Teacher ratings of academic skills and academic enablers of children on the autism spectrum

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Abstract

Academic underachievement, as measured on standardised assessments, is commonly reported among students on the autism spectrum. However, little is known about the factors that predict academic (under)achievement, limiting the development of effective and targeted interventions. This study explored teacher ratings of academic skills and enabling behaviours of a community sample of students on the autism spectrum in Grades K-2 (5-8 years, *n* = 54) and 6-8 (9-12 years, *n* = 59) attending inclusive or special education settings. Teachers completed the Academic Competence Evaluation Scale (ACES). Results showed that children on the spectrum were rated by teachers to perform below expected levels in both academic skill areas and academic enabling behaviours. Teacher ratings of academic skills and enablers for students were higher for those in inclusive than those in special education settings. Receptive language emerged as an important predictor of teacher-reported performance. Targeting academic enabling behaviours may help to improve academic achievement and lead to better educational outcomes for these students.

Keywords: autism, school, academic achievement, academic enablers

Introduction

Autism is a neurodevelopmental disorder characterised by differences in reciprocal social communication and interaction and individualised patterns of repetitive and restrictive behaviour (American Psychiatric Association 2013). High rates of underachievement have previously been consistently reported among school-age children on the autism spectrum (Ashburner, Ziviani, and Rodger 2010; Blumberg et al. 2013; Mayes and Calhoun 2007), yet little is known about the causes for this or associated factors (May et al. 2013).

Research has clearly shown that a combination of both academic skills and a range of non-cognitive, classroom-related behaviours contributes to overall academic achievement (DiPerna and Elliott 1999). These classroom behaviours have been referred to by DiPerna and Elliott as academic enablers and include the attitudes and behaviours that facilitate a student's participation in, and benefit from, academic instruction in the classroom (DiPerna and Elliott 2002). Specific enablers that have been identified include motivation, engagement, study skills, and interpersonal skills (DiPerna and Elliott 2002). Motivation refers to the student's approach, persistence, and level of interest in academic subjects. Engagement relates to a student's attention and active participation in classroom activities. Study skills are behaviours that facilitate the processing of new material and test-taking. Interpersonal skills involve cooperative learning behaviour necessary to interact with others.

Academic enabling behaviours are not often taught in the classroom, yet deficits in these areas contribute to the academic underachievement of at-risk students (Elliott et al. 2004). DiPerna (2006) proposed that academic enablers play an important role in facilitating classroom learning and that concentrating on academic skills alone may be insufficient to improve academic outcomes. It is important to investigate whether students on the autism spectrum are experiencing differences or difficulties in these enabling behaviours and the extent to which this may be contributing to their academic achievement. As these behaviours

are considered quite malleable (Kautz et al. 2014), identifying deficits in this domain could lead to more targeted and effective interventions to support the learning and development of students on the autism spectrum.

Previous studies investigating academic achievement in students on the autism spectrum have mostly used researcher-administered standardised achievement tests to measure academic skills (Keen, Webster, and Ridley 2016). These do not adequately capture the range of non-cognitive skills of these children that are an important component of overall academic achievement. Seeking information from teachers on a broader range of non-cognitive factors can be beneficial. The validity of teachers' judgments of students' academic achievement has been quite highly rated, with a previous study finding moderately high correlations between teachers' judgments of academic competence and students' actual academic achievement on standardised assessments (Demaray and Elliott 1998).

One teacher rating scale used to measure academic competence that demonstrates good reliability and validity is the Academic Competence Evaluation Scale (ACES; DiPerna and Elliott 2000). The ACES is a norm-referenced scale comprising two domains: academic skills and academic enablers. It has been used in numerous studies investigating the relationship between academic enablers and academic skills in the general population, in students 'at risk', and in students with learning disabilities (e.g., DiPerna, Volpe, and Elliott 2002; DiPerna, Volpe, and Elliott 2005; Elliott et al. 2004; Jenkins and Demaray 2015), documenting higher levels of academic enablers in students without disabilities than in students with disabilities and students at risk (Elliott et al. 2004). A number of models purporting relationships between academic skills and enablers have been proposed. DiPerna et al. (2002, 2005) found that prior achievement and interpersonal skills predicted motivation which then predicted study skills and engagement, and that study skills and engagement were positively associated with academic achievement for reading/language arts and mathematics

