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RESEARCH ARTICLE

Characteristics of children on the autism spectrum who benefit the most from receiving intervention in inclusive versus specialised early childhood education settings

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Abstract

This study examined the factors associated with social-communicative outcomes for children on the autism spectrum receiving early intervention in inclusive versus specialised early childhood education programmes. Fifty-eight preschool-aged children randomly assigned to receive the Group-Early Start Denver Model (G-ESDM) in either inclusive or specialised (i.e., autism-specific) classrooms across one calendar year showed similar outcomes at group mean-level across measures of communication and social behaviour. We examined factors moderating outcomes across settings. Novel moderation analyses revealed that higher baseline social interest and nonverbal cognitive skills were associated with increased social communication gains for children in the inclusive classrooms, but not for those in specialised settings. Children who spend more time paying attention to people and have higher cognitive skills might benefit from receiving early intervention in inclusive settings, whilst these factors might be less relevant for children educated in specialised settings.

Lay Summary

This study examined the characteristics of children on the autism spectrum who benefit the most from receiving intervention in inclusive versus specialised early childhood education settings. Fifty-eight preschool-aged children were randomly assigned to receive an evidence-supported intervention called the G-ESDM in either inclusive or autism-specific classrooms across one calendar year. Children who spent more time paying attention to people and had higher cognitive skills prior to receiving the intervention experienced more gains in inclusive settings. Conversely, these factors were unrelated to gains for children educated in specialised settings.

KEYWORDS

autism spectrum disorder, early intervention, early start Denver model, inclusion, mainstream education, moderators, predictors

INTRODUCTION

A critical dilemma faced by families, professionals, and policy makers is whether children on the autism spectrum should be educated in inclusive or specialised settings. Although educational policies and human rights conventions (National Research Council, 2001; United Nations, 2006) point to the importance of

providing educational opportunities in the least restrictive environment suitable for a child's needs, the mere physical integration of autistic children in mainstream classrooms is widely considered insufficient for a successful educational experience (Lai et al., 2020; Pellicano et al., 2018). Several studies have suggested that children on the autism spectrum educated in inclusive settings have poorer outcomes compared to their non-autistic peers when autism-specific strategies and supports are not provided (Roberts & Simpson, 2016). Further, they might experience negative interactions with peers that exacerbate, rather than alleviate, their social communication difficulties (Goodall, 2018).

Even when specialised training is provided, mixed reports on the learning outcomes and lived experiences of individuals on the autism spectrum suggest that current inclusion practises might not benefit all children equally (Goodall, 2019; Humphrey & Symes, 2011; Waddington & Reed, 2017). Indeed, whilst the premise for inclusive education is the opportunity to engage in social learning experiences that involve interaction with "role model" typical peers, many children on the autism spectrum find themselves on the periphery of peer groups despite physical proximity, and often show poor response to educational strategies designed for the neurotypical population (Brede et al., 2017). This has led several scholars and stakeholders to advocate for "autism-friendly" specialised educational settings that are tailored to their communication, sensory and learning needs, and which allow autistic children to acquire new skills without the distractors and stressors of mainstream settings (Leyser & Kirk, 2004; Mesibov & Shea, 1996; Smith, 2011). Nevertheless, concerns have been raised about the possible deprivation of appropriate stimulation as well as the risk of marginalisation associated with specialised placements (e.g., Howlin, 1998; Strain, 1983) and empirical research in this area has provided a mixed picture, with no conclusive evidence in favour of inclusive or specialised settings (Saggers et al., 2019; Vivanti et al., 2019).

A possible explanation for the lack of unequivocal evidence on whether socially inclusive or specialised settings are the best educational option for children on the autism spectrum concerns the heterogeneity within this population. As children on the autism spectrum vary in terms of their learning resources and preferences—including their motivation and ability to engage with, imitate, and learn from their peers—it is plausible that autistic children with specific characteristics might benefit from receiving their educational interventions in inclusive versus specialised settings. For example, Wing (2007) and Smith (2011) have each suggested that children who have more social initiative and curiosity about their peers might benefit more from the opportunity for interaction within inclusive settings compared to autistic children who are less socially motivated. This notion has been supported by empirical research indicating that more socially motivated children on the autism spectrum are less likely to display school refusal behaviour (Munkhaugen et al., 2019). Additionally, child social behaviour, together with emotional, cognitive, and sensory characteristics is considered to be a critical factor for successful engagement in inclusive settings by teachers, parents, and clinical practitioners (Humphrey & Symes, 2013; Larcombe et al., 2019).

