

Adaptive Behavior Profiles and Their Association with Cognitive Ability and Symptom Severity in Children with High-Functioning Autism Spectrum Disorder

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Purpose: This study explores the profiles of adaptive behaviors in school-going children with high-functioning autism spectrum disorder (HFASD) and their relationship with intelligence quotient (IQ) and the severity of ASD symptoms. **Methods:** Sixty-eight seven- to 12-year-old children with HFASD were divided into intellectually gifted (IG_HFASD) and non-intellectually gifted (Non-IG_HFASD) groups based on their IQ. The groups' adaptive behaviors were compared by the Vineland Adaptive Behavior Scales-Second Edition. The correlations between these behaviors and IQ as well as the severity of ASD symptoms were also examined in each group. **Results:** The IG_HFASD group performed significantly better than the Non-IG_HFASD group in the Communication domain. There were no differences between the groups in other domains of behavior. According to the observation assessment, the Non-IG_HFASD group had more repetitive/stereotypical behaviors than the IG_HFASD group. Among all the children, there was a positive correlation between IQ and the Communication domain, and a negative one between severity and Socialization domains. Examining the correlations in each group revealed that the IG_HFASD group had a moderately negative one between severity and the Daily Living as well as Socialization domains; no significant correlations were found between their IQ and any adaptive behaviors. In contrast, in the Non-IG_HFASD group, non-verbal intelligence was mainly associated with the Socialization domain. **Conclusion:** IQ is mainly associated with the Communication domain of adaptive behaviors in children with HFASD. The severity of ASD symptoms plays an important role in the Socialization domain and other subdomains. Notably, the two groups show distinct levels of correlations between adaptive behaviors and IQ as well as severity.

Keyword: *high-functioning autism spectrum disorder (HFASD), severity, intelligence quotient, adaptive behavior*

Extended Abstract

Individuals with high-functioning autism spectrum disorder (HFASD) do not have intellectual disabilities, but share core deficits with other ASDs in terms of social communication and social interaction. They also show restricted and repetitive patterns of behavior, interest, or activities (American Psychiatric Association, 2013). With respect to behaviors required for personal and social sufficiency, it is likely that individuals with HFASD fail

to convert their cognitive abilities to adaptive behaviors (Sparrow et al., 2005). The Vineland Adaptive Behavior Scale (VABS; Sparrow et al., 1984; VABS-II; Sparrow et al., 2005) is a measure commonly used to assess adaptive behaviors in ASD research. VABS is executed as a semi-structured interview that assesses domains of communication, daily living, socialization, and motor skills (before 6 years of age) from birth to adulthood. The

ASD profile obtained from the VABS usually highlights significant impairments in the socialization domains relative to their strengths in the daily living domain (Carter, et al., 1998; Volkmar et al., 1987). As such, the VABS can effectively discriminate between individuals with ASD and those with other neurodevelopmental disorders (e.g., intellectual disability, attention-deficit/hyperactivity disorder; Sparrow et al., 2005).

Given the importance of adaptive functioning in daily life, researchers have attempted to find the causes of adaptive impairments in ASD populations during childhood. Cognitive ability, as measured by intelligence quotient (IQ) tests, has been shown to influence adaptive behaviors in children with ASD. However, many such findings have been made based on comparisons between ASD groups with low and high IQs (cut-off point: 70-80; e.g., Bölte & Poustka, 2002; Kanne et al., 2011; Liss et al., 2001; Mougá et al., 2015). Very few studies have specifically discussed the diversity of adaptive behaviors exhibited by individuals with HFASD (e.g., Saulnier & Klin, 2007). A related study by Matthews et al. (2015) showed differences in the communication and daily living abilities of adolescents and adults with HFASD with an average IQ (85-115) and those with an above-average IQ (> 115). Therefore, it has been proposed that individuals with HFASD of different IQ levels might diverge in terms of the adaptive behaviors they show during childhood.

