ORIGINAL PAPER

"He Sees his Autism as a Strength, Not a Deficit Now": A Repeated Cross-Sectional Study Investigating the Impact of Strengths-Based Programs on Autistic Adolescents

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Abstract

Recent studies have reported that strengths-based programs, leveraging autistic adolescents' abilities and interests, could improve their skills and facilitate social engagement. However, little is known about the long-term impact of strengths-based approaches. This study aimed to explore the long-term outcomes of community strengths-based programs designed to support autistic adolescents in developing interests and skills in Science, Technology, Engineering, Arts, and Mathematics (STEAM) and the factors influencing their participation in these programs. A repeated cross-sectional survey study over three years recruited 52 parents in 2018, 52 parents in 2019, and 38 parents in 2020. Results highlighted the positive impact of these programs on autistic adolescents' health and well-being, social relationships and interactions, self-confidence and self-esteem, sense of belonging, and activities and participation. Five key elements influencing participation included the enthusiasm of the participants, their self-perception, the approach of the programs, the learning environment, and the attitudes of the mentors. This study implies that strengths-based approaches to intervention and support for autistic adolescents in a supported environment are a social model solution that could potentially have positive participant outcomes. Findings from this study could provide a framework underpinning future strengths-based interventions.

Keywords Adolescents · Autism spectrum disorder · Employment · Interests · Strengths-based program · Transition to adulthood

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Introduction

Autism Spectrum Disorder (ASD) is a lifelong condition that affects how an individual thinks, feels, interacts with others and experiences their environment (American Psychiatric Association, 2013; Autism Spectrum Australia, 2022). It is a neurodevelopmental disorder characterised by difficulty in social interaction and communication, repetitive behaviours and restricted interests (American Psychiatric Association, 2013; Bölte et al., 2021). Globally, there is a rise in the prevalence and incidence of autism over the past two decades (Australian Bureau of Statistics, 2019; May et al., 2017; Russell et al., 2015). The 2018 Australian Survey of Disability, Ageing and Carers (SDAC) estimated 205,200 Australians had autism, a 25.1% more than the number since 2015, noting a higher prevalence rate among children and younger people aged between 10 and 19 years (Australian Bureau of Statistics, 2019).

Many autistic individuals possess strengths (de Schipper et al., 2016; Kirchner et al., 2016; Meilleur et al., 2015) including enhanced visual-spatial processing, attention, memory and sensory acuity (Baron-Cohen et al., 2009). A predisposition to monotropic tendencies, or the ability to hyper-focus on areas of interest (Murray et al., 2005), underpins the drive of many autistic individuals to build their expertise and knowledge in specific areas (de Schipper et al., 2016). Collectively, these attributes contribute to the high performance of autistic individuals in areas such as technology, mathematics and creative or artistic pursuits (de Schipper et al., 2016).

Despite recognition of these strengths, interventions for autistic individuals have largely targeted impairments, underpinned by the notion of remediating core autistic characteristics will improve functioning (McDonald & Machalicek, 2013). Though autistic individuals may experience difficulties and require support the almost exclusive focus of interventions on remediating impairments may inadvertently devalue and stigmatise autistic individuals (Pellicano & Stears, 2011), leading to negative experiences (den Houting et al. 2021) promoting feelings of disempowerment and poor self-esteem (Urbanowicz et al., 2019). Many autistic individuals seek to 'hide' their autistic traits, owing to fears of negative evaluations from others, (Lawson, 2020) with negative consequences for their self-esteem (van der Cruijsen & Boyer, 2020) and quality of life (van Heijst & Geurts, 2015).

The social model of disability has challenged the deficit-focussed medical model of disability where 'disability' is seen to be the problem of the individuals, focussing on what a person cannot do and be (Finkelstein, 2001; Thomas & Burton, 2018). In the medical model treatments or interventions are mainly to control the impact of disability (Sharma et al., 2012). Conversely, the social model sees 'disability' as resulting from the interaction between a person's physical or mental traits and their environment.(Shakespeare & Watson, 2001), focussing on an individual's abilities and barriers within their social and physical environment (Shakespeare & Watson, 2001; Sharma et al., 2012). In the field of autism research the medical model has underpinned a deficit-focussed approach, failing to recognise and take advantage of the multiple strengths that many autistic individuals possess, likely contributing to their poor education and employment outcomes (Black et al., 2019; Scott et al., 2018). In response to this deficit-focus positive psychology promotes a more holistic view of functioning, focussing on supporting individuals to reach their potential, achieving 'optimal functioning' by building resilience, strengths and positive experiences (Lopez et al., 2018; Seligman & Csikszentmihalyi, 2000). Positive psychology approaches focussing on strength-development have been associated with positive psychological outcomes including well-being and confidence, educational attainment and employment related-outcomes (Linley & Joseph, 2012).