achievement in primary-school-aged children. Jenkins and Demaray (2015) examined the link between academic enablers and different types of reading achievement in primary-school-aged children, finding that academic enablers (most notably motivation) predicted all four types of reading outcome measured: classroom grades, global ratings of reading skills, standardised test scores, and reading curriculum-based measurement scores, although as these explained only 11-45% of the variance, there are likely to be other factors also influencing performance. To date, the impact of academic enablers on academic skills has not been explored in students on the autism spectrum, so the extent to which previous findings about the relationships between skills and enablers may generalise to or be valid for autism is unknown and requires investigation.

In addition to academic enablers, other environmental factors such as the students' educational setting may impact on academic achievement for students on the autism spectrum. Only a small number of studies have investigated this aspect. Kurth and Mastergeorge (2010) compared the academic achievement of students on the autism spectrum in either an inclusive or a self-contained special education classroom setting. While there were only 15 participants in this study, results indicated that although the groups did not differ on intelligence or adaptive behaviour scores, those in the inclusive setting had significantly higher academic achievement than students in self-contained classrooms. Conversely, Waddington and Reed (2017) used primary and secondary data analysis of 108 students on the spectrum (aged 5-17) to determine whether children on the autism spectrum in inclusive settings outperformed students in specialist settings, concluding that students in inclusive settings had no greater academic achievement than students in specialist settings. Finally, Kim, Bal and Lord (2018) found in their longitudinal study that children who remained in general education/inclusive settings had higher achievement than those in special education settings. Given the limited number of studies on educational setting in autism and

the mixed findings, further research is warranted. To date, interpretations of comparisons of outcomes between mainstream and special educational settings are hampered by the combination of differing child factors (e.g., IQ, autism characteristics, behaviour) and different opportunities available within each setting. To further our knowledge in this domain, analysis needs to allow for the identification of the relative contribution of these two areas through regression or modelling techniques, such as those used within this study.

The aim of the current study was to explore and describe teacher ratings of the academic skills and academic enabling behaviours of a community sample of students on the autism spectrum in Grades K-2 and 6-8 attending either inclusive or specialist settings. The following research questions were addressed:

1. How are children on the autism spectrum reported to be performing compared to a normative sample of age-matched typically developing students on (i) the ACES measure of academic skills, and (ii) the ACES measure of academic enablers?
2. To what degree do child factors (autism characteristics, receptive language skills, educational setting) and academic enablers predict teacher ratings of academic skills in children on the autism spectrum? Do these prediction models differ as a function of academic skills of interest (i.e., language, mathematics, critical thinking)?

In relation to the first research question, we hypothesised that children with autism in this study would be rated by their teachers as performing below the normative sample on ACES academic skills and enablers. In relation to the second research question, we hypothesised that autism characteristics, receptive language skills, educational setting, and academic enablers would predict teacher ratings of academic skills in the sample. Further, we hypothesised that the prediction models would differ as a function of academic skill areas.

Method

Data Source

Data presented in the paper were collected as part of a larger study described in <removed for blind review> designed to investigate the longitudinal educational and participation trajectories and outcomes for students on the autism spectrum. In brief, parents of children on the spectrum aged 4-5 or 9-10 years living in <removed for blind review> were invited through clinics and advertisements on social media to take part in a 6-year study with annual online data collection. The sample was therefore self-selecting. Data collection commenced in 2015 with caregiver information provided on 272 children in two age cohorts: 4 years 0 months-5 years 11 months, and 9 years 0 months-10 years 11 months at time of enrolment (Year 1). Caregivers were requested to provide copies of their child's diagnostic reports and to complete an online questionnaire on their child's autism characteristics, developmental skills, and behaviour. Where parents consented, data collection from schools began in Year 2 via an online questionnaire. To allow for the maximum size cohort and a spread of ages, data for this study were drawn from both Year 2 and Year 3 of the longitudinal study; if a child had two complete data sets, the data from Year 3 were selected. Thus, the age range of the participants in the current study was 5-8 years and 9-12 years. Ethical approval for this study was obtained from participating universities and health authorities.

