HOW CAN EDUCATION BETTER SUPPORT THE MENTAL HEALTH & WELLBEING OF YOUNG PEOPLE? CONTRIBUTIONS FROM DEVELOPMENTAL PSYCHOPATHOLOGY & EDUCATIONAL EFFECTIVENESS RESEARCH

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PUBLISHED IN: Frontiers in Education, Frontiers in Psychology and Frontiers in Psychiatry

frontiers Research Topics

frontiers

ISSN 1664-8714
ISBN 978-2-88963-146-9
DOI 10.3389/978-2-88963-146-9

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HOW CAN EDUCATION BETTER SUPPORT THE MENTAL HEALTH & WELLBEING OF YOUNG PEOPLE? CONTRIBUTIONS FROM DEVELOPMENTAL PSYCHOPATHOLOGY & EDUCATIONAL EFFECTIVENESS RESEARCH

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How can education better support the mental health & wellbeing of young people? Research in the 1970s that addressed this question has since proven seminal to the development of two co-existing fields of research that continue to offer mutually informative insights: Developmental Psychopathology (DP) and Educational Effectiveness Research (EER). DP and EER share the common agenda of understanding factors that relate to individuals' learning and development: DP focuses on the individual learning and developing in context, EER investigates the educational systems, structures, and processes that shape how individuals learn and develop.

Given the complementarity of DP and EER, it is somewhat surprising that they have rarely joined forces and synthesised knowledge to develop a fuller understanding of the roles educational contexts play in the mental health and wellbeing of students. This Research Topic aims to stimulate such collaboration.

Citation: Hall, J. E., Kreppner, J. M., eds. (2019). How Can Education Better Support the Mental Health & Wellbeing of Young People? Contributions From Developmental Psychopathology & Educational Effectiveness Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-146-9

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frontiers in Education

EDITORIAL
published: 29 August 2019
doi: 10.3389/feduc.2019.00093

Editorial: How Can Education Better Support the Mental Health and Wellbeing of Young People? Contributions From Developmental Psychopathology and Educational Effectiveness Research

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Keywords: mental health, well-being, education, developmental psychopathology, educational effectiveness research

Editorial on the Research Topic

How Can Education Better Support the Mental Health and Wellbeing of Young People? Contributions from Developmental Psychopathology and Educational Effectiveness Research

OPEN ACCESS

Edited and reviewed by:
Douglas F. Kauffman, Medical University of the Americas – Nevis, United States

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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *30 July 2019*
Accepted: *19 August 2019*
Published: *29 August 2019*

Citation:
Hall JE and Kreppner JM (2019) Editorial: How Can Education Better Support the Mental Health and Wellbeing of Young People? Contributions From Developmental Psychopathology and Educational Effectiveness Research. Front. Educ. 4:93. doi: 10.3389/feduc.2019.00093

Research in the 1970s that addressed this question (e.g., Rutter et al., 1970, 1976, 1979) has since proven seminal to the development of two distinct fields of research that continue to offer mutually informative insights: Developmental Psychopathology (DP) and Educational Effectiveness Research (EER).

Influenced by a modern medical biopsychosocial model (Engel, 1977), Developmental Psychopathology is concerned with the study of developmental processes in biological and psychological systems to inform understanding of adaptation and maladaptation - knowledge used to develop better prevention and treatment of psychopathologies (Rutter and Sroufe, 2000; Toth and Cicchetti, 2010). This focus on the drivers of development is shared by EER as it investigates, "*all the factors within schools in particular, and the educational system in general, that might affect the learning outcomes of students in both their academic and social development*" (p. 197; Reynolds et al., 2014). DP and EER share the common agenda of understanding factors that relate to individuals' learning and development: DP focuses on the individual learning and developing in context, EER investigates the educational systems, structures, and processes that shape how individuals learn and develop.

Given the complementarity of DP and EER, it is therefore somewhat surprising that they have rarely joined forces and synthesized knowledge to develop a fuller understanding of the roles educational contexts play in the mental health and well-being of students. This Research Topic aims to stimulate such collaboration.

Together, the 11 contributions in this Research Topic demonstrate the complementarity of DP and EER via their focus on how individuals learn and develop in context (educational and otherwise). Most contributions focus on individual learners and consider differences over time, and concentrate more upon the immediate environments around the learner than those more distant (e.g., broader society and culture). **Table 1** maps the 11 studies onto the ecologies and systems that surround the learner. Two theoretical frameworks are used for this mapping to further illustrate the complementarity of the fields—one prominent in DP (Bronfenbrenner, 1986) and one in EER (Creemers and Kyriakides, 2006).

TABLE 1 | The focus of the eleven studies in this Research Topic mapped on to the ecologies and systems understood to surround the learner.

The 11 papers featured within this Research Topic	The various ecologies and systems understood to surround the learner					
	<-Closer to the learner			Further from the learner->		
	The ecological levels of Bronfenbrenner (1986):					
	1. The learner	2. Microsystem (immediate environments; e.g., classrooms and teachers)	3. Mesosystem (connections between immediate environments)	4. Exosystem (indirect environments; e.g., the school; neighborhood)	5. Macrosystem (social and cultural values)	6. Chronosystem (changes over time)
	The multiple levels within the dynamic model of educational effectiveness (Creemers and Kyriakides, 2006):					
	A. Student level	B. Teacher/classroom level (e.g., quality of teaching)		C. School level (e.g., school policies)	D. System level (e.g., national policies; societal values)	E. Dynamic change overtime (in/from interplay between levels)
1. Kreider et al.	x	x	x	x	x	x
2. Melhuish and Gardiner		x		x		x
3. Palardy	x	x	x	x		
4. Evans et al.	x	x	x			x
5. Demir and Leyendecker	x	x	x			x
6. Malboeuf-Hurtubise et al.	x	x				x
7. Unwin et al.	x	x				x
8. Allen et al.	x	x				
9. Chen et al.	x	x				
10. Xu et al.	x					x
11. Orylska et al.	x					x

We organize the contributions in this Research Topic by adopting a prospective developmental perspective and according to age-related levels of education. We begin with a contribution by Melhuish and Gardiner who analyse longitudinal data from 600 contemporary Early Childhood Education and Care (ECEC) settings, and draw on results spanning 20 years, to argue that educational policy change may improve child development via changes to the quality of ECEC settings.

Three papers are concerned with primary school-age children. Orylska et al. investigate the learning trajectories during an 8-week working memory training intervention of 126 children (aged between 5.9 and 6.5 years) of which 65 met diagnostic criteria for ADHD. Findings demonstrated that learning curves for most children (both ADHD and non-ADHD) followed an inverted U shape suggesting that young children showed initial learning but did not benefit from extended training. Malboeuf-Hurtubise et al. present results from a series of 8-week Mindfulness-Based Interventions (MBIs) carried out with 13 primary school students taught in special education classrooms due to learning needs arising from clinically diagnosed psychiatric disorders. No firm conclusions regarding benefits from the MBIs could be drawn. By consequence, this study reflects the need for caution regarding the use of MBIs in such settings until further data is available. In the third paper, Evans et al. review literature on the impact of transitioning from primary to secondary education on student attainment and well-being. They identify a number of putative risk and protective factors to help inform further research on how education can contribute to mental health and well-being during primary-to-secondary transitions.

Two papers consider both primary and secondary school students. Demir and Leyendecker analyse data from 161 primary and secondary school-aged Turkish immigrants in Germany. Results highlight that across primary and secondary school years, children are differentially responsive to the potential supportive roles of immediate educational environments, peers, and teachers. Unwin et al. evaluate the effectiveness, acceptability, and feasibility of a school-based mental health programme delivered in 8 special schools to 53 students aged 5–15 years using a within-group repeated measures design. While teacher—but not parent—ratings supported the feasibility of the programme, further evidence is required from studies that include control groups. Still, the study provides important pointers for future research into how schools can support students' mental health and well-being.

Three papers focus on secondary school students. In a study of 2,541 high school students, Palardy demonstrates that the non-academic attributes of participants' peers, including behavioral

engagement, cognitive engagement, conscientiousness, self-efficacy, and hope, were important for academic achievement beyond participants' own non-academic attributes. Importantly, this paper shifts attention to the influences of peers on young people's educational experiences. Allen et al. recruited 437 secondary school students and 12 teachers for a mixed-method cross-sectional study investigating difficulties faced by students high in Callous-Unemotional (CU) traits. Their findings highlight the need for adaptation of school-based interventions to lessen the risk of disruptive behavior and poor motivation in this high-risk subgroup of antisocial children. In a cross-sectional study of 677 senior high school students, Chen et al. demonstrate that the association between student shyness and reduced learning adjustment may be mediated via students' goal orientation and academic help seeking. Findings indicate possible targets for interventions designed to benefit the well-being and achievement of shy students.

Finally, two contributions concern students in higher education. Using a mixed-method within-group evaluation design, Kreider et al. report results from a multilevel intervention to support educational opportunities for 173 undergraduate Science, Technology, Engineering, and Math (STEM) students with learning disabilities. Their findings demonstrate possible benefits from such multilevel interventions for students' educational progress and well-being. Xu et al. report results from 55 undergraduate medical students who participated in a randomized controlled trial investigating the impact of positive psychological interventions (PPIs) on subjective well-being, depression, anxiety, and neural correlates assessed via electroencephalography (EEG). Results suggest PPIs may improve subjective well-being and reduce emotional distress by promoting adaptive emotional regulation that was associated with change in frontal alpha EEG asymmetry. This paper demonstrates one potential neurological mechanism underpinning the effects of PPIs—a form of intervention common in educational settings (see, Shankland and Rosset, 2017)—on mental health.

With this collection of papers in this Research Topic we hope to stimulate further research collaborations across DP and EER that will improve understanding of the roles educational contexts play in the mental health and well-being of students.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

ACKNOWLEDGMENTS

Our thanks to Dr. Chris Downey (C.J.Downey@Soton.ac.uk) and Dr. Ariel Lindorff (Ariel.Lindorff@Education.ox.ac.uk) for commenting on draft versions of this editorial.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 07 May 2019
doi: 10.3389/feduc.2019.00035

Structural Factors and Policy Change as Related to the Quality of Early Childhood Education and Care for 3–4 Year Olds in the UK

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In many developed countries it is now the norm for preschool children to spend time outside the home in early childhood education and care (ECEC). Research indicates that attending ECEC can promote longer-term positive life outcomes, which is more likely when the ECEC is of higher quality. In a UK study of 600 ECEC group settings for 3–4 year olds, staff qualifications were predictive of quality at private (for profit) settings. For voluntary (not for profit) settings, which were more homogenous in staff qualifications, having a staff training plan and a better staff to child ratio were found to be significant predictors of quality. However, state funded nursery classes/schools, which tend to have less favorable staff to child ratios than private and voluntary settings, also tended to have higher process quality ratings, where the presence of more highly qualified staff apparently allowed quality to be maintained with a larger number of children per staff member. A comparison of equivalent quality data from separate UK studies, conducted before and after a period of substantial policy change in relation to ECEC quality, indicated that policy change may have powerful effects in improving ECEC quality with implications for long-term child, and potentially adult, well-being.

Keywords: early childhood education and care (ECEC), preschool, policy change, early years educational policy, early years and leadership

OPEN ACCESS

Edited by:
Douglas F. Kauffman, Medical University of the Americas–Nevis, United States

Reviewed by:
Virginia Tompkins, The Ohio State University at Lima, United States
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *12 July 2018*
Accepted: *09 April 2019*
Published: *07 May 2019*

Citation:
Melhuish E and Gardiner J (2019) Structural Factors and Policy Change as Related to the Quality of Early Childhood Education and Care for 3–4 Year Olds in the UK. Front. Educ. 4:35. doi: 10.3389/feduc.2019.00035

INTRODUCTION

Early Childhood Education and Care

In many developed countries it is now the norm for preschool children to spend time outside the home in early childhood education and care (ECEC). For instance, on average across OECD countries, 70% of 3-year-olds, 85% of 4-year-olds and 95% of 5-year-olds were enrolled in paid ECEC of some form (or primary education) in 2014 (OECD, 2017). In the UK much of this ECEC is in private (for profit), voluntary (not for profit) or state settings. State provision includes nursery classes attached to a school, or a nursery school catering specifically for pre-school children, with a small number of local authority nurseries, and also children's centres that combine ECEC provision with other services.

Research indicates that attending ECEC promotes school readiness and contributes to later school attainment and positive life outcomes into adolescence (Sylva et al., 2008; Melhuish et al., 2017). As well as affecting cognitive and educational outcomes, there is clear evidence that ECEC experience can have long-term consequences for socio-emotional development. In the USA, several

studies evaluating programs with disadvantaged populations that use high quality ECEC as the intervention find positive effects on socio-emotional development. Barnett (2008) found that participation in the Early Head Start (EHS) program was associated with small improvements in children's behavioral problems (Sammons et al., 2002; Love et al., 2005) in terms of positive impacts on children's social-emotional development, including less aggressive behavior, more sustained attention, and higher engagement in play.

Two Domains of ECEC Quality

Two broad dimensions of quality have been identified that facilitate children's development and learning: structural quality (Early et al., 2007)—which includes adult-child ratios, staff qualifications, group size, and the characteristics of the physical space—and process quality (Slot et al., 2015)—which includes the quality of the curriculum, pedagogical practices and the quality of children's experiences that support development. Frequently there are relationships between structural characteristics and process quality; for example the Effective Provision of Pre-school Education (EPPE) study found that process quality was associated with the qualification level of ECEC staff (Sylva et al., 1999a; Melhuish et al., 2006) and the quality of early years provision has also been shown to be associated with managers' qualification level (Mathers et al., 2007; Roberts et al., 2010; Karemaker et al., 2011). In light of these findings, there has been support to improve the qualification level of ECEC staff in England, and there is evidence that it has indeed risen (Brind et al., 2014; Simon et al., 2016). This increase in qualifications may be related to improvements in quality ratings of preschool provision over time (Ofsted, 2015). Another structural characteristic that has been associated with better quality provision is higher staff to child ratios (Mathers et al., 2007; Roberts et al., 2010). For example, higher staff to child ratios have been associated with a higher quality of staff/child interactions in preschool settings (Karemaker et al., 2011). There is also evidence that type of setting may be associated with the quality of provision, for example two UK studies (Sylva et al., 1999b; Roberts et al., 2010) found higher quality in state-maintained settings.

It is likely that the relationships observed between aspects of structural quality and process quality are, at least to some extent, causal. We would therefore anticipate that changes to factors such as staff qualifications and training or staff to child ratios will ultimately affect the process quality of settings.

Research Aims

The aim of this research is to investigate the associations between structural and process quality measures at settings in the SEED study, and to explore the hypothesis that these relationships may vary according to the type of ECEC settings considered (e.g., private provision, state-funded provision). This research is of importance because, as discussed in the following section, the process quality of the ECEC which children attend may affect their educational and later life outcomes. An understanding of how structural quality influences process quality is therefore of use in developing more effective ECEC provision.

The Benefits of High Quality ECEC

It has been shown that positive benefits of ECEC are more likely if the ECEC experiences are of high quality. In studies of the general population, there is also evidence that the quality of the ECEC is important for children's future educational, cognitive and behavioral outcomes (Melhuish, 2004; Sylva et al., 2004, 2010; Barnes and Melhusih, 2016) all of which are relevant for subsequent mental health. Similarly, the high quality ECEC intervention in the Abecedarian Project (Muennig et al., 2011) was linked with long-term beneficial effects. Manning et al. (2010) in a meta-analysis showed reduced deviance, increased social participation, and reduced crime once children had reached adolescence. McLaughlin et al. (2007) showed that the early intervention reduced later depression, and Barnett (2008) reported that the Abecedarian program group reported fewer depressive symptoms and less substance abuse at age 21. Other evidence comes from less intensive intervention. A study conducted in Chicago (Reynolds et al., 2011) gives evidence of long term benefits for less advantaged children who started preschool aged three or four compared to those who started later. These benefits were larger for boys than for girls and were also larger among children whose parents did not complete high-school. When followed up at age 28, children who had started preschool aged three to four had higher levels of educational achievement, higher incomes and were less likely to have drug problems or involvement with crime, as compared to children who had started preschool at a later age. For example, in the Netherlands, Broekhuizen et al. (2014) found beneficial effects on behavior problems associated with higher quality of ECEC, which were also found in the UK (Sammons et al., 2002; Sylva et al., 2004). In the USA, research has indicated that higher ECEC quality (e.g., child-teacher relationships and interactions) can be prospectively related to more social competence and fewer behavioral problems (Peisner-Feinberg et al., 2001; NICHD Early Child Care Research Network, 2006; Burchinal et al., 2008; Mashburn et al., 2008), with some effects lasting into adolescence (Vandell et al., 2010). Studies have also demonstrated that children's behavioral self-regulation and emotional understanding can be improved by exposure to ECEC of high quality, specifically where there is a comprehensive socio-emotional curriculum and where staff development has focussed on the responsiveness of staff/child interactions (Bierman et al., 2014; Landry et al., 2014). This indicates that changing the quality of ECEC may enhance children's outcomes, including socio-emotional development.

The relevance of high quality ECEC is likely to differ depending on child characteristics. Studies have shown that exposure to ECEC of high quality can help to close the gap between levels of behavioral problems found in boys and girls, which generally tend to be higher in boys. Among disadvantaged children, it has been found that the level of behavioral problems in boys is reduced by exposure to high quality ECEC whilst the same exposure has much less effect on the levels of behavioral problems in girls (Votruba-Drzal et al., 2004, 2010). This may be in part because boys, who tend to have lower levels of self-regulation than girls, derive greater benefit from exposure to more structured environments (Votruba-Drzal et al.,

2004, 2010). A study by Broekhuizen et al. (2015) explored whether children's emotional self-regulation and their gender were independent moderators of the effects of ECEC quality or whether the generally lower levels of emotional self-regulation among boys was a partial explanation for the moderating effect of child's gender. The study concluded that children's emotional self-regulation and their gender were independent moderating factors. This study also provides evidence for differences in the susceptibility of children to the effects of ECEC quality depending on their temperaments. Specifically, children with lower self-regulation show greater decreases in social abilities when exposed to low quality ECEC and also greater increases in social abilities when exposed to high quality ECEC, as compared to children with higher levels of self-regulation. This finding bears out earlier work by Belsky (1997). A similar pattern has been observed with regard to children's reactivity. Children with more reactive temperaments are both more likely than other children to exhibit behavioral problems when exposed to low quality ECEC and are also more likely to exhibit good levels of socio-emotional skills when exposed to high quality ECEC (Deynoot-Schaub and Riksen-Walraven, 2006; Pluess and Belsky, 2009; Almas et al., 2011; Phillips et al., 2012).

The Relevance of the Policy Context—Illustrated by the UK

In the UK, the period since 1999 has seen substantial policy developments for ECEC provision influenced extensively by research findings (Melhuish, 2016). Based on the established benefits of ECEC, successive UK government policies provided free ECEC provision for all 3–4 year olds in 2004 and undertook to improve the quality of provision through various measures, and have also extended funding for ECEC provision by increasing the number of hours funded and decreasing the age at which eligibility starts.

In 2017 provision was extended to 570 h annually for all 3–4 year olds, with an additional 570 h annually for children whose parents are working (Melhuish et al., 2017). From 2013 2 year old children from disadvantaged families (defined by the receipt of specific benefits) also became eligible for 570 annual hours of funded ECEC, and from 2015 this provision was extended to 2 year old children from households which were moderately disadvantaged, including children from families with low incomes and children with Special Educational Needs/Disabilities (SEN/D). This state provision of funding for ECEC for 2 year old children in the UK covers approximately the 40% most disadvantaged families by income.

The Statutory Framework for the Early Years Foundation Stage, which has legal foundations in the Childcare Act 2006, sets out statutory requirements for ECEC for children aged 0–5 in the UK with the aim of ensuring that all provision is of high quality so that "no child gets left behind" (Department for Education, 2014). The extent to which early years providers satisfy these requirements has been monitored by the Office for Standards in Education (Ofsted), since Ofsted began monitoring ECEC in 2001. In addition, there have been several government-funded schemes to improve quality of ECEC provision particularly from 2004 onwards, when state-funded universal provision started for 3 and 4 year olds.

This paper considers the relationship between structural and process aspects of quality in ECEC group settings for 3- and 4-year-old children from the Study of Early Education and Development (SEED) study, a large-scale ongoing longitudinal study in England that is investigating the potential impact of ECEC on children's outcomes in school and personal well-being. Then a comparison is presented between ECEC quality data from the SEED study collected in 2014–2016 and equivalent data from the Effective Provision of Pre-school Education (EPPE) study (Sylva et al., 2004, 2010). The EPPE study was conducted in six English local authority (LA) areas, chosen to provide coverage of urban and rural areas, more and less disadvantaged areas and to ensure ethnic diversity. Within each LA, centres were selected from the six most common types of provision: playgroups, local authority/voluntary day nurseries, private day nurseries, nursery schools, nursery classes, and integrated centres combining care and education. Centres were selected randomly within each type of provision in each LA. The sample consisted of 141 centres (Sylva et al., 2004).

The existence of these two large datasets on the quality of group ECEC in England, which are approximately nationally representative at their respective time points, enables a comparison before and after a period of extensive policy change that transformed the early years sector, and which was intended to increase both the uptake and quality of ECEC for children, particularly for those 3–5 years of age. This comparison can inform on whether policy change, as seen in the UK, is associated with change in ECEC quality. If so, then there is the possibility that there may be consequences for later child outcomes, including socio-emotional development and well-being, for the country's population. It may also be transferable to other contexts.

Strengths and Limitations

Strengths of this study are the large sample size, comprising 598 ECEC settings, and the wide range of settings type studied. ECEC settings are also included from all regions of England. A limitation of the study is that settings were chosen that were attended by children from the SEED study, which was highly clustered and in which disadvantaged children were over-represented. For this reason, although the SEED sample of settings is geographically diverse and includes settings of all main types, it is not a representative sample of all ECEC settings in England.

METHODS

Sampling

As part of the SEED longitudinal study, a sample of 5,642 children born in England between September 2010 and August 2012 was selected using national child benefit records (state benefits available to parents with children). Sampling on the basis of geographical location (postcode districts) eligible families with children of the relevant age were selected for interview. This procedure produced a highly clustered sample. Children were

selected according to family income so that approximately one third of the sample came from the most disadvantaged 20% of families by income, one third of the sample came from the next most disadvantaged 20% of families and one third of the sample came from the least disadvantaged 60% of families. A list of ECEC settings was obtained by asking parents which settings their children were attending as part of the SEED parent interviews. The sample was stratified by provider type, with settings classified as one of private, voluntary, state nursery class, nursery school, children's centre or local authority nurseries (LAN) (Melhuish and Gardiner, 2018).

Settings were selected so that the percentage in each category was similar to the percentage in that category across all settings used by children participating in the SEED study. If a provider did not wish to participate it was, wherever possible, replaced with the same type of provider from the same geographical area. The sample of ECEC settings came from all parts of England; it comprised 598 settings attended by children aged 3 to 4 participating in the SEED study.

Structural Quality

A staff interview was conducted with the manager of each childcare setting. During this structured interview a questionnaire was completed by the visiting researcher recording information on the structural quality of the ECEC setting provided by the setting manager. Information gathered comprised answers on the following topics: number of places at the setting, setting on single site/multiple sites, minimum age of children, maximum age of children, staff to child ratio, whether the settings had special educational needs and disability (SEN/D) provision, mean level of staff qualification, manager's highest qualification, whether the setting had a staff training plan, whether the setting had a staff training budget, frequency of staff continuing professional development (CPD), frequency of staff supervision and rate of staff turnover.

The overall staff to child ratio was calculated as the number of staff at a setting divided by the number of children at the setting, so higher ratios mean that there are fewer children per member of staff. The qualifications of ECEC staff and managers were recorded as equivalent to the following levels: Level 1 = GCSE (General certificate of secondary education; taken at age 16) D-G (lower level of pass), Level 2 = GCSE A*-C (higher level pass), Level 3 = A-Level (Advanced level examinations taken at age 18), Level 4 = Certificate of Higher Education (beyond age 18; lower level), Level 5 = Diploma of Higher Education (beyond age 18, higher level), Level 6 = Batchelor's degree, Level 7 = Master's degree, Level 8 = Doctorate.

Process Quality

Process quality was assessed by trained researchers during a half-day observational visit to each setting included in the study. Overall process quality for the settings attended by 3–4 year olds was assessed using the revised Early Childhood Environmental Rating Scale (ECERS-R) (Harms et al., 2005). This assessed settings quality using five domains: Space and Furnishings (e.g., room layout, accessibility of resources), Personal Care Routines (e.g., welfare requirements such as health & safety and provision for sleeping), Language and Reasoning (e.g., supporting children's communication, language and literacy development; supporting children's critical thinking), Activities (e.g., provision of an exciting and accessible learning environment, resources to support specific types of play), Interaction (e.g., supervision, support for social interactions) and Programme Structure (e.g., opportunities for children to access their own curriculum, planning schedules/routines to meet children's needs). The curriculum extension of the ECERS-R scale, ECERS-E (Sylva et al., 2011) was used to assess the specifically educational quality of the settings for 3–4 year olds; this consisted of the three domains: Literacy (e.g., opportunities for emergent writing, letters and sounds), Mathematics (e.g., number skills and reasoning) and Diversity (e.g., planning for children's individual learning needs, valuing and respecting other cultures, gender diversity). The quality of staff/child interactions was assessed using the Sustained Shared Thinking and Emotional Well-being scale (SSTEW) (Siraj et al., 2015) comprising five domains: Building Trust, Confidence and Independence (e.g., self-regulation and social development, encouraging choices and independent play, planning for small group, and individual interactions); Supporting and Extending Language and Communication (e.g., encouraging children to interact with others, staff actively listening to children, and encouraging children to listen, staff supporting children's language use); Supporting Emotional Well-being (staff supporting children's social and emotional communication); Supporting Learning and Critical Thinking (e.g., supporting curiosity and problem solving, encouraging sustained, shared thinking during story time, encouraging sustained, shared thinking in investigation, and exploration, supporting concept development and higher order thinking); and Assessing Learning and Language (e.g., using assessment to support and extend learning and critical thinking, assessing language development). For all three scales the total scale score was the mean of the subscale scores. The scores on the process quality scales had a range of 1–7. Quality was classified as Inadequate (<3), minimal (≥ 3 and <4), adequate (≥ 4 and <5), good (≥ 5 and <6) or excellent (≥ 6).