Increasingly contemporary approaches in autism are embracing strengths-based approaches (Huntley et al., 2019; Urbanowicz et al., 2019), fundamentally acknowledging that autistic individuals have many strengths, seeking to harness their interests and abilities in developing their skills (Jones et al., 2021). In neurotypical populations, focussing on strengths has been found to improve self-efficacy, self-esteem, and motivation (Hiemstra & Van Yperen, 2015). Further complimenting this approach, the International Classification of Functioning, Disability and Health (ICF) points to the potential utility of interventions targeting environmental factors and personal strengths (Bölte et al., 2021). Strengths-based approaches that focus on strengths and interests have been used in many areas for autistic individuals such as in teaching literacy skill (Brown & Stanton-Chapman, 2015) and joint attention for autistic children (Kryzak & Jones, 2014; Vismara & Lyons, 2007), in a peer mentoring program for autistic youth and young adults (Thompson et al., 2018), in post-school transition planning for autistic adolescents (Hatfield et al., 2018), in work experience placement (Lee et al., 2019), in physical activities participation for children with ASD (Rinehart et al., 2020) and in technology related programs for autistic teenagers and young adults (Ashburner et al., 2017; Diener et al., 2016; Jones et al., 2018; Lee et al., 2020).

While autistic individuals have varied strengths and interests (de Schipper et al., 2016), technology strengths-based programs are popular and for many align with their interests. Individuals with ASD have high levels of interest in technology-based activities such as playing computer games and creating animations (Anthony et al., 2013; Lin et al., 2013; Valencia et al., 2019). This is likely underpinned by the alignment between the strengths of autistic individuals and technological environments, which are largely predictable and rule-based (Jones et al., 2021; Mazurek et al., 2012).

The Development of Community Strengths-Based Programs

In response to a call from autistic individuals and the autistic community, and to harness the skills and abilities of autistic individuals, Autism Academy for Software Quality Assurance (AASQA) and Spectrum Space (formerly Autism West) deliver community technology focus strengths-based programs to autistic adolescents aged between 10 to 18 years old in Western Australia (WA). Early adolescence begins with puberty from ages 10 to 14 and late adolescence from 15 to 19 years of age (Edwards, 2014). In the Australian context, the population prevalence of autism in the population aged 10 to 19 years is estimated to be 3% (Australian Bureau of Statistics, 2019).

The aim of AASQA and Spectrum Space is to develop the interests of autistic adolescents in STEAM. These programs engage autistic adolescents in STEAM-based shared interests, while facilitating social interaction and motivation (Jones et al., 2021; Lee et al., 2020). AASQA has delivered computer coding and mathematic enrichment programs through its outreach program to primary and high school autistic students aged between 10 to 18 years since 2016. Spectrum Space delivers special interest programs focussing on STEAM activities through two social groups, the Awesome Social Group for autistic young adolescents (with participants aged 10 to 15 years, since 2014) and the Yes Social Group (for autistic adolescents aged 13–18 years, since 2013).

A previous study exploring the first wave of a 3-year study evaluating the impact of these strengths-based programs for autistic adolescents found that the strengths-based programs provided a safe environment for autistic adolescents to develop their technological and social communication skills, fostering social relationships, confidence, self-esteem and well-being (Lee et al., 2020). While there is emerging evidence supporting the use of strengths-based approaches for autistic individuals (Ashburner et al., 2017; Dunn et al., 2015; Wainer et al., 2010; Wright et al., 2011) more research is needed to inform evidence-based practices and to understand particularly the long term impact of these approaches (Dunn et al., 2015). This paper, therefore, focusses on the long-term outcomes of these strengths-based programs, investigating the changes and impact of these strengths-based programs on autistic adolescents' health and well-being, social relationships and interactions, confidence and self-esteem, sense of belonging and activities and participation over three years. Factors that influence adolescents' participation were also explored.

Method

Research Design

This research adopted a repeated cross-sectional design (Steel, 2008) across three years investigating the impact and changes in outcomes of autistic adolescents participating in strengths-based programs. In a repeated cross-sectional design, valid inferences of change can be made despite no overlap in the samples across data collection periods (Beidas et al., 2019). Using a mixed-method approach (Creswell & Plano Clark, 2007), an online Qualtrics survey with closed and open-ended questions was conducted over three consecutive years (2018, 2019, 2020). The details of the baseline results have been previously reported (Lee et al.,

2020). Ethical approval for this study was granted by the Curtin University Human Research Ethics Committee in WA [HRE2017-0147].

The Strengths-Based Program

Both AASQA and Spectrum Space delivered a range of strengths-based computer coding and STEAM extra-curricular programs to autistic adolescents aged between 10 to 18 years, including coding, Lego Robotics, Arduino, Nao Robotics, mathematics, visual arts, music, and digital media, in a supportive and emotionally safe group environment (Jones et al., 2018; Lee et al., 2020). Sessions run for 2 to 3 h weekly on Saturdays during the Australian school year, which is broken into four teams of approximately 10 weeks each. In line with their interests, autistic adolescents choose to learn skills such as computer programming languages (including Scratch, Java, Python, HTML, C, and JavaScript). Adopting a participant-led approach the delivery of these programs is supported by mentors who encourage peer-to-peer learning, leverage participants' shared interests, and foster logical thinking and problem-solving skills (Lee et al., 2020). Mentors include technical (volunteer computer sciences, mechatronics, and mechanical engineering university undergraduates) and autism specialists (including occupational therapy undergraduates) who focus on promoting social communication and emotion regulation (Lee et al., 2020). At the end of each term participants have an opportunity to showcase their work to their parents and mentors. There was no limit on the number of terms autistic adolescents could enrol.