Participant and Informant Characteristics

Complete data sets were provided by teachers of 113 children on the spectrum (81.4% males and 18.6% females). Children were categorised based on grade groupings used in the ACES, the primary outcome measure. These groups are based on the USA educational system, with participants being within the Kindergarten to Grade 2 (K-2) group or Grade 6 to 8 group.

Child Demographics

There were 54 children in the sample who fell into the Grades K-2 category (*M*age 82.05 months, *SD* = 8.99) and 59 children in Grades 6-8 (*M*age 139.15 months, *SD* = 8.93). Participants who scored above the autism cut-off on the Social Communication Questionnaire (see measures) and had teacher-reported data on the academic competency measure were included. A subsample of 91 children (K-2 [*n* = 47], *M*age 81.91 months, *SD* = 9.16; Grades 6-8 [*n* = 44] *M*age 139.95 months, *SD* = 9.02), with receptive language domain scores from the Vineland Adaptive Behavior Scales, was identified.

Teacher Demographics

Demographics of teacher informants and the education context are provided in Table 1 for both the sample and subsample. Over 50% of the teacher respondents were female, although one third of the teachers did not complete the gender question. There was a range in teachers' experience and years' experience teaching children with disabilities. The minimum number of months that the teacher had been teaching the student was three.

++Insert Table 1 about here++

Caregiver Demographics

Caregivers provided general information about their child, in addition to information about their child's autism characteristics and receptive language skills. Caregivers included mothers (85%), fathers (12.4%), and others (2.6%). Caregivers were asked to provide their age within a range; 8% were between 21-30 years, 54% aged between 31-40 years, and 38.1% between 41-50 years. Based upon caregiver self-report, 4.5% had a diagnosis on the autism spectrum and 29.2% had a diagnosis of a mental health disorder. The majority (77.9%) of caregivers had completed tertiary education and approximately half of the sample (50.4%) reported a family income (before tax) of AUD$80,001-$180,000 per annum.

Measures

Autism characteristics. Autism characteristics were measured using the parent-rated Social Communication Questionnaire Lifetime version (SCQ: Rutter et al. 2003). This includes 40 items scored on a scale of 0 or 1. A cut-off score of 15 is recommended for identifying potential cases of autism and a cut-off of 11 has been used to identify potential cases of autism in young children (Eaves et al. 2006).

Academic competence. The Academic Competence Evaluation Scale—Teacher Form (ACES-TF: DiPerna and Elliott 2000) is a teacher-rated assessment tool designed to measure the academic functioning of students in Grades K-12. This scale includes 73 items rated on a 5-point scale with 33 items measuring academic skills (reading, mathematics, and critical thinking), for example, 'word attack', 'uses numbers to solve daily problems', 'developing a solution to a problem', and 40 items measuring academic enablers (interpersonal skills, engagement, motivation, and study skills), for example, 'interacts appropriately with other students', 'speaks in class when called upon', 'persists when task is difficult', 'finishes class work on time'. The scale is completed based on direct observation of skills and behaviours in the classroom setting by respondents who have known the student in their classroom for a recommended minimum of 6 weeks.

The ACES demonstrates strong psychometric properties for Academic Skills and Academic Enablers. Test reliabilities were .95 and .96 respectively and interrater agreement .99 and .61 respectively. Mean coefficient alphas for Academic Skills and Academic Enablers scales for the teacher form are .99 (DiPerna and Elliott 2000). Within this sample, Cronbach's alpha was 1.0 for Reading/Language, .97 for Mathematics, .97 for Critical Thinking, .94 for Interpersonal Skills, .93 for Engagement, .95 for Motivation, and .74 for Study Skills.