Despite the growing motivation amongst stakeholders, researchers, and policymakers alike to tailor early learning opportunities to the strengths and needs of individual children on the autism spectrum, empirical knowledge on the specific child-factors associated with positive outcomes in inclusive versus specialised settings remains limited. This research gap reflects methodological challenges, including a scarcity of studies examining relative outcomes for children receiving different interventions (e.g., Rogers et al., 2021), or the same educational interventions accessed within different placement settings. To address this latter question, we conducted a randomised controlled trial comparing relative outcomes for young children on the autism spectrum who received the same intervention within either a mainstream or a specialised early childhood education setting (Vivanti et al., 2019). Forty-four children diagnosed with autism, aged 15–36 months, were randomly assigned to receive the group-based Early Start Denver Model (G-ESDM; Vivanti et al., 2017a) for one school calendar year within either classrooms that included only autistic children or mostly children who were typically developing. Our primary report on the trial suggested similar benefits for children irrespective of intervention setting (Vivanti et al., 2019).

Individual variation was also evident in the extent to which children made gains during the time they received G-ESDM in either the mainstream or specialised settings (Vivanti et al., 2019). Here, we sought to examine the degree to which children's social and cognitive characteristics at baseline might help to explain differential outcomes in the social and communication domains within each of the educational settings. Our research question was based on the frequently voiced notion that inclusive settings might be more appropriate or beneficial for children with higher cognitive skills (e.g., Jury et al., 2021), and the clinical observations of Wing (2007) and Smith (2011) that children with a higher level of social interest would be better equipped to gain advantage from the richer social input offered within an inclusive environment (e.g., they might increase their vocabulary and improve their social skills by interacting and practising with 'role model' typical peers). Specifically, we predicted that children with higher cognitive functioning and social interest at baseline may make greater social and communication gains if they received their intervention within a mainstream classroom, whilst this would not to be the case for children receiving their intervention in specialised classrooms.

METHOD

Participants and design

Approval was provided by the La Trobe University Human Ethics Committee (UHEC 14–082) for a RCT focused on the G-ESDM (Vivanti et al., 2017a)—an intervention approach that uses the principles and strategies of the Early Start Denver Model (ESDM; Rogers & Dawson, 2010) in classroom settings—delivered for children randomised to inclusive and specialised classrooms. As detailed in Vivanti et al. (2019) children were eligible if they (1) met Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) criteria for Autism Spectrum Disorder (ASD) confirmed via clinical judgement and administration of the Autism Diagnostic Observation Schedule–2nd edition (ADOS-2; Lord et al., 2012) by a research-reliable assessor; (2) were enrolling in the La Trobe University Community Children's Centre, a community service which includes an early intervention programme for children on the autism spectrum across autism-specific classrooms and a regular daycare programme for children of families in the local community, or Gowrie Victoria, a second community childcare service, attending for a minimum of for 3 days (15-h) per week, across one school calendar year between 2015–2018. In addition to the 44 participants reported by Vivanti et al. (2019), data for the current analyses were available for an additional 14 children who enrolled in 2018. Fifty-eight preschool aged children (35% female) meeting these criteria were randomly assigned to receive their G-ESDM programme (Vivanti et al., 2017a) in either inclusive or specialised autism-specific classrooms within the childcare centres referenced above. As shown in Table 1, there were no differences between children randomised to the inclusive or specialised classrooms on baseline measures of child age, autism symptoms, measured by the ADOS, or verbal/nonverbal developmental quotient (DQ), measured via the Mullen scales of early learning (MSEL; Mullen, 1995).

Caregivers of participating children were highly educated (university-level qualification for 84% of mothers, 75% of fathers). A large subgroup of caregivers identified as culturally and linguistically diverse (36%); born outside Australia or speaking a home language other than English.

Setting and intervention

Also detailed by Vivanti et al. (2019), the RCT was conducted within the La Trobe University Community Children's Centre, which includes an early intervention programme for children on the autism spectrum across autism-specific classrooms and a regular childcare programme, and Gowrie Victoria, a partnered community childcare. The autism-specific classrooms included up to 10 children on the autism spectrum attending on any given day, whilst each inclusive classroom had between one and three children on the autspectrum and an average of 12 non-autistic peers attending on any given day. Across settings, the staff: child ratio was 1:4.

Staff across all settings were trained in the G-ESDM (Capes et al., 2019; Vivanti et al., 2017a), with support from ESDM certified allied health staff (psychology, speech therapy, and occupational therapy). In the G-ESDM a comprehensive set of goals is generated based on the specific profile of strengths and weaknesses for each child across multiple developmental domains, including verbal and nonverbal communication, socialisation, as well as cognitive and adaptive skills. Goals are targeted by educational staff during daily classroom routines and cooperative play activities with peers using a set of manualised naturalistic developmental behavioural techniques (Capes et al., 2019; Vivanti et al., 2017a). Additionally, peer-mediated strategies are used, with adults providing guidance so that children elicit and reinforce appropriate behaviours for their peers, and persist in their efforts to do so (Vivanti et al., 2017a).