These measures were selected because they are commonly used in the UK and internationally to assess the quality of ECEC settings, they have high levels of inter-rater reliability (Clifford and Reszka, 2010; Whitebread et al., 2015), and they have been shown to capture key elements of settings quality. Quality assessed using these methods has also been shown to have some predictive value for the future outcomes of children attending ECEC settings (Sylva et al., 2010).

Analysis Strategy

Structural characteristics of settings and process quality were compared by provider type: private, voluntary, state nursery class/school, and children's centre (the number of local authority nurseries was small and these were omitted from comparisons). Means of the continuous measures were compared using the Wilcoxon rank sum test, while the proportions for binary characteristics—including whether or not process quality was "excellent" or "good or better"—were compared using the χ-square test for proportions.

The relationship between structural factors and process quality was examined using multiple linear regression of process quality measures as predicted by the structural characteristics of settings. Manager's highest qualification was omitted from the list of structural covariates because of potential collinearity with mean level of staff qualification. Factors associated with settings achieving "excellent"/"good or better" process quality were explored using logistic multiple regression models. Preliminary analysis showed that the relationships between structural characteristics and process quality differed by setting type; these regression models were therefore fitted separately for the different types of settings. For nursery classes/schools and children's centres the logistic regression models for "excellent" and "good or better" scores were not fitted as the sample sizes were too small to make these models reliable.

Comparing the Quality of ECEC Before and After Significant Policy Change

In order to examine how quality of ECEC provision has changed over time in England, this section compared data collected in 2015–2016 from the SEED study with data collected in 1998–1999 for the Effective Provision of Pre-School Education (EPPE) study (Sylva et al., 1999b). This enabled a comparison between the quality of ECEC settings before and after a period of rapid policy development in the area of ECEC, which occurred across the years 1999–2014 as described by Melhuish (2016). Both studies collected data on samples of settings that were approximately representative of ECEC group settings for 3–4 year old children in England at the relevant time. Both the EPPE (Sylva et al., 1999a) and SEED (Melhuish and Gardiner, 2018) studies included data collected by similar methodologies using the ECERS-R (Harms et al., 2005) and ECERS-E (Sylva et al., 2011) measures, as well as data on structural characteristics through similar staff interviews. In both studies the ECERS-R and ECERS-E were conducted according to the respective manuals. In both studies researchers collecting quality data were trained extensively on the observational instruments and one person acted as the "standard" in a reliability exercise. Inter-observer reliability was checked through five centres being rated by a researcher and the person acting as "standard." Comparison between observers indicated good levels of inter-observer reliability (Kappa range = 0.75–0.90, median = 0.81). Further information on the methodology of the EPPE study can be found in Sylva et al. (1999b) and for the SEED study in Melhuish and Gardiner (2018).

RESULTS

Type of SEED Settings

The largest type of ECEC settings in the SEED study was private (302, 50.5%), with voluntary settings providing the second largest group (143, 23.9%), nursery classes/schools made up 20.6% (123), and the 26 children's centres represented 4.3%. The four local authority nurseries (0.7%) were too few for reliable analysis.

Structural Characteristics of SEED Settings

Summary statistics for structural characteristics of settings are shown for continuous measures in **Table 1**, and for binary measures in **Table 2**. Structural characteristics for the different settings types were compared with those for private settings which, as the largest group, was use as the baseline. There were a number of significant differences in structural characteristics between types of settings. Voluntary settings tended to be smaller than private settings and tended to have a narrower age range for children. Nursery classes/schools tended to have more highly qualified managers and staff than private settings, but also had lower staff to child ratios (i.e., more children per member of staff).

Quality of SEED Settings and Quality by Type

Mean ECERS-R (overall quality) for all settings was 5.28, a "good" rating, whilst ECERS-E (educational quality) and SSTEW (quality of staff/child interactions) had means of 4.18 and 4.70, respectively, (both in the "adequate" range); see **Table 3**. 62.7% of settings achieved a "good or better" standard on the ECERS-R scale, with 26.8% achieving an "excellent" rating. These figures were somewhat lower for the other scales with 44.3% registering "good or better" and 14.5% "excellent" on the SSTEW scale and 26.4% achieving "good or better" ratings on the ECERS-E scale and 5.7% achieving "excellent" scores on this scale. Children's centres and nursery classes/schools had significantly higher mean quality scores than private settings (reference group) on all three quality scales. The proportions of children's centres and nursery classes/schools with "excellent" and "good or better" scores were significantly higher than the proportion of private settings achieving scores in these ranges. Voluntary settings had significantly lower mean scores than private settings on the ECERS-E scale (educational quality) and the proportion of voluntary settings with "good or better" ECER-E scores was significantly lower than for private settings.

Process Quality in Terms of Structural Quality in the SEED Study

The results of the regression models of process quality in terms of structural characteristics of ECEC settings are given in **Tables 4**–**7**. Statistically significant associations between structural characteristics and process quality were found for all settings types. As hypothesized, the associations between structural and process quality also differed between the different settings types.

In private settings, there were significant associations between higher quality on the ECERS-R, ECERS-E and SSTEW scales and having a larger number of places, a higher mean level of staff qualification and a minimum age of 2 for children. Having SEN/D provision was significantly associated with higher ECERS-E scores. Achieving excellence on the ECER-R scale was associated with a higher mean level of staff qualification and a lower frequency of staff CPD. Larger settings (settings with a larger number of places) were associated with higher

TABLE 1 | Summary of continuous structural characteristics.

Structural characteristic	Missing values		Minimum value	Maximum value	Mean value	Mean values by type			
	N	%				Private	Voluntary	Nursery class/school	Children's centre
Number of places	7	1.17	4	318	50.75	54.95	***38.27***	***51.65***	***69.48***
Minimum age of children	0	0.00	0	3	1.31	0.65	***1.54***	***2.76***	0.81
Maximum age of children	0	0.00	3	19	5.80	6.10	***5.46***	***5.55***	5.46
Ratio: children aged 3–4 per staff member	1	0.17	2	13	8.13	7.70	***7.36***	***10.03***	***8.65***
Overall ratio: children per staff member	8	1.34	1	40	5.53	4.33	4.34	***10.08***	4.89
Mean level of staff qualification	0	0.00	0	5.88	3.17	3.02	2.90	***3.78***	***3.43***
Manager's highest qualification	15	2.51	2	8	5.11	4.91	***4.52***	***6.16***	***6.08***
Frequency of CPD	14	2.34	1	24	4.73	4.39	***3.63***	***6.10***	***8.50***
Frequency of staff supervision	11	1.84	1	52	8.67	9.02	7.13	***10.14***	7.00
% staff replaced in last year	1	0.17	0	100	10.57	11.62	***9.66***	***9.29***	10.18
Group size					598	302	143	123	26

Mean values for a given type of setting are shown in bold italics if they are statistically significantly different from the mean value for private settings which, as the largest group of settings, is used as the reference group. The test used is the Wilcoxon rank sum test for difference in means; the cut-off for statistical significance is p = 0.05 in a two-sided test.

TABLE 2 | Summary of binary structural characteristics.

Structural characteristic	Missing values		% with characteristic	% with characteristic by type			
	N	%		Private	Voluntary	Nursery class/school	Children's centre
Centre on single site	2	0.33	75.7	59.9	***90.1***	***96.7***	76.9
Has SEN/D provision	11	1.84	63.2	61.5	67.1	62.8	65.4
Has training plan	2	0.33	86.6	90.0	***80.4***	84.4	92.3
Has training budget	2	0.33	56.4	49.8	43.4	***82.8***	***80.8***
Group size			598	302	143	123	26

The percentage of setting with a given structural characteristic is shown in bold italics if it statistically significantly different from the percentage for private settings which, as the largest group of settings, is used as the reference group. The test used is a chi-square test for a difference in proportions; the cut-off for statistical significance is p = 0.05 in a two-sided test.

likelihood of achieving excellent ECERS-E scores, whilst excellent SSTEW scores were associated with larger settings and a higher overall staff to child ratio. Larger settings were associated with a higher likelihood of achieving "good or better" scores on all three quality scales. A minimum age of 2 for children was associated with "good or better" scores on the ECERS-E and SSTEW scales, a higher mean level of staff qualification was associated with achieving "good or better" scores on the ECERS-R and SSTEW scales; a higher overall staff to child ratio was associated with achieving "good or better" ECERS-R scores; see **Table 4**.

In voluntary settings, having a training plan in place and a higher overall staff to child ratio were associated with higher scores on the ECERS-R scale. Having a higher staff to child ratio (i.e., fewer children per member of staff) was associated with higher scores on the ECER-E scale. Having a training plan in place was also associated with higher SSTEW scores. Not having SEN/D provision was associated with an increased probability of achieving excellent ECERS-R scores. A higher staff to child ratio and a minimum age of 0–1 for children were associated with an increased probability of achieving "good or better" ECERS-E scores. Finally, having a training plan in place was associated with an increased probability of achieving "good or better" SSTEW scores; see **Table 5**.

For nursery classes/schools a lower maximum age for children was associated with higher ECERS-R and ECERS-E scores; having a training budget in place was associated with higher ECERS-E and SSTEW scores and a lower rate of staff turnover was associated with having higher SSTEW scores; see **Table 6**.

For children's centres a higher mean level of staff qualification was associated with achieving higher scores on the ECERS-R scale; see **Table 7**.

Results of the Comparison Between SEED and EPPE

The ECERS-R and ECERS-E quality scores were compared for the SEED and the earlier EPPE samples overall. The mean ECERS-R score (overall quality) for settings in the EPPE study was 4.29, compared to a mean of 5.28 in SEED. For ECERS-E the mean for EPPE was 3.17 whilst the mean for SEED was 4.18. A comparison of these scores by category is given in **Figure 1** (ECERS-R) and **Figure 2** (ECERS-E). There is a greater proportion of poorer quality settings (i.e., inadequate, minimal,

TABLE 3 | ECEC Settings quality scores.

	Group	*N*	ECERS-R	ECERS-E	SSTEW
Mean quality scores	All	598	5.28	4.18	4.70
	Private	302	5.14	4.03	4.51
	Voluntary	143	5.12	***3.81***	4.51
	Nursery class/school	123	***5.68***	***4.79***	***5.26***
	Children's centre	26	***5.72***	***4.85***	***5.34***
Percentage with excellent quality scores	All	598	26.8	5.7	14.5
	Private	302	21.2	3.3	9.6
	Voluntary	143	19.6	2.8	8.4
	Nursery class/school	123	***45.5***	***12.2***	***29.3***
	Children's centre	26	***38.5***	***15.4***	***30.8***
Percentage with good or better quality scores	All	598	62.7	26.4	44.3
	Private	302	57.0	20.9	37.4
	Voluntary	143	55.2	***12.6***	35.7
	Nursery class/school	123	***80.5***	***51.2***	***65.0***
	Children's centre	26	***84.6***	***46.2***	***69.2***

The mean quality score for a given type of setting is shown in bold italics if, in a linear regression of quality score in terms of setting type, it showed a significant difference from the Private settings which, as the largest group, was used as the baseline (comparison) group.
The percentage of settings of a given type with excellent quality scores is shown in bold italics if, in a logistic regression of "excellent quality score (yes/no)" in terms of setting type, it showed a significant difference from the Private settings which, as the largest group, was used as the baseline (comparison) group.
The percentage of settings of a given type with good or better quality scores is shown in bold italics if, in a logistic regression of "good or better quality score (yes/no)" in terms of setting type, it showed a significant difference from the Private settings which, as the largest group, was used as the baseline (comparison) group.

and adequate) in the EPPE study than in the SEED study for both ECERS-R and ECERS-E. This indicates that the quality of ECEC settings in England on these measures has improved between the time of EPPE and the time of SEED.

From the staff interviews carried out by both studies, comparable data on staff qualifications were derived. The qualification levels of both managers and staff at ECEC settings increased between the EPPE interviews in 1998–1999 (Taggart et al., 2000) and the SEED interviews in 2014–2016 (Melhuish and Gardiner, 2018). A comparison of manager's highest qualification between the EPPE and SEED studies is shown in **Figure 3**. The percentage of managers with a degree (Level 5 or above) rose from 43% in the EPPE study to 66% in the SEED study. Comparing the mean level of staff qualification (see **Figure 4**), we see that the most common level was 3–4 in both the SEED and EPPE studies; the second most common level for EPPE was a Level 2, whilst for SEED it was a Level 5 or above. It seems likely that the rise in ECEC quality between EPPE (1998–1999) and SEED (2014–2016) is partly due to the improvements in the qualification levels of staff and managers over this period.

DISCUSSION

Factors Associated With Process Quality

In line with previous research (Sylva et al., 1999b; Roberts et al., 2010; Brind et al., 2014; Ofsted, 2015), quality was found to vary by type of setting, with nursery classes/schools and children's centres tending to have higher process quality than the private and voluntary settings, which made up the majority of ECEC provision.

This study also found a wide ranging pattern of associations between the structural characteristics of ECEC settings and their process quality, which are relevant to policy development. As with any observational study, it cannot be assumed that these associations are causal, nor can it be assumed that, if they are causal, the direction of causation necessarily runs from structural characteristics to process quality. In some cases it is possible that causation could go in the other direction; for example, it could be that the associations between higher levels of staff qualification and higher process quality arise because higher quality settings are more successful in recruiting more highly qualified staff. There may also be unobserved confounding factors, which influence both structural characteristics and process quality. Nevertheless, it is cautiously suggested that the best explanation for the observed associations is mainly a causal one from structural characterizes to process quality, so that over time improving factors such as staff qualification levels and staff to child ratios would tend to result in improvements in ECEC settings quality.

There were some differences depending on the way that centres were funded and managed. It appears that staff qualification level was a significant driver of quality at private ECEC settings, which is in accord with existing research (Sylva et al., 1999b; Melhuish et al., 2006; Mathers et al., 2007; Roberts et al., 2010; Karemaker et al., 2011) For voluntary (not for profit) settings, which may be more homogenous in the level of staff and manager qualifications, the presence of a training plan was a significant predictor of higher quality. In line with earlier studies, a higher staff to child ratio was found to be a significant predictor of quality (Mathers et al., 2007; Roberts et al., 2010; Karemaker et al., 2011). However, it should be noted that state

TABLE 4 | Results of regression models of quality in terms of structural characteristics; private settings.

Model coefficient	Quality outcome								
	ECERS-R			ECERS-E			SSTEW		
	Predictors of ECERS-R	Predictors of excellent ECERS-R	Predictors of good or better ECERS-R	Predictors of ECERS-E	Predictors of excellent ECERS-E	Predictors of good or better ECERS-E	Predictors of SSTEW	Predictors of excellent SSTEW	Predictors of good or better SSTEW
	β	OR	OR	β	OR	OR	β	OR	OR
Setting is on single site	−0.004	1.52	1.34	+0.038	1.79	1.19	+0.176	2.08	1.62
Number of places at setting	***+0.335***	1.67	***1.91***	***+0.613***	***5.93***	***3.64***	***+0.400***	***2.92***	***2.09***
Minimum age for children is 2 vs. 0–1	***+0.296***	1.76	1.40	***+0.476***	0.85	***2.79***	***+0.460***	2.71	***2.01***
Maximum age for children	−0.015	0.89	1.18	+0.069	0.70	0.98	+0.001	1.26	1.14
Staff to child ratio for 3- to 4-year olds	−0.110	0.57	1.06	−0.130	0.23	0.60	+0.044	0.43	1.72
Overall staff to child ratio at setting	+0.286	1.43	***2.03***	+0.278	1.02	2.12	+0.289	***3.14***	1.76
Mean level of staff qualification	***+0.635***	***3.78***	***3.00***	***+0.630***	1.52	2.31	***+0.723***	2.50	***3.15***
Setting has SEN/D provision	+0.170	1.02	1.20	***+0.338***	0.92	1.64	+0.235	0.81	1.45
Training plan in place	+0.080	1.18	1.76	+0.195	1.83	1.26	+0.171	3.58	1.20
Training budget in place	+0.006	1.00	1.01	−0.125	0.32	0.64	+0.043	0.93	1.12
Frequency of staff CPD	−0.213	***0.45***	0.77	−0.089	0.47	0.52	−0.144	0.62	0.77
Frequency of staff supervision	−0.070	0.51	1.29	−0.016	0.00	0.85	−0.034	0.42	1.03
Rate of staff turnover	−0.147	0.55	0.79	−0.072	3.32	0.70	−0.146	1.52	0.92

Sample size = 285.

β is the model coefficient from multivariate linear regression of quality in terms of the covariates. For continuous covariates this gives the change in the outcome variable corresponding to a 2 standard deviation change in the covariate. For binary covariates this gives the difference between settings with and without the characteristic in question.

OR is the odds ratio for "excellent"/"good or better" values of quality corresponding to a 2 standard deviation change in the continuous covariates or, for binary covariates, the difference between settings with and without the characteristic in question.

Model coefficients which are significantly different from zero at the p = 0.05 level are shown in bold italics.

TABLE 5 | Results of regression models of quality in terms of structural characteristics; voluntary settings.

Model coefficient	Quality outcome								
	ECERS-R			ECERS-E			SSTEW		
	Predictors of ECERS-R	Predictors of excellent ECERS-R	Predictors of good or better ECERS-R	Predictors of ECERS-E	Predictors of excellent ECERS-E	Predictors of good or better ECERS-E	Predictors of SSTEW	Predictors of excellent SSTEW	Predictors of good or better SSTEW
	β	OR	OR	β	OR	OR	β	OR	OR
Setting is on single site	−0.135	1.30	0.71	−0.202	0.28	0.59	−0.297	0.34	0.89
Number of places at setting	+0.213	3.92	1.30	−0.073	0.35	0.44	+0.164	0.20	1.42
Minimum age for children is 2 vs. 0–1	+0.256	1.31	2.26	+0.008	1.13	***0.12***	+0.190	0.19	0.61
Maximum age for children	+0.153	1.22	2.03	+0.033	5.01	0.64	+0.134	0.42	1.25
Staff to child ratio for 3- to 4-year olds	+0.033	1.23	1.06	***+0.386***	3.51	***4.50***	+0.236	1.78	1.15
Overall staff to child ratio at setting	***+0.452***	1.48	1.89	+0.358	0.98	0.47	+0.416	0.80	1.17
Mean level of staff qualification	+0.125	1.60	1.27	+0.175	0.88	1.53	+0.228	2.54	1.79
Setting has SEN/D provision	−0.257	***0.22***	1.08	−0.270	0.31	0.39	−0.225	0.57	0.79
Training plan in place	***+0.537***		2.51	+0.381		5.31	***+0.620***	7.71	***7.58***
Training budget in place	+0.089	1.39	1.52	−0.106	0.25	0.96	−0.190	0.17	0.84
Frequency of staff CPD	+0.008	1.21	0.90	+0.353	0.29	1.32	+0.036	2.75	0.82
Frequency of staff supervision	−0.213	0.18	0.64	−0.184	0.34	1.24	−0.343	0.14	0.47
Rate of staff turnover	−0.043	0.92	0.94	−0.091	0.15	0.46	−0.294	0.47	0.65

Sample size = 134.

β is the model coefficient from a multivariate linear regression of quality in terms of the covariates. For the continuous covariates this gives the change in the outcome variable corresponding to a 2 standard deviation change in the covariate. For binary covariates this gives the difference between settings with and without the characteristic in question.

OR is the odds ratio for "excellent"/"good or better" values of quality corresponding to a 2 standard deviation change in the continuous covariates or, for binary covariates, the difference between settings with and without the characteristic in question.

Model coefficients which are significantly different from zero at the p = 0.05 level are shown in bold italics. Cells are left blank where a finite model coefficient could not be calculated due to insufficient variability in the data.

TABLE 6 | Results of regression models of quality in terms of structural characteristics; nursery classes/schools.

Model coefficient	Quality outcome		
	ECERS-R	ECERS-E	SSTEW
	Predictors of ECERS-R	Predictors of ECERS-E	Predictors of SSTEW
	β	β	β
Setting is on single site	+0.072	−0.354	+0.074
Number of places at setting	+0.276	+0.234	+0.163
Minimum age for children is 3 vs. 0–1	+0.289	+0.360	+0.162
Maximum age for children	***−0.328***	***−0.431***	−0.218
Overall staff to child ratio at setting	+0.304	+0.278	+0.125
Mean level of staff qualification	−0.039	−0.245	+0.046
Setting has SEN/D provision	+0.164	+0.297	+0.220
Training plan in place	+0.050	+0.180	+0.057
Training budget in place	+0.231	***+0.573***	***+0.613***
Frequency of staff CPD	−0.025	−0.061	−0.061
Frequency of staff supervision	−0.146	−0.232	−0.130
Rate of staff turnover	−0.113	−0.181	***−0.307***

Sample size = 106.

β is the model coefficient from a multivariate linear regression of quality in terms of the covariates. For the continuous covariates this gives the change in the outcome variable corresponding to a 2 standard deviation change in the covariate. For binary covariates this gives the difference between settings with and without the characteristic in question. Model coefficients which are significantly different from zero at the p = 0.05 level are shown in bold italics.

TABLE 7 | Results of regression models of quality in terms of structural characteristics; children's centres.

Model coefficient	Quality outcome		
	ECERS-R	ECERS-E	SSTEW
	Predictors of ECERS-R	Predictors of ECERS-E	Predictors of SSTEW
	β	β	β
Setting is on single site	+0.111	+0.491	+0.355
Number of places at setting	+0.317	+0.539	+0.625
Minimum age for children is 3 vs. 0–1	+0.157	+1.407	−0.099
Maximum age for children	+0.755	−0.111	+0.337
Overall staff to child ratio at setting	−0.010	+1.164	+0.759
Mean level of staff qualification	***+0.893***	+0.883	+1.128
Setting has SEN/D provision	−0.466	+0.204	−0.686
Training plan in place	+1.857	+0.846	+1.584
Training budget in place	−0.953	−0.587	−0.859
Frequency of staff CPD	+0.069	+0.082	−0.328
Frequency of staff supervision	+0.960	−1.239	−0.244
Rate of staff turnover	−0.946	−0.534	−1.390

Sample size = 25.

β is the model coefficient from a multivariate linear regression of quality in terms of the covariates. For the continuous covariates this gives the change in the outcome variable corresponding to a 2 standard deviation change in the covariate. For binary covariates this gives the difference between settings with and without the characteristic in question. Model coefficients which are significantly different from zero at the p = 0.05 level are shown in bold italics.

funded and managed nursery classes/schools, which tend to have lower staff to child ratios than private and voluntary settings, also tended to have higher process quality ratings. It may be that the presence of more highly qualified staff and managers allows quality to be maintained with a larger number of children per staff member. In a number of cases a narrower range of child ages was associated with higher quality provision, although this finding was not uniform since in voluntary settings for 3–4 year olds an increased probability of achieving "good or better" curriculum quality was associated with settings having a younger starting age for children. This is an area which may merit further study. At private settings for 3–4 year olds, excellence on the ECER-R scale was associated with a lower frequency of staff professional development (CPD). It is probable that this is an instance of reverse causation. That is, those settings that are seeking to improve have increased their frequency of CPD whilst those that have already achieved high quality standards have not needed to do so.

Changes Over Time Between the EPPE and SEED Studies

The EPPE (1998–1999) and the SEED (2014–2016) samples of ECEC settings were approximately representative of the early years sector at the time of the studies. The increase in quality between the EPPE and SEED studies over more than a decade on both the overall quality (ECERS-R) and curriculum quality (ECERS-E) is striking, during which time period there was a strong policy focus on increasing both the quantity and the quality of provision. This trend of increasing quality over time is in line with observations by the national organization responsible for assuring quality in the UK (Ofsted). The proportion of ECEC providers they judged to be good or outstanding increased from 74% in 2012 to 93% in 2017 (Ofsted, 2017), although it should be borne in mind that the validated quality measures used in the EPPE and SEED studies and the criteria used by Ofsted are significantly different. An increase in the qualification level for both setting managers and staff was also observed between the EPPE project and the SEED study. This is in line with evidence from the UK Labor Force Survey, which covers a similar period of time (Simon et al., 2016) It is probable that this increase is related to the rise in quality levels.

During the period of time between the two studies, raising staff and manager qualifications and facilitating in-service professional development have featured in government policy initiatives. These factors are likely to increase quality

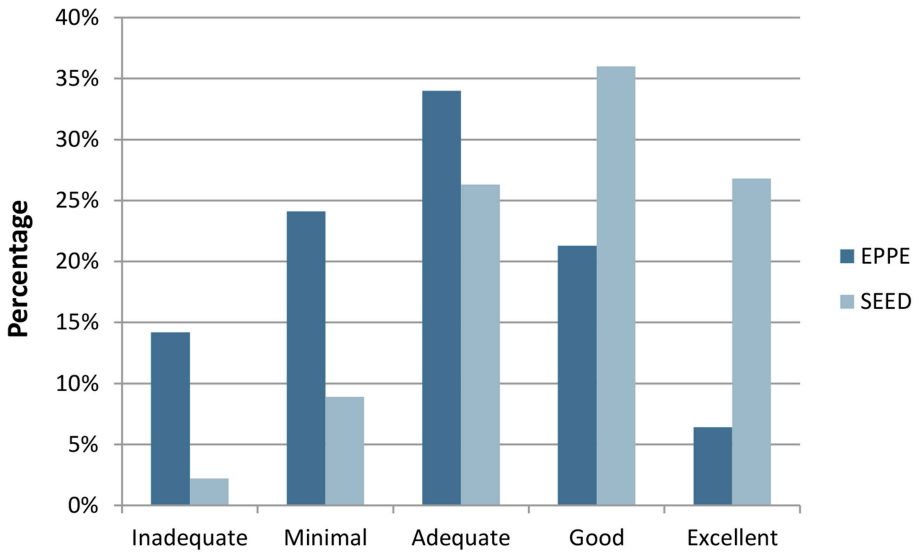

FIGURE 1 | Percentage breakdown of ECERS-R scores by quality level in the EPPE and SEED studies. Quality is classified as Inadequate (<3), minimal (≥3 and <4), adequate (≥4 and <5), good (≥5 and <6) or excellent (≥6). Figure © 2017 NatCen Social Research, University of Oxford and Action for Children, reproduced with permission.