Autistic symptomatology has frequently been considered to be associated with adaptive behaviors shown by ASD populations. However, previous reports on the severity of ASD symptoms related to adaptive disability in children with ASD have been inconsistent. Some studies have measured ASD symptoms using the Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 1999), a standardized diagnostic assessment that is based on clinical observations. These studies have shown that communication and socialization symptoms are negatively correlated with the VABS Communication or Socialization domains (Kanne et al., 2011; Klin et al., 2007). Other studies have used the Autism Diagnostic Interview, Revised (ADI-R; Rutter et al., 2003), a semi-structured diagnostic interview for use with caregivers that assesses the severity of ASD symptoms and can

reveal significant relationships between restricted and repetitive behavior symptoms and the socialization domain (Lopata et al., 2012; McDonald et al., 2015). The discrepancy in these findings on the association between adaptive impairments and ASD symptoms might be due to the use of different assessment tools and the characteristics of the participants (e.g., age and severity)

Little is known about the relationship between adaptive behaviors and IQ in school-aged children with HFASD in Taiwan. Due to the heterogeneity of adaptive impairments in HFASD populations, this study aimed to (1) explore any differences in adaptive behaviors and ASD symptoms in Taiwanese children with HFASD of different IQ levels; the children with HFASD were divided into an intellectually gifted (IG_HFASD) and a non-intellectually gifted (Non-IG_HFASD) group; the ASD symptoms were obtained from interviews with caregivers, clinical observations, and parent reports; and (2) understand the extent of the relationship between IQ, ASD symptoms, and adaptive behaviors in children with HFASD of different IQ levels. We also examined the relationships between adaptive behavior, IQ, and ASD severity in each HFASD group. The IG_HFASD group was predicted to show better adaptive behaviors, but fewer ASD symptoms than those in the Non-IG_HFASD group. We also expected to observe relationships between adaptive behavior, IQ, and severity of ASD symptoms in the HFASD participants, but with different strengths of correlations for the two HFASD groups.

Methods

The participants were 68 children between the ages of 7 and 10, recruited using online advertisements. All of the children met the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria for ASD (American Psychiatric Association, 2013). They were diagnosed using the ADOS (module 3) and ADI-R scales for symptoms of communication, social interaction, and restricted, repetitive, and stereotyped behaviors. All the participants had an IQ ≥ 70 , as assessed using an abbreviated version of the Chinese Wechsler Intelligence Scale for Children-III (WISC-III). To compare adaptive

behaviors in children with HFASD and of different cognitive abilities, the participants were divided into two groups based on their IQ scores (Tsou & Lu, 2011). The IG_HFASD group ($N = 33$) had either a Full Scale IQ (FSIQ) ≥ 115 or a Verbal IQ/Non-Verbal IQ (VIQ/ NVIQ) ≥ 120 . The remaining 35 participants were classified as belonging to the Non-IG_HFASD group. The parents of the participants were interviewed using the VABS-II by research assistants who were trained by clinical child psychologists. These parents were also required to complete the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005), a quantitative questionnaire that assesses autistic traits in the general population. Written consent was obtained from the participants' parents, which was approved by a university ethics committee.

Results

Table 1 shows the differences in the VABS-II communication domain between the two groups. The IG_HFASD group had better communicative skills than the Non-IG_HFASD group. Aside from the domain scores, the IG_HFASD group also performed better than the

Non-IG_HFASD group in the expressive communication, writing, community, and play/leisure subdomains. Regarding the severity of ASD symptoms, Table 2 lists a significant difference only in the ADOS restricted and repetitive behaviors between the two groups. Based on the clinical observations, the IG_HFASD group appeared to show fewer restricted and repetitive behaviors than the Non-IG_HFASD group.