MEASURES AND PROCEDURE

Predictor variables

Primary putative predictors of interest in informing differential child outcome were measured at intake into intervention, and included indicators of social interest quantified within two experimental eye tracking paradigms (Vivanti, Fanning, et al. 2017, Vivanti, Hocking, et al., 2017) designed to capture complementary dimensions: (1) relative interest in people versus objects and (2) duration of attention to people showing socially engaging facial expressions. Both were passive viewing

TABLE 1 Sample characteristics across groups at baseline

	Inclusive ($N = 30$)	Specialised ($N = 28$)	p
Child sex (Female N%)	8 (26.7%)	12 (42.9%)	0.195
Child age at intake (months)	24.51 (4.74)	26.80 (5.20)	0.086
ADOS calibrated severity score	7.41 (2.24)	7.71 (1.84)	0.584
Verbal developmental quotient	61.38 (25.80)	59.54 (34.95)	0.819
Nonverbal developmental quotient	80.10 (17.51)	75.12 (24.98)	0.381

Note: Statistics are mean (standard deviation), unless otherwise specified, p values derived from chi square and simple t-tests. Verbal and nonverbal developmental quotient from the Mullen scales of early learning.
Abbreviation: ADOS, autism diagnostic observation schedule.

tasks administered via a computer monitor, with participants' eye movements recorded using a Tobii X2-60 binocular eye-tracker and Tobii Studio software, which presents stimuli on a computer-like monitor. The child was seated in a comfortable chair, approximately 60 cm (36.46° visual angle) from the eye-tracking monitor. Areas of interest (AOIs) were predefined using Tobi Studio software. The experimenter first calibrated the child's visual fixations using the built-in five-point Tobii Studio calibration and validation procedure. Following this, each child passively viewed the experimental stimuli according to one of two counterbalanced orders, with a fixation cross presented for 1 s before each stimulus.

The *Preferential Social Orientation* paradigm measured preferential orientation to social and nonsocial stimuli across static and dynamic trials (Vivanti et al., 2017b). Static stimuli included digitised photographs depicting a naturalistic scene that involved people and objects similar in size and visual salience, each presented for 5 s. Dynamic stimuli were presented as three movies of 7 s duration, each involving a social and nonsocial scene displayed side by side and moving in simultaneous, time-linked fashion (e.g., a person and a rotating chair spinning, with synchronized speed, and timing of movement). The side (left/right) of presentation of social and nonsocial stimuli was counterbalanced and static and dynamic trials were interspersed amongst one another according to two fixed random orders. Social interest was operationalised as the relative duration of attention to the social versus nonsocial AOIs.

The *Attention to a Playful Adult* task was derived from a paradigm previously described in Vivanti et al. (2016). Participants were shown four 10-s video-stimuli in which a female actor displayed playful, positive affect whilst showing direct gaze and performing a simple action involving one of several objects placed on a table in front of her. Examples of the actions used include moving a slinky back and forth between open hands and patting a ball against the shoulder. The female actor, unfamiliar to participants, was the same in each of the four video-stimuli, whilst the actions and objects used differed across videos. Figure 1 shows a screenshot of one of the four video-stimuli. The presentation of the video stimuli was arranged in two fixed random orders, which were counterbalanced across participants. Duration of attention in response to the playful actor in the video was used as an indicator of social interest.

FIGURE 1 Screenshot from one of the four video-stimuli comprised in the *attention to a playful adult* eye-tracking paradigm.

Other child characteristics considered in the analyses were child age at intervention intake and nonverbal DQ measured by the MSEL (Mullen, 1995) and generated from age-equivalence scores on the visual reception and fine motor domains.

Outcome variables

As reported in the original publication reporting on the RCT outcomes (Vivanti et al., 2019), key outcomes of interest included proximal blinded measures of social-communication skills. *Social Interaction* was operationalised as the total number of times a child initiated or responded to another child or adult, blind coded from 10-min video samples of free-play and snack-time sessions following the modified classroom observation schedule to measure intentional communication (M-COSMIC; Clifford et al., 2010). The M-COSMIC is a coding system designed to capture the frequency of social-communicative acts from video-recorded samples, including child initiations and responses towards a peer or an adult, using either verbal or nonverbal means (see Vivanti et al., 2019, for details on coding procedures). Inter-rater reliability based on intra-class correlation on 30% of double-coded tapes was excellent (ICC = 0.93).