Receptive language. A measure of receptive language was included as it has been found to be a strong predictor of academic outcomes for children on the autism spectrum (Venter, Lord, and Schopler 1992). Receptive language was measured using the receptive domain on the Vineland Adaptive Behavior Scales, 2nd edition (VABS: Sparrow, Cicchetti, and Balla 2005), an interview-based measurement of adaptive behaviour. Test reliabilities for the receptive subdomain across the ages (3-6; 7-13 years) were .86 and .88 respectively. Cronbachs alpha was .76 - .80 for the age groups included in the sample (Sparrow et al. 2005). V-scale scores were used for analyses as they provide an estimate of the child's ability relevant to other children their age.

Class placement. Placement in an inclusive setting was determined by attendance in a general education classroom or part-time inclusion. Children in a full-time, autism-specific setting or special school for children with disabilities were identified as attending a special education setting.

Data Analysis

Data were screened for missing values. No single item was missing for more than 2% of the sample in the Reading, Mathematics, Critical Thinking, Interpersonal, Engagement, and Motivation subscales. Within the Study Skills subscale (which was only completed for the older cohort), eight items (of the 11 within that subscale) were missing for more than 2% of the sample. Missing value analysis of this subscale suggested that data were missing completely at random (Little's MCAR test; $\chi 2(10399) =$, $p = 1.0$).

Means and standard deviations were calculated separately for the Grades K-2 and Grades 6-8 cohorts. In order to compare academic achievement and academic enabler scores for the K-2 and 6-8 grade groups in inclusive and special education settings to published normative data (DiPerna and Elliot 2000), one-sample *t*-tests were used. Effect sizes were

calculated using Cohen's d. An alpha level of .01 was used for all analyses to control for inflated Type I error.

Prior to examining prediction models, bivariate and point-serial correlation analysis for participants within the regression models (n = 91) were conducted. These revealed no collinearity of predictors (r > .80), thus all were retained (see Table 2).

++Insert Table 2 about here++

Hierarchical multiple regression analyses were then conducted with the raw scores for each academic skill to investigate the variance explained by the combination of factors, independent unique contributions per predictor, and the variance added by each predictor group (i.e., child characteristics/educational setting; academic enabler skills). In the initial stage of these analyses, autism characteristics, child age, receptive language skills, and educational setting (coded as a nominal level variable for inclusive [1] vs. special education setting [2]) were entered as predictor variables. This served as the 'baseline' model wherein the contribution of additional predictors was examined using enter selection procedures. In the second stage, the three factors from the ACES related to academic engagement (interpersonal skills, engagement, and motivation) were entered into the model. Both steps of the regression were undertaken using the SPSS 'enter' procedure (forced entry), where all variables within each step were entered simultaneously. This is considered an appropriate analysis when dealing with a small set of predictors and it is not known which independent variables will create the best prediction equation.

Results

ACES Academic Attainment and Enablers: Comparisons to Normative Data

Table 3 displays the means and standard deviations for the academic attainment (reading/language, mathematics, critical thinking) and academic enabler (interpersonal skills, engagement, and motivation) variables split by grade (K-2 or 6-8) and educational setting (inclusive or special education). A series of one-sample *t*-tests was conducted separately for each academic attainment area, comparing the data from children on the autism spectrum either in inclusive or special education settings to the comparable age published normative data (DiPerna and Elliott 2000).

++Insert Table 3 about here++

Children on the autism spectrum in Grades K-2 attending inclusive schools achieved scores significantly below the published norms in all the areas assessed, with medium to large effect sizes. Children in Grades 6-8 attending inclusive schools achieved significantly lower scores than the published norms in overall academic score, the overall academic enablers score, as well as the critical thinking, interpersonal skills, engagement, and motivation subscales, all with medium to large effect sizes. Children in special education settings scored significantly below the normative data on all subscales of the ACES with large effect sizes for all comparisons except for engagement and study skills in the Grade 6-8 cohort.