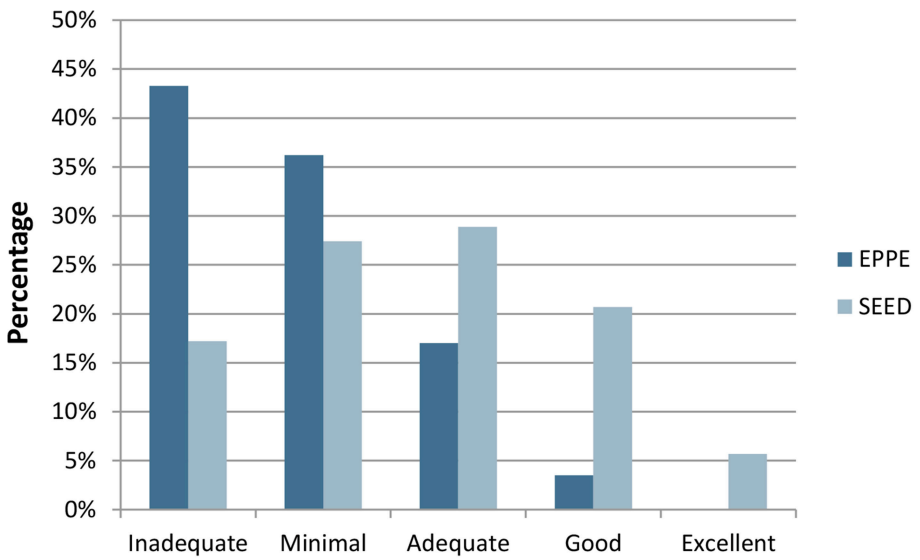

FIGURE 2 | Percentage breakdown of ECERS-E scores by quality level in the EPPE and SEED studies. Quality is classified as Inadequate (<3), minimal (≥3 and <4), adequate (≥4 and <5), good (≥5 and <6) or excellent (≥6). Figure © 2017 NatCen Social Research, University of Oxford and Action for Children, reproduced with permission.

according to the analyses of structural factors as predictors of quality. Hence these findings may indicate that the increasing professionalization of the ECEC workforce as well as influencing qualification guidelines in the early years statutory framework, as elements of the policy change over the period, are factors in the observed change in ECEC quality in the approximately 15 years between the EPPE and SEED studies.

The improvement in quality seen between the time of the EPPE and SEED study is linked to a reduction in the incidence of poor quality and a corresponding increase in medium and high quality. This is relevant to future research that explores the relationship between ECEC quality and child development. Previously, where studies have found effects upon child outcomes linked to quality the studies have typically included ECEC centres that vary substantially across the quality range including substantial amounts of poor quality. Much of the effect upon outcomes in such studies (Sammons et al., 2002; Burchinal et al., 2008; Mashburn et al., 2008; Broekhuizen et al., 2015) derives from the poorer outcomes associated with poor quality

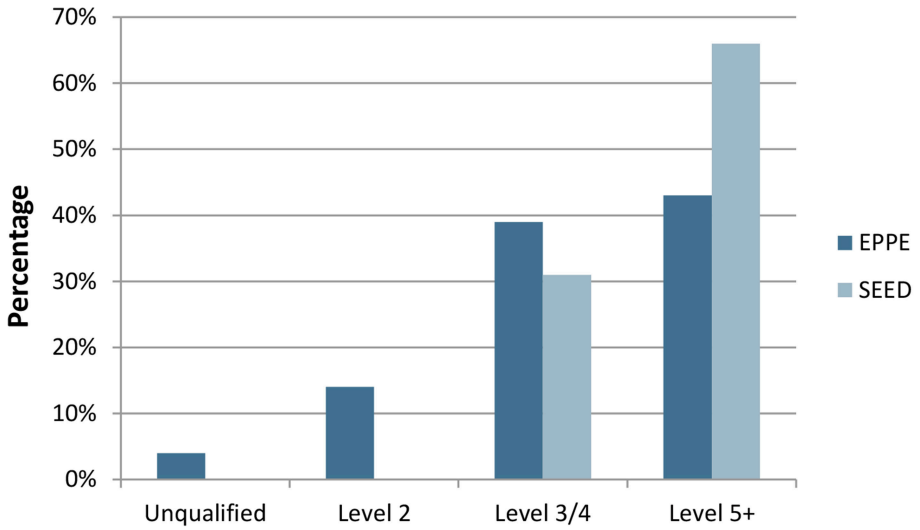

FIGURE 3 | Comparison of level of manager's qualification in the EPPE and SEED studies. Figure © 2017 NatCen Social Research, University of Oxford and Action for Children, reproduced with permission.

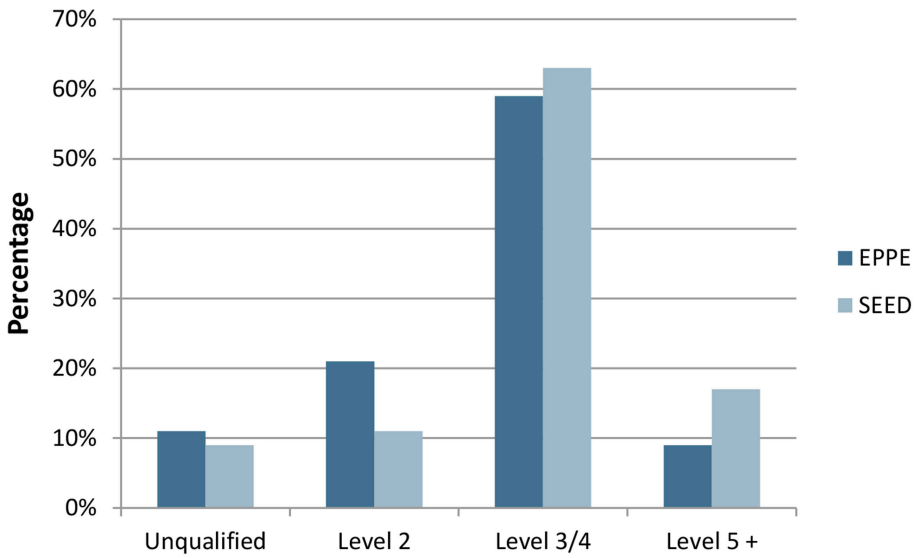

FIGURE 4 | Comparison of level of staff qualification in the EPPE and SEED studies. Figure © 2017 NatCen Social Research, University of Oxford and Action for Children, reproduced with permission.

as compared with medium to high quality. The consequence therefore of reducing the prevalence of poor quality is likely to be that quality effects upon child outcomes will be reduced and potentially be too small to be systematically of statistical significance in situations where there are a large number of covariates that are associated with powerful effects upon child outcomes. In such circumstances a study may conclude that there are no quality effects upon child outcomes, and this message may be seized upon by those (e.g., politicians) eager to reduce expenditure on maintaining good quality ECEC provision. Hence there is a socio-political danger inherent in the interpretation of a study's results without reference to the larger context of research.

Burchinal (2017) has referred to the reducing size of quality effects in more recent studies and possible reasons given are the reducing incidence of poor quality ECEC, and the inability of existing measures to adequately capture the aspects of ECEC most likely to influence child outcomes. This latter reason was the motivation behind the production of the Sustained Shared Thinking and Emotional Well-being (SSTEW) scale (Siraj et al., 2015) that focuses specifically on interactional quality likely to enhance language development and self-regulation, which

have been linked with better long-term educational and socio-emotional outcomes (Malecki and Elliot, 2002; Trentacosta and Shaw, 2009; Moffitt et al., 2013). Further work is needed in improving ECEC quality measures, including both interactional and pedagogical aspects of quality.

Educational and Policy Implications

It is increasingly clear that ECEC is a substantial contributor to the longer-term educational, social and economic success of individuals (Heckman, 2008; Melhuish et al., 2015). Hence, if a country improves ECEC quality for its children then it is not only enhancing children's lives in the "here and now" it is also advancing the long-term outcomes for children, and by doing so it is investing in the future. In the current study staff qualifications were predictive of quality at private (for profit) settings, whilst for voluntary (not for profit) settings, which were rather homogenous in staff qualifications, having a staff training plan (in-service professional development) and a better staff to child ratio were predictive of higher quality. However, state funded ECEC centres, which tend to have less favorable staff to child ratios but more highly qualified staff than private and voluntary settings, tended to have higher quality. This indicates that the presence of more highly qualified staff may be more influential on quality than the staff: child ratio, at least within the range of these variables found in the UK. Earlier findings in the UK from the EPPE study led to an increased policy emphasis on improving ECEC quality through improving staff qualifications and training (Melhuish, 2016). This change in policy seems to have borne fruit in that a comparison of equivalent quality data from separate UK studies, conducted before and after this period of policy change, found improvement both in observed quality and staff qualifications, as reported in the current study. Overall these findings indicate that countries wishing to improve the quality of their ECEC provision should actively seek to improve both staff qualifications and in-service professional development. The potential for in-service professional development to improve ECEC quality is further supported by a recent RCT study in Australia (Siraj et al., 2018) where in-service professional development had clear effects upon observed quality in ECEC as well as potential effects for child outcomes. Hence it would be appropriate for policy in this area to be framed to increase staff qualifications and to provide enhanced opportunities for ECEC staff to obtain in-service professional development. Additionally, staff: child ratios should be maintained at as favorable a level as is pragmatically viable.

CONCLUSION

Structural aspects of quality such as staff qualifications and continuous professional development as well as staff:child ratios are linked to process quality in group ECEC settings. The 20 years since the start of the EPPE study have seen great changes in the level of use of ECEC in the UK and in the nature of the ECEC provided, to a large extent because of changes in government policy. The quality of ECEC provision has risen significantly over this period, as has the typical level of qualification of staff and managers. The almost universal use of ECEC, for 3–4 year olds in the UK, and other countries, makes the effectiveness of the provision crucial for children's later development. Whilst some of the factors that produce high quality ECEC are clear, well qualified staff/managers and adequate staff to child ratios being the best attested, this is an area where further research is still needed. However, the lessons from these two UK longitudinal studies provide an important indication for other countries about ways that child development may be enhanced through policy change, contributing to improvements in child well-being and later adult development.

ETHICS STATEMENT

Ethics approval was given by the University of Oxford ethics committee. Written informed consent was obtained from all adult study participants and from the parents/legal guardians of all non-adult participants.

AUTHOR CONTRIBUTIONS

EM proposed the research hypotheses. JG carried out the data analysis. Both authors contributed to the writing of the paper and approved it for publication.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 22 February 2019
doi: 10.3389/feduc.2019.00012

A Growth Mixture Modeling Study of Learning Trajectories in an Extended Computerized Working Memory Training Programme Developed for Young Children Diagnosed With Attention-Deficit/Hyperactivity Disorder

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OPEN ACCESS

Edited by:
Vasiliki Totsika, University College London, United Kingdom

Reviewed by:
Mats Granlund, Jönköping University, Sweden
Jessica A. Church-Lang, University of Texas at Austin, United States

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Specialty section:
This article was submitted to Special Educational Needs, a section of the journal Frontiers in Education

Received: *23 July 2018*
Accepted: *04 February 2019*
Published: *22 February 2019*

Citation:
Orylska A, Hadwin JA, Kroemeke A and Sonuga-Barke E (2019) A Growth Mixture Modeling Study of Learning Trajectories in an Extended Computerized Working Memory Training Programme Developed for Young Children Diagnosed With Attention-Deficit/Hyperactivity Disorder. Front. Educ. 4:12. doi: 10.3389/feduc.2019.00012

This study explored (1) whether growth mixture modeling (GMM) could identify different trajectories of learning efficiency during a working memory (WM) training programme for young children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), compared with a typically developing (TD) control group, and (2) if learning trajectories and outcomes were different for simple and complex training tasks. Children completed simple visuospatial short-term memory (VSSTM) and complex visuospatial WM (VSWM) tasks for 15 min a day, 5 days a week, and for 8 weeks. Parent-reported executive functioning, and children's WM and attention control, educational achievement, and IQ were measured prior to (T1), immediately following (T2) and 3 months after training (T3). GMM analysis showed that WM training was represented as one learning curve, and there was no difference for the trajectories of the ADHD and TD groups. The learning trajectory for the VSSTM tasks across groups was represented as one learning curve and for the VSWM tasks there were three learning curves. Learning for the VSSTM tasks and for most children in the VSWM tasks was characterized by an inverted-U shape, indicating that training was effective for up to 15 sessions, was stable and declined thereafter, highlighting an optimal training timeframe. For the VSWM tasks, the two remaining groups showed either a U-shaped or a high inverted U-shaped trajectory, with the latter group achieving the highest T1T2 change score (i.e., children showed a lower starting point and the most gain in terms of learning and post-training performance). There were no broader benefits of training at post-test or follow-up. Further research should explore who would benefit most from intensive cognitive training, as well as the potential benefits for mental health and well-being.

Keywords: WM training, learning trajectories, young children, attention-deficit/hyperactivity disorder (ADHD), growth mixture modeling (GMM)

INTRODUCTION

Developmental research has highlighted that attentional control skills, including working memory (WM), are positively linked to several indices of adjustment in childhood and adolescence, such as emotion regulation (reviews by Hadwin et al., 2016; Moran, 2016). In addition, research has shown that performance in WM tasks in children and adolescents is positively associated with educational achievement in core subjects, including text comprehension and reading (e.g., Daneman and Carpenter, 1980; Perfetti, 1985; Baddeley, 1986) and mathematical problem solving (e.g., Bull and Scerif, 2001; Swanson and Beebe-Frankenberger, 2004). These associations are argued to reflect cognitive potential that is separate from current knowledge (e.g., Gathercole et al., 2004; Phye and Pickering, 2006; Halford et al., 2007; Cowan, 2014).

Several studies have aimed to improve attentional control via WM training in clinical populations who experience difficulty with inattention. Training typically focuses on increasing short-term memory and WM skills using adaptive procedures that are delivered across multiple 30–40 min sessions each week (Klingberg et al., 2002, 2005). Task difficulty is typically adjusted automatically to performance across sessions to maximize learning at the boundaries of an individual's competence (Cortese et al., 2015). Several studies have found that improvements in WM associated with training is underpinned by neural change (Vinogradov et al., 2012) and that some degree of adaptability is a necessary precondition for its continuity (Poldrack and Gabrieli, 2001; Lewis et al., 2009).

Evidence further suggests that WM training represents one potential avenue for reducing symptoms of inattention and hyperactivity in Attention Deficit Hyperactivity Disorder (ADHD) (Klingberg et al., 2002, 2005). Building on evidence of brain plasticity from rehabilitation science and contemporary developmental neuroscience, WM training is premised on the notion that it impacts key brain networks implicated in ADHD (Vinogradov et al., 2012). Additionally, researchers have suggested that neuropsychological deficits mediate the pathways between originating causes and ADHD symptoms. It is argued, therefore, that improvement in neuropsychological functioning, including WM, may be a prerequisite for ADHD symptom reduction (Coghill et al., 2005).

Several recent reviews of research in WM training have questioned the viability of existing training programs to impact core symptoms and improve daily functioning in individuals diagnosed with ADHD (Chacko et al., 2014). These have highlighted the lack of scientific rigor in existing studies. In addition, they have raised concerns around goodness of fit that reflects the heterogeneous symptom profile in ADHD. For example, researchers have concluded that the results of WM training studies are inconsistent because of inadequate controls and ineffective measures to understand change in core cognitive functioning (e.g., Shipstead et al., 2010). Moreover, a systematic meta-analytic review of WM training studies with children and adult populations with ADHD used stringent criteria for inclusion to ensure that all ($N = 23$) studies were either randomized controlled trials or quasi-experiments (Melby-Lervåg and Hulme, 2013). The review found collective short-term improvements in practiced skills in clinical populations diagnosed with ADHD, however, there was no clear evidence for transfer to broader cognitive functioning or generalization (i.e., a reduction of ADHD symptoms in daily life).

A further meta-analysis considered the effect of cognitive training on ADHD symptoms, comparing reported outcomes across individuals who were blind or not blind to the intervention group (Sonuga-Barke et al., 2013). The analysis showed significant positive change in parent and teacher reported ADHD symptoms, however, this effect was lost when blinded assessments were analyzed. Moreover, a further meta-analysis showed that reported improvements dropped substantially and became statistically non-significant when only blinded measures were considered (Cortese et al., 2015).

Reviews of this evidence highlight that WM training for individuals diagnosed with ADHD leads to short-term improvements in WM functions that are directly taught. Increasingly, however, the proposed effectiveness of WM training to improve inattention and the quality of daily life more broadly for children and young people diagnosed with ADHD has been met with skepticism. Given that ADHD is a neuropsychological heterogeneous disorder (Nigg et al., 2005; Willcutt et al., 2005; Noreika et al., 2013), then the promise of the effectiveness of WM training may only apply to a subgroup of individuals who show specific processing impairments (Cortese et al., 2015).

The current study extended previous work to explore the possibility that training outcomes were moderated by individual characteristics. Specifically, we used growth mixture modeling (GMM) to investigate individual differences in training efficiency by analyzing trajectories of learning performance across an extended series of training sessions (Muthén and Muthén, 1998; Muthén and Shedden, 1999). GMM is a widely applied data analysis technique used to identify unobserved heterogeneity in a population and to describe and examine longitudinal change within these sub-populations (Nylund et al., 2007; Ram and Grimm, 2009). The results will have significant implications for understanding the development of key cognitive skills known to impact emotion regulation and learning and that can be delivered in an educational context for the benefit of children and young people.

We used an intensive computer WM training protocol that was developed in-house and delivered over 40 sessions and across 8 weeks to young typically developing (TD) children and those given a diagnosis of ADHD. In addition, we measured learning post-training and 3 months later to assess its impact on taught (near transfer) and novel (far transfer) tasks. We investigated three research questions to consider (1) whether trajectories of learning in performance during WM training (i.e., an index of training efficiency) were different between individuals diagnosed with ADHD vs. TD controls; (2) whether GMM would allow us to identify sub-groups with different trajectories of training efficiency for simple and complex training tasks and (3) if different trajectories were associated with near and far transfer in non-trained outcomes. Near transfer tasks included

WM tasks completed by the children. Far transfer tasks included constructs that are known to be associated with performance in WM training (i.e., educational achievement and IQ) (Holmes et al., 2009; Jaeggi et al., 2010; Dahlin, 2011; Rudebeck et al., 2012). In addition, we also explored parent reported general behavior and cognitive ability in offspring.

MATERIALS AND METHODS

The study was registered via the ISRCTN registry as a retrospective trial (https://doi.org/10.1186/ISRCTN15153056).

Participants

We recruited one-hundred-and-twenty-six children from pre-school and primary schools located in the Warsaw area of Poland. Sixty-one TD children were free of developmental disability and any other emotional or behavioral disorders (mean age = 6.70, $SD = 0.39$, range = 5.90–7.50). Sixty-five children (mean age = 6.70, $SD = 0.39$, range = 5.90–7.50) met diagnostic criteria for ADHD (American Psychiatric Association, 2000). In addition, five children in this group had a comorbid disorder including oppositional defiant disorder ($N = 2$) or autism spectrum disorder ($N = 3$). No one in the group was using psychotropic medication (e.g., methylphenidate) for ADHD disorder. The WM training group was made up of $N = 126$ children ($N = 65$ children diagnosed with ADHD and $N = 61$ typically developing children; see **Figure 1**).

WM Training Intervention

The computerized WM training was developed by the first author and was based on a published WM training program (Thorell et al., 2009). Because children younger than 7 years typically rely on visuospatial STM and WM (e.g., Hitch and Halliday, 1983; Hitch et al., 1988), training included only visuospatial training tasks. Five visuospatial short-term memory (VSSTM) tasks based on a similar theme were included. In two tasks, participants were shown the position of a target (presented for 1,000 ms) in a series of 4 × 4 matrices and they were asked to recall its location by using the mouse to tap the squares on the computer screen. With progression multiple targets appeared at the same time and were displayed for 2,000 ms. The third VSSTM task required the participant to tap the squares on the computer screen to identify the position of a previous target in a series of 2 × 5 matrices. In the last two VSSTM tasks the child was shown the position of a target in an irregular place and had to recall all positions by tapping the mouse in each position on the computer screen.

Three visuospatial WM (VSWM) tasks used moving stimuli that switched into targets to change color one by one and the target (presented for 1,000 ms) was held in a different color. When the last target was shown, the stimuli stopped moving, the child was asked to point to the targets in the order of appearance. In the first two tasks all stimuli moved in regular way around circle and then around an irregular figure. In the last task the movement was irregular.

Each task had six levels of difficulty, and each of these had three sub-levels. Task performance was recorded as the highest score obtained in each session and where each level corresponded to the number of items that the child had to remember. There were 2 items at level 1 and 7 items at level 6. Learning (training efficiency) was calculated across eight blocks each with five training sessions (the possible score range for each block was 1–18).

The training interface provided children with feedback for correct and incorrect performance (a smiley or sad face). The task was continuously adapted across training so that the difficulty level reflected current performance (i.e., three correct trials were required in order to advance to the next level, and for each incorrect trial, difficulty decreased by three sublevels). Children were asked to complete three tasks per session. The training was scheduled so that children worked on each task equally across 40 training sessions.

Pre- and Post-training Measures of Transfer

Working Memory

Our primary measure of memory improvement was derived from a tablet-based test of Working Memory Capabilities (*Test pamięci roboczej*- TPR, Educational Research Institute) (Kaczan et al., 2014), designed for children aged 6 and 7 years. It measures three aspects of STM/WM (Oberauer et al., 2003, 2008), including a counting span task, a set switching task and a task that measured memory for spatial locations.

With respect to the counting span task, children counted balls that were the same color as a target box (located at the bottom in the left corner of the screen on each trial) and ignored balls of a different color. The number of balls to be counted on each screen varied from one to five. On each trial children were asked to count the number of balls displayed and to remember and repeat them in the order of appearance. Children completed two practice trials followed by two sets of two, three, four and five screens (eight sets in total, presented in a quasi-random order, so that the difference in number of items to be remembered between adjacent screens was not bigger than two). Scores represent the proportion of correctly recalled balls.

In the set switching task, children were presented with a series of drawings of boys' or girls' emotional faces (happy or sad) presented in a square divided into four quarters (Rogers and Monsell, 1995). The task was to switch between decision making criterions that included a YES/NO response; "YES" to a BOY'S face (if the face appeared in the upper quarter of the screen and irrespective of emotion) or a HAPPY face (if the face appeared in the lower quarter and irrespective of gender), and "NO" otherwise. The task had 6 practice trials and five sets of 12 trials, where the criterion (between gender and emotion) switched after two trials and child response triggered the next trial. On each trial, accuracy was recorded and scores reflected the proportion of correct trials.

In the spatial location memory task children were asked to remember the position of 2–5 ladybirds that appeared sequentially on a matrix (6 × 6 squares) and across 12 trials (there were three trials at each level of difficulty). The test starts with a training trial with two objects (ladybirds). Performance reflects the mean accuracy of remembered sequences between

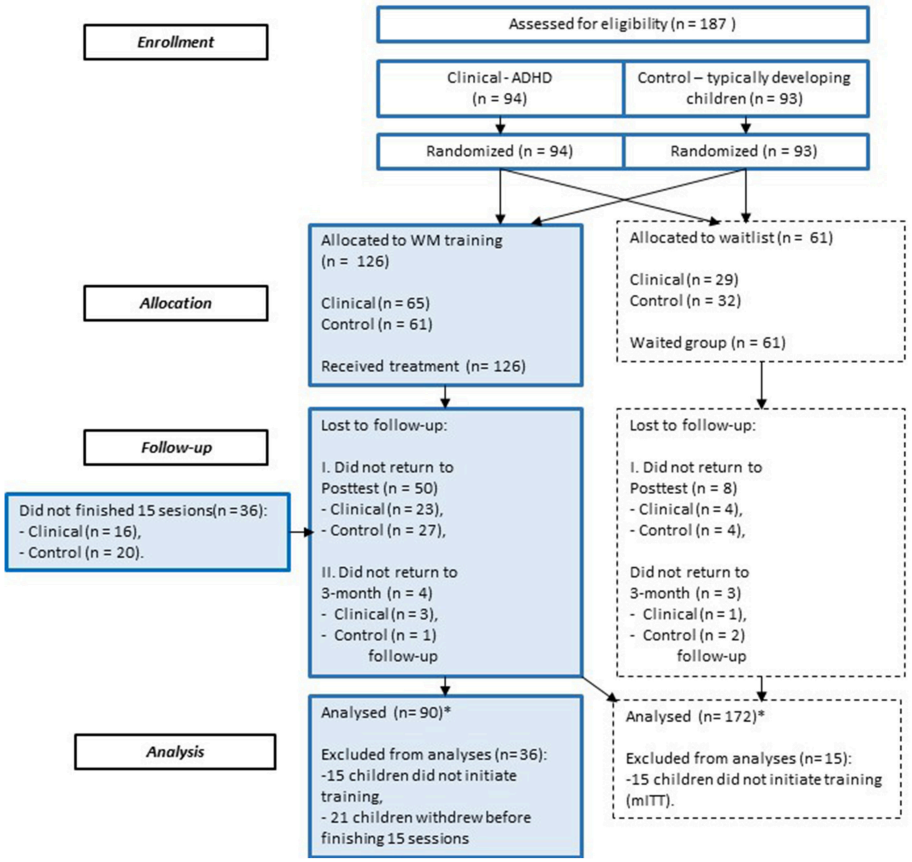

FIGURE 1 | shows the flow of participants through each stage of the study. Blue frames display participants through the intervention described in the article. *To deal with missing data we used Expectation Maximization (EM).

the presented elements and where higher scores (expressed as a proportion of correct responses) reflected increased accuracy.

Executive Attention

Attentional control was measured using a version of the Erikson Flanker task (Eriksen and Schultz, 1979). Participants were asked to identify a centrally presented target (happy face vs. unhappy) and to ignore flanker faces that were the same (congruent trials) or different (incongruent trials) to the central face. All children completed 6 practice trials (3 congruent and 3 incongruent) and 2 blocks of test trials. Each block included 32 randomly presented trials; 22 congruent (11 happy and 11 unhappy faces) and 10 incongruent trials. The main outcome measure in this task is a conflict score, calculated by subtracting the mean RT of the incongruent items from the mean RT of the congruent items on correct trials and where higher scores indicate increased distractor interference from flanker stimuli.