Participants and Recruitment

Parents of autistic adolescents who had participated in a strengths-based program at AASQA or Spectrum Space for more than one term were invited to complete a survey via email. In 2018, 52 parents (representing 53 autistic students), in 2019 52 parents (representing 54 autistic students), and in 2020 38 parents (representing 40 autistic students) provided informed consent and completed the survey (Fig. 1). The mean age of parents for three consecutive years was 46.7 years (SD = 6.6), 48.0 (SD = 5.9), and 47.2 (SD = 8.7), respectively, while the mean age of adolescents was 14.1 (SD = 2.3), 14.7 (SD = 2.6), and 14.9 (SD = 3.1), respectively. As shown in Table 1, most of the children were male and received an ASD diagnosis on average at 8 years of age. The average Autism Spectrum Quotient (AQ) score was 34.8 (SD = 5.7) in 2018, 33.4 (SD = 7.3) in 2019, and 34.0 (SD = 7.8) in 2020. An AQ score of 32 or above indicates on average a strong likelihood of Asperger syndrome or autism (Baron-Cohen et al., 2006).

Fig. 1 Student composition in each year's survey
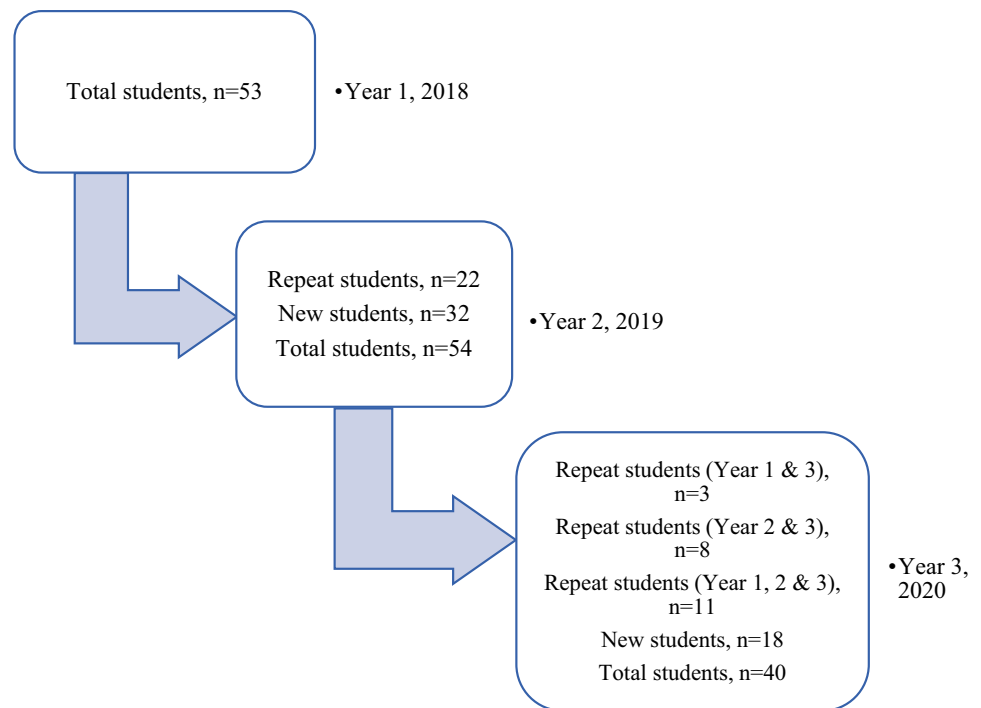
Table 1 Demographic and clinical information of autistic adolescents and their reporting parents participating in strengths-based programs across the three study years, 2018, 2019 and 2020

	2018 (valid %)	2019 (valid %)	2020 (valid %)
Number of students	53	54	40
Repeat students	–	22 (41%)	11[a] (28%) 11[b] (28%)
New students		32 (59%)	18 (44%)
Gender*			
Male	39 (87%)	36 (82%)	32 (89%)
Female	6 (13%)	8 (18%)	4 (11%)
Mean age (SD)	14.1 (2.3)	14.7 (2.6)	14.9 (3.1)
Mean age of diagnosis (SD)	8.1 (3.3)	8.6 (4.0)	7.6 (3.6)
Mean AQ score (SD)	34.8 (5.7)	33.4 (7.3)	34.0 (7.8)
Parent age mean (SD)	46.7 (6.6)	48.0 (5.9)	47.2 (8.7)

[a]Participated twice in 2020 and in the Year 2018 or Year 2019

[b]Participated in 2018, 2019 & 2020

*Only binary options (male/female) were included in this study

In 2019, approximately 40% (n=22) were repeat participants while around 60% (n=32) were new participants. In 2020, nearly 56% (n=22) were repeat participants who also participated in 2018 or 2019 or both years, while 44% were new participants.

Instruments

Online Survey

A link to an online survey administered via Qualtrics, taking approximately 40 min to complete, was sent to all parents whose children were attending the AASQA and Spectrum Space strengths-based programs in 2018, 2019 and 2020.

This survey obtained demographic and clinical information (parent/child age, gender, age of diagnosis, and diagnosis) and autistic traits as measured by the AQ Adolescent Version (parent proxy report), a 50-item measure (Baron-Cohen et al., 2006).