Additionally, a measure of *Spontaneous Vocalisation* was sampled from 40-min semi-structured interactions, using the Language Environment Analysis (LENA; Gilkerson & Richards, 2008; Xu et al., 2009), an automated speech analysis software that uses a digital language processor and audio processing algorithms to yield an objective measure of language and vocalisations during natural interactions (Gilkerson & Richards, 2008; Xu et al. 2009). Children wore an unobtrusive portable recording device during semi-structured interactions with centre staff. A blinded research assistant later extracted data from 40-min samples of each recording, which generated a total count of spontaneous vocalisations (including words, word approximations and other vocalisations; see Vivanti et al., 2019, for additional details on procedures and reliability data).

Verbal DQ, assessed on the MSEL following intervention, was also examined as a distal standardised measure of verbal skills. This was computed for each child based on age-equivalence scores in the receptive and expressive language domains as a function of chronological age.

Analyses

Normality for the study variables was assessed using z-skewness and kurtosis indices, with a critical value set at ±3.29 (Tabachnick & Fidell, 2007). Three univariate outliers were identified and trimmed to the next closest value +1 (Tabachnick & Fidell, 2007). Baseline measures of the proximal communication outcomes (M-COSMIC and LENA) were positively skewed, with square root transformation applied prior to proceeding with parametric analyses.

As the current study reports on 14 new participants in addition to the 44 whose data were originally reported in Vivanti et al. (2019) we first conducted a series of mixed 2 (Setting) × 2 (Time) analysis of variances (ANOVAs) to examine whether social and communication gains differed for participants in inclusive versus autism-specific specialised classrooms for this larger sample ($n = 58$) across the three blinded outcome measures described above (Supplemental Materials, Table 5).

Next, the hypothesis that higher social interest and cognitive skills would be associated with outcomes in the inclusive setting but not in the specialised setting was tested by examining the pattern of correlations among variables of interest and then conducting moderation analyses where indicated. That is, exploratory Pearson's partial correlations were computed, separately for each group, between the putative predictors—preferential social attention, attention to playful adult, and nonverbal DQ—and outcomes of interest—social interaction (M-COSMIC), and spontaneous vocalisations (LENA), and verbal DQ—controlling for baseline levels of the relevant outcome measure. Child age was included as a potentially relevant covariate. Where the pattern of correlations appeared different across groups (i.e., a significant correlation was evident in one group only, or the direction or strength of effect was different), exploratory simple moderation analyses were conducted using PROCESS v4.0 (Hayes, 2021). Bootstrapped confidence intervals were computed based on 5000 samples. The Johnson-Neyman approach to probing interactions was adopted to identify the value at which the effect of the moderator transitioned between statistical significance and nonsignificance at the $p = 0.05$ level.

RESULTS

Baseline participant characterisation across groups is shown in Table 1, with no significant between-group differences on chronological age, cognitive functioning, male/female ratio and age at intake. Descriptive statistics and intercorrelations between putative predictor variables and baseline outcome measures are reported in Supplemental Materials Table 4.

Results of the ANOVAs testing whether outcomes differed for participants in inclusive versus specialised settings across frequency of spontaneous vocalisations (captured via LENA recordings), social interaction (measured via the M-COSMIC) and Verbal DQ (measured via the Mullen Scales of Early Learning) are presented in Supplemental Materials Table 5. Spontaneous vocalisations, social interaction, and verbal DQ scores showed significant improvement over time but no main effect of setting or setting × time interaction. That is, consistent with Vivanti et al. (2019), which included 44 of the 58 children in the current sample, participants in each setting increased their frequency of spontaneous vocalisations and social interaction and experienced an increase in verbal DQ across the intervention year, with no between-group differences apparent at baseline, nor any evidence of superior gains amongst children in one setting over the other.

Partial correlation analyses between baseline putative predictors and outcome measures revealed some differential patterns of correlations for children randomised to the inclusive versus specialised settings (Table 2). Specifically, a strong positive correlation was evident between baseline attention to a playful adult and social interaction outcome in the inclusive setting group, whilst a nonsignificant weak negative correlation was evident between these for children in the specialised setting group. Similarly, in the inclusive setting group there was a strong positive correlation between baseline attention to a

TABLE 2 Pearson's partial correlations between baseline putative predictors of outcomes and social-communication outcome measures (controlling for baseline measures[a])