Parent-Reported Executive Abilities

We used a Polish version of the Behavior Rating Inventory of Executive Function (BRIEF) (Gioia et al., 2000a). The parent report BRIEF estimates executive function abilities in children ranging from 5 to 18-years-old. It includes two domains (i) behavioral regulation (inhibition, shifting and emotional control) and (ii) metacognition (initiation, WM, planning, organization of materials and monitoring). The questionnaire has 86 items and 72 are used to compute the final score (Gioia et al., 2000a). Answers are given on a 3-point Likert scale (0-never to 2-often, making a total possible global score from 0 to 144 (and sub-scale scores for behavioral regulation and metacognition; maximum scores of 56 and 88 respectively). Parents are asked to rate behavior in relation to the context of their child's everyday home setting (Gioia et al., 2000b). This questionnaire was adapted from an existing measure that was independently translated into Polish by two researchers (both fluent in English). The final version was based on these two translations and a back translation and was evaluated by a group of experts (child psychiatrists and psychologists specializing in ADHD). Questionnaire items were accepted as final when the original and back-translated versions were identical or very similar.

Educational Achievement

We used the tablet based Test of Knowledge and Competences (*Test UmiejętnościnaStarcieSzkolnym*–TUNSS; Educational Research Institute) (Kaczan et al., 2014), designed to measure knowledge and skill in mathematics, reading and writing in

6- and 7-year-olds. (1) The numeracy skills scale includes numbers, measurement, space and shape, relationships and interconnections. (2) The writing skills scale measures visuomotor, visuospatial and audiolingual skills, penmanship and writing. (3) The reading skills scale measures audiolingual, audiovisual and reading skills. The test is completed individually and it includes an introductory phase (aimed at building a relationship with children and to familiarize them with the tablet and program) and a test phase. In the test phase the child is asked to complete a maximum of 10 tasks from each scale (reading, writing and numeracy skills) and the TUNSS score provides an estimate of a child's skill levels in each area. The score was computed as a variable theta (normal distribution, scale with $M = 0$ and $SD = 1$) for each scale (reading, writing and numeracy).

IQ

We used the Raven's CPM (Raven et al., 1986) to measure general intelligence. The test is designed for 4–10-year-olds and consists of 36 items in three sets that test a child's ability to complete continuing patterns, to perceive spatial relations and for abstract thinking. The items are presented in the form of incomplete patterns or matrices and children are asked to choose the missing element from a given set of possible answers. Each item was scored 1 for correct answer or 0 for incorrect answer. The maximum score is 36. **Figure 2** presents a summary of all pre- and post-tests, follow up measures and WM training tasks.

Procedure

This study was approved by the Institutional Research Ethics of Empirical Research with the Participation of People as Persons Researched. Parents and children were invited to take part in the study via a letter and each provided informed written consent. The children were asked to practice on the training task for 15 min a day on their personal computers at home, 5 days a week for 8 weeks. There were two inclusion criteria for both groups: participants were required to have an IQ score of $\geq$85, and we asked for an overview of the child's educational and social functioning, as reported by their teacher.

Participants were assessed individually in the University of Social Sciences and Humanities laboratory at three different time points; prior to training (pre-test/T1), post-test-no more than 1 week after training was completed (T2) and follow up-3 months after completing training (T3). All assessments were conducted by research staff in a laboratory, where children also completed the working memory, attention control measures, educational achievement, and IQ test. Additionally, parents of children completed the BRIEF scale.

RESULTS

Statistical Analysis

We contrasted the training trajectories for the ADHD and the control (typical develop children–TD) groups by using latent growth curve modeling (LGCM) for time series data from the eight training blocks (one block made up 5 training sessions) (Duncan et al., 2011). First, an intercept-only model (a model with an assumption of no change in time) and then models with linear and quadratic slopes were estimated. The fit of individual models and comparisons between models were based on the chi-square value (χ^2), the normed chi-square (χ^2/df), the non-normed fit index (also known as Tucker–Lewis Index, TLI), the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), and the Information Criteria Indexes: the Bayesian Information Criterion (BIC), and the Akaike Information Criterion (AIC).

A non-significant χ^2 test indicates a good model fit, although its use is not free from limitations, especially for small sample sizes. Thus, the ratio of χ^2 to degrees of freedom was also used, with values lower than 2 assumed to be satisfactory (Tabachnick and Fidell, 2007). The TLI and CFI threshold values of 0.90 indicate satisfactory fit, whereas values above 0.95 indicate good fit (Hooper et al., 2008). For a well-fitting model, the RMSEA should be close to 0: values below 0.05 indicate a good model fit and a value of 0.08 represents reasonable errors of approximation, whereas the SRMR should be below 0.10. The model with the lower information criterion values are preferable as they indicate better fit. The group comparison (ADHD vs. TD) was based on χ^2 Wald test. The maximum likelihood (ML) as estimator was applied (Muthén and Muthén, 1998). Factor loadings corresponded directly to the blocks timing.

We then used growth mixture modeling (GMM) to identify sub-groups of individuals across groups with distinct training trajectories using data from the eight training tasks. GMM was performed with Mplus Version 7.3 (Muthén and Muthén, 1998). GMM allows the existence of latent homogeneous sub-populations of individuals within heterogeneous samples to be identified (i.e., the latent classes of individuals characterized by different learning curves). The maximum likelihood with robust standard errors (MLR) as estimator was applied (Muthén and Muthén, 1998). Factor loadings corresponded directly to the blocks timing. Both linear and quadratic slopes were estimated. Analyses were performed separately for (1) all training tasks combined, and for (2) VSSTM training tasks and (3) VSWM training tasks separately, and models for 1–4 classes were computed.

The models were compared using the Bayesian Information Criterion (BIC), the Akaike Information Criterion (AIC), the Bootstrap Likelihood Ratio Test (BLRT), the Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMRLRT), the entropy value, the subsample size, and practical usefulness of the latent training efficiency curve classes (Jung and Wickrama, 2008; Duncan et al., 2011). The model with the lower BIC and AIC values, greater entropy value ($>$0.80) indicated good fit (Jung and Wickrama, 2008; Duncan et al., 2011). The BLRT and VLMRLRT tests compare two models with different parameters. Significant p-values of tests indicated that the estimated model is preferable over a model with one fewer latent class (Nylund et al., 2007). The results were replicated to avoid local solutions (Jung and Wickrama, 2008).

Finally, we compared the subgroups identified using GMM in terms of pre-, post-intervention changes in our transfer of training measures. In order to compare training effects for sub-groups of children with different trajectories using

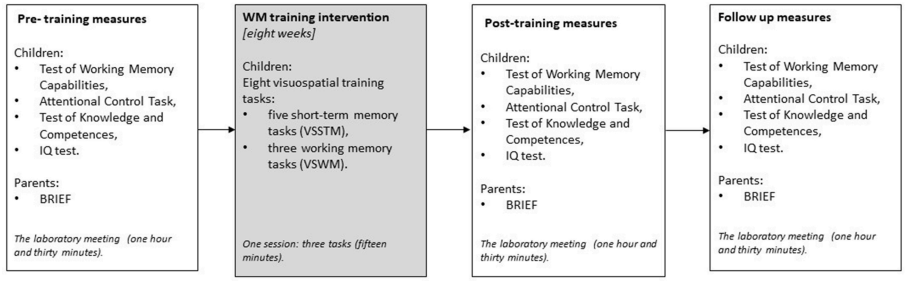

FIGURE 2 | presents a summary of all pre- post-tests, follow up measures and WM training tasks.

one-way ANOVA analyses (SPSS Version 22) with GMM sub-group membership as baseline (pretest outcome measures) and change indicators including (1) pretest—posttest (T1T2) and (2) pretest—follow-up (T1T3) as the dependent (created by standardized regression residuals) (Duncan et al., 2011). Increasingly positive scores indicated positive change, scores that tend to zero reflect no change, and negative scores indicate negative change.

Missing Data

Missing training efficiency data varied between 2.2 and 28% per participant across training blocks. In order to maintain the full time series missing data was modeled using Full Information Maximum Likelihood (FILM) estimation with robust standard errors (Asparouhov and Muthen, 2010). This approach uses all observations in the dataset to produce the maximum likelihood estimation parameters without imputing data and is reported to be one of the best approaches currently available to handle missing time series data (Graham, 2009). Missing data in non-trained outcome measures (working memory, executive attention, educational achievement and IQ) varied from 1.1 to 28.9% across all measures. We used Expectation Maximization (EM) (Dong and Peng, 2013) to deal with missing pre- and post-intervention data, that were imputed with maximum likelihood values (Acock, 2005; Schlomer et al., 2010; Dong and Peng, 2013). Additionally Missing Value Analysis (Little's MCAR test) was consistent with a "missing at random" assumption for training tasks and non-trained outcome measures (Chen and Little, 1988).

Training Compliance

Ninety participants (71% overall), 41 TD (67%) and 49 ADHD (75%), completed 15 or more training session within 8 weeks (our minimum compliance criteria). Fifteen children did not initiate training, 21 children withdrew before finishing 15 sessions. Overall, compliance to the intervention was good, in the context of a long and intensive home-based intervention parent-supported intervention delivered via the Internet (40 sessions over 8 weeks). Across 90 participants, 94% ($N = 85$) finished 20 sessions (1 block), 91% ($N = 82$) finished 25 (2 blocks), 88% ($N = 79$) finished 30 (3 blocks), 72% ($N = 65$) finished 35 (4 blocks), and 62% ($N = 56$) finished 40 sessions (5 blocks).

Process Measures

Compliance was defined as completing ≥15 of the 40 training sessions within a 8-week period. Using this algorithm, each child was categorized as compliant or noncompliant to treatment.

Does Training Efficiency Follow Different Trajectories Between ADHD and TD Groups?

Table 1 shows the fit indicators for the unconditional growth models (stability, linear and quadratic change) based on all training (VSSTM and VSWM) tasks performed over 8 blocks of training. For all outcomes the quadratic slope model fitted better than the intercept-only and linear models, thus, the assumption of quadratic change over training in the whole sample is preferred, over the assumption of no change or linear change.

Means and variance of intercept and slopes in each task were significantly different from zero (see **Table 2**). When group was considered as a whole there was a significant increase and then decrease in latent tasks scores across time (i.e., the quadratic slope has a negative sign). There was also a significant slope factor variance. That means that children differed, not only in their initial latent task scores, but also in their training trajectories over time. However, the training trajectories of ADHD and TD groups did not differ significantly across all tasks (χ^2 Wald test $= 0.155$, $df = 1$, $p = 0.694$), for the VSSTM (χ^2 Wald test $= 0.895$, $df = 1$, $p = 0.344$), and the VSWM (χ^2 Wald test $= 3.706$, $df = 1$, $p = 0.054$) tasks.

Are There Sub-groups of Individuals Marked by Different Trajectories of Learning/Training Efficiency?

Table 3 presents the descriptive statistics for performance across training sessions for all tasks, and for the VSSTM and VSWM tasks separately and for the participant group as a whole. Models were generated for the total group of participants and across 8 blocks of training efficiency (see **Table 4**). With respect to all training tasks, the entropy value and the AIC value supported a two-class model, whereas the BIC value supported the one-class solution. VLMRLRT and the BLRT tests indicated that two- or more-class models were not superior to the one-class solution. Based on these indices, the one-class model was considered as the best fit model. With respect to the VSSTM, the AIC, the

TABLE 1 | Fit indicates for latent growth curve modeling (LGCM) models based on all memory training tasks (WMT) combined, and for visuospatial short-term training tasks (VSSTM) and visuospatial working memory training tasks (VSWM) over 8 learning sessions and across the whole sample ($N = 90$).

	Loglikeli-hood	AIC	BIC	χ^2	*Df*	*P*	χ^2/df	RMSEA	CFI	TLI	SRMR
WMT											
Intercept	−1282.75	2585.50	2610.49	322.47	34	0.000	9.48	0.307	0.537	0.618	0.245
Linear	−1258.32	2542.65	2575.15	273.62	31	0.000	8.83	0.295	0.610	0.648	0.295
Quadratic	−1168.11	2368.11	2408.22	93.20	28	0.000	3.33	0.161	0.895	0.895	0.080
VSSTM											
Intercept	−1261.02	2542.03	2567.03	231.01	34	0.000	6.79	0.254	0.597	0.668	0.321
Linear	−1248.46	2522.91	2555.41	205.89	31	0.000	6.64	0.250	0.642	0.677	0.259
Quadratic	−1176.02	2386.03	2428.53	61.01	27	0.000	2.26	0.118	0.930	0.928	0.129
VSWM											
Intercept	−1283.75	2587.50	2612.50	112.93	34	0.000	3.32	0.161	0.830	0.860	0.113
Linear	−1264.13	2554.26	2586.76	73.69	31	0.000	2.38	0.124	0.908	0.917	0.107
Quadratic	−1251.79	2537.59	2580.08	49.01	27	0.006	1.81	0.095	0.953	0.951	0.073

AIC, Akaike's Information Criterion; BIC, the Bayesian Information Criterion; RMSEA, the Root Mean Square Error of Approximation; CFI, the Comparative Fit Index; TLI, the non-normed fit index; SRMR, the Standardized Root Mean square residual.

TABLE 2 | Means and variances in latent growth curve modeling (LGCM).

	Intercept		Slope linear		Slope quadratic	
	M (SE)	*SD² (SE)*	*M (SE)*	*SD² (SE)*	*M (SE)*	*SD² (SE)*
WMT	9.219** (0.174)	2.729** (0.407)	0.872** (0.081)	0.398** (0.083)	−0.133** (0.012)	0.006** (0.002)
VSSTM	9.712** (0.179)	2.473** (0.459)	0.861** (0.099)	0.567** (0.137)	−0.121** (0.014)	0.008* (0.002)
VSWM	8.680** (0.224)	3.866** (0.647)	0.335* (0.097)	0.440** (0.135)	−0.038* (0.012)	0.006* (0.002)

*WMT, all training tasks; VSSTM, visuospatial short term memory tasks; VSWM, visuospatial working memory tasks; *p < 0.01; **p < 0.001.*

BIC values, as well as the VLMRLRT test, supported the one-class model. In contrast, the *p*-values of the BLRT test indicated that the two-class model was superior ion. Based on these indicators, but primarily the meaningfulness of the identified curves of training efficiency and class sizes, the one-class model was chosen. With respect to the heterogeneity of the learning curve of VSWM, the AIC and the BIC values supported the four- or one-class model respectively. The remaining indices supported the three-class solution. Based on the meaningful curves of training efficiency the three-class model was considered as the best fitting model.

According to GMM analyses, the whole sample ($N = 90$) across all WMT tasks represented an inverted U-shaped category (intercept = 9.22, $SE = 0.17$, slope = 0.87, $SE = 0.09$, quadratic = −1.13, $SE = 0.01$, $p < 0.001$), indicating gradual increase to Block 3 (15 sessions), followed by stability and then a decrease thereafter (see **Figure 3A**). Similar results were found for VSSTM tasks performance. Here training efficiency patterns followed a curvilinear trajectory, increasing to Block 3, stability and followed by a decrease (intercept = 9.71, $SE = 0.18$, slope = 0.86, $SE = 0.09$, quadratic = −0.11, $SE = 0.01$, $p < 0.001$), see **Figure 3B**. The analysis for the VSWM produced a three-class model. In this case, more than half of the sample ($N = 69$; 76.7%) was characterized by an inverted U-shaped (see class 2; intercept = 8.41, $SE = 0.23$, slope = 0.47, $SE = 0.08$, quadratic = −0.06, $SE = 0.01$, $p < 0.001$), with performance, increasing to block 3, stability and subsequently decrease. The second group (class 1, $N = 14$; 15.5%) was characterized by a U-shaped curve, with the highest starting scores then deterioration of performance up to block 5 and then slight increase (intercept = 10.05, $SE = 0.83$, slope = −0.94, $SE = 0.25$, quadratic = 0.13, $SE = 0.03$, $p < 0.001$). The smallest group (class 3; $N = 7$; 7.8%) was characterized by a high inverted U-shaped curve (intercept = 7.48, $SE = 0.99$, slope = 2.15, $SE = 0.26$, quadratic = −0.24, $SE = 0.03$, $p < 0.001$), highlighting the lowest starting scores and the highest improvement in performance across training (see **Figure 3C**).

Do GMM Training Trajectory Groups Predict Transfer to Different Measures?

Table 5 presents the descriptive statistics for outcome measures for the three trajectory groups (from GMM in VSWM training tasks). Considering associations between learning and change between pretest-posttest (T1T2) outcome measures, the results showed a statistical trend toward significance for group for the spatial location memory task [$F_{(2,89)} = 2.60$, $p = 0.080$, $\eta^2 = 0.06$]. Here, the class 3 achieved the highest change T1T2 score in spatial location memory task (M =0.39, $SD = 0.18$). Furthermore, class 1 had a trend toward a significant greater improvement in T1T2 spatial location memory task (M =0.32, $SD = 0.13$), compared with sub-group class 2. All other results were not significant.

TABLE 3 | Performance for working memory tasks for the typically developing and children with ADHD over 8 blocks (each with 5 sessions) for all working memory training tasks (WMT) combined, and for visuospatial short-term training tasks (VSSTM) and visuospatial working memory training tasks (VSWM) separately ($N = 90$).

Tasks	Block 1 *M* (*SD*)	Block 2 *M* (*SD*)	Block 3 *M* (*SD*)	Block 4 *M* (*SD*)	Block 5 *M* (*SD*)	Block 6 *M* (*SD*)	Block 7 *M* (*SD*)	Block 8 *M* (*SD*)
WMT	9.22 (1.66)	10.19 (2.06)	10.77 (2.30)	10.54 (2.11)	10.57 (2.36)	10.08 (2.38)	9.27 (1.95)	9.15 (2.07)
VSSTM	9.68 (1.70)	10.56 (2.04)	11.04 (2.41)	11.32 (2.17)	11.27 (2.54)	11.21 (2.65)	10.13 (2.16)	10.16 (2.37)
VSWM	8.60 (2.04)	9.16 (2.30)	9.50 (2.45)	9.38 (2.28)	9.03 (2.11)	9.04 (2.31)	9.24 (2.30)	9.06 (2.03)

TABLE 4 | Fit indices for GMM models based performance for WM tasks for the typically developing and clinical intervention groups over 8 blocks (with including 5 sessions) for all tasks combined (WMT) and for visuospatial short term memory (VSSTM) and visuospatial working memory tasks (VSWM) separately ($N = 90$).

Model	Log likelihood	Entropy	AIC	BIC	VLMRLRT (*p*-value)	BLRT (*p*-value)	Class sizes (*n*)
WMT							
1 class	−1168.11	-	2368.23	**2408.22**	-	-	90
2 class	−1157.16	**0.971**	**2358.33**	2413.32	0.297	0.109	5/85
3 class	−1156.95	0.842	2363.91	2426.40	0.650	0.375	63/4/23
4 class	−1153.74	0.716	2369.48	2446.98	0.555	0.999	11/25/6/48
VSSTM							
1 class	−1176.02	-	**2386.03**	**2428.53**	-	-	90
2 class	−1186.85	0.698	2411.69	2459.19	0.127	**0.000**	27/63
3 class	−1168.17	**0.734**	2386.33	2448.83	0.170	0.267	36/20/34
4 class	n/a[a]	n/a	n/a	n/a	n/a	n/a	n/a
VSWM							
1 class	−1251.79	-	2537.59	**2580.08**	-	-	90
2 class	−1259.12	0.778	2557.12	2604.61	0.040	0.000	74/16
3 class	−1245.23	**0.863**	2540.46	2602.95	**0.028**	**0.030**	14/69/7
4 class	−1237.52	0.714	**2537.04**	2614.54	0.379	0.500	5/39/34/12

AIC, Akaike's Information Criterion; BIC, the Bayesian Information Criterion; VLMRLRT, the Voug-Lo-Mendel-Rubin Likelihood Ratio Test; BLRT, the Bootstrap Likelihood Ratio Test. Best fitted parameters are bolded.

[a] *Model did not converge.*

DISCUSSION

The current study extended previous research to utilize GMM to explore learning/training efficiency during an extended WM training protocol for TD children and children given a diagnosis of ADHD. We examined performance curves using GMM across 40 training sessions (represented in 8 blocks) to explore performance between groups and across the sample. In addition, we investigated whether child characteristics were important in understanding individual differences in learning. Furthermore, we considered learning for simple and complex training tasks on training efficiencyand transfer to tasks that were conceptually similar to trained tasks (near transfer), as well as those not associated with training (far transfer).

Considering group differences in training efficiency, the results showed that young children diagnosed with ADHD did not differ from the TD group in their learning trajectories, and where this result was evident for all training tasks combined and when considering training on learning simple VSSTM, as well as more complex VSWM tasks. Specifically, the results showed that across groups learning during WM training (across all WM and for simple short term memory tasks) was characterized by an inverted-U highlighting initial learning (increased performance to block 3; around 15 training sessions), stability and then gradual decrease in performance. When learning more complex tasks (VSWM), three independent learning curves were identified; most children followed the same inverted-U trajectory described above, and two smaller groups were characterized by a U-shaped curve (a high starting point, followed by initial deterioration and then increase) or a sharp inverted-U, that showed the largest increase in learning over the first three blocks. Further analysis highlighted that this latter group showed the lowest pre-training WM scores and the highest T1T2 change.

The results provide a novel set of findings associated with training WM in young children. They highlight that across training tasks learning was most evident in the first 15 training sessions, it then remained stable and showed some deterioration thereafter. The results indicate that WM training is most effective in the short term, and that young children (at least in this sample) did not benefit from an extended approach to training. These results contradict previous findings from adult samples, where a greater number of training sessions was linked to more effective outcomes (Jaeggi et al., 2008; Schmiedek et al., 2010). This difference raises the possibility that the motivation for intense and sustained intellectual effort across weeks in young children is different compared with adults. It is possible that adults have

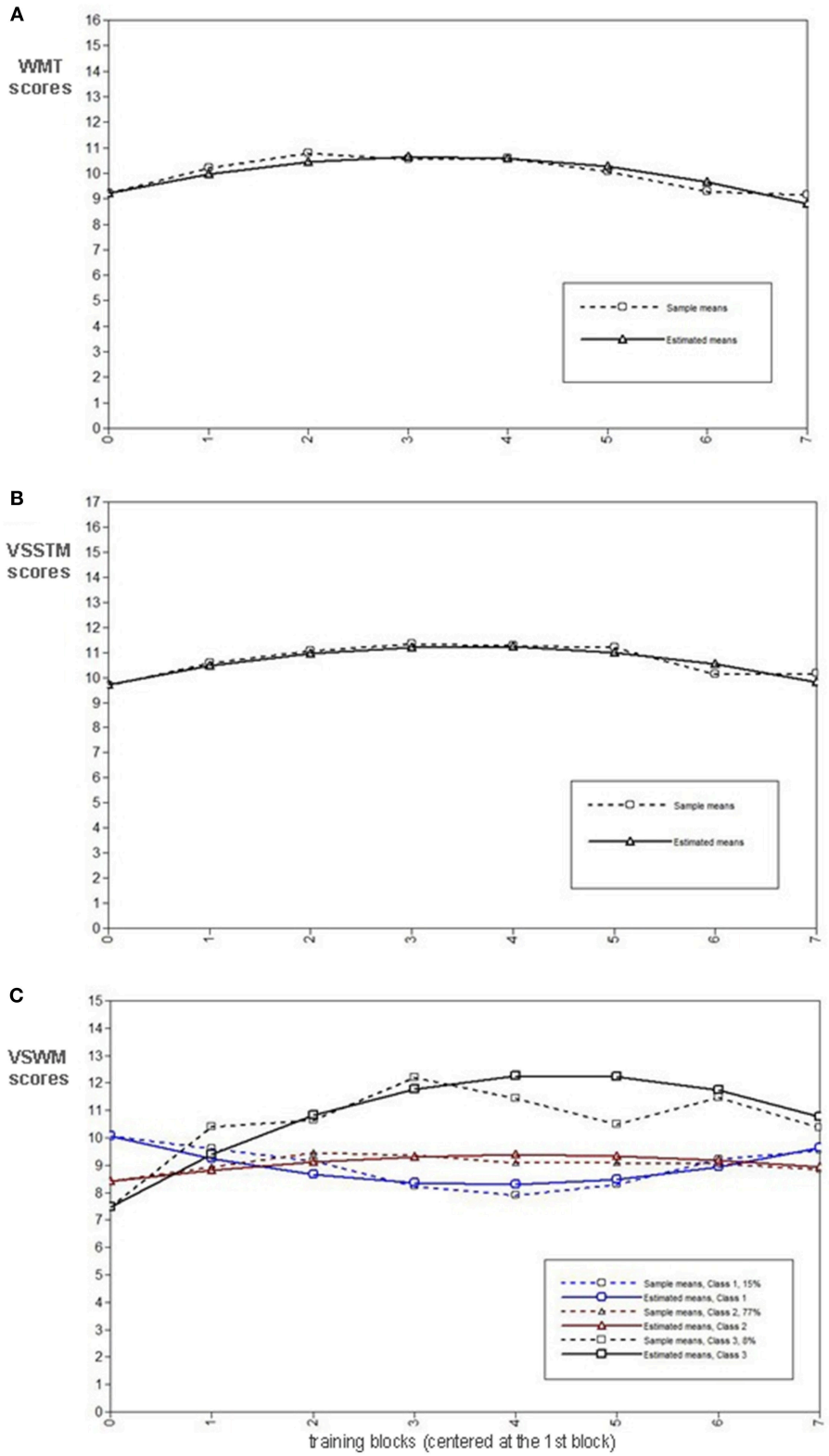

FIGURE 3 | latent learning curve over 8 blocks for all tasks in all working memory training tasks (WMT; **A**), visuospatial short-term training tasks (VSSTM; **B**) and visuospatial working memory training tasks (VSWM; **C**) separately ($N = 90$).

TABLE 5 | Performance for pre-test outcome measures for three trajectory groups (from GMM in VSWM training tasks).