A series of questions measured program outcomes in the five domains of health and well-being; social relationships and interactions; confidence and self-esteem; sense of belonging; and activities and participation (Appendix

Table 2 Outcomes for health and well-being, social relationships and interactions, confidence and self-esteem, and sense of belonging of autistic adolescents attending strength-based programs as reported by their parents

Outcome	Year	Mean (CI)	p-value for year overall	Pairwise p-values	
				Year 2	Year 3
Health & well-being	1	7.55 (6.91–8.20)	0.286	0.895	0.196
	2	7.50 (6.89–8.12)			0.135
	3	8.13 (7.42–8.84)			
Social relationships/interactions	1	7.01 (6.41–7.62)	0.305	0.614	0.134
	2	7.16 (6.58–7.74)			0.241
	3	7.53 (6.88–8.18)			
Confidence and self-esteem	1	7.60 (6.99–8.21)	0.039*	0.061	0.603
	2	7.02 (6.43–7.60)			0.021*
	3	7.80 (7.14–8.44)			
Sense of belonging	1	8.38 (7.70–9.06)	0.160	0.060	0.465
	2	7.64 (7.01–8.27)			0.307
	3	8.06 (7.33–8.78)			

*p-value < 0.05

A). Parents' perception of the impact of participating in the strengths-based program for their children for the first four domains was elicited via a single question measured on a 10-point semantic differential scale with 1 being 'not at all' and 10 being 'a great deal'.

The fifth domain, activities and participation, was measured with 18 items drawn from the ICF core sets for ASD (Bölte et al., 2019). These items spanned four components, including communication (1 item), interpersonal interactions and relationships (13 items), major life areas (2 items), and community, social and civic life (2 items), measured on a five-point Likert scale (1 being 'strongly agree' and 5 being 'strongly disagree').

Additionally, open-ended questions sought parents' perceptions of the impact of the strengths-based program on their children (Appendix A). Sample questions are: "Please provide some details of how the strength-based program has affected your child's health and well-being" and "Please provide some details as to why your child feels they belong at the program?"

Data Analysis

Quantitative data

All analyses were conducted at the item level, that is, those with missing data were excluded from specific analyses for these items but retained in the data set. One-way analysis of variance (ANOVA), linear mixed model (LMM), and generalized estimating equations (GEE) were used to analyse data. LMM was used to analyse the domains of health and well-being; social relationships and interactions; confidence and self-esteem; and sense of belonging, while LMM with binary logistic was used to analyse the components of activities and participation. For each respondent, the mean score for each component of the activities and participation domain was calculated and recorded as '1' for a score less than 2.5 and '0' for a score greater than or equal to 2.5, setting year as fix factor and Year 1 (2018 data) as reference.

Qualitative data

Parents' responses to open-ended questions were analysed using directed content analysis, a deductive approach informed by an existing framework (Hsieh & Shannon, 2005). Factors parents perceived as influencing their child's participation in the strengths-based programs were grouped according to the ICF domains of body functions and structures, activities, environmental factors, and personal factors (World Health Organisation, 2007). Personal factors, such as gender, age, personality traits, beliefs and attitudes are not included in the ICF (Grotkamp et al., 2012). However, it was anticipated that personal factors would significantly influence participation in strengths-based programs. For this reason, person factors as proposed by Grotkamp et al. (2012) were used, supplementing the ICF domains of personal factors in this study. Concepts were initially extracted for coding (completed by EALL and reviewed and discussed with ED) and merged based on similarity (Lincoln & Guba, 1985).

Results

One-way ANOVA revealed no significant differences with regard to age of students in Years 1, 2 and 3 F(2, 116) = 1.041, p = .0356), similarly for the diagnosis age F(2, 107) = 0.566, p = .0570), AQ score F(2, 122) = 0.427, p =

Table 3 Proportions for "agree" and "strongly agree" of the strengths-based programs positive impact on the components of activities and participation as defined by the International Classification of Functioning, Disability and Health core sets for ASD[1]

	Year 1 (2018)	Year 2 (2019)	Year 3 (2020)	Total* (%)
Communication	63	65	68	65
Interpersonal interactions and relationships	62	52	69	60
Major life areas	51	34	51	45
Community, social and civic life	31	27	49	34

[1]Bölte et al. (2019)

*Average percentage of "agree'" and "strongly agree" for three years

0.653 and parents' age $F_{(2, 118)} = 0.406$, $p = .667$) inferring homogeneity in the samples across years.

Results from LMM (Table 2) indicated no differences in health and well-being, social relationships and interactions, and sense of belonging across the three years, while confidence and self-esteem demonstrated a significant difference at the $p < 0.05$ level between Year 2 and Year 3 [$p = 0.021$, d = 0.36 (small effect) (Cohen, 1988)]. In general, the mean scores were close to '8' at each of the three-time points for health and well-being, confidence and self-esteem, and sense of belonging, while for social relationships and interactions the mean score was close to '7'. Overall, these scores are close to the maximum of '10', indicating positive outcomes of attending the strengths-based programs.

Nearly two-thirds of the parents "agreed" and "strongly agreed" that their child had improved in the ICF chapters relating to communication and interpersonal interactions and relationships as a result of attending the strengths-based programs (Table 3). Further analysis with GEE (Table 4) revealed no differences across years in all components of activities and participation except community, social and civic life where a difference was found between Year 1 and Year 3. Though no difference was found in the overall p-value major life area, a difference was found between Year 1 and Year 2.

For community, social and civic life, the overall p-value < 0.05 indicated a significant difference in improved agreement. Results show a significant difference between Year 1 and Year 3 ($p = 0.035$), implying participants in Year 3 were more than twice as likely (odds ratio = 2.198) to agree that there was an improvement in community, social and civic life than participants in Year 1 as a result of attending the strengths-based programs.