	Social interaction[b]		Spontaneous vocalisation[c]		Verbal DQ	
	Inclusive	Specialised	Inclusive	Specialised	Inclusive	Specialised
Attention to playful adult	0.586*	−0.127	0.555*	0.204	0.135	0.236
Preferential social attention	−0.073	−0.142	−0.008	0.285	0.120	0.141
T1 nonverbal DQ	0.376	0.381*	0.514*	0.009	0.390*	0.381*
Child age	0.233	−0.282	0.351	0.133	−0.331	−0.498*

Note: *$p < 0.05$.
Abbreviation: DQ, developmental quotient.
[a]Control measures included baseline level of the relevant outcome measure.
[b]As measured via the M-COSMIC and controlling for baseline M-COSMIC, which was sqrt transformed.
[c]As measured via LENA and controlling for baseline spontaneous vocalisation, which was sqrt transformed.

playful adult and spontaneous vocalisation outcome, with a nonsignificant weak positive correlation evident between these in the specialised group. A differential pattern of correlations was also evident between baseline nonverbal DQ and spontaneous vocalisation outcome, with a strong positive relationship evident in the inclusive group and no relationship evident in the specialised group. There were no differences in the patterns of correlations across groups on measures of verbal DQ.

Moderated multiple regression analyses were conducted to examine the role of intervention setting in the relationship between significant predictors and outcome measures. Conditional effects for each model are presented graphically in Figures 2 and 3.

Model 1 predicting Social Interaction was significant, $F(5,46) = 4.54$, $p = 0.002$, accounting for 33% of variance (Table 3), and including a significant interaction of attention to a playful adult by group which contributed 10% of variance ($F[1,46] = 6.89$, $p = 0.012$, $R^2\Delta = 0.100$). Conditional effects indicated that attention to a playful adult had no significant impact on social interaction for children receiving G-ESDM in the specialised setting (b = −1.56, 95%CI[−4.09–0.97], $p = 0.222$). Conversely, baseline attention to a playful adult was positively associated with social interaction outcomes after placement in the inclusive setting (b = 2.84, 95%, CI [0.39–5.29], $p = 0.024$). Further probing of the interaction identified a region of significance (Figure 2) indicating that children who attended to the playful adult stimuli for <2.37 s (out of 10 s) had lower social interaction outcomes in inclusive settings.

Model 2 predicting spontaneous vocalisations was significant, $F(4,49) = 7.21$, $p < 0.001$, and accounted for 37% of variance in outcomes (Table 3). Here, interaction between attention to a playful adult and group was not significant ($F[1,49] = 0.874$, $p = 0.355$, $R^2\Delta = 0.011$), with only baseline spontaneous vocalisation (entered as a covariate) a significant unique predictor of outcome.

Model 3, which examined the relationship between nonverbal DQ and spontaneous vocalisation, was significant $F(4,53) = 7.77$, $p < 0.001$ and accounted for 37% of the variance in outcome (Table 3). The interaction between nonverbal DQ and group was significant $F(1,53) = 4.17$, $p = 0.046$, $R^2\Delta = 0.049$, and contributed 5% of variance to the model. Conditional effects indicated no relationship for nonverbal DQ and spontaneous vocalisation outcomes for children in the specialised setting (b = 0.04, 95%CI[−1.29–1.36], $p = 0.096$)——however baseline nonverbal DQ was positively associated with spontaneous vocalisation outcome after placement in the inclusive settings (b = 2.34, 95%CI[0.51–4.17], $p = 0.013$). Further probing of the interaction identified a region of significance (Figure 3) indicating that children with NVDQ < 37.16 had fewer spontaneous vocalisations at outcome in the inclusive settings.

DISCUSSION

We examined the factors associated with differential outcome for children on the autism spectrum receiving an evidence-supported intervention programme in either