Pretest outcome measures	Class 1 (U-shaped curve)		Class 2 (inverted U-shaped curve)		Class 3 (high inverted U-shaped curve)	
	M	(*SD*)	*M*	(*SD*)	*M*	(*SD*)
WM global	0.76	0.11	0.73	0.09	0.71	0.07
Counting span	0.51	0.24	0.47	0.21	0.44	0.24
Set switching	0.87	0.12	0.81	0.14	0.89	0.06
Spatial STM	0.91	0.09	0.91	0.06	0.82	0.12
Flanker	−3.10	252.81	79.50	331.34	244.61	228.84
BRIEF global	61.08	19.04	53.90	24.35	63.79	26.41
Behavioral regulation	21.93	11.06	20.64	11.30	24.57	12.71
Metacognition	40.14	15.79	35.38	16.06	41.00	18.16
Knowledge/global	0.40	0.80	0.38	0.63	0.17	0.63
Maths	0.40	1.24	0.65	0.47	0.54	0.54
Reading	0.35	1.03	0.38	0.95	0.10	0.91
Writing	0.46	0.99	0.11	0.84	−0.12	0.74
IQ	24.64	3.71	25.21	4.03	23.14	5.27

Pretest measures: Test of Working Memory Capabilities (WM Global score and subscale scores: Counting Span, Set Switching, Spatial Short Term Memory), Attentional Control (Flanker Conflict Score), Behavior Rating Inventory of Executive Function (BRIEF) Questionnaire (Global and Behavioral Regulation and Metacognition Subscale Scores), Test of Knowledge and Competences (Global and Maths, Writing and Reading skills subscale scores) and IQ (Raven's Colored Progressive Matrices).

increased metacognitve skills in learning and therefore may be more aware of the potential benefits of their efforts. Alternatively, children may have a limited ability to acquire new mnemonic strategies, and while existing techniques allow them to learn quickly at the beginning of training, this limitation may prevent them from developing further as the training progresses. This explanation is consistent with the development of short term memory, which highlights that it is not until middle childhood (around 7 years of age) that children will typically start to utilize mnemonic strategies to enhance performance in memory tasks (Cowan, 1997). Further studies into the potential moderators of outcome, for example, an exploration of the function of mnemonic techniques and metacognitive awareness in learning would allow for further delineation of children who might benefit most from training.

The results also highlighted training in the most complex tasks revealed a different pattern of learning efficiency. Specifically, they indicated that a small subgroup of children who performed less well at pre-test benefitted most from training and achieved the highest change score (T1T2) in complex spatial WM tasks (showing a high inverted U-shaped training curve). This finding highlights most benefit for this group of children on near transfer tasks, i.e., those that tap working memory function (vs. attentional control more broadly; see also Oberauer et al., 2008). The current study did not reveal benefits to executive functioning more broadly or to parent reports of daily behavior and educational achievement, see also Chacko et al. (2014) for similar results. In addition, one further group of children in the current study did not show any benefit of training. While the lack of transfer to distant, non-trained tasks in the current study might reflect the decline in learning over the course of the program, this result is consistent with recent reviews of WM training which suggest that WM training has most impact on tasks that are most similar to those that are trained (Shipstead et al., 2010). In the current paper, the results suggest that children who show difficulties with WM benefitted most from training. Future research should be focused more carefully on identifying further sub-groups that might benefit from WM training.

The current study revealed that most children were able to show improvements in WM tasks during training and where this increase was most effective for 15 sessions of training (with stability and decrease thereafter). In addition, it highlighted that children who experienced the lowest scores on WM tasks showed most learning and broader benefits post-training in similar non-trained WM tasks. There was no evidence of broader benefits in attention tasks or on parent-reported daily functioning and educational achievement. Future research should focus on possible enhancement of the capacity working memory through training and the possibility of far transfer (e.g., academic skills). Further studies into the potential moderators of outcome, for example, an exploration of the function of mnemonic techniques and metacognitive awareness in learning would allow for further delineation of children who might benefit from training. The results indicate that those young children who show difficulties with tasks that require attentional control in an educational context might benefit from WM training, and further research should focus on understanding whether there are longer term benefits of enhancing working memory skills in the short term. In addition, the research field would benefit from the use of standardized and reliable and valid tests to assess executive functions and evaluate the effectiveness of training tasks. This could facilitate a more accurate analysis of cognitive training effectiveness and the stability of its effects over time.

The present study had several limitations. In order to understand potential change associated with time or the active nature of this intervention, the study would have benefitted from a placebo intervention group, as well as a passive control group. In addition, WM training was conducted via the Internet

and the children participated under parental supervision, consequently, we were not able to monitor treatment integrity across the intervention. Moreover, a diagnostic approach that generated a continuous measure of ADHD would have enabled a comprehensive profile of symptoms across the entire sample.

DATA AVAILABILITY

Please see registration: ISRCTN15153056 https://doi.org/10.1186/ISRCTN15153056 working memory training effects on young children's functioning.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of Study Protocol Approved by Ethics Committee, SWPS University of Social Sciences and Humanities, Warsaw, Poland "Training, motivation and maturation influences on the development of executive functions at early childhood," [Komisja ds. Etyki Badań Empirycznych z Udziałem Ludzi jako Osób Badanych, Warszawa, Polska "Wpływ treningu motywacji, dojrzewania na rozwój funkcji wykonawczych u dzieci we wczesnym wieku rozwojowym"] with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Ethics Committee, SWPS University of Social Sciences and Humanities, Warsaw, Poland; number 2/V/11-12 [Komisja ds. Etyki Badań Empirycznych z Udziałem Ludzi jako Osób Badanych, Warszawa, Polska; nr 2/V/11-12].

AUTHOR CONTRIBUTIONS

AO, JH, AK, and ES-B: contributed to the conception and design of the study; AO: organized the database, the project administration and was the research leader; AO and AK: performed the statistical analysis; AO, AK, and JH: wrote the first draft of the manuscript; AO, JH, AK, and ES-B: wrote sections of the manuscript. All authors contributed to manuscript revision, read and approved the submitted version.

FUNDING

This research and preparation of the paper were supported by grants from the National Science Centre, Poland (UMO-2011/03/N/HS6/04849 and UMO-2014/12/T/HS6/00216).

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 03 September 2018
doi: 10.3389/feduc.2018.00066

A Mindfulness-Based Intervention for Students With Psychiatric Disorders in a Special Education Curriculum: A Series of n-of-1 Trials on Internalized and Externalized Symptoms

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Background: Mindfulness-based interventions (MBIs) constitute a promising option to alleviate psychological symptoms in students with psychiatric disorders.

Objective: This study evaluated the impact of a MBI on psychological symptoms of elementary school students with psychiatric disorders in a special education curriculum.

Method: A series of n-of-1 trials with an experimental A-B-A design and 10 assessment time-points was used. Participants were two special education classrooms of elementary school students (Group A, $n = 7$; Group B, $n = 6$; $n_{total} = 13$) and their teachers.

Results: Analyses showed that, at follow-up, students from Group A reported significant decreases in inattention and a trend ($p = 0.051$) was observed in anxiety symptoms, whereas their teacher reported only deteriorating anxiety scores. No significant results were found in students from Group B.

Conclusion: Results from this study show substantial variation between students, tested cohorts and raters of internalizing and externalizing symptoms and behaviors. Therefore, the conservative conclusion from such variation can only be that more research is needed, as no firm conclusion as to the utility of MBIs for such groups of children with special education needs can be established.

Keywords: school psychology, mindfulness-based interventions, psychiatric disorders, internalized symptoms, externalized symptoms, mental health

OPEN ACCESS

Edited by:
Claudio Longobardi,
Università degli Studi di Torino, Italy

Reviewed by:
Sharinaz Hassan,
Curtin University, Australia
J.E. Hall,
University of Southampton, United Kingdom

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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *12 April 2018*
Accepted: *31 July 2018*
Published: *03 September 2018*

Citation:
Malboeuf-Hurtubise C, Taylor G, Paquette L and Lacourse E (2018) A Mindfulness-Based Intervention for Students With Psychiatric Disorders in a Special Education Curriculum: A Series of n-of-1 Trials on Internalized and Externalized Symptoms. Front. Educ. 3:66. doi: 10.3389/feduc.2018.00066

INTRODUCTION

In Canada, 20% of students suffer from a mental health problem, causing significant educational and psychosocial adaptation difficulties (Canadian Teachers' Federation., 2012). These problems jeopardize academic achievement and lead to impaired functioning in school-based settings (Oberle et al., 2014). Students with psychiatric disorders show important deficits on several levels: cognitive (e.g., more or less severe and frequent loss of contact with reality, incoherent speech, academic delays), emotional (e.g., anxiety, irritability, and/or depression symptoms, aggressiveness), behavioral

(e.g., bizarre or incoherent behavior, limited interests, opposition, and disorganized behavior) and social skills (e.g., withdrawal, rejection from peers). They also present significant levels of internalized and externalized symptoms (Lavoie et al., 2017). These difficulties can be linked to significant deficits in emotional regulation skills. Special education classrooms for students with severe psychiatric disorders typically regroup youth showing a vast array and heterogeneity in symptoms and diagnoses, namely because of administrative constraints and paucity of space and resources. Thus, these children are very often regrouped within the same classrooms. Faced with such an important proportion of psychological problems, it appears crucial to develop empirical and skill-based interventions adapted to the reality of these very heterogeneous classrooms. Mindfulness-based interventions (MBIs) are increasingly implemented in school-based settings to foster better emotional regulation skills and higher resilience to stress in students with special education needs such as severe learning disabilities and psychological disorder diagnoses (Malboeuf-Hurtubise et al., 2017c). This article presents a first, small-scale attempt to conduct research on a MBI with two small classes of special needs boys. Specifically, the goal of this n-of-1 trial design was to evaluate the impact of a MBI on internalized and externalized symptoms in two groups of elementary school students with psychiatric disorders in a special education curriculum.

Mindfulness-Based Interventions in School-Based Settings

Mindfulness can be defined as "…the process by which we pay attention in a particular way, on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994). Mindfulness research in youth is still considered to be in its early phase, although there has been a significant amount of articles published in recent years documenting the impact of MBIs for children and adolescents (Taylor and Malboeuf-Hurtubise, 2016). Evidence from a recent meta-analysis suggests that MBIs hold promise in reducing internalized symptoms ($d = 0.37$) such as anxiety, depression, and inattention, while promoting better emotional and stress regulation skills in youth both in regular classrooms and with an identified psychological disorder (Zenner et al., 2014; Zoogman et al., 2014). For the purposes of this article, we present results from research evaluating the impact of MBIs that were adapted, developed and inspired from the Mindfulness-Based Stress Reduction (Kabat-Zinn, 2003) and/or Mindfulness-Based Cognitive Therapy (Segal et al., 2018) interventions, in which the major component of all cited interventions constitutes the practice of mindfulness meditation itself.

Mindfulness-Based Interventions as Universal Prevention

In school settings, the impact of MBIs has been studied with students in regular classrooms and students in a special education curriculum. In regular classrooms, from a universal prevention perspective, mindfulness has been shown to decrease inattention symptoms and overall internalized problems in elementary school students with no known psychological difficulties, when compared to students in an active emotion awareness intervention control group (Crescentini et al., 2016). Decreases in anxiety have also been reported in elementary school children from regular classrooms, in comparison to wait-list controls (Tarrasch et al., 2017). In a recent study, Sibinga et al. (2016) have reported similar decreases in depressive symptoms, rumination and negative affect in elementary school students from regular classrooms in underprivileged neighborhoods, when compared to an active health education control group, indicating that MBIs can be useful in alleviating the negative impact of stress in these students. Finally, using a similar study design, Schonert-Reichl et al. (2015) have reported that mindfulness had a positive impact on elementary school students' social and emotional regulation skills, while decreasing depressive and aggressiveness symptoms. Overall, the available evidence tends to indicate that MBIs are useful in promoting better mental health and coping strategies in school settings for children in regular classrooms with no identified psychological diagnoses, namely by acting preventively on stress and on the emotional burden that children experience daily.

Mindfulness-Based Interventions as a Transdiagnostic Treatment Option and as Targeted Prevention

In recent years, researchers have started to investigate and evaluate the impact of transdiagnostic treatments to alleviate symptoms of psychological disorders in youth and adults (Boswell et al., 2014). This line of research aims to evaluate and develop unified evidence-based treatment options that can be applied across different psychological conditions and diagnoses. As such, MBIs have been identified as potentially good transdiagnostic options for treating various psychological disorders in children (Malboeuf-Hurtubise et al., 2017b). However, to date, this research remains preliminary and results are still inconclusive.

Students with identified disabilities in special education curriculum classrooms rarely present homogeneous conditions and diagnoses, and, thus, would greatly benefit from the development of such transdiagnostic MBI treatments. However, the amount of research published on the impact of MBIs for elementary school students with special education needs (e.g., students in a special education curriculum or students with an identified mental health disorder) is far less voluminous. The available evidence shows contradictory results regarding the benefits of mindfulness practice in this population. For example, a recent article presenting results from a quasi-experimental, one group pre-test post-test design for elementary school students with severe learning disabilities showed that MBIs could be useful in decreasing anxiety, depression, inattention, and aggressiveness in these students, thereby alleviating the psychological distress and overall mental health burden associated with severe learning disabilities (Malboeuf-Hurtubise et al., 2017c). On the other hand, inconclusive results were found in three elementary school students suffering from major depressive and anxiety disorders, as two participants reported improvements on anxiety and depression, while their teachers reported deteriorating scores on these variables (Malboeuf-Hurtubise et al., 2017b). These preliminary, contradictory results suggested that caution should

be exercised when considering the overall applicability of MBIs as a universal treatment option for children with special education needs in elementary schools. Furthermore, the small number of current studies highlights the need to document the impact of MBIs in greater detail for students who have underlying mental health issues, to determine in which contexts and with what populations (e.g., as a transdiagnostic clinical intervention for children with a variety of mental health disorders or a clinical intervention for children with a specific mental health disorder, such as an anxiety disorder, ADHD or major depressive disorder) this practice can be of use to decrease internalized and externalized symptoms.

Elementary school students struggling with severe mental health problems are particularly vulnerable to physical and psychological stress, along with psychological distress (Mental Health Commission of Canada, 2013). Given the high cost of these psychological difficulties on a personal, social and school level, it is paramount to pay attention to these issues, in order to foster better mental health and to avoid future psychosocial adaptation problems in these students (Smetanin et al., 2015). However, there is a paucity of available MBI research on this issue. Only two studies were found pertaining to the impact of a MBI for adolescents with psychiatric disorders in a psychiatric setting. Results from these studies indicated that the intervention had an overall positive impact on mood (decreasing, namely, anxiety and depression), self-regulation, self-esteem, and social skills in adolescents with severe mood and anxiety disorders, oppositional-defiant and conduct disorders, attention deficit and hyperactivity disorders and reactive attachment disorders (Biegel et al., 2009; Van Vliet et al., 2017). To our knowledge, no published quantitative study has ever evaluated the impact of a MBI for children with similar psychiatric disorders in a school-based setting.

N-of-1 Trials

N-of-1 trials are used to evaluate within-subject differences over time. Research projects using N-of-1 trials can be comprised of one person (i.e., case study) or multiple individuals (Wood and Brown, 1994; Molenaar and Campbell, 2009). This design has been suggested to be especially relevant and informative in intervention development and research, such as MBI research for youth in school-based settings. Through the use of repeated measures, N-of-1 trials provide large amounts of data that allow for a detailed study of change in targeted variables, longitudinally (Schork, 2015). Although the main concern with n-of-1 trials is not generalizability, with large enough sample sizes, results from multiple n-of-1 trials can be aggregated to provide an estimated global effect of a given treatment option for a specific population, such as students in a special education curriculum (Schork, 2015).

N-of-1 trials are considered to be a sound, experimental design alternative to studies incorporating larger sample sizes, allowing for a more detailed measure of the amplitude of change through means of regularly scheduled repeated assessment (Vohra et al., 2016). Furthermore, n-of-1 trials are considered to be especially appropriate when small pools of participants are available—e.g., in program evaluation studies targeting a specific population such as students with special education needs—and when a control group is not available (Spector, 1981; Harris et al., 2006; Gravetter and Forzano, 2011; Vohra et al., 2016). N-of-1 trials are considered to be a rigorous approach that allows an evaluation of the impact of interventions such as MBIs, while narrowing the gap between educational or psychological research and practice (Vohra et al., 2016). As an example, n-of-1 trials can be especially useful to evaluate the impact of alternative and complementary therapies such as MBIs for youth.

PRESENT STUDY

This article presents a first, small-scale attempt to conduct research on a MBI with two small classes of special needs boys. The goal of the present study was to evaluate the impact of a MBI on internalized (anxiety, depression, and inattention) and externalized (hyperactivity and aggressiveness) symptoms in elementary school students with psychiatric disorders in a special education curriculum. In order to do so, we implemented a n-of-1 trial design in which 10 assessment time-points were included (three pre-intervention, four during the intervention, three follow-ups), and documented the progression of symptoms in our participants over a 3-months during the follow-up period. Student and teacher-reported data was collected in this project.

Primary Hypotheses

Given the prevalence of both internalized and externalized symptoms in these students, we hypothesized that the MBI would have a significant and positive impact on all symptoms studied (i.e., anxiety, depression, inattention, hyperactivity, and aggressiveness), while increasing mindfulness skills in participants. Specifically, we hypothesized that:

1) We would observe clinically and statistically significant decreases in anxiety, depression, inattention, hyperactivity, and aggressiveness scores pre-to-post intervention;
2) These decreases would be maintained at follow-up.
3) Mindfulness scores would increase pre-to-post intervention;
4) This increase would be maintained at follow-up.

METHODS

An experimental A-B-A n-of-1 trials series design with 10 assessment time-points and a 3-months follow-up was used in this project. This project was conducted in collaboration with a school board and elementary school from Chicoutimi, Canada. Ethics approval was obtained from all institutions involved. Informed consent was obtained from all individual participants, their parents, and the teachers taking part in this study.

Participants

Elementary school students with psychiatric disorders from two special education classrooms took part in this study, along with their teachers. Two different classrooms of elementary school students (Group A and Group B) took part in this study ($n_{\text{total}} = 13$). Students received the intervention separately and at a different moments in time, and were consequently considered

as two distinct cohorts. All students in both classrooms were boys. To be in a special education classroom for students with psychiatric disorders, all students had been previously assessed, and were still closely monitored, either by a child psychiatrist or a by child psychiatry unit at the regional hospital. They had all received a diagnosis of a severe form of psychological disorder (e.g., major depressive disorder, anxiety disorder, attention-deficit, and hyperactivity disorder, conduct disorder). The severity of their disorder prevented them from being schooled in a regular classroom. Specifically, 69% of them had a diagnosis of Attention Deficit and Hyperactivity Disorder (ADHD), 31% had a diagnosis of Tourette's disorder and 8% had a diagnosis of major depressive disorder. A significant proportion (92%) of students met the diagnostic criteria for more than one mental health disorder. In addition to their pervasive psychological disorders, a large majority of these students (69%) were in foster care at the time of this study, and had an additional diagnosis of reactive attachment disorder or disinhibited social engagement disorder (American Psychiatric Association, 2013). As such, these students were receiving additional psychological support in their respective classroom, namely through regular visits from the school psychologist. As part of the educational model of these two classrooms—called Kangaroo or nurture classrooms—students were not taught to or treated according to their age, but according to their level of emotional development (Bennathan and Boxall, 2013; Lavoie et al., 2017). For the purposes of this study, participants had to be willing to participate in an 8-week MBI and be available to answer questionnaires during all phases of the study. It was also necessary that their teachers were available to fill out questionnaires at the same time as their students for all assessment time-points. As this project was conducted in French, participants were required to speak and understand the language. No attrition was experienced in this study; all students and their respective teachers filled out pre- and post-intervention questionnaires. Participant characteristics can be found in **Table 1**.

Mindfulness-Based Intervention

An 8-weeks MBI, specifically adapted for elementary school children, and empirically validated with students having special education needs, was used in this project (Malboeuf-Hurtubise et al., 2017a,c). The group met once a week. This intervention, called *Mission Meditation*, was designed to be implemented specifically in school-based settings, namely by ensuring that each session fit into a daily classroom period (∼45–60 min) and that mindfulness practices were developmentally appropriate to match elementary school students' shorter attention span (Malboeuf-Hurtubise and Lacourse, 2016). MBI sessions were led by a school psychologist with extensive knowledge and an ongoing personal practice of mindfulness meditation of many years. She also had extensive experience and skills in providing therapy in group-based settings. This psychologist was specifically trained to facilitate the *Mission Meditation* workshops and received individual supervision from the main researcher on this project throughout the course of the intervention. Weekly sessions included introduction to formal and informal mindfulness practices (e.g., mindful eating, mindfulness through the senses, body scan, sitting, and breathing meditations), with a specific emphasis on awareness of thoughts, emotions and physical sensations. On average, students spent 30–40 min on various mindfulness practices, and 15–20 min were allocated to psychoeducational components. Homework was assigned every week and in-class practice, led by the teacher, was required at least once a week. Teachers were trained in order to guide in-between session meditation practices, and individual supervision was offered both by the school psychologist and members of the research team, upon request. In-class practice was carefully tracked through a weekly log filled out by the teachers. As requested, homework was completed every week during class time and a minimum of one in-class practice took place between sessions. The intervention did not include a silent retreat. Although *Mission Meditation* was not originally intended for students with psychiatric disorders, previous work from the first author has evaluated its impact in elementary school students with special education needs, such as severe learning disabilities and various mental health disorders (e.g., major depressive disorder, ADHD, and anxiety disorders), and, in our experience, this technique appears to have been useful in alleviating internalized symptoms in these populations. Thus, the content of the intervention was not adapted specifically for this population. In terms of safety precautions, given the school psychologist was familiar with all students taking part in this project, she was able to ensure that all of them felt at ease while completing meditation exercises. She also reminded students on multiple occasions of their right to opt out of practice without having to provide a reason to do so. The aim of this intervention was to provide an in-school treatment option youth with severe psychiatric disorders in a special education curriculum, in order to alleviate symptoms and to foster better functioning in school and at home. The MBI was not intended to replace any treatment and guidance that was given by the hospital, doctors and psychiatrists in tertiary prevention. For a detailed description of the intervention, please refer to **Table 2**. The full intervention content has also been published as a book by the first and last authors of this paper (Malboeuf-Hurtubise and Lacourse, 2016).

TABLE 1 | Participant demographics.

Participants (*N*)	13
Group A	7
Group B	6
AGE	
Group A	
M	9.7
SD	0.29
Group B	
M	10.8
SD	0.17
Students in foster care (*N*)	9
Group A	6
Group B	3

TABLE 2 | Mindfulness-based intervention session content.

Session	Content
1	Overview of class rules and participant presentations. Introduction to mindful eating.
2	Body scan meditation. Introduction to emotions, thoughts and physical sensations and stress.
3	Breathing meditation. Introduction to sitting meditation. Mindful movements through yoga-like poses.
4	Breathing meditation. Introduction to concepts of acceptance of emotions.
5	Mindful check-in exercises. Mindfulness through the senses.
6	Breathing meditation with a special focus on thoughts and judgements. Group discussion on thoughts and judgements.
7	Walking meditation. Group discussion on self-care and acceptance.
8	Short sitting meditation. Feedback regarding intervention.

Measures

For the purposes of this study, a validated French version of each scale was selected. Given the amount of assessment time-points included in this project, specific items of the following scales were selected, to ensure that both students and teachers could fill out the questionnaires in a reasonable amount of time (∼5–10 min). A total of 21 items were administered to students and 20 items were administered to teachers.

Symptom Measure

Behavior Assessment System for Children, Second Edition (Basc-II)

This measure was used to evaluate internalized and externalized symptoms in students. Items from the Teacher Report Form and the Self-Report Form were used for this project. This measure presents good inter-rater agreement ($r = 0.53$–0.74) and test-retest reliability ($r = 0.7$–0.8), along with high internal consistency ($\alpha = 0.8$–0.9) and clinical validity (Reynolds and Kamphaus, 2004). The following subscales were used: anxiety (self-report; 3 items, e.g., "I worry about little things" and teacher report; 3 items, e.g., "Worries about things that cannot be changed"), depression (self-report; 5 items, e.g., "Nothing ever goes right for me" and teacher report; 5 items, e.g., "Seems lonely"), inattention (self-report; 4 items, e.g., " I forget to do things" and teacher report; 3 items, e.g., "Has a short attention span"), hyperactivity (self-report; 3 items, e.g., "I have trouble standing still in lines" and teacher report; 4 items, e.g., "Is overly active") and aggressiveness (teacher report; 5 items, e.g., "Defies teacher"). All subscales presented good to excellent internal consistency in this sample, except for the aggressiveness subscale: anxiety (self-report: $\alpha = 0.90$; teacher-report: $\alpha = 0.90$), depression (self-report: $\alpha = 0.94$; teacher-report: $\alpha = 0.78$), inattention (self-report: $\alpha = 0.93$; teacher-report: $\alpha = 0.79$), hyperactivity (self-report: $\alpha = 0.97$; teacher-report: $\alpha = 0.84$) and aggressiveness (teacher-report: $\alpha = 0.47$).

Process Measure

Five Facet Mindfulness Questionnaire (FFMQ)

This measure was used to evaluate mindfulness in students (Baer et al., 2008). It assesses the extent to which students become more mindful as they are exposed to the intervention. The measure presented excellent internal consistency in this sample ($\alpha = 0.96$). A total of six items from this scale were used in this project, taken from the following subscales: Observe (e.g., "When I take a shower or bath, I stay alert to the sensations of water on my body"), Act with Awareness (e.g., "I do jobs or tasks automatically without being aware of what I am doing") and Non-react (e.g., "I perceive my feelings and emotions without having to react to them"). Items were selected based on their relevance with regards to mindfulness concepts that were taught in this MBI.

Procedure

Both students and teachers completed a total of 10 assessment time-points in this study. Teachers completed one questionnaire per student at each assessment time-point. No financial incentive was given to the teachers, although an agreement with the school board allowed them to fill out the questionnaires during working hours. Three baseline assessments were completed during phase A (one assessment per week), four assessments were completed during the active treatment phase B (one assessment every 2 weeks in order to allow participants to acquire and practice new skills) and three assessments were taken during the 3-months follow-up phase A (one assessment per month). All questionnaires were completed by students during class time, at the beginning of the MBI sessions.