For major life areas, the overall p-value was not significant ($p > 0.05$). However, the p-value was significant for Year 2 ($p = 0.029$), implying participants in Year 2 were

Table 4 GEE outcomes for the components of activities and participation

Outcome	Year	Odds ratio [Exp (B)]	95% Confidence Interval	p-value
Communication				0.941
	1	1 (reference)		
	2	1.110	0.531–2.324	0.781
	3	1.141	0.509–2.557	0.748
Interpersonal Interactions & relationships				0.230
	1	1 (reference)		
	2	0.693	0.346–1.388	0.300
	3	1.361	0.585–3.164	0.475
Major life areas				0.071
	1	1 (reference)		
	2	0.474	0.242–0.928	0.029*
	3	0.859	0.370–1.997	0.724
Community, social and civic life				0.009*
	1	1 (reference)		
	2	0.671	0.302–1.492	0.328
	3	2.198	1.055–4.577	0.035*

*p-value < 0.05

nearly 50% less likely (odds ratio = 0.474) to agree that there was an improvement in major life areas than participants in Year 1. However, there was no significant difference between Year 1 and Year 3 ($p = 0.724$).

Factors Influencing Participation

Parents' responses to the open-ended questions provided insight into those factors acting as facilitators or barriers to autistic students' participation in the strengths-based programs. Responses were coded in reference to the ICF concepts of body functions and structures, activities and participation, contextual (personal and environmental) factors as illustrated by sample quotes in Table 5. Pseudonyms were used in all sample quotes.

Discussion

The present study is a repeated cross-sectional study over three years investigating the impact and changes in outcomes of autistic adolescents participating in strengths-based programs. Overall, findings indicated that parents perceived these programs positively impacted their children's health and well-being, social relationships and interactions, confidence and self-esteem and sense of belonging. Parents consistently reported their child's improvements in their communication and interpersonal interactions, their relationships and participation in activities (World Health Organisation, 2007). These findings align with previous research that community strengths-based programs had a positive impact on autistic adolescents' health and well-being (Ohrberg, 2013), confidence (Ashburner et al., 2017; Wainer et al., 2010; Wright et al., 2018; Wright et al., 2011), and social skills including starting and sustaining a conversation with group members and other people (Ashburner et al., 2017; Diener et al., 2016; Lee et al., 2020; Wright et al., 2011). The safe environment not only allowed the autistic adolescents to learn and harness skills of interest, but also gave them a sense of belonging where they felt accepted by their peers and mentors who shared similar interests (Jones et al., 2018; Lee et al., 2020). This could possibly explain why the parents agreed there was an improvement in the community, social and civil life of the participating autistic adolescents as they looked forward to attending the coding club or social group each week. Through these community strengths-based programs, autistic adolescents could interact and socialise with like-minded people which may help reduce social isolation. This is important as limited social relations contribute to higher anxiety in school-aged autistic children (Eussen et al., 2013; Mazurek et al., 2012). In general, the consistently positive results over the three-time

points provide convincing evidence that programs focussing on the strengths of autistic adolescents and their shared interests are beneficial.

Parents perceived that their children's participation in the strengths-based programs was influenced by factors associated with all domains of the ICF, highlighting the role of factors both internal and external in influencing participation. Person related factors included participants' enthusiasm towards the programs and self-perception (Grotkamp et al., 2012). Consistent with the findings of Donahoo and Steele (2013) external factors impacting adolescents' participation included the approach of the program, the learning environment and the attitudes of the mentors. These findings align with contemporary perspectives of functioning in autism highlighting the powerful role of environmental factors in promoting functional outcomes (Bölte et al., 2021).

Overall, parents highlighted their children's enthusiasm and motivation to attend the strengths-based programs, noting their excitement and the lack of prompting necessary in getting them ready to attend. Parents reported their children were more motivated to engage in the strengths-based program than any other program they had attended, with some parents noting that these programs were a valued aspect of their child's routine and the only out of school activity their child attended. Parents attributed their children's drive and enthusiasm for the programs to the activities, shared friendships, and the sense of enjoyment they felt at belonging to a peer group of autistic adolescents (Ashburner et al., 2017). Parents noted the knowledge and skills their children gained as a result of attending the programs, highlighting the alignment between the available activities and their children's interests, strengths, and future career aspirations (Donahoo & Steele, 2013). Parents consistently contrasted their child's positive experience of the strengths-based program with their experience of school. Many autistic adolescents have a negative experience of school, with consequences not only for their academic achievement, but their future education and career choices (Autism Spectrum Australia (Aspect), 2013; Keen et al., 2016). It has been suggested that programs which focus on building the strengths of autistic children in the pre-teenage years could help to smooth the transition to high school (Keen et al., 2016).