Hierarchical Regression Analyses for Language Achievement

Using the ACES languague/reading achievement score as the criterion variable, a hierarchical regression analysis was undertaken using the predictor entry strategy described above. The results are presented in Table 4. The baseline model (including SCQ, VABS, child age, and educational setting) was significant, $F(4,81) = 16.8$, $p < .001$, with receptive language and educational setting identified as significant predictors. The second-stage model (including SCQ, VABS, child age, educational setting, and the three ACES academic

enablers – interpersonal skills, engagement, and motivation) was significant, $F(7,78) = 15.5$, $p < .001$) and accounted for an additional and significant 13% of the variance, $F_{change}(3, 78) = 7.91$, $p < .001$. The second-stage model indicated that 58.1% of the variance was explained by the combination of factors. Receptive language, educational setting, and motivation were identified as unique significant predictors explaining 11%, 6%, and 6% of the variance respectively. This indicated that within the model, higher receptive language scores, an inclusive setting, and higher motivational scores predicted higher scores on the language/reading achievement ACES score.

++Insert Table 4 about here++

Hierarchical Regression Analyses for Mathematics Achievement

Using the ACES mathematics achievement score as the criterion variable, a hierarchical regression analysis was undertaken using the predictor entry strategy described above. The results are presented in Table 4. The baseline model (including SCQ, VABS, child age, and educational setting) was significant, $F(4,81) = 10.8$, $p < .001$, with receptive language and educational setting identified as significant predictors. The second-stage model (including SCQ, VABS, child age, educational setting, and the three ACES academic enablers) was significant, $F(7,78) = 12.2$, $p < .001$, and accounted for an additional and significant 17% of the variance, $F_{change}(3,78) = 9.2$, $p < .001$. The second-stage model indicated that 47.6% of the variance was explained by the combination of factors. Motivation, interpersonal, receptive language, and educational setting were identified as unique significant predictors explaining 8%, 7%, 6%, and 5% of the variance respectively. This indicated that within this model, higher motivational skills, lower interpersonal skills, higher

receptive language score, and an inclusive educational placement predicted higher teacher ratings on the mathematics achievement score of the ACES.

Hierarchical Regression Analyses for Critical Thinking

Using the ACES critical thinking achievement score as the criterion variable, a hierarchical regression analysis was undertaken using the predictor entry strategy described above. It is important to note that this analysis was only undertaken with those in Grade 3 or above, as only limited questions are asked to children in the younger grades. The results are presented in Table 4. The baseline model (including SCQ, VABS, child age, and educational setting) was significant, $F(4,35) = 5.7$, $p = .001$, with receptive language identified as the only significant predictor. The second-stage model (including SCQ, VABS, child age, educational setting, and the three ACES academic enablers) was significant, $F(7,32) = 1.1$, $p < .001$, and accounted for an additional and significant 31% of the variance, $F(3,32) = 11.5$, $p < .001$. The second-stage model indicated that 70.8% of the variance was explained by the combination of factors. This indicated that higher motivational scores and lower interpersonal scores predicted higher scores on the critical thinking score of the ACES, with these variables explaining 15% and 11% of the variance respectively.

Discussion

This study used the ACES to investigate teacher ratings of the academic achievement and academic enablers of students on the autism spectrum. Overall, teachers rated students on the spectrum in inclusive settings, and particularly those in special settings, as performing below published norms in almost all subscales of academic attainment and academic enablers. These findings are consistent with previous studies that have found students on the autism spectrum performing below their non-autistic peers (Mayes and Calhoun 2007) and that those in inclusive settings tend to perform better than those in special education settings (Kurth and Mastergeorge 2010).

In relation to academic enabling behaviours, students on the spectrum were found to have scores significantly below the norms for interpersonal skills and motivation. Students in inclusive settings also scored below the ACES published norms on engagement whereas students in special education settings were at or above the norms in this domain, suggesting that teachers may have rated students in relation to their expectations for a student in a special school rather than in relation to the broader age-matched population. The overall lower performance on academic enablers is concerning, given previous research showing the importance of academic enablers for academic success (DiPerna and Elliott 1999; Elliott et al. 2004).

