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A comparison of two models of support for students with autism spectrum disorder in school and predictors of school success

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ABSTRACT

Background: There is little comparative data on models of support for children with Autism spectrum disorder (ASD) in school. The objectives of this research were (1) to compare the outcomes of two service delivery models (Autism Spectrum Australia satellite support class and Autism SA consultative model) that were designed to facilitate the support of children with ASD in mainstream schools and (2) to examine factors that were associated with successful outcomes. **Method:** A total of 90 students were followed 6-monthly for up to 7 rounds (3.5 years). Primary outcomes of interest included continuity of placement, school engagement and adjustment, perceived success of placement, and parent/teacher/principal satisfaction with service delivery. **Results:** Continuity of placement was relatively high in both models. There were no differences in child outcome across the models but the parents in the satellite model rated placement success higher, albeit in the context of high overall ratings in both groups. Parents and principals also rated satisfaction with support higher in the satellite model but transitions from the model into regular classes were low during the period of the study. Teacher rated academic skill predicted child social skills as well as engagement and adjustment, child problem behavior negatively predicted parent and teacher rating of placement success and adaptive behavior predicted teacher and principal rating of placement success.

Conclusions: The present study offers insight into possible program and child related predictors of a range of outcome measures. Implications for the respective service delivery models and directions for future research are presented.

1. Introduction

Autism spectrum disorder (ASD) is a developmental disorder characterized by deficits in social communicative behaviors and behavioral flexibility (American Psychiatric Association, 2013). In Australia, recent estimates of the prevalence of autism range between 2.5% and 3.9% in children aged 11–12 years, based on parent reported diagnosis (May, Sciberras, Brignell, & Williams, 2017). The level of intellectual ability of children with ASD varies widely and it is estimated that between 25% and 45% of children

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with ASD have typical intellectual functioning (Bourke, de Klerk, Smith, & Leonard, 2016; Newschaffer et al., 2007). Further, more recent evidence suggests that the proportion of children with ASD who do not have an intellectual disability has increased over time (Van Naarden Braun et al., 2015)

1.1. Models for transition and support

Students with ASD are commonly included in mainstream schools (Roberts & Simpson, 2016) and a variety of models have been proposed to offer transition and support (Carter et al., 2014) including special classes within regular schools. For example, Grindle et al. (2012) described a small scale study examining the provision of an intensive ABA program within a special class in a mainstream school. The approach involved one-to-one intervention for an average of approximately 15 h per week with students participating in small group activities in their ABA class or attending mainstream classes with a therapist shadow for the remaining time. Over time, as skills developed, the focus shifted to generalization from the one-to-one setting into small groups and, finally into mainstream classes.

Another special class model is offered by Autism Spectrum Australia (Aspect) in New South Wales (NSW). Aspect is Australia's largest national service provider for people on the autism spectrum, and provides evidence informed school programs for more than 1000 students through nine schools and more than 100 satellite classes. The Aspect satellite class program involves student placement in an autism specific class (5–6 children) five days per week in a mainstream “host” school, autism-specific teaching strategies and an individualized program for transition into regular classrooms (Keane, Aldridge, Costley, & Clark, 2012). The higher initial level of structure and support of this model may be advantageous given core deficits in ASD (Keane et al., 2012) as it provides more gradual adjustment to school (Roberts, Keane, & Clark, 2008). Autism-specific teaching strategies can be used within the context of a mainstream curriculum and timetable with gradual opportunities for integration into mainstream classrooms (Keane et al., 2012). In the long-term, transition into regular classrooms potentially can provide better opportunities for development of social skills (Keane et al., 2012), allow peer interaction, facilitate academic stimulation and provide more ready access to the broad curriculum (Roberts et al., 2008).

When children are placed in regular classrooms from the point of school entry, a range of supports may also be provided. This may include generic (non-autism specific) assistance, which may take the form of school-based special education support and there is often extensive reliance on teacher aide support (Butt, 2015; Carter, Stephenson, & Webster, 2018; Giangreco, Doyle, & Suter, 2012; Sharma & Salend, 2016). Autism specific support services may also be offered. For example, Simpson, de Boer-Ott, and Smith-Myles (2003) proposed the Autism Spectrum Disorder Inclusion Collaboration Model. This approach involves expert support personnel working within a collaborative consultation framework with regular classroom teachers to address areas including environmental and curricular modifications, classroom support, instructional methods, student attitudinal and social support and home-school collaboration (Simpson et al., 2003). In South Australia (SA) Autism SA offers a somewhat similar on-demand autism specific itinerant support services to children in regular classes from a range of professionals. Support of this type has a number of potential advantages. In particular, students may be provided with exposure to typically developing social and communication models from the point of school entry.

1.2. Research of models of educational service delivery

Despite a variety of options being available, there is little comparative data examining the outcomes of different transition and support options for children with ASD. In their intensive ABA special class model, Grindle et al. (2012) reported significant gains in adaptive behavior of students, when compared to a “treatment as usual” group (who were in either mainstream or special education settings). After attending the program for one year, students in the ABA special class model were reported to spend an average of 3 h per week in a mainstream class, with shadow support. After, two years in the program students were reported to spend an average of 6 h per week in a mainstream class. Frederickson, Jones, and Lang (2010) conducted research in the UK and found that features of placements identified as important for students with ASD were more likely to be found in schools with an ASD unit than in schools receiving consultative support only. It should be noted that this study focused on the features of placement rather than outcomes.