Within the strengths-based programs social engagement evolved naturally from the context (Diener et al., 2016; Lee et al., 2020; Muller et al., 2008), with parents noting that many friendships extended beyond the programs. Forming and maintaining friendships is a crucial aspect of adolescence (Poulin & Chan, 2010). Participating in community activities which tap interests and build skills positively impact the health and well-being (Putnam, 2000) and quality of life (Tobin et al., 2014) of autistic adolescents. Building new friendships is frequently an important goal for autistic adolescents, but a goal they struggle to achieve (Afsharnejad

Table 5 Body functions and structures, activities and participation, and contextual factors influencing participation

ICF domain[1]	Key Points	Sample quotes
Body functions and structures		
Enthusiasm and enjoyment	Participants enjoyed and were passionate about the programs.	He is very happy to attend each week… he looks forward to Saturday's… he has little to no anxiety in attending. (2018) [Robert] did not ever want to go anywhere. This was the first activity that he wanted to go to. He would be looking at his watch, waiting to go. (2020)
Motivation	The programs focussed and motivated participants towards their life goals.	[The club] motivated him and created a focus and purpose for him to participate. (2019) He loves coding, he would like to pursue a career in programming/game development so this is the perfect pathway for him to achieve that goal. (2018)
Mental well-being	Mental well-being can hinder participation.	As he gets older, currently he is in Year 11 at school, his social anxiety has increased making it difficult for him to interact with others. (2019)
Sensory functions	Participants' sensory hypersensitivity may limit their ability to engage with and interact with others.	[Kim's] social skills have decreased as she has struggled with appropriate conversation and behaviour. I think it is high anxiety from boys running around-causing sensory overload. (2018)
Activities and participation		
Gaining new knowledge/learning new skills	Participants developed a wide range of skills aligned with their interests potentially enabling future employment.	[The club] my son attends has allowed him to develop more skills in his areas of special interest while spending quality time with new friends. (2018) He has been able to develop and learn skills that will assist him greatly in future opportunities with employment, considering the world is moving to technology-based skill sets. (2020)
Social interaction	The programs facilitated social interaction, participation and feelings of inclusion, increasing participants' confidence in interacting with mentors and peers.	[The club] gives him opportunities for modelling appropriate social interaction, it helps with behaviour modification, and gives him a feeling of inclusion with peers. (2019) He is excited to attend each Saturday. He has made friends and interacts with mentors and peers … He never wants to miss a class and always feels totally comfortable in the classes. (2020)
Communication	Participants could communicate with others without judgement.	[Lina] is very closely bonded with [the club]. She knows all the people there, delights in seeing the girls who do the art and crafts and willing engages in conversations. (2018) He is better at participating in two-way conversations and listening to other people's viewpoints. The program has helped him understand tolerance and patience and that other people's priorities are different to what his priorities are and learning to accept that. He will initiate conversations and be interested in other peoples' lives. (2019)

Table 5 (continued)

ICF domain[1]	Key Points	Sample quotes
New friendships	New friendships developed and extended beyond the program.	She learnt that there are others just like her, she was able to make friends with people who cared about her, she learnt something of her strengths and attend outings she wouldn't have had the chance to. She also made a best friend who she sees regularly. (2020)
		He has made a lot of progress with making and keeping friendships with other children in this program and was invited to his first ever birthday party! (2018)
Recreation and leisure activities	Participants were motivated to leave the house and engage in community and leisure activities.	[Jasmine] also attends Spectrum Space [social group] on the holidays, so this is just an extension of the term and keeps her connected. (2018)
		The club encourages him to get out of the house and be actively learning instead of watching you tube videos and playing on his phone or Xbox thereby affecting his health in a positive way. (2018)
Employment opportunities	The program facilitated participants' employment opportunities.	He went on to have three lots of work experience, where the people were very impressed with his performance. This helped him to secure an internship for 3 months. After completing his internship, he was offered a job at the company, which he decided to pursue part-time while he completed his degree (and he hasn't even passed his first-year units yet!) (2020)
Personal factors[2]		
Empowerment	Participants were empowered to take more control of their direction in life and more motivated to connect with others.	His exposure to a university environment through the club has excited him… As a direct result of him attending the club he now knows what he wants to be when he grows up and is already independently trying to work towards this goal. He is doing things at home on the computer that he has never done before. (2018)
		He is confident to talk to people about what he can do and has been invited to speak at public events about his life, his achievements and improvements that can be made in schools to support people on the autism spectrum. (2020)
Openness to new experiences	Participants were exposed to new experiences and training opportunities.	Work placements in [technical support and banking] exposed him to real life society, preparing him for work in different environments. (2019)
		Completing the [International Software Testing Qualifications Board] ISTQB and receiving his award made him realise that he CAN do great things while being himself, and that he doesn't need to be like other people, because he is great on his own. This helped him gain entry to university, where he is now thriving and participating in university social clubs. (2019)
		[Alex's] confidence has soared after participating in all the work experience and internship opportunities that have been available to him through AASQA. Also, his mental health has improved as it has given him purpose and makes him happy as he feels like he is contributing to something. (2020)

Table 5 (continued)