In order to answer the research question of whether academic enabling behaviours contribute to overall teacher ratings of academic achievement, a two-stage regression model, exploring and then controlling for child factors (such as receptive language and educational setting), was undertaken. These results indicate that academic enablers may contribute to teacher ratings of academic skills in complex ways that could help to explain the variability often reported within and between students on the autism spectrum. Three key findings will be discussed. First, prior to consideration of academic enablers, receptive language and educational setting predicted scores on language/reading and mathematics, and receptive language predicted critical thinking skills over and above autism characteristics or child age. This highlights the importance of disentangling communication (as measured by the VABS) from social communication (as measured by the SCQ). The finding that receptive language (as measured by the VABS) played a key role in predicting academic skills is consistent with previous research that found receptive language, as measured by the Peabody Picture Vocabulary Test, predicted academic achievement (Venter et al. 1992).

Second, when academic enablers were entered into the regression model, there was a significant increase of the variance explained for all three academic areas, although the

relationship between predictor variables and specific academic skills differed. Whilst no child factors and two academic enablers (interpersonal skills and motivation) predicted critical thinking, a combination of child factors (receptive language and educational setting) with academic enablers (interpersonal skills and motivation) predicted mathematics. The findings in relation to critical thinking require further investigation longitudinally to determine if interpersonal skills and motivation are mediating the relationship between ability and critical thinking. This could have important implications in terms of specific skills that could be targeted to improve academic achievement in these children. Interpersonal skills, beliefs, and emotions towards school have been found to be predictive of overall academic achievement (Graziano et al. 2007; Lecce, Caputi, and Hughes 2011) as well as performance in specific academic areas (e.g., reading; McKown et al. 2016) in children without a diagnosis on the autism spectrum, but warrant more research for students on the spectrum.

Third, the findings suggest that the various academic enablers and the child's VABS receptive language score can make different and independent contributions across each of the academic skill areas, with increased motivation but lower interpersonal scores being associated with increased teacher ratings of academic skills. This is an interesting finding as previous research has suggested a strong association between better social skills and higher academic achievement in the typically developing population (Malecki and Elliot 2002). One possible explanation for this finding is that, while presenting as more socially competent and thereby receiving higher ratings on interpersonal skills, these students may have less time and energy to spend on academic skills. Recent research in adolescents and adults with autism suggests that camouflaging autistic characteristics in social situations may be a common strategy and that a consequence of camouflaging can be exhaustion, anxiety, and stress (Hull et al. 2017; Tierney, Burns, and Kilbey 2016). Achieving higher ratings on interpersonal skills may be an indicator of this camouflaging of social impairments in the classroom with

decreased academic skills a consequence. Further research is needed to investigate this interpretation of the results.

The findings from this research suggest that even by kindergarten, young children on the autism spectrum – regardless of educational setting – are performing well below their non-autistic peers in academic skills and enablers. When coupled with findings that children on the spectrum as young as 5 years old are participating less in school activities than their peers (Simpson et al. 2018) and may already be impacted by anxiety at school (Adams, Simpson, and Keen 2018; Adams et al. 2019), this particular finding highlights the importance of identifying not only ways to improve academic achievement but also academic enablers and experiences early in the child's schooling. These supports and interventions must continue as students progress through grade levels. Careful consideration is needed when designing educational interventions for students on the autism spectrum both in the identification of desirable outcomes and in determining specific skills and behaviours that should be targeted.

There are limitations to this study that need to be considered when interpreting the findings. Determining the factors that may influence academic achievement is complex. The educational setting was only deemed as 'mainstream' or 'special' in this study, with no measurement of opportunities or environmental factors within the child's setting that may have contributed to the outcomes. Second, the VABS-II receptive language score was used in lieu of a direct measure of cognitive ability. While this measure has been found to correlate with IQ in children with autism (Kanne et al. 2011; Klin et al. 2007; Yang, Paynter, and Gilmore 2016), an additional direct measure of IQ may have proved a useful addition in this study. However, the receptive language score allowed for the inclusion of students with low cognitive ability who have previously been excluded from studies on academic achievement in autism (Jones et al. 2009; Keen et al. 2016). Finally, although comparisons to normative

data are widely used when interpreting scores on standardised measures, it is acknowledged that using such data may have introduced confounds to the comparisons reported.

