to examine behavioral levels using a robot motion tracking system and to conduct an evaluation through comparative analysis of the results from the Child Behavior Checklist (CBCL) and the Attention-Deficit / Hyperactivity Disorder Diagnostic Scale (ADHD-DS), which are the currently standard evaluations for ADHD diagnosis.

Results

There were significant differences between the ADHD group's and control group's averages in their CBCL measuresfor attention problem (52.78±3.90 vs. 63.40±7.57, p<0.001), ADHD problem (53.64±5 .31 vs. 67.77±11.07, p<0.001) and ADHD-DS (25. 37±6.30 vs.12.36±3.39, p<0.001) as depicted in Table 1.

Table 1. Mean and standard deviation of ADHD scales between two groups

Scale		ADHD (N = 35)	Control (N = 50)	P-value
CBCL - Attention problem	M	63.40	52.78	<0.001***
	SD	7.57	3.90	
CBCL - ADHD	M	67.77	53.64	<0.001***
	SD	11.07	5.31	
ADHD-DS	M	25.37	12.36	<0.001***
	SD	6.30	3.39	

Analysis using Independent t-test * : p < 0.05, ** : p < 0.01, *** : p < 0.001, ADHD : Attention-Deficit/Hyperactivity Disorder, CBCL : Child Behavior Checklist for Ages 6-17, ADHD-DS : Attention-Deficit/Hyperactivity Disorder-Diagnostic scale, SD : Standard deviation

Results

There were also significant differences between movement distance (4968.64±4201.53 vs. 830.89± 6324.45, p<0.001) and movement speed (361.17± 133.49 vs. 735.60±1227.55, p=0.035) in that the control group traveled longer distances at slower rates while the ADHD group traveled shorter distances at faster rates (Table 2).

Table 2. Mean and standard deviation of activity detection by two groups

Scale		ADHD (N = 35)	Control (N = 50)	P-value
Migration Distance (m)	M	0.83	4.97	<0.001**
	SD	6.32	4.20	
Migration rate (m/s)	M	0.74	0.36	0.035*
	SD	1.23	0.36	

Analysis using independent t-test * : p < 0.05, ** : p < 0.01, *** : p < 0.001, ADHD : Attention-Deficit/Hyperactivity Disorder, SD : Standard deviation

The results from the correlational analysis showed that the distance of travel was significantly correlated to CBCL's attention problem and to both CBCL's and ADHD-DS's ADHD problem, while movement speed was significantly correlated to CBCL's and ADHD-DS's ADHD problem as illustrated in Table 3.

Table 3. Correlation between scores on newly developed robot executive function test and existing standardized test

		CBCL -attention problem	CBCL -ADHD	ADHD-DS
Migration Distance	r	-0.306**	-0.356**	-0.426**
	p-value	0.004	0.001	<0.001
Migration Rate	r	0.158	0.335**	0.240*
	P-value	0.149	0.002	0.027

Analysis using Pearson's correlation test * : p < 0.05, ** : p < 0.01, *** : p < 0.001, ADHD : Attention-Deficit/Hyperactivity Disorder, CBCL : Child Behavior Checklist for Ages 6-17, ADHD-DS : Attention-Deficit/Hyperactivity Disorder-Diagnostic scale, SD : Standard deviation

Conclusion

Children with ADHD were characterized by moving small distances faster than children without ADHD within the same period of time during tasks. Moreover, Robot motion tracking analysis can be used to overcome limitations of previous questionnaires by producing objective results about children's activities to determine the diagnosis and treatment effectiveness.

References

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