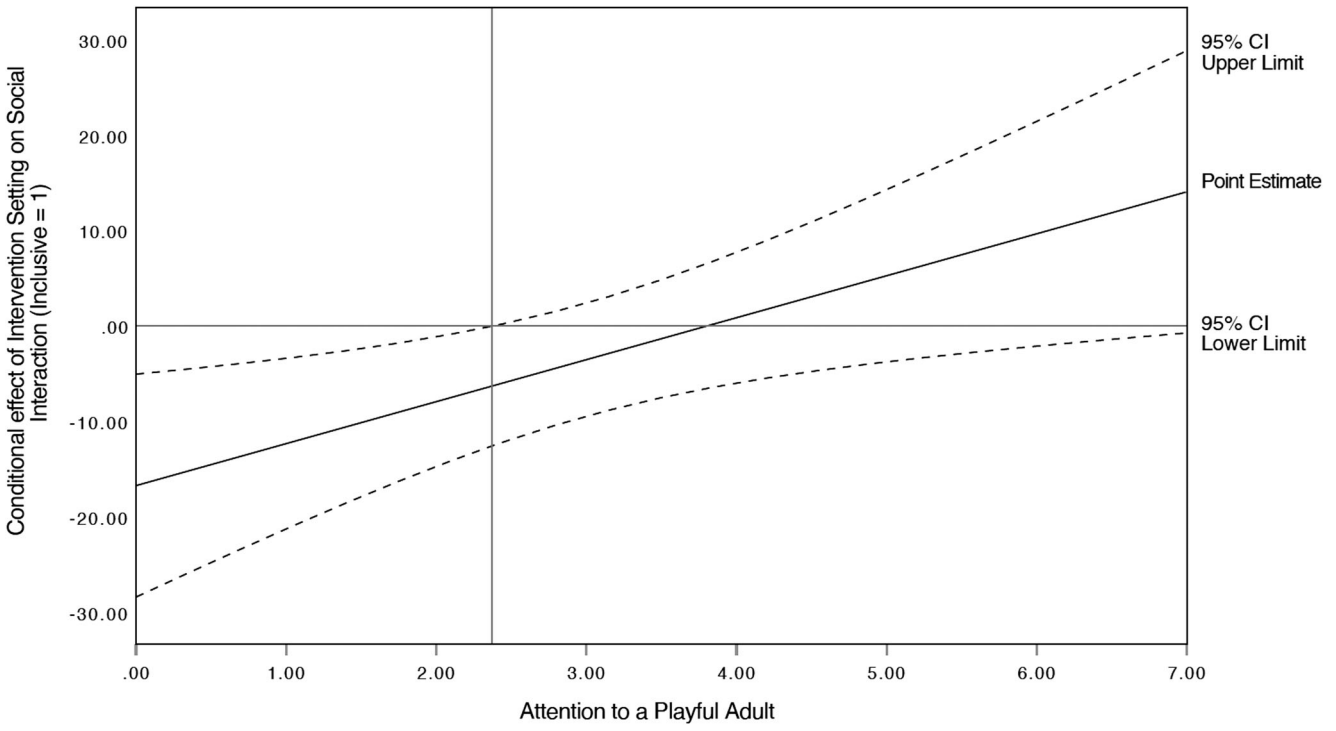

FIGURE 2 Visual representation of the conditional effect of intervention setting (inclusive vs. specialised) on the interaction between attention to a playful adult and social interaction outcomes (M-COSMIC)