There have been preliminary evaluations of the satellite class model in NSW (Keane et al., 2012; Roberts et al., 2008). Roberts et al. (2008) reported that 61% of students who had moved from satellite classes transitioned into regular classes and a further 23% into generic support classes in local area schools. Further, 7–12 years after transition, 95% remained in a placement of similar type to that into which they transitioned. Keane et al. (2012) surveyed families of satellite class graduates (i.e., students who had left satellite classes) between 1994 and 2002. A total of 70% of students transitioned to a mainstream educational setting and 28% moved to a special class. Eighty-nine percent of children transitioning to a mainstream class were reported to be in similar placements. The majority of parents rated the satellite program and transition planning as “very good” or “excellent”. Despite these encouraging findings, the existing evaluations did not include a comparison group. Carter et al. (2014) presented early (first round only) data from the present research but this was limited to placement satisfaction and the examination of barriers and facilitators to regular class placement.

1.3. Outcome predictors

Research on predictors of adult outcomes for individuals with ASD has often focused on functional engagement and adjustment including independent living, relationships, social integration and employment (see Howlin & Moss, 2012; Howlin, Goode, Hutton, &

Rutter, 2004; Levy & Perry, 2011). There has been considerable interest in school outcomes for children with ASD but much of this research (e.g., Assouline, Foley Nicpon, & Dockery, 2012; Eaves & Ho, 1997; Estes, Rivera, Bryan, Cali, & Dawson, 2011; Griswold, Barnhill, Myles, Hagiwara, & Simpson, 2002) has focused on academic progress (for review see Keen, Webster, & Ridley, 2016) rather than engagement and adjustment. For the purposes of this research, the term school engagement and adjustment was used to refer to the “student’s ability to perform important functional activities that support or enable participation in the academic and related social aspects of an educational program” (Coster, Deeney, Haltiwanger, & Haley, 1998 p. 2). This would be reflected in student capacity to perform functional activities that facilitate both access to the curriculum as well as successfully participate more broadly in school life and would include a range of behaviors referred to as “survival skills” (Kemp & Carter, 2005, 2006a). These capacities include functional communication, following social conventions, compliance with adult directives and school rules, task related behavior and task completion, positive interaction, behavior regulation and safety-related behaviors (Coster et al., 1998). Engagement and adjustment was of interest in the present study as it both forms a foundation for academic learning and reflects broader adaptation to the school environment. Jones and Frederickson (2010) have examined predictors of social acceptance of children with ASD and Locke, Williams, Shih, and Kasari (2017) examined predictors of social success measured by playground interactions and social network salience. Nevertheless, relatively few studies have examined engagement and adjustment within school or factors that are associated with these outcomes.

The primary focus of this research was to compare the outcomes of two approaches (Aspect satellite class and Autism SA consultative model) both of which are designed to facilitate the successful support of children with ASD in mainstream schools and transition into regular primary school classrooms. Two research questions were addressed:

- 1 What are the differences in outcomes of the Aspect satellite class and Autism SA consultative models in supporting students with ASD in relation to (a) continuity of placement, (b) school engagement and adjustment, (c) perceived success of placement, and (d) parent/teacher/principal satisfaction with service delivery?
- 2 What child related factors (IQ; autistic symptomatology, problem behavior adaptive behavior, social skills, academic competence) predicted outcomes?

2. Method

A non-equivalent comparison group design was used as the research was pragmatic in nature, taking advantage of different intervention models across jurisdictions, and randomization was not possible. The inclusion criteria for the project were that the child required a formal diagnosis of Asperger’s disorder or autistic disorder according to DSM-IV (American Psychiatric Association, 2000), be functioning within or above the mild range of intellectual disability (IQ above 50), be placed in Kindergarten/Reception (the first year of schooling) to Year 3 at project commencement, and be eligible to receive consultative support in SA or be placed in an Aspect satellite class in NSW. The two programs operated in two different Australian states and thus participants in each program were drawn from the state in which that program was implemented.

Primary child outcomes were nominated prior to the commencement of the project. These related to continuity of placement, social behavior, and school engagement and adjustment. Primary outcomes for school staff and parents related to satisfaction with service delivery and perception of the success of placement. A summary of key measures in the study is included in Table 1.

2.1. Ethics approval

Ethics approval was required by participating universities, service delivery organizations (Aspect and Autism SA) as well as the

Table 1
Summary of Measures.

Measure	Completed by	When Completed		
		Pretest	Term 2 Each Year	Term 4 Each Year
Wechsler Intelligence Scale for Children - IV ^b	Psychologist	✓		
Social Responsiveness Scale ^b	Parent	✓		
Vineland Adaptive Behavior Scale – 2 ^b	Parent	✓		
Social Skills Improvement System Rating Scales (Social Skills) ^b	Parent	✓		
Child Behavior Checklist ^b	Parent		✓	✓
School Function Assessment ^c	Teacher		✓	✓
Perceived success of placement ^c	Parent, teacher, principal		✓	✓
Satisfaction with support ^c	Parent, teacher ^a , principal		✓	✓
Social Skills Improvement System Rating Scales (Social Skills) ^c	Teacher			✓
Social Skills Improvement System Rating Scales - academic competence items ^c	Teacher			✓

^a Rating of support only provided in NSW post-transition.

^b Predictor in multilevel analysis.

^c Outcome in multilevel analysis.

relevant public and private school sectors in which the research was conducted. The research was approved by the human research ethics committee (or relevant approving authority) of Macquarie University (approval 5201100729), The University of Melbourne (approval 1137015), Aspect (approval 1126), Autism SA (approval PP201107), NSW Department of Education and Training (approval 201143), South Australian Department for Education and Child Development (approval CS/11/102-4.2), Catholic Schools Office Diocese of Broken Bay, Catholic Schools Office Diocese of Maitland-Newcastle, Catholic Education Diocese of Parramatta, Catholic Education Office Sydney (approval 784) and, Catholic Education South Australia.