A Pearson correlation analysis was conducted to determine the linear relationships between the VABS score, IQ (with covariance of age), and severity of ASD symptoms (with covariance of age and FSIQ) across all the participants. Overall, there was a positive correlation between IQ and the communication domain ($r = .29 - .33$), whereas the severity of ASD symptoms was negatively associated with the daily living and socialization domains ($r = -.33 - -.24$). We also categorized the relationships based on the HFASD group. Table 3 shows that there were no significant correlations between IQ and any of the domains of adaptive behaviors in the IG_HFASD group. In contrast, their ASD symptoms were negatively correlated with the daily living and socialization domains. In the Non-IG_HFASD group (Table 4), IQ, particularly NVIQ, was positively correlated with the communication

Table 1

The comparisons between the IG_HFASD and Non-IG_HFASD groups in all domains and subdomains of VABS-II

	IG_HFASD	Non-IG_HFASD	$t(df = 66)$	p
Communication	85.61 (8.79)	80.26 (6.65)	2.84	<.01
Receptive	11.79 (2.20)	11.37 (2.22)	.78	.44
Expressive	11.91 (1.68)	10.82 (1.18)	3.05	<.01
Written	13.88 (2.03)	12.49 (2.01)	2.85	<.01
Daily Living Skills	88.39 (11.69)	84.80 (12.43)	1.23	.22
Personal	13.00 (2.77)	12.43 (2.90)	.83	.41
Domestic	12.30 (2.20)	11.60 (2.38)	1.26	.21
Community	15.18 (2.00)	13.46 (2.25)	3.33	<.01
Socialization	73.00 (7.19)	71.82 (6.74)	.69	.49
Interpersonal	9.21 (1.73)	9.20 (1.43)	.03	.98
Play and Leisure	11.67 (1.74)	10.82 (1.67)	2.02	<.05
Coping	9.21 (1.67)	9.37 (1.40)	-.43	.67

Table 2*The comparisons between the IG_HFASD and Non-IG_HFASD groups in all scales of ADOS, ADI-R and SRS*

	IG_HFASD	Non-IG_HFASD	<i>t</i> (<i>d</i> = 66)	<i>p</i> 值
ADOS				
Communication	3.30 (1.53)	4.00 (1.50)	-1.90	.06
Social Interaction	7.73 (2.28)	7.94 (2.24)	-.39	.70
Repetitive Behavior	1.33 (1.02)	2.09 (1.54)	-2.36	.02
ADI_R				
Communication	14.24 (4.98)	15.29 (4.98)	-.86	.39
Social Interaction	12.21 (4.22)	12.97 (3.99)	-.76	.45
Repetitive Behavior	4.58 (2.84)	5.14 (2.77)	-.83	.41
SRS				
Total	79.33 (12.16)	83.54 (13.10)	-1.37	1.18
Social awareness	73.76 (11.10)	75.80 (10.06)	-.80	.43
Social cognition	79.58 (11.30)	84.31 (11.01)	-1.75	.09
Social communication	76.12 (12.79)	80.03 (13.27)	-1.24	.22
Social motivation	68.76 (12.75)	73.54 (14.43)	-1.45	.15
Autistic Mannerisms	78.42 (15.24)	80.11 (18.66)	-.41	.69

Table 3*Correlations between VABS-II and IQs, ADOS, ADI-R and SRS scores in the IG_HFASD group*