ICF domain[1]	Key Points	Sample quotes
Helping others	Participants shared their knowledge and skills with others facilitating social interaction and engagement.	Now that he is older, he feels that he can help with the younger and newer members of the group. (2019) He started sharing information about coding with other kids (2019). He interacts with participants and helps them. (2018)
Self-esteem	Participants felt a sense of personal worth and pride at being recognised for their strengths and knowledge.	He was able to share his skills and knowledge with other participants and mentors (2018) He already thinks he is very intelligent, but I think being with people that acknowledge his strengths, boosts his self-esteem. (2019) He feels part of a team, and this helps his confidence and self-esteem (2020)
Self-confidence	Meeting other autistic adolescents promoted participants' self-confidence.	[Matthew] is more confident and he feels he is in a good place at [the club]. He is relaxed when he is there and looks forward to coming along each week. I think the confidence has been huge for [Matthew]. We are so pleased to see this. (2018) It has made him aware that there are other people with autism which has increased his self-confidence. (2018)
Maturing and age	Activities need to be age- and interest-appropriate.	[My son] outgrew the activities and participants. He has now moved onto other things. (2020) Activities may need some tweaking at [the club] to ensure they are age appropriate. My son rapidly lost interest as he "grew-up" at about the age of 17, and he did not enjoy the less mature members of the group-perhaps groups could be structured to be interest-based rather than aged based? (2019)
Belonging	Participants felt a sense of acceptance and belonging.	[Steven] told me when he started attending [the club], that for the first time in his life he feels he belongs. (2020) He fits and can talk about what he enjoys with people who understand what he is talking about and can have a knowledgeable conversation about his favourite topics. (2018) It has broadened her scope of people to connect with, giving her a sense of belonging and a place where she fits in … this restores her depleted sense of self from struggling with a public school system each week and the constant feeling of failure. (2019)
Personality	Personal clashes can hinder participation.	Social struggles with some personality clashes with other attendees. (2018) Due to the personality clashes he is only able to attend every second week as he rotates with the child who he has trouble with. This unfortunately caused him to feel left out. (2018)
Being oneself	Participants can just be 'themselves' without the need to impress others.	He knows that he is accepted and understood … even when a leader has had to put boundaries on his behaviour or correct him. He does not feel any need to 'perform' or 'impress'. (2018) He feels he is known and appreciated for being himself. (2019)

Table 5 (continued)

ICF domain[1]	Key Points	Sample quotes
Change of mindset/paradigm shift	The program added meaning to the participants' lives, changing their perspective.	[Michael] sees his autism as a strength not a deficit now. He feels less alone now that he is able to have mates with similar interests to himself. (2019) [At the strength-based program he was] viewed as a person with strengths not as someone with issues that need fixing. (2020)
Environmental factors		
Friendly and inclusive	Participants enjoyed the less formal, inclusive and non-judgemental environment.	The environment is casual and friendly, [Kevin] looks forward to coming. He looks forward to learning new things. He is beginning to feel confident enough to share what he has learnt with the group, he has not been comfortable in the past to do this. (2018) Being all-inclusive and non-judgemental is a big one and she identifies with others quirky ways in more positive light. (2020) Yes, there is an understanding and respect for each other as they share the same interest, but have different levels of talent and development, so they are happy to learn from one another. (2020)
Safe and supportive	The environment was described as a 'safe haven' for the participants.	He was willing to separate from family and go out. [The club] gave him an opportunity to learn how to communicate effectively in a safe environment. (2020) The program is like a small community that supports and encourages her differences and identifies her talents. This program gives her hope where the school system lets her down. (2019)
Strengths and needs focussed	Participants appreciated that the environment focussed on their strengths and needs.	The incredible mentors, [the program co-ordinators] have created a space that is focussed on her strengths so there is already the interest and when encouraged and understood it starts to become a purpose. (2019) He wants to attend every week. The group is tailored to his needs and likes. (2018) He feels like he is accepted and appreciated for his unique talents and abilities. The focus is NOT on his diagnosis of Autism, SPD [Sensory Processing Disorders] and Tourette Syndrome, but instead on his passion for IT, coding, robotics and other multi-media which he is very good at. (2018)
Gender imbalance	An environment dominated by boys was a barrier to girls' participation.	It was hard as she was only one of two girls so that did make it hard for her to belong at times, but the girls became very close, but when her friend left, she wasn't able to continue being the only girl. (2020)
Attitude of mentors	Supportive mentors enhanced and motivated participation.	Mentors are always happy to listen to him and take an interest in him. (2020) He knows there are other people like him who appreciate the things he is into and will listen to him. He comments that [a mentor] will really appreciate something he has found or done and that he is looking forward to showing it to them. He seems really happy and confident when he talks about this. (2018)

Table 5 (continued)

ICF domain[1]	Key Points	Sample quotes
Likeminded people	The program delivered opportunities for mixing and interacting.	He looks forward to Saturdays as he can work on his favourite hobby and passion in computers and technology and is surrounded by like-minded peers and mentors. (2018) The group has helped [Jack] to feel connected to a group and he has found some likeminded peers who have become friends. (2019)
Change in program leadership and format	Change in leadership and format could hinder participation.	He found it difficult to adjust to changes in leadership and format. He mentioned that the people that he 'communicates with' have left the group. (2019) It was such a shame that the structure changed so much after [Michelle] left. [Rob] refused to attend after that. (2020)

[1]World Health Organisation (2007)
[2]Supplemented by personal factors proposed by Grotkamp et al. (2012)

et al., 2019; Diener et al., 2016). These strengths-based programs appeared to buffer adolescents' feelings of social isolation and exclusion (Autism Spectrum Australia (Aspect), 2013; Whitehouse et al., 2009).

Parents of autistic adolescents participating in the strengths-based programs reported that their child's attendance positively impacted their perceptions of themselves and their autism, helping them to embrace their autism as a strength rather than a deficit. This is in line with the neurodiversity paradigm that views autism as a neurological diversity rather than a disorders and understands and values the strengths, capabilities and competencies of autistic individuals (Donaldson et al., 2017). This shift in mindset and disposition likely had benefits for adolescents' mental health and confidence (Naseem & Khalid, 2010), empowering them in achieving their future goals (Lyubomirsky et al., 2005; Pajares & Schunk, 2002). Comments from parents indicated that the strengths-based programs fostered adolescents understanding of their strengths and confidence in their abilities, encouraging them in planning for future education and career pathways. Further, recognition of their knowledge, strengths and skills from mentors and peers boosted their confidence, self-esteem, and sense of belonging. Parents perceived their adolescents as valuing the programs because they were able to be 'themselves', without needing to pretend, perform and impress others.