Data Analysis

Methods of assessment in n-of-1 trials have been the subject of ongoing debates in the past years, specifically with regards to the appropriateness and accuracy of suggested methods of analysis (Smith, 2012). Experts in quantitative research and statistical methods have recently suggested that statistical analyses be used in analyzing results of n-of-1 trials (Kratochwill et al., 2012; Shadish, 2014). Multilevel modeling strategies, when used in n-of-1 trials research, have been put forward as a method that can inform researchers with regards to the presence of treatment effects. Namely, these allow to test for differences in intercept and slopes of scores (i.e., symptoms) from the pre-intervention to the active intervention and post-intervention phases (Shadish et al., 2008; Van den Noortgate and Onghena, 2008; Smith et al., 2015). Furthermore, multilevel modeling is a valid approach with small sample sizes (e.g., $N = 4$–8) (Ferron et al., 2009; Shadish et al., 2013).

In this study, primary hypotheses were tested using a multiple, single case multilevel modeling strategy to compare and evaluate statistical significance in fluctuations of scores between A-B-A phases. These analyses are based on a modeling strategy suggested by Moeyaert and colleagues (Moeyaert et al., 2014). The parameter b_0 is interpreted as the baseline intercept, b_1 as the treatment-baseline difference in intercepts and b_2 as the follow-up-baseline difference in intercepts (Moeyaert et al., 2014; Maric et al., 2015). Autocorrelation was considered through AR1. Fixed effect coefficients and their *p*-values are presented in **Tables 2**, **3**. *P*-values were considered according to the $p = 0.05$ threshold. Visual analysis of the mean change in participants from both groups separately was also completed. As students received the intervention separately and at different moments in time, they were considered as two distinct cohorts in our

TABLE 3 | Results of empirical estimations of the case-specific effects using the basic three levels model for all variables for Group A students.

		Parameter	Parameter estimate	Standard error	*P*
ANXIETY					
Self-report	Baseline	β_0	4.39	0.40	**<0.001**
	Treatment	β_1	−0.12	0.51	0.810
	Follow-up	β_2	−1.14	0.56	0.051
Teacher report	Baseline	β_0	4.70	0.74	**<0.001**
	Treatment	β_1	1.09	0.79	0.173
	Follow-up	β_2	2.02	0.97	**0.044**
DEPRESSION					
Self-report	Baseline	β_0	6.59	0.79	**<0.001**
	Treatment	β_1	−0.03	0.87	0.976
	Follow-up	β_2	−1.05	1.03	0.315
Teacher report	Baseline	β_0	5.63	0.88	**<0.001**
	Treatment	β_1	−0.85	1.09	0.439
	Follow-up	β_2	0.51	1.23	0.679
INATTENTION					
Self-report	Baseline	β_0	5.74	0.56	**<0.001**
	Treatment	β_1	−0.80	0.78	0.312
	Follow-up	β_2	−1.86	0.84	**0.037**
Teacher report	Baseline	β_0	5.15	0.36	**<0.001**
	Treatment	β_1	−0.11	0.47	0.812
	Follow-up	β_2	0.06	0.52	0.908
HYPERACTIVITY					
Self-report	Baseline	β_0	4.25	0.54	**<0.001**
	Treatment	β_1	−0.38	0.61	0.535
	Follow-up	β_2	−1.11	0.72	0.131
Teacher report	Baseline	β_0	6.71	0.81	**<0.001**
	Treatment	β_1	−1.01	1.00	0.315
	Follow-up	β_2	−0.11	1.13	0.920
AGGRESSIVENESS					
Teacher report	Baseline	β_0	5.10	0.84	**<0.001**
	Treatment	β_1	−0.87	1.06	0.417
	Follow-up	β_2	−1.22	1.18	0.310
MINDFULNESS					
Self-report	Baseline	β_0	6.93	0.81	**<0.001**
	Treatment	β_1	1.08	0.87	0.220
	Follow-up	β_2	1.44	1.02	0.166

Numbers in bold are statistically significant values, i.e. $p < 0.05$.

statistical analyses. Group-based analyses allowed to control for cohort effects. Statistical analyses were conducted using SPSS 24 software.

RESULTS

Internalized and Externalized Symptoms

Self-Reported Data

Statistical analyses show a trend in phase differences between the treatment and follow-up phases for anxiety scores [$\beta_2 = -1.14$, $t_{(4.16)} = -2.04$, $p = 0.051$] of Group A students, indicating lower anxiety scores at the end of the follow-up period, when compared to the active treatment phase (see **Table 3**). Visual analysis of the group mean data shows moderately high levels of anxiety symptoms in the baseline and active treatment phases, followed by a steady decrease in scores during the follow-up period (see **Figure 1**). Specifically, out of the seven students comprising the Group A, two have overall stable scores, whereas two have decreasing anxiety scores, two have increasing scores and one shows no clear pattern in the data.

Results further show significant phase differences between the treatment and follow-up phases for inattention scores [$\beta_2 = -0.19$, $t_{(4.88)} = -2.21$, $p = 0.037$] of Group A students, indicating lower inattention scores at the end of the follow-up period, when compared to the active treatment phase (see **Table 4**). Visual analysis of the group mean inattention data

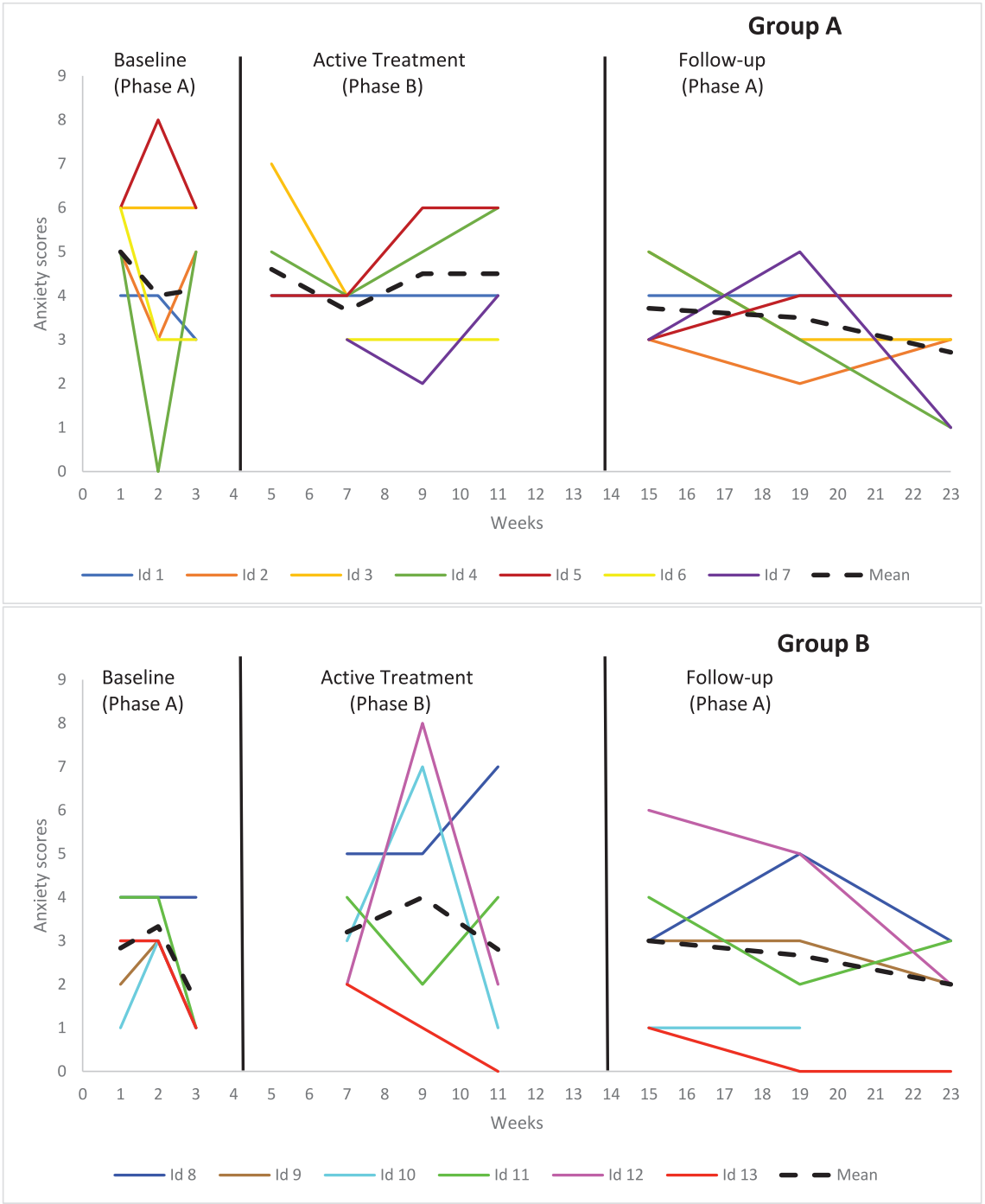


FIGURE 1 | Graphical display of baseline level and changes in level between consecutive phases in anxiety for self-reported data.

shows somewhat unstable scores during the baseline phase, followed by a subtle increase in scores during the active treatment phase. At follow-up, inattention scores decrease sharply (at the beginning of the phase) and steadily throughout the period (see **Figure 2**). Specifically, out of the seven students comprising the Group A, three have overall stable scores and three have decreasing scores, after showing an initial increase in inattention at the beginning of the active treatment phase.

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment and the follow-up phases for depression and hyperactivity symptoms of Group A students (see

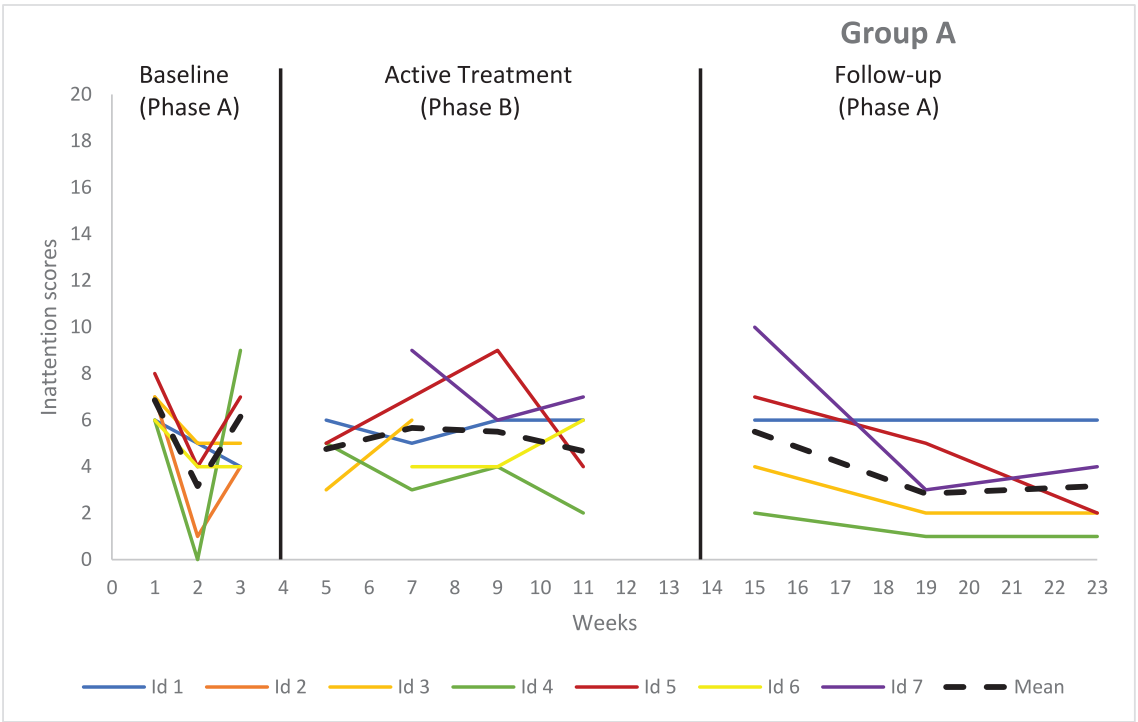
TABLE 4 | Results of empirical estimations of the case-specific effects using the basic three level model for all variables for Group B students.

		Parameter	Parameter estimate	Standard error	*p*
ANXIETY					
Self-report	Baseline	β_0	2.59	0.52	**<0.001**
	Treatment	β_1	0.67	0.71	0.347
	Follow-up	β_2	0.04	0.73	0.961
Teacher report	Baseline	β_0	4.47	0.86	**<0.001**
	Treatment	β_1	−1.21	0.77	0.122
	Follow-up	β_2	0.27	0.98	0.782
DEPRESSION					
Self-report	Baseline	β_0	3.69	0.87	**<0.001**
	Treatment	β_1	−0.96	1.12	0.400
	Follow-up	β_2	−1.35	1.21	0.276
Teacher report	Baseline	β_0	5.40	1.08	**<0.001**
	Treatment	β_1	−1.15	1.06	0.284
	Follow-up	β_2	−2.36	1.32	0.081
INATTENTION					
Self-report	Baseline	β_0	4.54	1.21	**0.005**
	Treatment	β_1	−0.76	0.84	0.373
	Follow-up	β_2	−0.28	1.10	0.803
Teacher report	Baseline	β_0	5.94	0.35	**<0.001**
	Treatment	β_1	−0.22	0.38	0.557
	Follow-up	β_2	0.15	0.45	0.735
HYPERACTIVITY					
Self-report	Baseline	β_0	2.97	0.94	**0.015**
	Treatment	β_1	0.10	0.48	0.843
	Follow-up	β_2	−0.16	0.64	0.804
Teacher report	Baseline	β_0	4.32	1.23	**0.009**
	Treatment	β_1	−0.41	0.64	0.521
	Follow-up	β_2	−1.42	0.87	0.093
AGGRESSIVENESS					
Teacher report	Baseline	β_0	3.13	1.16	**0.025**
	Treatment	β_1	0.42	0.77	0.583
	Follow-up	β_2	0.16	1.04	0.881
MINDFULNESS					
Self-report	Baseline	β_0	5.73	0.90	**<0.001**
	Treatment	β_1	0.25	0.90	0.785
	Follow-up	β_2	0.21	1.10	0.846

Numbers in bold are statistically significant values, i.e. $p < 0.05$.

Table 3 and **Figures 3**, **4**). Visual analysis of depression scores shows that, out of the seven students comprising Group A, two had overall stable scores, two had constant decreasing scores, one had increasing scores, and two showed no clear pattern in their data. Visual analysis of hyperactivity scores shows that, for the same age group, all students had overall stable scores throughout the baseline, intervention and follow-up periods.

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment and the follow-up phases for anxiety, depression, inattention, and hyperactivity symptoms of Group B students (see **Table 4** and **Figures 1**–**4**). Visual analysis of anxiety scores shows that, out of the six students comprising this group, two have overall stable scores, three have increasing anxiety scores, and one has decreasing scores. Visual analysis of inattention scores shows that two students have initial increase in scores, followed by a subsequent and constant decrease, two have noticeable increases in scores during the follow-up period, and two have overall stable scores. Visual analysis of depression scores shows that three students have overall low and stable scores, one has an initial increase in scores that subsequently stabilizes and two do not show any clear pattern in their data. Finally, visual analysis of hyperactivity scores shows that all students have overall low and stable scores, except for one student who has stable and high scores.



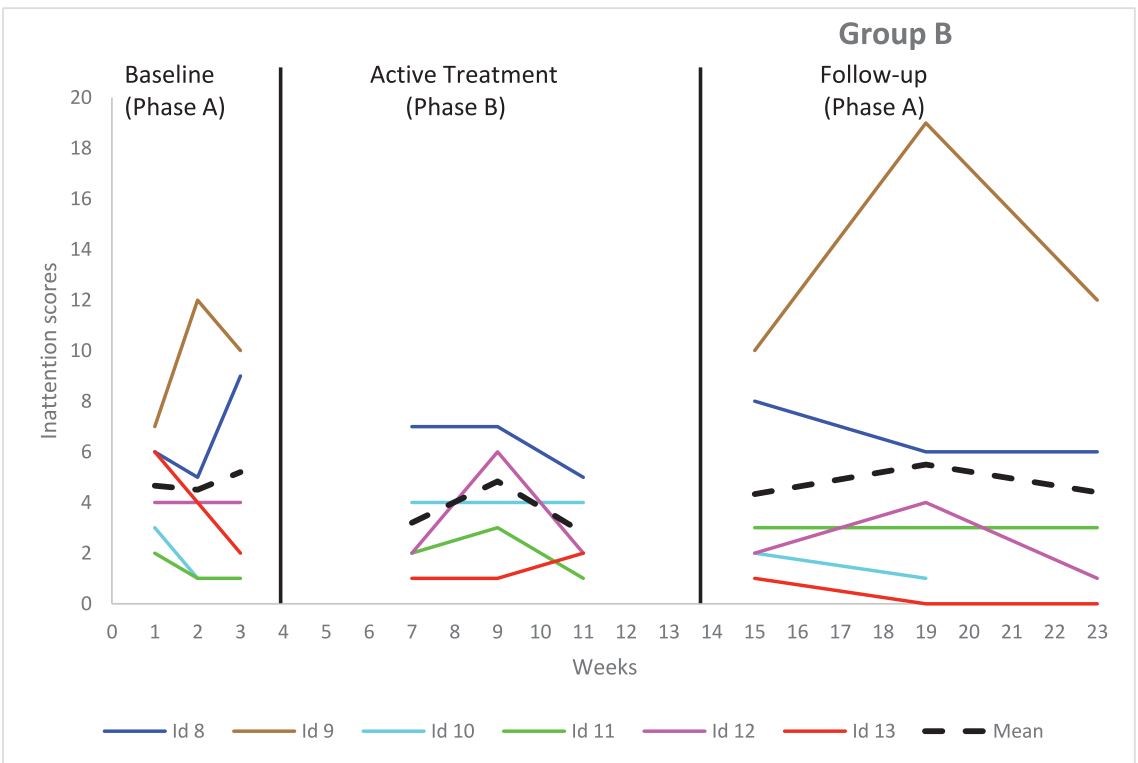


FIGURE 2 | Graphical display of baseline level and changes in level between consecutive phases in inattention for self-reported data.

Teacher-Reported Data

Statistical analyses show significant phase differences in scores between the treatment and follow-up phases for anxiety scores [$\beta_2 = 2.02$, $t_{(4.31)} = 2.07$, $p = 0.044$] from teacher-reported data of Group A students, indicating higher anxiety scores at the end of the follow-up period, when compared to the active treatment

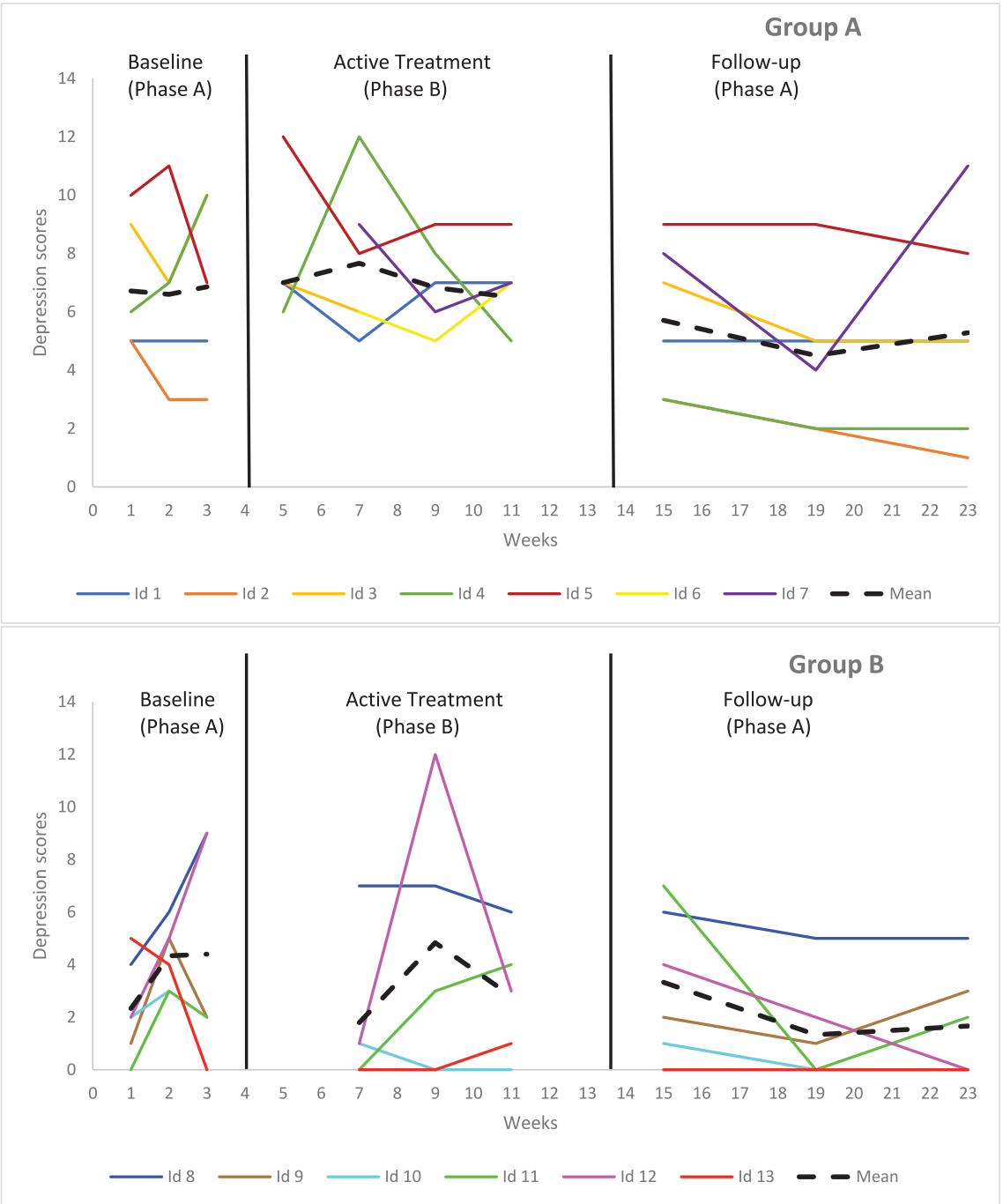


FIGURE 3 | Graphical display of baseline level and changes in level between consecutive phases in depression for self-reported data.

phase (see **Table 4**). Visual analysis of the group mean data shows declining scores in anxiety during the baseline phase, followed by a sharp increase in scores at the beginning of the active treatment phase. Scores then decrease up until the 7th week of the project, to finally re-increase steadily throughout the active treatment phase and the follow-up period (see **Figure 6**). Specifically, out of the seven students comprising Group A, four have an initial decrease in anxiety, followed by a constant increase in their scores, two have overall stable scores, and one does not show a clear pattern in the data.

Visual analysis of all teacher-reported group mean data for Group A indicates similar patterns of initial decreases in scores, followed by a steady increase throughout the active treatment phase and follow-up periods, starting at week 7 (see **Figures 7–10**). Specifically, visual analysis of inattention scores show that, out of the seven students comprising Group

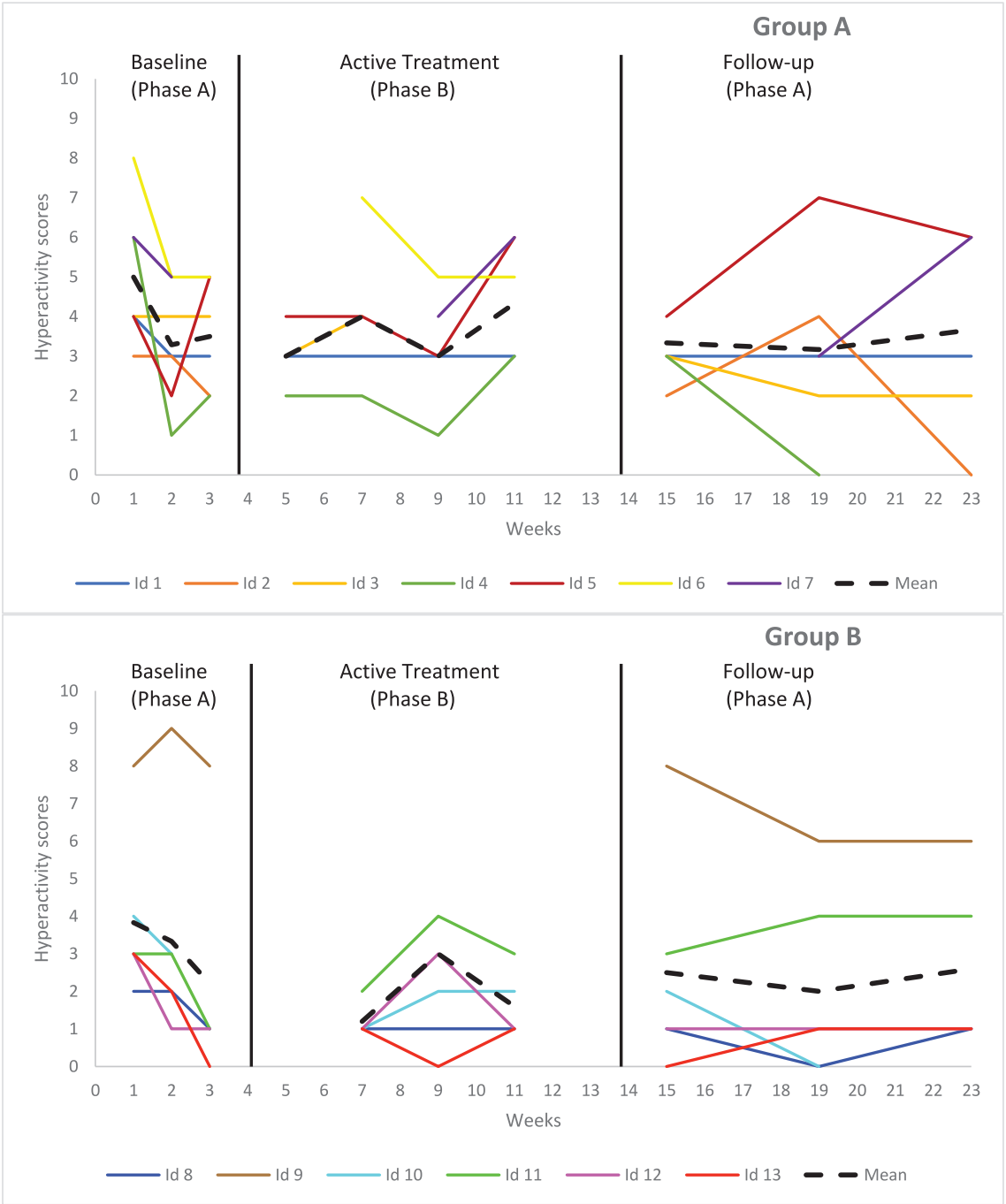


FIGURE 4 | Graphical display of baseline level and changes in level between consecutive phases in hyperactivity for self-reported data.