	Communication				Daily Living				Socialization			
	Total	Receptive	Expressive	Written	Total	Personal	Domestic	Community	Total	Interpersonal	Play & Leisure	Coping
FSIQ	.04	-.14	.12	.20	.03	-.34	-.13	.26	-.08	-.08	.04	-.14
NVIQ	-.05	-.10	.02	.03	-.13	-.19	-.16	.22	-.17	-.19	.01	-.21
VIQ	.13	-.08	.16	.27	.21	-.27	-.01	.14	.09	.11	.06	.06
ADOS_Communication	-.17	-.05	-.32	-.04	-.30	-.01	.05	.20	-.16	.04	-.36*	-.05
Social Interaction	-.06	-.11	-.26	.24	-.01	.15	.06	.19	-.05	.05	-.24	.09
Repetitive Behavior	.05	.06	-.10	.14	-.17	-.17	-.05	.14	-.04	.35*	-.36*	-.06
ADI-R_Communication	-.10	-.19	-.31	.28	-.32	-.52**	-.44*	-.22	-.36*	-.07	-.35*	-.43*
Social Interaction	-.18	-.24	-.38*	.18	-.24	-.34	-.44*	-.30	-.38*	-.32	-.38*	-.21
Repetitive Behavior	.03	-.10	.07	.11	-.18	-.16	-.21	.13	-.13	.07	-.05	-.30
SRS_Social awareness	-.22	-.38*	-.35*	.24	-.37*	-.43*	-.42*	-.02	-.42*	-.14	-.43*	-.41*
Social cognition	-.18	-.27	-.22	.09	-.14	-.18	-.08	-.14	-.39*	-.19	-.34	-.39*
Social communication	-.04	-.01	-.30	.16	-.17	-.31	-.19	.03	-.36*	-.20	-.28	-.38*
Social motivation	.12	.14	-.23	.28	-.21	-.33	-.15	-.12	-.43*	-.17	-.47*	-.38*
Autistic Mannerisms	-.05	-.13	-.24	.25	-.06	-.30	-.15	.21	-.19	.01	-.23	-.21

p* < .05, two-tailed. *p* < .01, two-tailed.

Table 4

Correlations between VABS-II and IQs, ADOS, ADI-R and SRS scores in the Non-IG_HFASD group

	Communication				Daily Living				Socialization			
	Total	Receptive	Expressive	Written	Total	Personal	Domestic	Community	Total	Interpersonal	Play & Leisure	Coping
FSIQ	.22	.12	.14	.15	.22	.17	.05	.36*	.47**	.26	.45**	.45**
NVIQ	.33*	.38*	.19	-.02	.33	.10	.32	.49**	.42*	.23	.42*	.37*
VIQ	.01	-.15	.03	.19	.03	.15	-.20	.08	.29	.16	.25	.30
ADOS_Communication	-.01	-.14	-.01	.16	-.03	-.09	.08	.01	-.07	.01	-.10	-.12
Social Interaction	.09	-.08	.01	.27	-.19	-.15	-.14	-.18	-.04	-.08	.02	-.09
Repetitive Behavior	-.03	-.03	-.06	.03	-.17	-.17	-.02	-.24	-.20	-.07	-.29	-.11
ADI-R_Communication	-.07	-.03	-.20	.03	-.28	-.27	-.26	-.16	-.32	-.19	-.43*	-.17
Social Interaction	-.14	-.06	-.33	.02	-.31	-.31	-.26	-.19	-.35*	-.17	-.43*	-.25
Repetitive Behavior	-.05	-.14	.13	-.02	-.13	-.23	-.04	-.06	-.20	-.07	-.15	-.29
SRS_Social awareness	-.30	-.28	-.48**	.19	.12	.10	.05	.11	-.02	-.27	.12	.06
Social cognition	.02	-.03	-.16	.17	.24	.32	.12	.07	-.23	-.32	-.11	-.16
Social communication	-.05	-.16	-.32	.32	.18	.24	.10	.02	-.23	-.40*	-.07	-.19
Social motivation	.08	.00	-.11	.22	.19	.17	.02	.27	-.25	-.35*	-.17	-.15
Autistic Mannerisms	-.03	-.08	-.28	.23	.13	.24	.05	-.10	-.23	-.32	-.10	-.20

* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

and socialization domains, whereas weaker associations were found between ASD symptoms and the socialization domain.

Conclusions and Implications

Our findings indicate that IQ plays an important role in determining the adaptive behaviors shown by children with HFASD, particularly in the communication domain. In contrast, the severity of ASD symptoms is more strongly related to their deficits in the daily

living and socialization domains. The present study also revealed that the strength of the relationship between adaptive behavior, IQ, and severity of ASD symptoms differs across children with HFASD of different IQs. It is likely that cognitive ability moderately compensates for adaptive behaviors in HFASD populations with an above-average IQ (> 115). This implies that distinct interventions should be delivered to individuals with HFASD who have different cognitive abilities.

nsidered for individuals with HFASD at different cognitive abilities.