The approach of the program also appeared to positively impact adolescents' participation. The strengths-based programs adopted a holistic and pragmatic approach to build the employability skills of the participants, leveraging their special interests in groups such as coding and robotics, training and education, and work-integrated learning and internships. The goal of these programs was to build participants skills, specifically their technological skills, with the long-term goal of creating employment opportunities. The program was underpinned by the tenets of the positive youth development paradigm, viewing the participants as having unique skillsets and abilities that offered opportunities for development (Benson et al., 2006; Jones et al., 2021). In addition to learning computer coding and programming, the program enabled opportunities for participants to obtain professional certification in software testing (ISTQB—International Software Testing Qualifications Board) and participate in software testing hackathons and work placements. A short-term work placement program was also offered to the participating adolescents (Lee et al., 2019) with older participants offered the opportunity to participate in an internship program.

Consistent with the previous studies of Donahoo and Steele (2013) and Jones et al. 2018), the success of the programs appeared to be strongly linked with the learning environment, which delivered a space where participants were at ease in talking about their passions and interests without

judgements with their autistic peers, volunteers, and mentors (Lee et al., 2020). Participants appreciated that the environment was tailored to their needs, including the provision of a quiet room for participants with sensory hypersensitivity to engage in activities of interest. This environmental adaptation supported participants in self-managing their sensory needs, mitigating their need to withdraw from the program due to sensory overload (Hahn, 2012; Piller & Pfeiffer, 2016).

In line with previous research the personal and professional attributes of mentors emerged as important (Ashburner et al., 2017; Diener et al., 2016; Donahoo & Steele, 2013; Jones et al., 2018). The participants valued the mentors for their guidance, support, and encouragement, and engendering an environment of respect and care, free from discrimination. The shared interests between the mentors and participants further enabled autistic adolescents' social engagement.

While parents were consistent in their endorsement of the positive outcomes fostered by the strengths-based programs several noted in the open-ended comments that their child at times felt 'out of place', 'clashed' with other participants or were socially anxious as a result of engaging with a group. Additional barriers highlighted included the noise of the group environment which was mitigated by the availability of 'quiet rooms' and the option for break out one-to-one sessions. These findings highlight the importance of considering environmental facilitators and barriers in delivering programs to autistic adolescents (Bölte et al., 2019). Parents of autistic girls also noted that the gender-imbalance within the groups posed a barrier. Changes to program routines or structure caused some participants to withdraw from the program, a finding aligned with previous research highlighting that disruptions to a routine or structure can lead to stress and confusion for autistic individuals (American Psychiatric Association, 2013; Vanbergeijk et al., 2008). In future similar programs should consider strategies to support participants in navigating these changes.

Limitation and Future Direction

While this study is unique in that it examines the impact of strengths-based programs on autistic adolescents over approximately three years, the findings should be interpreted in the context of several limitations. It is likely that the impact of the COVID-19 pandemic in Australia underpinned the lower response rate from parents in 2020. Further, due to the small number of repeat participants with less than half of the participants completing two waves of the study, and less than a third of participants completing all three waves, it was not ideal to use within-subjects design to assess changes within the same participants over time. However, changes over time were examined between year

groups providing evidence on the outcomes of participating in strengths-based programs. While a randomised controlled trial design enables insights into the true efficacy of these programs, there were issues of feasibility and acceptability of this design given the programs were established by the community in response to their apparent benefits to autistic teenagers (Goodkind et al., 2017; Lam et al., 1994). Future studies could consider employing a wait-list control design or a pre-test post-test approach to further evaluate the impact of these programs on participant outcomes. Further, evaluating the impact of the strengths-based programs on the constructs of activities and participation was limited by the absence of measures with established psychometric properties (Lee et al., 2020). This study, therefore, drew from the ICF core sets for ASD to ensure that the impact of the program was explored in areas commonly identified by international experts in this field (Bölte et al., 2019). With consideration to the length of the survey, single-item questions were used to measure the domains of health and well-being, social relationships and interactions, confidence and self-esteem, and sense of belonging (Lee et al., 2020). However, parents could expand their perceptions for each of these domains by open-ended questions (Lee et al., 2020).

Conclusion

The impact of the strengths-based programs on autistic adolescents was largely consistent over the three-time points with parents reporting a positive impact on their children's health and well-being, social interactions and relationships, confidence and self-esteem, sense of belonging, and activities and participation. Five key elements from internal and external factors including participants' enthusiasm towards the programs; participants' self-perception; the approach of the program; the learning environment; and the attitudes of the mentors appeared to underpin successful participation in these programs. While further research is needed it is likely that future programs, leveraging the strengths and interests of autistic adolescents and considering these key elements, will foster positive outcomes into adulthood. This study implies that strengths-based approaches to intervention and support for autistic adolescents in a supported environment are a social model solution that could potentially have positive participant outcomes. Findings from this study could provide a framework underpinning future strengths-based interventions.

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Declarations

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