This study has highlighted the importance of looking beyond autism characteristics to better understand how to support students with autism to achieve academically. Specifically, academic enabling behaviours could help to explain some of the observed within and between child variations in academic achievement and may prove to be responsive to intervention in this population. Future research will need to include students from a broader age range and consider a longitudinal approach that can better address issues of causality between the various variables of interest.

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Table 1.

Teacher and Class Demographics

Demographic variables	Total sample (N = 113) N (%)	Those with VABS data (n = 91) n (%)
Gender: Female	63 (55.8)	54 (59.3)
Years teaching experience		
≤ 5	32 (28.3)	26 (28.6)
6-10	34 (30.1)	28 (30.8)
11-15	16 (14.2)	11 (12.1)
≥ 16 +	27 (23.9)	22 (24.2)
Missing	4 (3.5)	4 (3.5)
Years teaching children with autism/disabilities		
≤ 2	30 (26.5)	27 (29.7)
3-5	25 (22.1)	20 (22.0)
6-10	24 (21.2)	19 (20.9)
≥ 11	24 (21.2)	17 (18.7)
Missing	9 (8.0)	8 (8.8)
Duration of teaching student/student in teacher's classroom		
3-6 months	27 (23.9)	22 (24.2)
7-12 months	63 (55.8)	50 (54.9)
13-24 months	17 (15.0)	14 (15.4)
25 months +	6 (5.3)	5 (5.5)

Table 2.

Pearson Correlations Between Predictor Variables

	2	3	4	5	6	7
1. SCQ	-.29*	.16	.12	-.05	-.07	-.10
2. VABS receptive language	-	-.13	-.35*	.33*	.32*	.36*
3. Child age		-	-.07	-.06	.15	-.04
4. Educational setting			-	-.22	-.28*	-.26
5. Interpersonal skills				-	.53**	.69**
6. Engagement					-	.71**
7. Motivation						-

** $p < .01$; ** $p < .001$.*
[a] point-biserial correlations.

Table 3.

ACES Mean (SD) of Raw Score Proficiency of Students' Skills and Enablers on the ACES by Grade Cluster Compared to Normative Data