2.2. Recruitment

Recruitment for the project commenced in late 2011 with a second round of recruitment in early 2012. In the first round of recruitment, 42 of 125 families with eligible children in NSW and 43 of 178 in SA accepted. In the second round of recruitment, 4 of 29 families that were approached agreed to participate in NSW and 9 of 35 in SA. Following two rounds of recruitment, parents of a total of 52 SA children and 46 NSW children agreed to enroll in the research. Four families in each group did not complete pre-test so were not considered enrolled, leaving a total of 42 children in NSW and 48 in SA. In their year of entry into the research, the mean age of children in NSW was 7.2 years ($SD = 1.1$, range 4.9–8.9) with 35 males and 7 females. In the year of entry into the research, the mean age of children in SA was 7.2 years ($SD = 0.9$, range 5.3–8.7) with 38 males and 10 females.

School principals were subsequently approached requesting participation and the collection of data in schools, including data not reported in this paper, such as detailed analysis of friendship characteristics (Petrina, Carter, & Stephenson, 2014; Petrina, Carter, & Stephenson, 2014; Petrina, Carter, Stephenson, & Sweller, 2016; Petrina, Carter, & Stephenson, 2017; Petrina, Carter, Stephenson, & Sweller, 2017). In SA, where principals agreed, teachers were approached for permission to collect data. In NSW, the satellite class teachers were employed by Aspect, rather than the host school. Consequently, when host school principals agreed for data to be collected in school and teachers agreed, data were collected at school. In cases where NSW principals hosting satellite classes did not agree for data to be collected at school, Aspect teachers who agreed to participate provided these data at another location or by telephone. Where children in NSW had transitioned from a satellite class, arrangements for consent were the same as for children in SA.

Teachers typically changed from year to year so it was necessary to obtain consent from new teachers annually. Where consent was incomplete for a particular child, data were collected where possible. For example, if teacher consent was not available in a given year, data were still collected from parents and principals. In NSW, across rounds, parent data were obtained from a mean of 91.1% (range 84.6%–97.4%) of children, teacher data were obtained for a mean of 88.2% (range 80.6%–97.4%) and principal data were obtained for a mean of 85.3% (range 79.4%–89.7%). In SA, across rounds, parent data were obtained from a mean of 89.2% (range 84.1%–95.7%) of children, teacher data were obtained for a mean of 59.6% (range 53.7%–65.2%) and principal data were obtained for a mean of 67.5% (range 54.3%–75.0%).

2.3. Attrition

Six data collection rounds were originally planned over a three-year period but this was extended to seven rounds due to funding availability. Consequently, parents were re-approached and offered the option of withdrawing from the final round. At the first round of data collection (end of year 2012), no families had withdrawn from either state. At the third round (end of year 2013), three families had withdrawn in NSW and two in SA. At the fifth round (end of year 2014) there were no additional withdrawals in NSW and there were five additional withdrawals in SA. At the seventh and final round (end of year 2015), five additional families had withdrawn in NSW and four in SA. Thus, across the project there were a total of 19 withdrawals, 8 in NSW and 11 in SA. Overall, four families had moved out of area; six families were unresponsive; five were no longer eligible (e.g., they left the satellite program for a special class or school) and four withdrew for other reasons (e.g., declined to continue in study). Students remained in the study and data were collected from parents, even if schools, principals or teachers failed to consent to participate in any given round. There was no clear pattern of difference in the profiles of students who withdraw from the research before the completion of all rounds.

2.4. Pre-test assessments

Pre-test data were collected on a range of measures to provide information on the initial status of groups. Measures included IQ assessment using the WISC-IV (Wechsler, 2003), where an assessment had not been completed in the past 12 months, and a number of parent completed measures. The parent completed measures included the Social Responsiveness Scale (SRS; Constantino, 2005), Social Skills Improvement System Rating Scales (Social Skills subscale) (SSIS; Gresham & Elliott, 2008) and the Vineland Adaptive Behavior Scale -2 (VABS; Sparrow, Cicchetti, & Balla, 2005). The SRS is a standardized measure of the severity of social impairment associated with ASD. The SRS scores correlate well with the Autism Diagnostic Interview-Revised (Rutter, LeCouteur, & Lord, 2003) algorithm scores for DSM-IV criterion sets (Constantino et al., 2003). The SSIS is a standardized instrument that generates subscale scores for social skills, problem behaviors and academic competence. The VABS is a standardized informant-completed measure of adaptive behavior including communication, daily living skills, socialization and motor skills. Comparative data are presented in Table 2. Independent t-tests were conducted and groups were similar on most pre-test measures with exceptions being that SA children had a statistically higher full scale IQ (but equivalent verbal IQ), and had higher scores on the SRS.

Table 2
Pre-test Measures.

Measure	Satellite	Consultative	<i>p</i>
WISC Full Scale	81.75 (n = 40, SD = 15.76)	91.09 (n = 46, SD = 14.72)	.006
WISC Verbal	87.12 (n = 42, SD = 18.23)	87.98 (n = 47, SD = 16.26)	.82
SRS	77.79 (n = 42, SD = 12.67)	84.63 (n = 48, SD = 12.19)	.01
SSIS Social Skills	81.26 (n = 42, SD = 14.36)	77.98 (n = 48, SD = 11.61)	.23
VABS Total Adaptive	78.71 (n = 42, SD = 8.17)	81.48 (n = 48, SD = 11.16)	.18

Note: Higher scores indicate better functioning except for SRS.

2.5. Other data

The rate of transition from satellite classes was lower than expected during the study period and, in the final round of data collection, both parents and teachers of children who had not transitioned were asked why the child had not transitioned. The reasons provided were transcribed verbatim.