A, four have overall stable scores, whereas three have initial increases in scores, followed by a small decrease. Visual analysis of depression scores shows that all students have initial decreases in their depression scores. However, out of the seven students, five of them have a significant peak increase in scores at the beginning of the active treatment phase, followed by a subsequent and constant decrease in scores. Visual analysis of hyperactivity scores for the same group shows that two have initial decreases in scores, followed by an increase, whereas three students have a strong overall decrease in hyperactivity scores, and two do not show a clear pattern in their data. Finally, visual analysis of aggressiveness scores shows that four students have overall decreasing scores, whereas three do not show a clear pattern in their data.

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment phase and the follow-up phase for anxiety, depression, inattention, hyperactivity, and aggressiveness symptoms from teacher-reported data of Group B students (see **Table 4** and **Figures 6–10**). Visual analysis of anxiety scores shows that, out of the six students comprising Group B, three have constant decreasing scores, whereas two have overall stable scores and one has an initial increase in scores, followed by a subsequent decrease. Visual analysis of inattention scores shows that all students have overall stable scores. Visual analysis of depression scores shows that four students have overall stable scores, whereas two have a marked increase in scores at the beginning of the active treatment phase, followed by a decrease. Finally, visual analysis of hyperactivity and aggressiveness scores shows that all students have overall stable scores throughout the baseline, intervention and follow-up periods.

Mindfulness

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment and the follow-up phases for mindfulness scores from self-reported data in both Groups A and B (see **Tables 3**, **4**). Visual analysis of the mean data shows somewhat flat and stable scores in mindfulness for students from both groups throughout all phases of this project, although a slight but non-significant increase in scores can be detected during the follow-up period for Group B students (see **Figure 5**). Specifically, out of the seven students comprising Group A, six have overall stable, but slightly increasing scores, whereas one has an initial drop in scores, followed by a stable increase. In Group B, out of the six students comprising this group, all have overall stable and slightly increasing scores.

DISCUSSION

The goal of this study was to evaluate the impact of a MBI on internalized and externalized symptoms in elementary school students with psychiatric disorders. In accordance with our initial hypothesis, the MBI was useful in decreasing inattention and indicative of a small effect on anxiety symptoms in Group A students, although there were no significant changes in symptoms from pre-to-post intervention in Group B students. Thus, our initial hypotheses have been somewhat supported in Group A students with regards to decreases in symptoms such as anxiety and inattention. However, our hypotheses were not supported for Group B students. Hypotheses regarding changes in mindfulness scores were not supported either. These results are similar to those that have been previously reported in the literature with regards to the impact of MBIs on mental health in clinical and school settings, among students in regular and special education classrooms (Zenner et al., 2014; Zoogman et al., 2014). However, it is imperative to note the high variability in individual trajectories from students in both groups, as highlighted by the detailed visual analysis. As such, although, as a whole, Group A students seem to have benefited more from the intervention than Group B students, high variability in scores showed that, in both groups, some students benefited from the intervention, whereas others reported a worsening of their symptoms. This is true of both Groups A and B students. Thus, results from this first, small-scale attempt to measure the impact of a MBI on students with severe psychological disorders need to be interpreted with caution. Furthermore, interestingly, results from the teacher-reported data showed a reversed pattern, i.e., a significant increase in anxiety scores during the follow-up phase for Group A students, and an absence of significant results for Group B students. This discrepancy between student and teacher reported data warrants careful attention.

Contrary to the self-reported data from Group A, the teacher-reported data show a significant increase in anxiety scores at follow-up. Furthermore, a visual analysis of all the teacher-reported data from Group A shows a similar pattern: an initial decrease in anxiety scores until week 7 (i.e., mid-intervention phase or 4th week of the MBI), followed by a steady increase in scores. At first glance, these results appear counterintuitive. Anecdotal evidence indicates that this teacher was especially fond of the MBI, convinced of its impact on her students and that she diligently completed in-between sessions assignments with her students. Specifically, she practiced a 3-min mindful stopping exercise once per day, every day, with her students. She also verbally reported that she saw important improvements in her students, specifically in terms of anxiety and inattention symptoms, and that she was impressed with their introspection skills and ability to share how they felt and reacted in regards to the mindfulness practice. However, the data seem to be telling a different story. Perhaps the process by which mindfulness develops can explain this discrepancy. As such, given that the teacher was taking part in the mindfulness sessions and that she extensively practiced with her students, it is quite possible that she, herself, developed heightened awareness skills throughout the intervention. This would have allowed her to identify and notice subtler manifestations of internalized and externalized symptoms in her students that she might not have noticed before. Thus, it is possible that, although she claimed that overall symptoms decreased in her students, she reported higher levels of these symptoms in the questionnaire, especially during the active treatment and follow-up phases, because of her sharpened and renewed awareness. Similar findings have been documented in children, where an initial increase in symptom scores was reported because of increased awareness skills, before an improvement could be observed (Malboeuf-Hurtubise et al., 2017b). This can impede the ability to use the multiple assessment design for MBIs. An avenue to disentangle this issue would be to assess the teachers' own mindfulness skills, before and after the intervention, as teachers' increasing self-awareness and self-regulation may indeed allow them to develop a higher degree of attachment with students, thus creating a shift in their ability to detect both internalized and externalized symptoms in their students. Direct assessment of awareness (e.g., breath counting tests) may also represent a good avenue to solve this issue in future work (Levinson et al., 2014). Another potential avenue to settle this issue and to control for this in future research

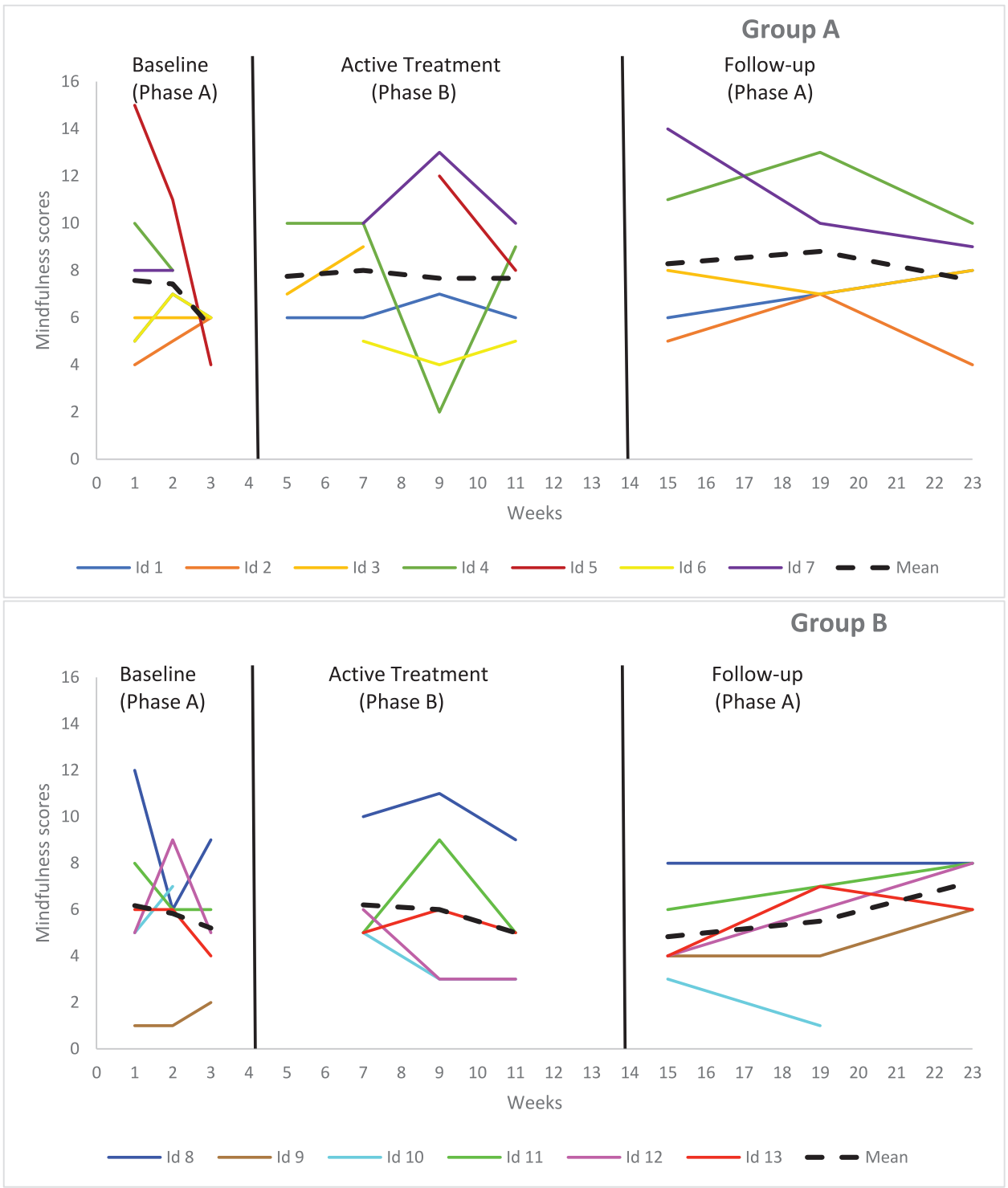


FIGURE 5 | Graphical display of baseline level and changes in level between consecutive phases in mindfulness for self-reported data.

would be to assess teacher expectations at pre-intervention. A teacher with high initial expectations could be potentially disappointed with a smaller decrease in symptoms than what would have been initially expected. This might bias the reporting of symptoms throughout time in students (G. Dupuis, personal communication, May 2017).

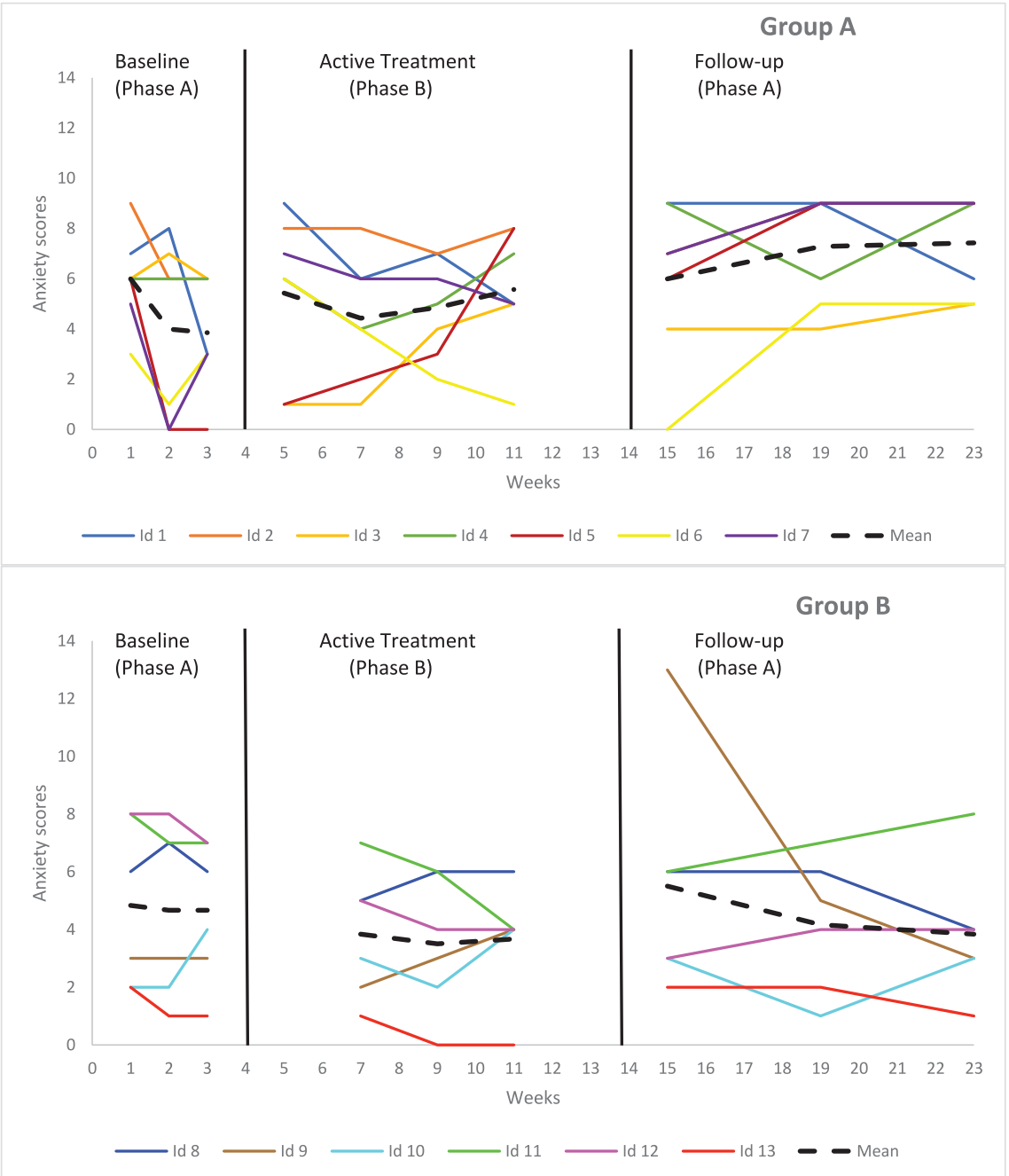


FIGURE 6 | Graphical display of baseline level and changes in level between consecutive phases in anxiety for teacher-reported data.

Discrepancies between self-reported and teacher-reported data from Group A also point to the importance of maintaining a regular meditation practice after the end of the intervention, in order to maintain and acquire lasting mindfulness skills. Specifically, these results shed light on the choice of the mindfulness instructor in school-based settings. In this study, the school psychologist led the intervention sessions. Thus, after the eighth and final session, she stopped visiting the classrooms once per week to meditate with students. Perhaps providing extensive mindfulness training to teachers, allowing them to lead sessions with their students, would ensure that regular practice and acquired skills are maintained over time throughout the follow-up period and once the 8-weeks intervention is completed, and that both teachers and students continue to observe improvements in internalized and externalized symptoms. This important consideration

FIGURE 7 | Graphical display of baseline level and changes in level between consecutive phases in inattention for teacher-reported data.

could be addressed in future MBI work in school settings, both in regular and special education classrooms, being as teachers, at least in the Quebec/French Canadian school system, have more consistent presence with students than school psychologists, namely for financial and budgetary reasons.

Furthermore, as previously stated, self-reported data from Group A indicates improvements in internalized symptoms (anxiety and inattention) that were not observed by their teacher. This might speak to the fact that improvements that were noted in internalized symptoms did not translate into overall improvements in classroom and school functioning, thus making

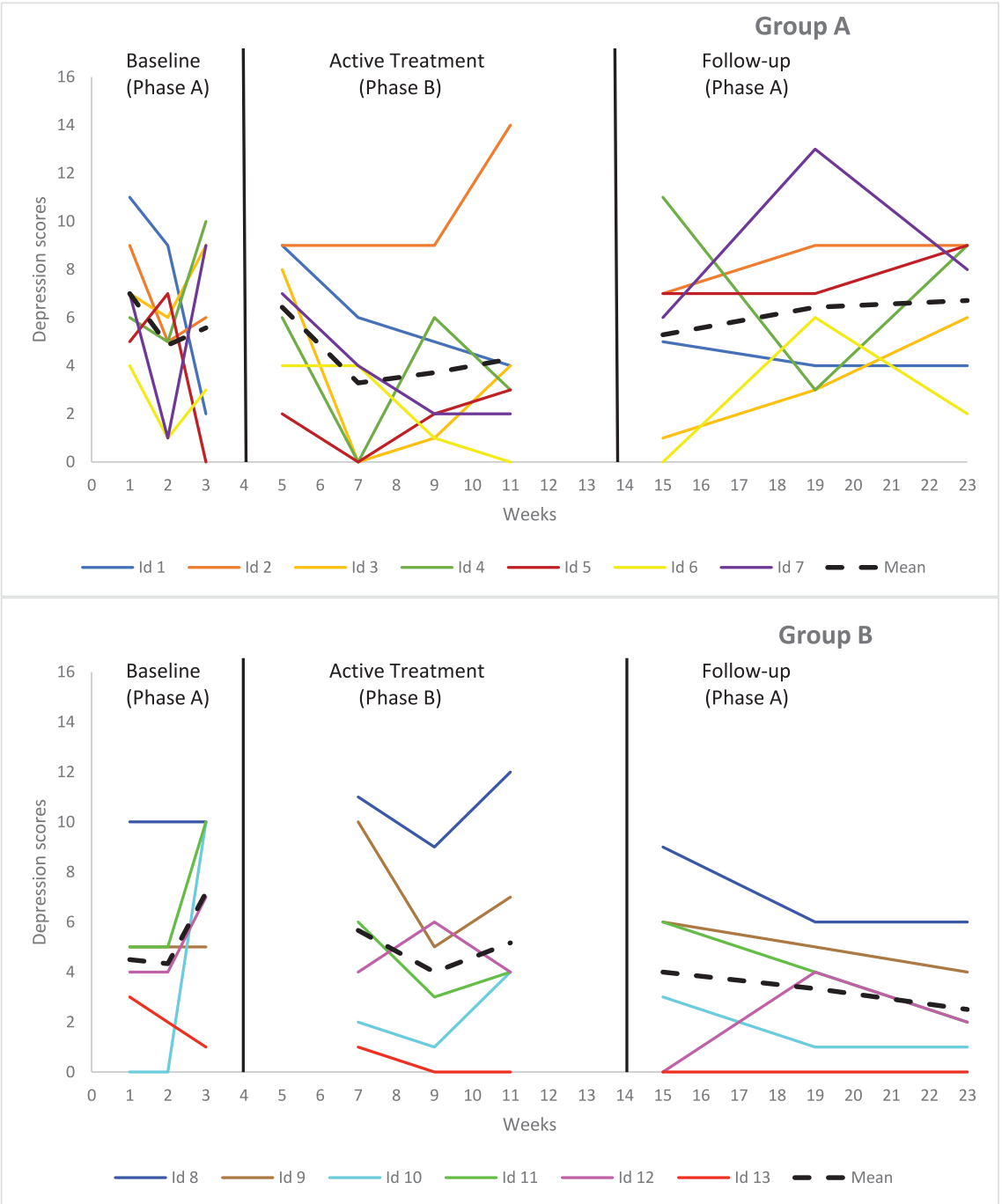


FIGURE 8 | Graphical display of baseline level and changes in level between consecutive phases in depression for teacher-reported data.

it difficult for the teacher to notice. One tentative explanation for this would be that teachers would be less able to discern changes in internalized symptoms, namely because these are less noticeable by a third-party observer, and because manifestations of this type of symptoms do not tend to disrupt classroom dynamics as much as manifestations of externalized symptoms (e.g., hyperactivity, aggressiveness). However, there is a paucity of research on teachers' ability to discern changes in internalized symptoms (namely anxiety) in their students, so this potential explanation needs to be interpreted with caution (Stanger and Lewis, 1993; Layne et al., 2006). This being said, similar results showing this type of discrepancy have been reported in previous work with elementary school students in regular and special education classrooms (Malboeuf-Hurtubise et al., 2017b,c).

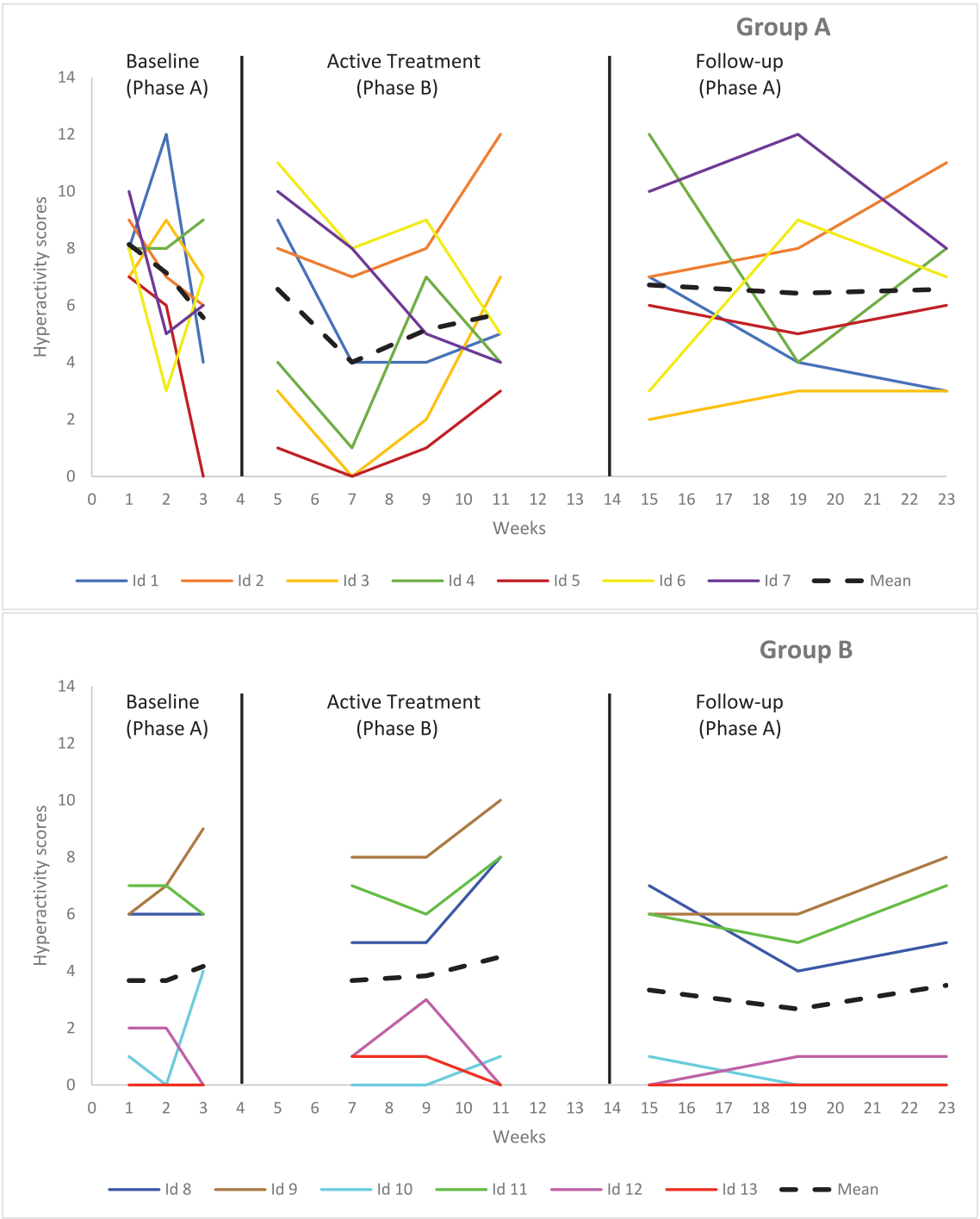


FIGURE 9 | Graphical display of baseline level and changes in level between consecutive phases in hyperactivity for teacher-reported data.