	Grades K-2					Grades 6-8				
	Norms Mean (sd)	Inclusive autism *n* = 31		Special education *n* = 23		Norms Mean (sd)	Inclusive autism *n* = 41		Special education autism *n* = 18	
		Raw score Mean (sd)	Comparison to normative data	Raw score Mean (sd)	Comparison to normative data		Raw score Mean (sd)	Comparison to normative data	Raw score Mean (sd)	Comparison to normative data
Academic Skills Total	88.6 (24.6)	72.4 (21.0)	$t(28) = -4.1$ $p < .001$ $d = 0.66$	49.4 (21.4)	$t(21) = -8.6$ $p < .001$ $d = 1.6$	101.2 (29.1)	87.6 (25.4)	$t(36) = -3.3$ $p = .002$ $d = 0.47$	59.5 (22.6)	$t(10) = -6.1$ $p < .001$ $d = 1.43$
Reading/Language	34.1 (11.1)	29.1 (9.1)	$t(30) = -3.1$ $p = .005$ $d = 0.45$	19.2 (8.5)	$t(22) = -8.4$ $p < .001$ $d = 1.3$	34.3 (9.2)	30.3 (9.4)	$t(39) = -2.7$ $p = .011$ $d = 0.43$	20.8 (8.0)	$t(15) = -6.8$ $p < .001$ $d = 1.43$
Mathematics	25.4 (7.2)	22.1 (6.5)	$t(30) = -2.9$ $p = .007$ $d = 0.46$	14.1 (6.2)	$t(21) = -8.6$ $p < .001$ $d = 1.6$	23.9 (7.8)	21.1 (7.9)	$t(39) = -2.2$ $p = .03$ $d = 0.36$	15.1 (5.9)	$t(17) = -6.3$ $p < .001$ $d = 1.13$
Critical Thinking	28.3 (7.5)	21.7 (6.6)	$t(28) = -5.4$ $p < .001$ $d = 0.88$	15.9 (7.1)	$t(22) = -8.3$ $p < .001$ $d = 1.7$	43.0 (12.2)	34.6 (10.5)	$t(38) = -5.0$ $p < .001$ $d = .0.69$	25.1 (9.5)	$t(16) = -7.8$ $p < .001$ $d = 1.47$
Academic Enablers Total	-		-		-	144.92 (36.6)	120.2 (28.0)	$t(29) = -3.8$ $p < .001$ $d = .0.68$	109.3 (32.9)	$t(11) = -3.8$ $p = .003$ $d = 0.97$
Interpersonal	40.1 (9.1)	36.3 (7.2)	$t(30) = -2.9$ $p = .006$ $d = 0.42$	33.3 (10.6)	$t(22) = -3.1$ $p = .006$ $d = 0.75$	40.2 (9.1)	34.4 (8.4)	$t(40) = -4.4$ $p < .001$ $d = .0.64$	31.3 (5.3)	$t(17) = -7.2$ $p < .001$ $d = 0.98$
Engagement	30.5 (7.2)	23.9 (6.4)	$t(30) = -5.8$ $p < .001$ $d = 0.92$	18.0 (8.6)	$t(22) = -7.0$ $p < .001$ $d = 1.7$	27.7 (7.8)	24.9 (6.0)	$t(40) = -3.0$ $p = .005$ $d = .0.36$	23.4 (10.7)	$t(16) = -1.3$ $p = .22$ $d = 0.55$
Motivation	37.6 (11.7)	30.1 (9.5)	$t(29) = -4.3$ $p < .001$ $d = 0.64$	26.4 (11.4)	$t(21) = -4.6$ $p < .001$ $d = 0.96$	36.1 (12.4)	29.4 (9.3)	$t(38) = -4.4$ $p < .001$ $d = .0.54$	25.8 (8.8)	$t(17) = -4.0$ $p < .001$ $d = 0.85$
Study Skills	-	-	-	-	-	41.0 (11.7)	29.8 (9.2)	$t(30) = -70$ $p = .49$ $d = 0.96$	26.5 (11.1)	$t(12) = -1.5$ $p = .17$ $d = 1.24$

Note. Varying *n* due to some subscales having missing data.

Table 4.

Hierarchical Multiple Regression Analyses for Prediction of ACES Academic Skills

ACES academic skill	Step	Predictor	Model 1		Model 2	
			β	sr^2%	β	sr^2%
Reading/language	1	SCQ	-.39	0	-.03	0
		Receptive language	.48**	.19	.38*	.11
		Child age	.15	.02	.14	.02
		Educational setting	-.31*	.09	-.26*	.06
	2	Interpersonal			-.16	.01
		Engagement			.08	0
		Motivation			.41**	.06
ΔR^2						.13
R^2				.45		.58
Mathematics	1	SCQ	-.06	0	-.04	0
		Receptive language	.41**	.14	.31*	.07
		Child age	.09	.01	.05	0
		Educational setting	-.29*	.07	-.24*	.05
	2	Interpersonal			-.33*	.06
		Engagement			.13	.01
		Motivation			.49**	.08
ΔR^2						17
R^2				.35		.52
Critical thinking	1	SCQ	-.05	0	-.01	0
		Receptive language	.44*	.21	.30	.07
		Child age	.11	0	.07	0
		Educational setting	-.33	.03	-.30	.05
	2	Interpersonal			-.48*	.11
		Engagement			.11	.01
		Motivation			.68**	.15
ΔR^2						.31
R^2				.40		.71

** $p < .01$; ** $p < .001$.*