2.6. Procedures

2.6.1. Pre-test assessments

Children were assessed on the WISC-IV at pre-test by a qualified psychologist, unless a psychometric test had been completed in the past 12 months, in which case this result was used. Trained research assistants administered the SRS, VABS and SSIS scales using parents as the informant and most of these interviews were conducted by phone.

2.6.2. Data collection rounds

Data reported in this paper were collected twice yearly (Term 2 and Term 4) over 7 rounds by trained research assistants. Data reported here were collected in every round with the exception of the SSIS related teacher data, which were only collected in Term 4 of each year. Parental data were mainly collected by telephone. Data from teachers were primarily collected in person but in some cases telephone interviews were conducted. Where telephone interviews were conducted with parents and teachers, information on the response rating options for the relevant scales were posted or emailed in advance. Interviews with principals were conducted via telephone.

2.7. Program descriptions

A summary of the key features of the program models is provided in [Table 3](#). The consultative model of service delivery in SA involved the provision of an on-demand outreach model to schools with children with ASD in regular classes. The support involved a multidisciplinary autism specific team consisting of teachers, speech pathologists, occupational therapists, psychologists, developmental educators and school support officers (paraprofessionals). The service was available from the point of school entry and under the terms of the agreement between Autism SA and the school system, requests for service needed to be initiated by the school. The mean percentage of students in the research receiving on-demand support from Autism SA per year was 26%, ranging from 38% in

Table 3
Key Features of the NSW Satellite Class and SA Consultative Models.

Satellite Class Model	Consultative Model
<ul style="list-style-type: none"> ● An intensive autism specific program for class of 5-6 students with ASD located in a mainstream school ● Designed to support the inclusion of students with ASD in a mainstream setting. Planned integrated activities support social and communication skills and peer interaction. ● The program incorporates specialized therapeutic and educational interventions, and is adapted to The Australian Curriculum. ● Underpinned by individual assessment, planning and programming with a focus on the identification and inclusion of individual strengths and interests ● Specialist therapeutic intervention (speech therapy, occupational therapy, psychology) delivered in the natural context of the classroom. ● Collaboration and training of parents, and mainstream school staff. ● Carefully planned transitions from satellite classes that prepare the child and their neighborhood mainstream school; includes the provision of follow-up support. 	<ul style="list-style-type: none"> ● Multidisciplinary autism specific support team consisting of teachers, speech pathologists, occupational therapists, psychologists, developmental educators and school support officers (paraprofessionals) ● On demand school-initiated consultancy and specialist advice to teachers and educators of students with ASD within the school setting ● Support with the development of individualized educational plans ● Specific assessment and intervention services from specialized disciplines (speech pathology, occupational therapy, psychology) ● Training and development for educators ● Time-limited direct student support

* Information adapted from [Keane et al. \(2012\)](#) and [Roberts et al. \(2008\)](#).

the first year of the study to 17% in the final year.

The satellite class model offered by Aspect in NSW involved placement of the student with ASD in an autism specific class (5–6 children) in a mainstream host school. Programs incorporated individual education goals within a framework based on the regular school curriculum with a carefully planned schedule of integrated activities.

2.8. Dependent variables

Child outcome variables defined at the commencement of the study related to social behavior, school adjustment and engagement, and continuity of placement. Social behavior was of specific concern (American Psychiatric Association, 2013). As previously outlined, school engagement and adjustment has not been the focus of extensive research in the area of ASD and reflects a key set of capacities for school success. Conversely, continuity of placement was regarded as important as placement breakdown and was considered to be a definitive indicator of unsuccessful placement. The SSIS Social Skills subscale (teacher completed) was used as the measure of social skills. Given that the children involved in the research did not have physical disabilities the School Function Assessment (SFA; Coster et al., 1998) Cognitive Behavioral Tasks and Activity Performance Scales were used to evaluate school adjustment and engagement. These scales provide information relating to functional adjustment and engagement with subscales addressing: functional communication; memory and understanding; following social conventions; compliance/school rules; task behavior/completion; positive interaction; behavior regulation; personal care/awareness; and safety. The SFA is standardized and generates a score between 0 and 100 for each subscale. For each scale in the SFA, a performance criterion cut-off is provided for students in grades kindergarten-3 and 4–6. This criterion indicates the level of performances expected of the top 95% of typically developing students within these grade ranges. To evaluate continuity of placement, records of placement changes were kept including movement into special schools, other special classes within regular schools, part-time attendance and home schooling.

Parent, teacher, and principal outcome variables defined at the commencement of the study that related to satisfaction with service support and perceived success of placement were collected (every round). Satisfaction with service support was evaluated by asking respondents to rate their current satisfaction with the level of support provided by the respective organizations using a five point Likert-type scale (very unsatisfied to very satisfied). In NSW, Aspect teachers in satellite classes were delivering the educational program and it was not appropriate to ask them to rate their own support. Thus, satisfaction with support data was only collected from teachers of post-transition classes. Stakeholder perception of success of placement can play an important role in decisions regarding continuing educational placement (Carter et al., 2014) and has been used as an outcome index of mainstream placements (Kemp & Carter, 2006b). In this study perceived success of placement was evaluated by asking respondents to provide an overall rating of the success of the placement of the child in school on a five-point Likert-type scale (very unsuccessful to very successful).

2.9. Predictor variables

We also examined variables that predicted the outcomes of interest. Existing research examining predictors of school success have tended to focus primarily on academic achievement. Nevertheless, factors identified as predictors have included IQ (Eaves & Ho, 1997; Venter, Lord, & Schopler, 1992), autistic symptomatology (Eaves & Ho, 1997), social skills (Estes et al., 2011) and teacher rated academic skills (Eaves & Ho, 1997).