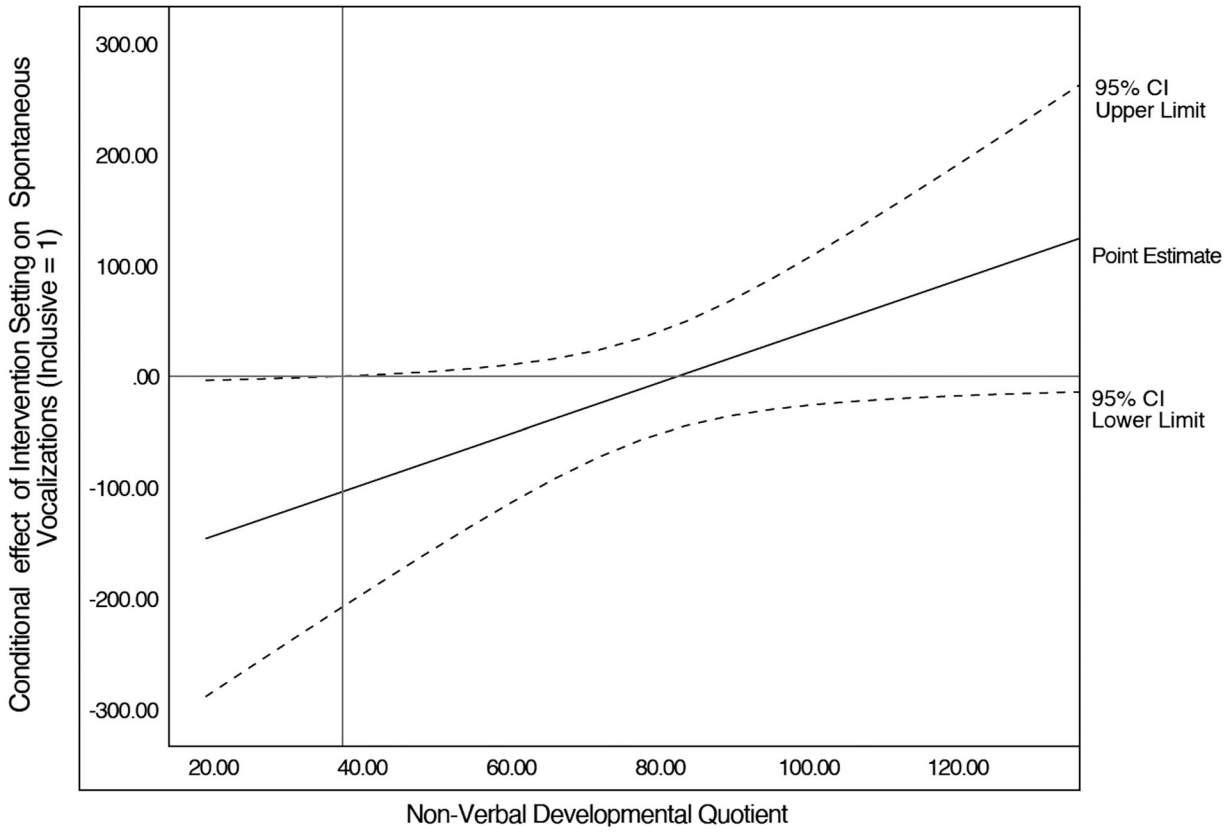

FIGURE 3 Visual representation of the conditional effect of intervention setting (inclusive vs. specialised) on the interaction between nonverbal developmental quotient and spontaneous vocalisation outcomes (LENA)

inclusive or autism-specific classrooms. Our findings lend partial support to the notion that children who have more social initiative towards their peers might benefit more from inclusive educational settings (e.g., Smith, 2011; Wing, 2007). Specifically, we found that children with higher social interest at baseline experienced superior intervention gains than did children with lower social interest, when they had received 1 year of early intervention within an inclusive setting. By contrast, for children who had received the same intervention within specialised settings serving children with autism only, there was no moderating association of baseline social interest on child outcomes.

Specifically, within the inclusive setting, attention to a playful adult, measured via a passive viewing eye-tracking paradigm (Vivanti et al., 2016), was associated with social interaction gains, measured via a proximal measure of child social behaviour in the classroom (i.e., M-COSMIC; Clifford et al. 2010). As illustrated in interaction plots, the impact of baseline social interest on post-intervention outcomes was particularly apparent for individuals with low social interest. That is, individuals with high levels of attention to a playful adult appeared to do equally well in both settings, whilst those with low social interest made smaller gains in inclusive settings relative to their peers with higher social interest. However, this finding should be interpreted with caution given broad confidence intervals and the relatively small sample size. Additionally, for children in the inclusive settings, lower nonverbal DQ at baseline was associated with fewer gains in the frequency of spontaneous vocalisations (measured via the LENA automated system) ——although, again, this finding should also be interpreted with caution given broad confidence intervals. Conversely, there was no evidence of effect of differential social-communication outcomes as a function of initial level of child social interest or nonverbal cognition within the specialised setting. Contrary to our hypothesis, outcomes for children in the inclusive setting were unrelated to preferential social orientation, as measured by an eye-tracking paradigm measuring relative attention to social over nonsocial stimuli.

The pattern of results suggests that social attention (as captured by our preferential social orientation task) is not sufficient to support social learning processes leading to intervention gains in inclusive settings. Rather, the ability to capitalise from the social learning opportunities provided by the inclusive setting might be supported by sustained visual engagement with social–emotional stimuli (presumably captured by our "attention to a playful adult" measure) and domain-general cognitive skills captured by nonverbal cognitive skills (Mullen nonverbal DQ scores).

TABLE 3 Regression analyses examining the moderation effect of intervention setting on the relationship between social interest, nonverbal cognition and outcome measures after 1 year of intervention

	b	SE	t	p	R^2
Model 1. Predicting social interaction					
Constant	7.00	4.96	1.41	0.165	0.331
Attention to playful adult (mean centred)	−1.56	1.26	−1.24	0.222	
Group (Inclusive = 1, Specialised = 0)	−3.60	2.94	−1.22	0.228	
Group * Attention to playful adult	4.40	1.68	2.62	0.012	
T1 social interaction (covariate)	1.32	1.01	1.31	0.198	
T1 nonverbal DQ (covariate)	0.13	0.65	2.04	0.048	
Model 2. Predicting spontaneous vocalisation					
Constant	46.13	37.52	1.23	0.225	0.371
Attention to playful adult (mean centred)	14.06	11.80	1.19	0.239	
Group (Inclusive = 1, Specialised = 0)	25.39	26.43	0.96	0.342	
Group * attention to playful adult	15.09	16.15	0.94	0.355	
T1 spontaneous vocalisation (covariate)	13.82	3.19	4.20	<0.001	
Model 3. Predicting spontaneous vocalisation					
Constant	34.94	35.20	0.99	0.325	0.370
Nonverbal DQ (mean centred)	0.03	0.66	0.05	0.958	
Group (Inclusive = 1, Specialised = 0)	−10.42	22.74	−0.46	0.649	
Group * nonverbal DQ	2.30	1.23	2.04	0.046	
T1 spontaneous vocalisation (covariate)	15.72	3.07	5.12	<0.001	