Thus, the following predictors were included in the analyses: model (NSW satellite or SA consultative); round (1–7); full scale IQ WISC at pre-test; autistic symptomatology as reflected in SRS total at pre-test; problem behavior as reflected in Child Behavior Checklist (CBCL Achenbach, 2001) total score at each round; adaptive behavior reflected in VABS at pre-test; social skills as reflected in SSIS (Parent) Social Skills scale at pre-test; academic competence reflected in the total of two SSIS teacher rated academic items (math and reading) at every second round. The two academic related SSIS items were selected as they required direct comparisons of the children with ASD with typically developing peers.

2.10. Approach to analysis

In an attempt to reduce the number of outcome variables to a manageable number, an exploratory factor analysis using principal component analysis was conducted on the subscales of the SFA to determine whether any scales could be combined. The earliest available data point for each child was used for this analysis. A parallel analysis using the rawpar.sps program by O'Connor (2000) suggested retaining one component. An examination of the scree plot and PCA results in which only one component had an eigenvalue above 1.0 confirmed the suitability of one component (analyses available from authors on request). Thus, all subscales loaded strongly on a single component, so an overall score was calculated for the SFA by taking each subscale from the criterion cut off and taking the mean of these scores.

Given the nested nature of the data, pre-test differences, and missing data, a multilevel model approach to data analysis was taken. Predictors of each outcome variable, including program model, were examined with data structured as rounds (repeated measure), nested within child, and nested within school (i.e., three-levels). Analyses were carried out for continuous dependent variables (DVs) (SSIS Social Skills, SFA cut-off scores difference) using the mixed procedure in Stata; analyses for ordinal dependent variables (all satisfaction and success variables) using gllamm. For ordinal DVs, categories 1 and 2 were combined, as there were very few respondents who selected either of these. Multiple imputation was performed in Stata and used for all analyses except SSIS Social Skills, as the dependent variable was missing on every second round. Continuous predictors were mean-centered prior to analysis.

Table 4
Parameter estimates and significance levels for each predictor by analysis.

Predictor	SSIS Social Skills		SFA (difference)		Principal Satisfaction		Principal Success		Teacher Satisfaction		Teacher Success		Parent Satisfaction		Parent Success	
	Coef (SE)	z	Coef (SE)	t	Coef (SE)	t	Coef (SE)	t	Coef (SE)	t	Coef (SE)	t	Coef (SE)	t	Coef (SE)	t
Model	0.23 (2.92)	0.08	43.16 (24.62)	1.75	-3.25 (0.45)	-7.18***	-0.46 (0.61)	-0.75	-0.37 (0.56)	-0.66	0.25 (0.51)	0.49	-4.11 (0.65)	-6.28***	-0.96 (0.44)	-2.16*
IQ	-0.16 (0.09)	-1.72	0.79 (0.72)	1.09	-0.01 (0.02)	-0.81	-0.02 (0.02)	-1.24	0.01 (0.01)	0.90	-0.01 (0.02)	-0.72	-0.03 (0.02)	-1.49	-0.03 (0.02)	-1.64
SRS	0.05 (0.12)	0.39	0.58 (0.99)	0.58	0.02 (0.02)	1.21	0.04 (0.03)	1.76	-0.01 (0.02)	-0.41	0.05 (0.02)	1.91	0.006 (0.03)	0.22	0.02 (0.02)	0.78
CBC	-0.08 (0.11)	-0.69	-0.30 (0.80)	-0.37	-0.01 (0.02)	-0.74	-0.03 (0.02)	-1.37	0.02 (0.02)	1.11	-0.06 (0.02)	-2.50*	-0.02 (0.02)	-1.13	-0.08 (0.02)	-3.89***
VABS	0.12 (0.16)	0.76	2.28 (1.29)	1.78	0.04 (0.02)	1.66	0.09 (0.03)	2.77***	-0.004 (0.02)	-0.16	0.07 (0.03)	2.21*	0.06 (0.03)	1.86	0.02 (0.03)	0.77
SSIS Parent Social Skills	0.14 (0.11)	1.29	0.02 (0.86)	0.03	-0.003 (0.01)	-0.24	-0.005 (0.02)	-0.24	0.01 (0.02)	0.50	0.03 (0.02)	1.52	0.01 (0.02)	0.62	0.03 (0.02)	1.32
SSIS Academic Competence	2.67 (0.53)	5.02***	8.40 (3.44)	2.44*	0.03 (0.11)	0.31	0.02 (0.11)	0.21	0.01 (0.12)	0.09	0.12 (0.09)	1.32	0.02 (0.10)	0.22	0.07 (0.08)	0.88
Round		χ^2		F		F		F		F		F		F		F
		4.51		1.82		1.53		2.03		0.81		5.23**		7.92***		1.72

Note: * $p < 0.05$, ** $p < .01$, *** $p < .0005$.

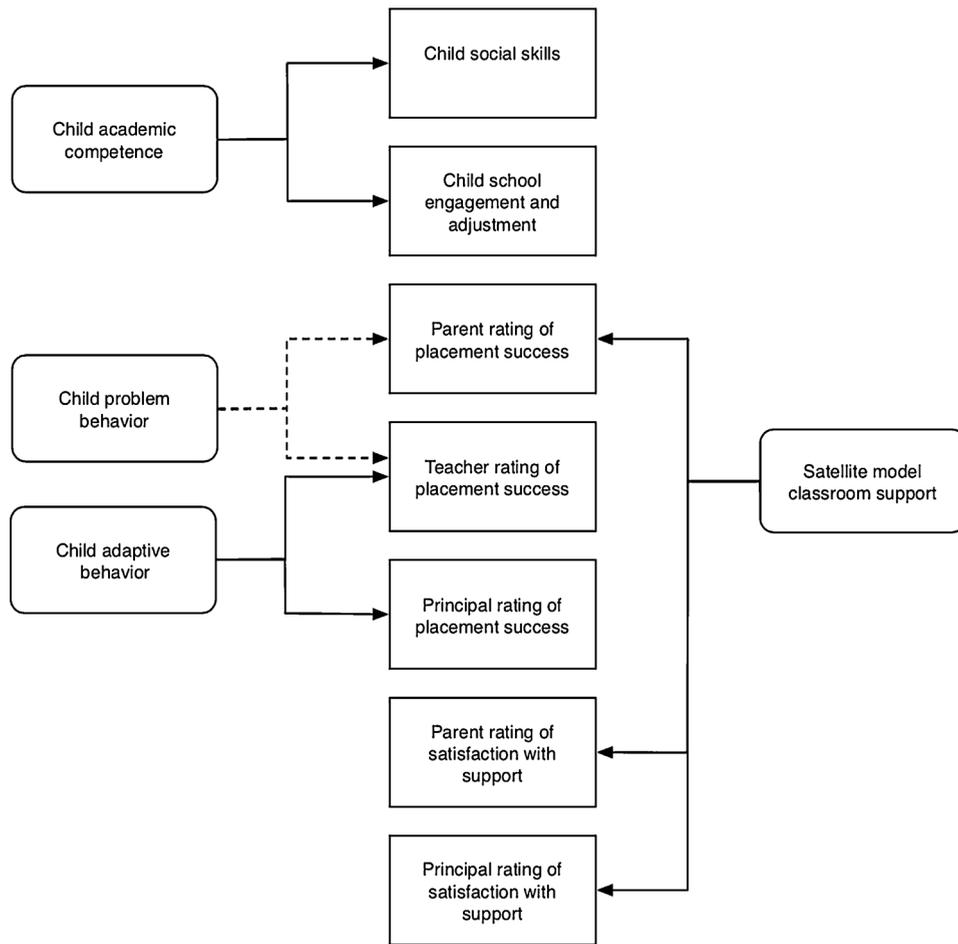


Fig. 1. Significant outcome predictors.
 Note: Dashed lines indicate negative effect.

3. Results

3.1. Predictors

Results below are pooled for multiply imputed datasets, with the exception of SSIS Social Skills, as noted above. Results are presented in Table 4 and summarized graphically in Fig. 1. As seen in Table 4, there was a significant positive effect of SSIS Academic Competence on SSIS Social Skills (teacher rated) and the SFA. No other predictors were significant in these models. For principal satisfaction, there was a significant effect of model, such that scores were higher for NSW than for SA. For principal success of placement on the other hand the only significant effect was the positive effect for the VABS. For teacher measures, while there were no significant effects for teacher satisfaction, for teacher success of placement there was a significant negative effect of the CBCL (higher level of problem behavior was associated with lower success ratings) and a significant positive effect of the VABS (higher adaptive behavior was associated with higher ratings), in addition to a significant overall effect of round of data collection. Orthogonal polynomial contrasts were run to further examine the effect of round, with a significant negative linear trend ($p = .028$) as well as a significant positive quadratic trend ($p = .001$), indicating that although teachers’ ratings of the success of the placement decreased with time, the rate of this drop also decreased with time. In other words, there was a stronger decrease initially, followed by a lower rate of decrease with subsequent rounds. For parent satisfaction, there was a significant effect of model, such that scores were higher for NSW than for SA, as well as a significant overall effect of round of data collection. Polynomial contrasts showed a significant negative linear trend ($p < .0005$) as well as a significant positive quadratic trend ($p < .0005$), again indicating a drop in parent satisfaction with time, albeit with the rate of drop decreasing over time. Finally, for parent success of placement, there was a significant effect of model, such that scores were higher for NSW than for SA, as well as a significant negative effect of CBCL. It should be noted that success of placement scores were high for both groups, typically between 4 and 5 on a 5-point scale.

Table 5
Reasons for Non-transition.

Reason	Parent	Teacher
Not ready for transition	8	12
Level/quality of support provided in satellite class	6	5
Safe environment provided in satellite class	4	1
Teacher advice	3	0
Not enough integration opportunities	1	0
Already has integration opportunities	2	0
Parent choice	0	5

3.2. Continuity of placement

In the SA consultative model, one student permanently moved from a regular class to home-schooling and an additional child was withdrawn for home-schooling before returning to a regular class. In the NSW Aspect model, one child moved from an Aspect satellite class to a (non-Aspect) special school and one child moved from a satellite class to a (non-Aspect) special class. Two children returned to a satellite class post-transition, one child moved to a (non-Aspect) special class approximately 2.5 years post transition, and one child reduced to part-time school attendance approximately one year post transition. In addition, one child permanently moved from a satellite class to an Aspect base special school, and one child moved to a base school for intensive programming prior to returning to the satellite class.

3.3. Reasons for satellite class retention

In NSW a total of 13 of 42 students transitioned from satellite classes to regular classes over the period of the study. A total of 23 parents and teachers for 19 students responded regarding the reasons for satellite class retention and some respondents gave multiple answers. These data are presented in Table 5. In addition, respondents were asked when transition was anticipated. Twelve parents and six teachers indicated that transition was not anticipated, three parents and three teachers indicated that transition was expected before high school, four parents and 6 teachers during high school, and four parents and four teachers were unsure.