Importantly, the groups received the same intervention, which was administered by staff who had received the same training and administered the intervention to a similar level of fidelity (as detailed in the original RCT report; Vivanti et al., 2019). Therefore, the differential associations between baseline skills and outcomes reported here are plausibly related to the unique presence of typical peers in the inclusive settings. The availability of peers might engage setting-specific social learning processes, including increased opportunities to learn from "role models" who might be more competent in terms of language, play, and other skills relevant to social-communication development. Our findings support the notion that some social and cognitive prerequisites might facilitate this process – although with some important caveats.

First, unlike our proximal measures of communication (M-COSMIC and LENA), the post-intervention MSEL verbal DQ was not differentially associated with baseline social interest measures in the two groups. This measure was correlated with baseline nonverbal DQ across groups suggesting that initial cognitive skills might support the development of knowledge in the communication domain captured by the MSEL irrespective of educational setting. Importantly however, the M-COSMIC and LENA measures were designed to capture spontaneous use of social communication during interactions in the classroom, possibly reflecting processes that are more closely associated to social interest and more sensitive to differences in patterns of associations across settings.

Another relevant limitation is that no information was available on whether social initiations and responses captured by the M-COSMIC were directed towards peers or adults. A more fine-grained analysis of not only the frequency of social interactions, but to whom those interactions are directed to, would provide important insight on socialisation and learning processes across settings.

Another important caveat is that children in this study were receiving an evidence-supported intervention designed to support learners on the autism spectrum across settings. This is not a typical situation in preschool settings that include children on the autism spectrum, particularly for nonspecialised inclusive classrooms. Therefore, caution is needed when inferring implications on appropriate classroom placement (inclusive or autism-specific) for autistic children in community settings in which evidence-based practises are not implemented. Additionally, the results should be interpreted cautiously given the variability in findings across measures, the relatively small sample size, the broad confidence intervals, and the finding that effects on proximal measures of social communication did not translate to the standardised measure of verbal DQ.

Additionally, the video-stimuli comprised in the "attention to a playful adult" measure involved an adult directing her gaze towards the viewer, raising the possibility that participants' attention to the stimuli reflected sensitivity to eye-contact and awareness of being the object of attention of others. Future research should disentangle how different dimensions of social interest

(attentional responses to social stimuli in general, emotional facial expressions, and direct gaze) and social awareness are related to intervention response across settings.

This is the first study to our knowledge to examine predictors of response to intervention for children on the spectrum educated in inclusive or specialised classrooms, bringing a critical empirical perspective to the broader policy-informing debate. In line with clinical observations from scholars in the field (e.g., Smith, 2011; Wing, 2007), our results support the notion that developmental level and degree of social interest may be relevant factors for families and service providers to consider when making decisions regarding intervention settings. As individuals with high levels of social interest appeared to do equally well across settings, whilst those with low social interest made smaller gains in inclusive settings relative to their peers with higher social interest, children showing lower attentional engagement with social–emotional stimuli might benefit from receiving focused interventions targeting this domain to fully benefit from the opportunities offered in inclusive settings. Several practises designed to facilitate attentional engagement with social–emotional stimuli exist, although additional research is needed to test their effectiveness in this specific domain. Additionally, further research is needed to substantiate our findings and examine their implications across different geographical and cultural contexts, interventions, and populations within the autism spectrum.

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CONFLICTS OF INTEREST

Giacomo Vivanti co-developed the group-based adaptation of the Early Start Denver Model (G-ESDM) and receives royalties from the book "Implementing the Group-Based Early Start Denver Model for Young Children with Autism." Cheryl Dissanayake co-founded the Victorian Autism Specific Early Learning and Care Centre, the clinical provider of G-ESDM in this research. Catherine Bent, Kristelle Hudry, and Giacomo Vivanti have previously received salary from grant funding to conduct research associated with the Victorian Autism Specific Early Learning and Care Centre and thus been affiliated with this clinical provider of G-ESDM. Kristy Capes and Shannon Upson are employed by and receives salary from the Victorian Autism Specific Early Learning and Care Centre, which is a clinical provider of G-ESDM.

DATA AVAILABILITY STATEMENT

The underlying research data are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The study protocol and procedures were approved by the La Trobe University Human Ethics Committee (UHEC 14-082).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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