4. Discussion

The present study was designed to compare the educational outcomes of two approaches designed to facilitate the successful support and transition of children with ASD in regular primary school classrooms as well as examine factors that were associated with outcomes. There was a high level of continuity of placement in both programs, similar student outcomes and similar ratings of placement success by teachers and principals. Enrolment in a satellite class was associated with higher parent ratings of placement success as well as higher parent and principal satisfaction with support. In addition, some child related variables predicted outcomes. The present research represents one of the very few attempts to compare program delivery options for students with ASD and provides insights into factors that may predict engagement and adjustment at school as well as perceived placement success.

4.1. Challenges in conducting multisystem research

The establishment and recruitment phase of this study took approximately 12 months. A significant portion of this time involved submissions to the 11 relevant human research ethics committees, many of which had significantly different administrative processes and required different information. While it is certainly reasonable and appropriate that some committees would require specific information relevant to their jurisdiction (e.g., practical impacts of research on the operation of schools) there would seem to be room for significant standardization of requirements and processes. The multi-level consents required for this research (parent, principal and teacher) and the need to obtain consent from new teachers each year in most instances, presented a considerable challenge in the conduct of the research and resulted in considerable missing data across the study. Nevertheless, data of this type are crucial to inform improvements in services provisions and options to facilitate research are at least worth considering. For example, it may be worth considering the possibility of embedding data collection as best care, perhaps as part of individualized education program and outcome assessment, with all families and schools being offered the chance to opt-out from data sharing with researchers.

4.2. Differences between programs

Continuity of placement was relatively high within both models. Nevertheless, there was more movement within the NSW system with a number of children moving between base (special) schools, satellite classes, other support classes and regular class. This may, in part, reflect the educational approach adopted within the NSW school system, where a "cascade of service" (Harwood, 2006) approach has been retained in large part, despite increasing emphasis of inclusion of children in regular classes. Developing appropriate and inclusive models of education for individuals with ASD presents a significant challenge (Jordan, 2008; Roberts & Simpson, 2016) and flexibility is a key element (Jordan, 2008).

Analysis did not reveal a significant relationship between program model and engagement and adjustment as measured by the SFA. Similarly, program model was not significantly associated with social skills. Thus, in relation to child outcomes, the programs did not appear to differ. In reviewing stakeholder perspectives on inclusion of children with ASD, Roberts and Simpson (2016) reported that social-communicative behaviors, in particular, are reported to significantly impact on teacher and peer relationships and are a key mediator of success. The present study did not include support options that were not autism specific. While there were no differences in child outcome for social skills or engagement and adjustment between the models examined, comparison of outcomes with a non-autism specific model would be of interest in future research.

There was a generally high perception of placement success by parents, teachers and principals in both program models. Principal and teacher-rated success of placement was not different between models, but parents in NSW rated school placement as more successful than parents in SA. This higher level of satisfaction with placement may reflect the more intensive support that was available to children in the satellite model. Both parent and teacher ratings of success trended down across the study. This was consistent with the finding of Starr and Foy (2012) who reported that parental ratings of satisfaction with education of children with ASD tended to decrease over time. This may reflect increasing challenges faced by students as the demands of schooling increase and would represent a valuable area for future research.

Parents and principals reported higher satisfaction with support in NSW. This may reflect the different structure of the support services, which were more episodic and time limited in SA. On average, 26% of students in SA accessed consultative support per year. Within the more intensive NSW satellite model, support included systematic training for parents. One issue was that within the SA funding model at the time of the research, the client for Autism SA is the school, not the parents, and schools are required to initiate a service request. It is possible that parents felt that more support was needed than the amount requested by schools. Frederickson et al. (2010) reported that features of placements identified as important were more likely to be found in schools with an ASD unit than in schools receiving consultative support only. It is not certain that this finding is relevant to the present study as the consultative model provided within SA was autism specific rather than generic. It would seem more likely that the intensive level of support and the perception of a protected and safe environment (reflected in reasons for non-transition) was related to the higher satisfaction with support ratings in NSW. While intensity of support differed across the models, both included several basic features that are considered best practice in support of children with ASD. Specifically, both include autism specific support (social-communication skills, sensory and behavior supports) by trained specialist educators and other allied health support staff, and the provision of training and support to educators in school settings. The intensity of support offered in both approaches was considerably less than that reported by Grindle et al. (2012) in their ABA class model in a mainstream setting. Nevertheless, the intensity of support offered was very different between the two models of service delivery and this needs to be considered in contextualizing the results.

The present study provided only limited identification of outcome differences between the two models of service delivery but the question of optimal models for supporting students with ASD remains relatively unexplored. The provision of autism specific services or programs that focus on specific areas of need in ASD have been recommended as best practice (National Research Council, 2001; Roberts & Simpson, 2016) but comparisons of autism specific and generic service provision do not appear to have been conducted at this point and this issue remains a potential direction for future research.

4.3. Transition and reasons for non-transition

An unexpected finding in the current study was the limited transition of children from satellite classes in NSW to mainstream classes, with only 13 such transitions across the 3.5 years of the study. In comparing these results with previous studies, it needs to be noted that prior researchers (Keane et al., 2012; Roberts et al., 2008) have reported on the types of placement following transition, not transition rates per se. In the present study, data were collected regarding non-transition in the final round of the study and the most common reasons cited by both parents and teachers related to the child not being ready for transition and the level and quality of support provided in the satellite class. About half of responding parents and a third of responding teachers indicated that they did not anticipate transition at all. The most frequent reason cited for lack of transition was that the child was not ready. This may reflect an actual lack of readiness or may represent a perceived lack of readiness, possibly related to insufficiently clear criteria for initiating transition. Given the relative cost of satellite support class placement, this issue warrants further exploration.

4.4. Predictors

In addition to models of service delivery, a number of other predictors were identified. With regard to child social skills (teacher rated) and school engagement and adjustment, the only significant predictor of both was teacher-rated academic competence. Eaves and Ho (1997) unsurprisingly found that teacher rated academic skills correlated with achievement test results. The relationship between teacher rated academic competence and social skills and school engagement and adjustment in the current study is more challenging to explain. Given that causal direction is uncertain, it would seem possible that engagement and adjustment as well as social skills set the foundation for development of academic skills. Some support for this proposition is offered by the study of Estes et al. (2011), who found that social skills in “higher-functioning” children with ASD at age 6 predicted later academic achievement, specifically word reading. Estes et al. (2011) suggested that future research should examine whether interventions directed at improving social functioning could improve academic performance and this proposition is supported.

Consistent with the finding of Eaves and Ho (1997), we found a lack of relationship between problem behavior and social skills, suggesting that these two factors may vary independently to some extent. Problem behavior did, however, significantly predict parent and teacher rating of placement success with higher problem behavior being associated with lower ratings of success. Given parents

and teachers probably have the greatest input into decisions regarding continuity of placement, the possible negative effect of problem behavior is highlighted, emphasizing the need for effective behavior support. The finding of a negative relationship between problem behavior and teacher rating of placement success is consistent with a number of reviews of teacher attitudes to inclusion (Avramidis & Norwich, 2002; de Boer, Pijl, & Minnaert, 2011), where problem behavior is associated with more negative attitudes toward placement.

The other significant non-model related predictor was pre-test adaptive behavior, which was related to both teacher and principal rating of success of placement. Given that the construct of adaptive behavior reflects a broad range of capacities needed for personal and social sufficiency (Sparrow et al., 2005), it is probably not surprising that it would be related to perception of placement success.

There were also a number of notable factors that were not significant predictors of the outcomes examined, in particular IQ and pre-test autistic symptomatology as measured by the SRS. In past research (Eaves & Ho, 1997; Venter et al., 1992), verbal IQ has been associated with type of class placement (special class versus regular class with and without aide). Locke et al. (2017) found that IQ did not predict overall social success in elementary-aged school children. However, IQ does not appear to have been examined in relation to the outcome variables reported in the present study. It should also be noted that the present study was by design limited to children who were functioning in the mild range of intellectual ability and above and this restricted range may have contributed to the lack of association with outcomes. Eaves and Ho (1997) found that autistic symptomatology as measured by the Childhood Autism Rating Scale scores was significantly associated with type of class placement and Locke et al. (2017) reported that autism symptom severity as measured on the Autism Diagnostic Observation Schedule predicted playground engagement and social network salience. The lack of predictive power of autistic symptomatology in relation to the outcomes in the present study may reflect limitations in the instrument used, statistical power or that symptomatology did not make a unique contribution, beyond other factors measured, such as problem behavior and academic competence. Replication is needed to examine this possibility.

Parent rated social skills at pretest was not predictive of later teacher rated social skills. This may appear counterintuitive but there is extensive research that indicates only limited correspondence between parent and teacher ratings of child behaviors (e.g., Renk & Phares, 2004; Verhulst & Akkerhuis, 1989; Winsler & Wallace, 2002). In the case of children with ASD, both contextual demands and the capacity to accommodate limitations in social skills may be quite different in home and school settings.

The present study offers insight into possible child program and child related predictors of a range of outcome measures. Nevertheless, there is relatively limited research on non-academic aspects of school outcome and replication and extension of the current research is warranted. In particular, given educational service delivery is adaptable, it would be valuable to examine educational service characteristics in greater detail in relation to child outcomes.

4.5. Limitations

The present study was by its nature opportunistic and used existing convenience samples of students enrolled in the programs of interest. While sample characteristics were considered in the statistical analyses, the pre-test differences in the samples need to be taken into account in interpreting the results. In addition, only a small proportion of parents invited to participate in the study agreed. Due to the need for teacher re-consent each year, there was considerable missing data, particularly in SA school staff. While attrition rates were low given the duration of the study, they also need to be considered when interpreting results. Finally, the sample size was modest and it is possible that additional associations would have become evident with a larger sample.

5. Summary and conclusion

The present study provided comparison of two models of school support for children with ASD as well as predictors of school success. Continuity of placement was high in both models and there were no significant differences in child outcomes across the models. Parents in the Aspect satellite model rated success of placement higher, but ratings in both groups were generally high. Parents and principals also rated support higher in the satellite model. In addition, teacher rated academic skills were associated with student school engagement and adjustment as well as social skills. Child behavior problems predicted both parent and teacher rating of placement success while pre-test adaptive behavior predicted both teacher and parent rating of placement success. Transition rates from the satellite support class into mainstream classes were low, possibly reflecting the higher level of support offered. A number of pragmatic recommendations and directions for future research arise from this study. In particular, there is a need to consider processes for streamlining multi-jurisdictional ethics approval and standardization of requirements. Major recommendations for future research include further examination of service delivery models, including comparison of autism specific and generic supports and longitudinal examination of school outcomes and engagement. Several implications for service delivery models arise from this investigation and, more generally, the need to further examine options for supporting students with ASD is highlighted.

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the

institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Declaration of Competing Interest

Authors Clark, Costley and Bruck were employed by Autism Spectrum Australia, who provided the satellite program evaluated in the research. Author Clark was also involved in the original development of the satellite program. Authors Martin and Davies were employed by Autism SA who provided the consultative model evaluated in the research. None of the previously mentioned authors were involved in data analysis or directly involved in service delivery but Clark, Costley and Martin were involved in design of the study. Authors Carter, Stephenson, Williams, Browne and Sweller declare they had no conflict of interest.

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