Finally, it is worth noting that only Group A students reported significant decreases in anxiety and inattention at follow-up. Group B students did not report significant changes on any variable. It is possible that Group A students were more impressionable and wanted to impress adults (whether this be the psychologists, researchers, or teachers), thusly impacting their self-report. However, anecdotal evidence provided by Group B's teacher and the school psychologist who led the sessions seems to indicate that these students were globally less motivated to participate in MBI sessions and to fill out the questionnaires. They also seemed to display more limits in terms of cognitive reasoning and introspection skills, which made sharing periods

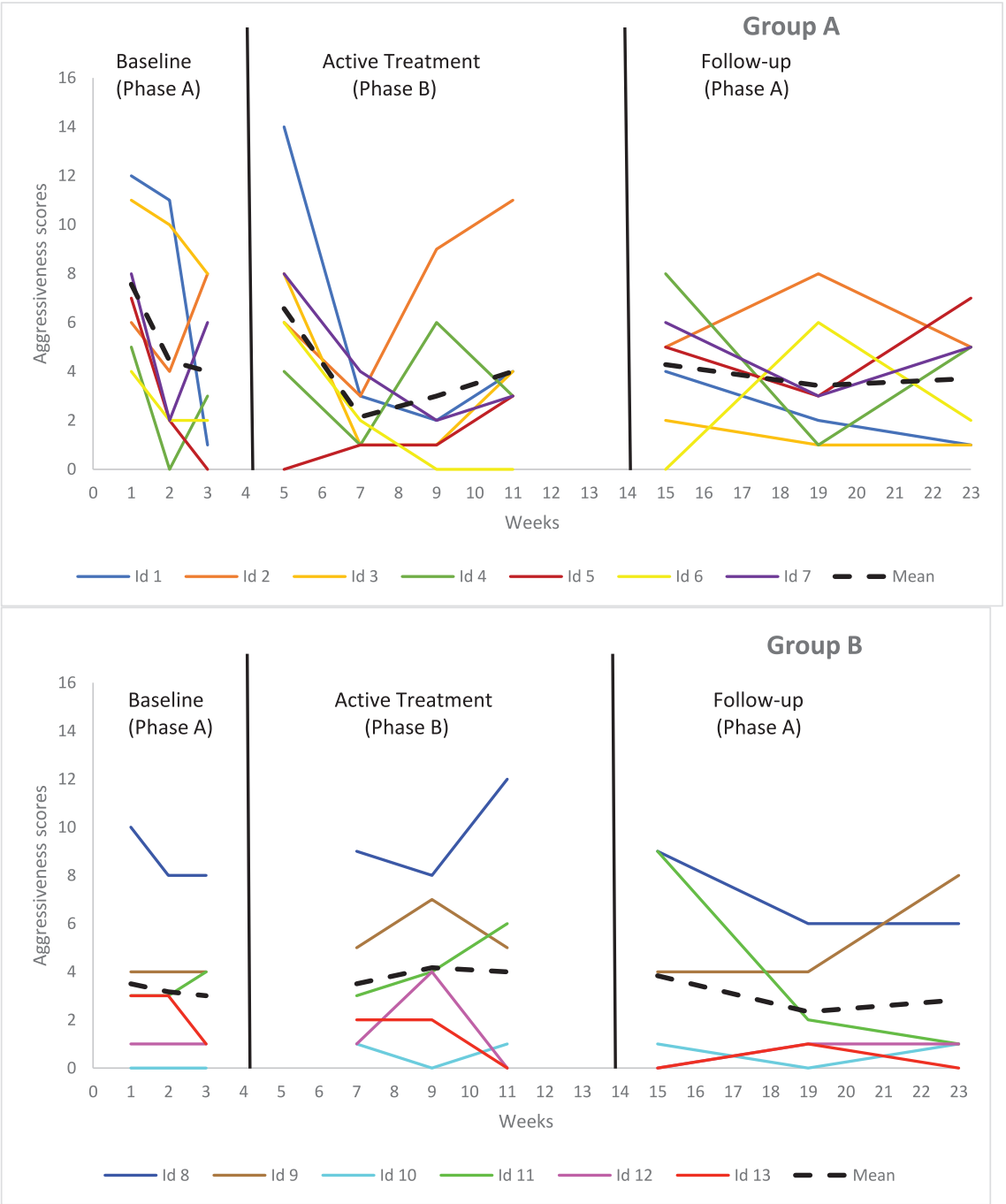


FIGURE 10 | Graphical display of baseline level and changes in level between consecutive phases in aggressiveness for teacher-reported data.

more strenuous. It seems that Group B students were also much more prone to social desirability and aware of others' reactions during sharing time, verbalizing that they did not want to "look stupid in front of others," or "give the wrong answer." Thus, given students from Group B were very sensitive to feedback from their peers, the judgment and perception of classmates might have a significant impact on their desire to engage in mindfulness meditation, especially in a classroom setting (Harter, 1990; Brown, 2004; Sebastian et al., 2008). In our opinion, this could have potentially biased the data collection for this group. Future work could evaluate if these feelings of self-consciousness and embarrassment around practicing with peers is a legitimate concern that could be generalized to a greater population. If so, designing a means to attenuate this effect would be desirable. Toward that end, having interventions delivered by trained individuals who are closer in age to students who

are like peer-mentors might alleviate some of these concerns for students, as they look up to people of this age bracket in different manner than they do with older adults (Malboeuf-Hurtubise et al., 2016). Finally, including a validated scale of treatment adherence in future studies of this sort could be useful, as treatment adherence could be used as a covariate in statistical analyses.

Perhaps the presence of significant results in Group A and the absence of significant results in Group B could also be explained by the age difference that was observed between students from each group. Indeed, typically, younger students seem to be naturally more mindful than their older counterparts (Snel, 2012). From a developmental perspective, younger children, who have not yet reached the stage of abstract reasoning, are more naturally inclined to be aware of the present moment and are less prone to ruminations, anxious and depressive thoughts (Piaget, 1962; Semple et al., 2010). Consequently, it is possible that these children may be more receptive to mindfulness meditation, and thus could benefit more from this type of intervention. Furthermore, given their history and background of psychiatric disorders and potential trauma (especially in the case of students who were in foster care at the time of conducting this study), it is possible that the MBI was more useful in alleviating symptoms in younger students, as maladaptive behaviors and reactive patterns were less crystallized and thus more malleable, leaving more room for improvements in terms of decreasing internalized and externalized symptoms (Broidy et al., 2003). Further work on the impact of MBIs for students with psychiatric and attachment disorders could thus look into trauma-sensitive mindfulness practices (Thompson et al., 2011; Boughner et al., 2016; Hanley et al., 2017) in order to take into account recommendations for the treatment of students living with the intense emotional trauma that is often associated with living in foster care, in order to increase the potential impact of this type of intervention. Furthermore, for students with severe trauma, there is the possibility that mindfulness meditation could bring up sublimated or repressed memories that might actually lead to an increase in anxiety and symptoms of depression. Therefore, additional literature that engages with this as a possibility is needed, so as to not fall into the trap of typifying mindfulness as a "silver-bullet" intervention. This being said, it is also a possibility that students from Group B might have grown over time in biological or psychological markers of emotional resilience, thus contributing to the fact that they did not report significant differences in scores over time. However, anecdotal evidence based on the feedback obtained from professionals and teachers participating in this project suggests that this was not the case for these students. This being said, given the fact that group differences were not statistically tested as part of this project, and especially because the age difference between groups remains quite small, these explanations remain, at best, very tentative at the moment. These potential explanations are thus presented here as food for thought. Future work evaluating group differences would help in either confirming or infirming these age-related hypotheses.

Strengths

This study counts notable strengths. It is the only one known to the authors that provides specific information regarding the impact of a MBI for students with psychiatric disorders (and, for the most part, a comorbid attachment disorder) in a special education curriculum. The n-of-1 trial design that was chosen for this study allowed for a detailed study of intra-individual changes in mindfulness as well as internalizing and externalizing symptoms over time in these students. This approach allowed us to evaluate statistically the process of change in both groups, which in turn provides valuable information to researchers interested in developing and testing MBIs for elementary school students with special education needs. Finally, no attrition was experienced in this study, solidifying our results.

Limitations

The A-B-A design that was chosen for this study presents minor risks in regards to internal validity, such as time-related factors or history (Barlow et al., 2009). As the intervention was conducted during the winter, it is possible that the weather and time of year influenced participants' mood. Furthermore, as the follow-up period took place in the spring, it is possible that the end of the school year induced more positive feelings in our participants. If the design of a study looks at the unfolding of processes upon a certain time window, it is crucial that these issues are sensitively recorded and taken into account. It is thus possible that the lack of significant changes may reflect a positive result, given that children would have gotten worse on some of the scales, within the time frame of the study. A multiple baseline approach could help in solving these issues. It is also possible that self-reported data overstated pre-to-post changes, as they were potentially expecting a positive impact of the MBI. In this study, the participating personnel were fully aware of the study design and hypotheses, and so by definition were biased. Measuring expectations at pre-intervention, as stated above, could help control for this issue, as well as including blind observers in future work.

Furthermore, given the repeated-measures component of this study and, consequently, the need to shorten the questionnaire completion time, only a few selected items from each scale were administered to participants. Additionally, these scales were not used as a diagnostic tool, but rather as an indicator of within-subject fluctuations in chosen symptoms. However, a more methodologically sound alternative could be to aggregate all scores together and study positive and negative changes in symptoms, instead of fluctuations of individual categories of symptoms. Also noteworthy is the fact that these scales had not been previously used in N-of-1 trials, and that data regarding within-subject variability inherent to multiple administrations is not available. It is thus possible that this variability has created noise that is larger than the observed effect of the MBI.

Suggestions for Future Studies

The addition of an active control group and randomization of participants in future n-of-1 trials of this sort would provide additional methodological rigor, allowing to draw more robust conclusions in regards to the impact of MBIs for students

with psychiatric disorders. The advantage of a control group, even a passive wait-list control group, is that it allows to track fluctuations that may be due to periods of possible increased stress (e.g., winter versus spring, examination periods, changes in school personnel, end of the year stress). Acknowledging caregivers and parental perspectives would also help to improve on this design, providing a more complete portrait of the situation. Caregivers can attest to pre-to-post changes in internalized and externalized symptoms in their children, which tend to manifest at home. Furthermore, it is possible that the degree of emotional support and engagement that students have in the home would have an impact on the degree to which they are able to emotionally engage in the MBI, as they are more likely to experience an environment in which they can have self and emotion regulation modeled for them in the home. Furthermore, combining MBI training programs for students and caregivers, in order to support students' practice at home, might be another viable option to bring about further positive results. However, given the fact that a majority of participants were in foster care at the time of conducting this study, it is a possibility that the involvement of parents would be difficult to obtain. Additional assessment time-points would also improve on the overall design of future studies of this sort. Although previous work on this issue has stated that a minimum of three assessment time-points per phase is necessary to observe change in participants, a targeted number of five per phase has been recommended, and would thus solidify future MBI n-of-1 trial designs (Smith, 2012).

Finally, results from this study evaluated the mean change in participants. However, individual differences in trajectories tend to reveal a more complex picture in regards to the impact of the MBI on participants' internalized and externalized symptoms. As such, individual variability of internalized and externalized symptoms scores suggests that the MBI worked differently for different students. However, individual trajectory analysis is beyond the scope of this paper. Future work could focus extensively on individual trajectories of elementary school students with psychiatric disorders receiving special education services, which would provide clues onto the differential impact of MBIs for this population. Another option could also be to include individual meetings in addition to the group-based intervention, in order to better track and understand why some youth benefit from the intervention and why some do not. This would allow researchers to have a more complete picture of the process of change in this heterogeneous sample of youth, especially given that the heterogeneity of the sample would be difficult to change in future work, because of the reality of school-based settings in which students with different severe psychiatric disorders are assigned to the same classroom. Individual meetings would also allow to identify further which factors can explain why some students report benefits from the intervention while others do not. It is quite possible that some of these factors were simply not identified in the present study, as we did not measure and control for individual characteristics attributable to group heterogeneity. Future work could also control for the differential impact of baseline meta-cognitive and self-awareness abilities in students, as one would expect that this would drive change more so than age.

CONCLUSION

Results from this study show substantial variation between students, tested cohorts and raters of internalizing and externalizing symptoms and behaviors. Therefore, the conservative conclusion from such variation can only be that more research is needed, as no firm conclusion as to the utility of MBIs for such groups of children with special education needs can be established: there was simply too much variation in the results. Nonetheless, the results do indicate directions for future research to explore this variation, namely in terms of who the respondents are, the homogeneity of the group within which the intervention is implemented, time of the year during which the intervention is implemented and by whom. Thus, these results warrant caution regarding the overall impact and efficacy of MBIs as a universal treatment option for youth with psychiatric disorders in a special education curriculum.

ETHICS STATEMENT

This study was carried out in accordance with requirements of the Research and Ethics Committee of the Sainte-Justine Mother and Child Hospital Center, in Montreal, Canada. The protocol and study were reviewed and approved by the Research and Ethics Committee of the Sainte-Justine Mother and Child Hospital Center, responsible for granting ethics approvals. All subjects and their parents gave written informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

CM-H conceptualized and coordinated the study, adapted the mindfulness-based intervention and trained the school psychologist involved in this study, performed data analysis, and drafted the manuscript. GT contributed extensively to data interpretation and revision of the manuscript. LP helped in data collection and coordination of the study, while contributing to data interpretation and revision of the manuscript. EL contributed to the design of the study and revision of the manuscript.

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Conflict of Interest Statement: CM-H and EL have released a manual on the mindfulness-based intervention described and used in this study (Midi Trente Publishers).

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

CORRECTION
published: 07 November 2018
doi: 10.3389/feduc.2018.00097

Corrigendum: A Mindfulness-Based Intervention for Students With Psychiatric Disorders in a Special Education Curriculum: A Series of n-of-1 Trials on Internalized and Externalized Symptoms

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Keywords: school psychology, mindfulness-based interventions, psychiatric disorders, internalized symptoms, externalized symptoms, mental health

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Approved by:
Frontiers in Education Editorial Office, Frontiers Media SA, Switzerland

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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *09 October 2018*
Accepted: *19 October 2018*
Published: *07 November 2018*

Citation:
Malboeuf-Hurtubise C, Taylor G, Paquette L and Lacourse E (2018) Corrigendum: A Mindfulness-Based Intervention for Students With Psychiatric Disorders in a Special Education Curriculum: A Series of n-of-1 Trials on Internalized and Externalized Symptoms. Front. Educ. 3:97. doi: 10.3389/feduc.2018.00097

A Corrigendum on

A Mindfulness-Based Intervention for Students With Psychiatric Disorders in a Special Education Curriculum: A Series of n-of-1 Trials on Internalized and Externalized Symptoms
by Malboeuf-Hurtubise, C., Taylor, G., Paquette, L., and Lacourse, E. (2018). Front. Educ. 3:66. doi: 10.3389/feduc.2018.00066

In the original article, we neglected to include the funder Bishop's University, Publication Grant, to Catherine Malboeuf-Hurtubise.

In the published article, there was an error regarding the affiliation**(s)** for Catherine Malboeuf-Hurtubise. As well as having affiliation(s) 2, Catherine Malboeuf-Hurtubise should also have Department of Psychology, Bishop's University, Sherbrooke, QC, Canada (added as affiliation 1). Please also note that, by adding a new affiliation, other consequent affiliation numbers have changed (as indicated above)**.** The authors apologize for these errors and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

REVIEW
published: 29 August 2018
doi: 10.3389/fpsyg.2018.01482

A Review of the Academic and Psychological Impact of the Transition to Secondary Education

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The transition from primary to secondary education is one of the most stressful events in a young person's life (Zeedyk et al., 2003) and can have a negative impact on psychological well-being and academic achievement. One explanation for these negative impacts is that the transition coincides with early adolescence, a period during which certain psychological disorders (i.e., anxiety disorders) become more salient (Kessler et al., 2005) and marked social, biological, and psychological development occurs (Anderson et al., 2000). This review evaluates the existing literature on the psychological and academic impacts of the transition to secondary education on young adolescents. We examine the factors that plausibly increase or mitigate the risk of developing mental health issues and/or a decline in academic performance during the transition to secondary education. We also review the interplay between psychological health and academic achievement across and beyond the transition. We conclude with a summary of what schools and parents can learn from these findings to support children in a successful transition into secondary education.

Keywords: school transition, anxiety, psychological health, academic achievement, secondary education, primary education

OPEN ACCESS

Edited by:
Michael S. Dempsey,
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Reviewed by:
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 April 2018*
Accepted: *27 July 2018*
Published: *29 August 2018*

Citation:
Evans D, Borriello GA and Field AP (2018) A Review of the Academic and Psychological Impact of the Transition to Secondary Education. Front. Psychol. 9:1482. doi: 10.3389/fpsyg.2018.01482

INTRODUCTION

The transition from primary to secondary education is a normative event for most children around the world, which typically occurs when children are early adolescents (mostly between the ages of 10–14). Although most students change school at some point during their education, systems around the world vary significantly. For example, in England, children transition in Year 6 at age 11, whereas in the United States (US), the age and grade of transition differs per school and per state, with children transitioning between the ages of 10 and 14 to a middle or high school (5th and 8th grade, respectively). While it is the norm to transition, it is possible that children may also attend schools in which they complete their education in one institution, though these are uncommon in the United Kingdom. To avoid switching between locale-specific terms, for the entirety of this review, primary education refers to schooling before children transition to a middle school, high-school (United Kingdom), secondary school, or a gymnasium around the ages of 10–14, while secondary education refers to schooling after this transition.

Around two in five students fail to reach their expected progress following the transition to secondary education (Galton et al., 1999), with around 40% of students making no progress in

English and reading (42 and 38%, respectively) and 34% making no progress in maths from Year 6 (age 10–11) to Year 7 (age 11–12) (Galton et al., 1999). In the United Kingdom, Ofsted (2002) concluded there was limited preparation available for the differences in teaching and learning children face after the transition.

The transition to secondary education has received increased interest from researchers in recent years, with many researchers regarding the change as one of the most stressful events young adolescents will experience (Chung et al., 1998; Coelho and Romão, 2016). Children report additional concerns during this time, including fear of bullies, being lost, peer relationship worries, and anxiety over coping with an increased workload (Zeedyk et al., 2003). Additionally, the transition to secondary education can directly impact educational attainment, with a reported interruption in students' academic growth during the transition year (Akos et al., 2015).

Figure 1 shows an attempt to organize the various constructs that, based on research, contribute to a successful transition to secondary education. The first consideration is what is deemed a "successful" transition. Although the adjustment to secondary education can be measured in various ways, most researchers regard it to encompass social, academic, and emotional adaptation (Duchesne et al., 2012). Hall and DiPerna (2017) particularly note the importance of relationships with peers, developing academic abilities, and a stable state of mental health as vital components of adjusting to secondary education. These components are not independent. Where there are declines in emotional well-being, there are also declines in peer relationship quality, and academic performance, though causality has yet to be established (e.g., Woodward and Fergusson, 2000; Reijntjes et al., 2010; Mundy et al., 2017; Rahman et al., 2018). Although many students adapt with relatively few issues, others find the transition impacts one, two, or all of these domains. It has been argued that children who express more worries prior to the transition are less likely to be well-adjusted in all three of these areas (Duchesne et al., 2012).

In terms of what predicts a successful transition, **Figure 1** organizes the key constructs into higher-order categories of contextual, environment-, and individual-level constructs. Contextual constructs are variables that could plausibly moderate any of the relationships between the environmental-level constructs, individual-level constructs and a successful transition. The contextual constructs could all plausibly have a direct impact on whether the transition is successful too. They have in common that they are either fixed during transition (e.g., pre-transition academic attainment/emotional health, biological sex, whether we consider the model for a specific subject area such as maths), likely not to change (e.g., SES), or the effect of change is likely to be fixed at the group level (for example, we might consider the effects of puberty to be somewhat similar for all boys). The environment- and individual-level constructs are ones that are highly likely to change heterogeneously during transition to secondary education (for example, there is likely to be considerable variability in how dramatically the school environment changes for different children). They differ, self-evidently, in whether they relate to the child's environment or his/her internal schema.

Within these categories, we have pulled together related measures from the literature into superordinate constructs. For example, researchers have looked at class size, teacher expectations, and academic goal orientation as predictors of a successful transition, all of which can logically be grouped as part of the school environment. Similarly, a child's set of beliefs about their social environment and her/his emotional responses to them (which we have labeled *social schema*) encompasses peer relations, teacher relations, affect to school (or belongingness), and social support more generally. The constructs identified are not exhaustive or definitive, they are merely a convenient way to organize the existing literature for the purpose of this review.

Within the environment-level constructs, most of the literature relates to changes in the child's school or home environment. The overall school environment typically changes during the transition to secondary education. Children often move from a smaller, personal primary school where they are taught by a single teacher in, primarily, a single classroom, to a larger, more complex, impersonal secondary school where they attend lessons in different locations with different teachers, often with larger class sizes. Secondary school buildings tend to be larger, and individuals are often required to travel further afield, often on public transport.

Within the individual-level constructs, the literature focuses on the belief systems in the child about their social position, their learning, and their academic self-concept. For example, Cantin and Boivin (2004) report a decrease in friendship network size following the transition, meaning children have fewer friends post-transition. Similarly, Martínez et al. (2011) note a decline in both general social support and the support given by teachers at this time. These findings are represented by social schema in **Figure 1**.

The constructs identified are, of course, not independent. The environment-level constructs could plausibly have a direct effect on a successful school transition, but also an indirect effect by influencing any one of the individual-level constructs. For example, the classroom goal structure alters post-transition with higher importance placed on performance goals, where the focus is on demonstrating ability relative to others, as opposed to mastery goals, where the focus is on increasing competence relative to self-set standards (Madjar et al., 2018). This shift in goals in turn negatively impacts social schema such as school belongingness/engagement (Madjar and Chohat, 2017). Similarly, decreased emotional support in the classroom has been reported following the transition (Shell et al., 2014), which is likely to impact social schema. The individual-level constructs are also likely to influence each other: social and learning schemas are both likely to influence academic self-concept and plausibly each other.

We aim to evaluate the academic and psychological impact of the secondary education transition, while examining risk and protective factors that may amplify or lessen these effects. Based on Hall and DiPerna's (2017) definition, we primarily review the evidence concerning emotional well-being and academic performance. Because so little is known about the causal

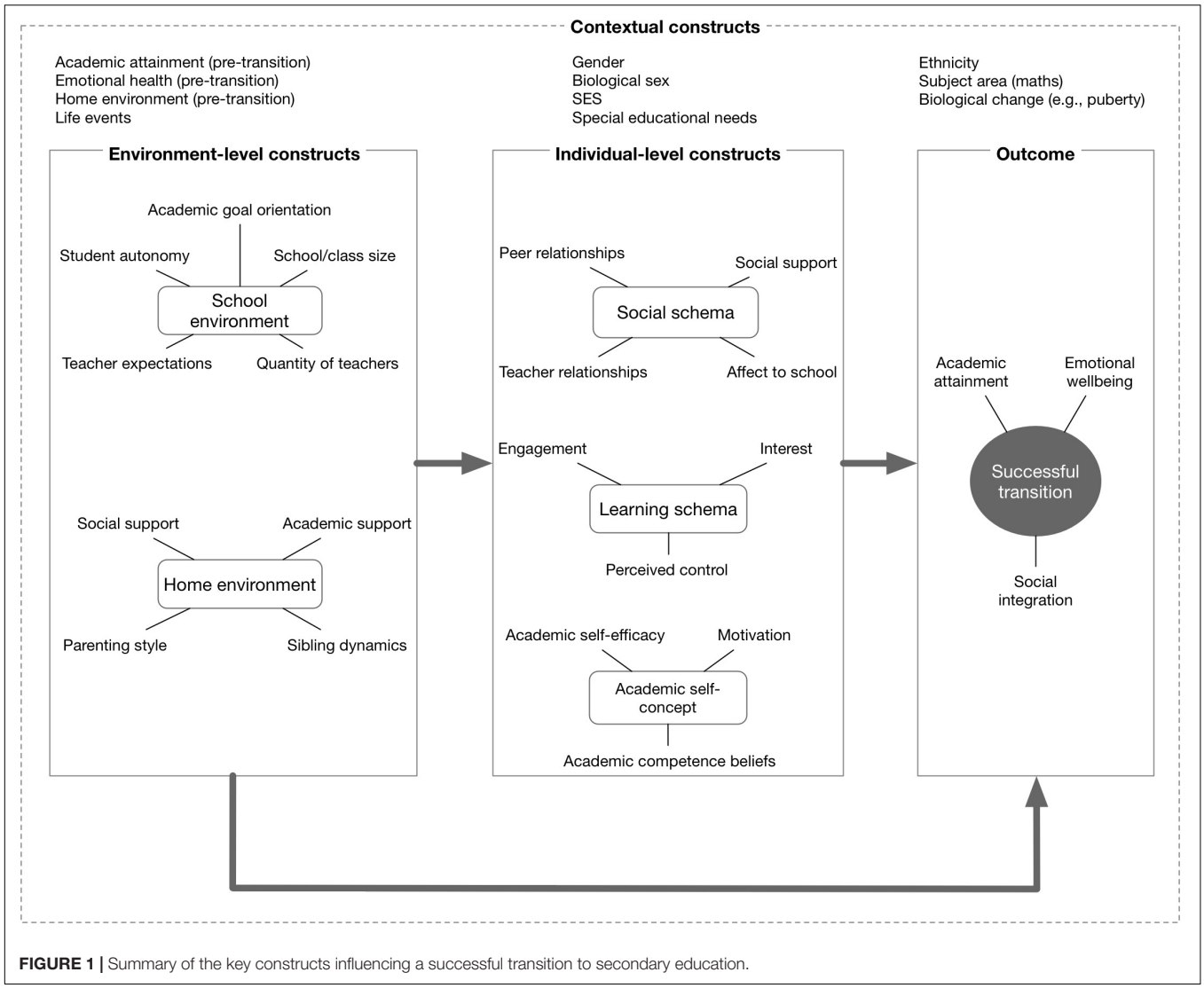

FIGURE 1 | Summary of the key constructs influencing a successful transition to secondary education.

relationships between the identified constructs we believe it is misleading (not to mention messy) to make individual connections in **Figure 1** between the various constructs that might imply causality. Instead, this review will highlight the relationships between the constructs in the **Figure 1** that have been observed, but there may be other connections that, as yet, have not been explored empirically.

THE EFFECTS OF THE TRANSITION TO SECONDARY EDUCATION ON ACADEMIC ACHIEVEMENT

The first indicator of a successful transition to secondary education is academic achievement (**Figure 1**). Academic achievement is essential for individual well-being across the lifespan (Gottfredson, 2004; Fiscella and Kitzman, 2009). The primary-to-secondary transition is a critical period of development in which many children are particularly vulnerable to lower levels of academic achievement. Low academic achievement during early adolescence is linked with various negative consequences, including early pregnancy and higher delinquency rates (Kasen et al., 1998; Freudenberg and Ruglis, 2007; Henry et al., 2012). Moreover, low achievement during this period tends to be succeeded by school dropout and low occupational achievement and income across the lifespan (Day and Newburger, 2002). In this section, we summarize research that has examined the impacts of the primary-to-secondary transition on academic-related outcomes in early adolescence.

A number of United States studies indicate that the transition from primary to secondary education has a negative impact on student grade point averages (GPA) and academic achievement (Felner et al., 1981; Simmons et al., 1991; Seidman et al., 1994; Alspaugh and Harting, 1995; Gutman and Midgley, 2000; Dotterer et al., 2009). Illustratively, United States students who moved from a primary to a secondary school experienced a decline in grades following the transition, unlike students

who were in the same grade but had not transitioned to secondary education (Felner et al., 1981). Alspaugh (1998) also found that U.S. children experience lower academic achievement after transitioning from primary school to secondary school. Moreover, children who transitioned into secondary education where peers attended a variety of primary schools experienced lower levels of achievement than children who transitioned into secondary education with peers who attended the same primary school. Results from achievement at the high school level indicated that U.S. children who transitioned multiple times, from primary to secondary school and from secondary school to high school, experienced higher declines in achievement than those who had fewer school transitions. Alspaugh's (1998) work is in line with other evidence (Rice, 2001) suggesting that the transition from primary to secondary education can have long-term negative consequences on academic outcomes.

Environment-Level Constructs

With respect to the environment-level constructs in **Figure 1**, developmental psychologists have attempted to understand why and how the transition to secondary education can negatively affect academic achievement. The *stage-environment fit* model (Eccles et al., 1993) suggests that a mismatch between children's developmental needs at the time of the transition and the social context of secondary schools contributes to a decline in academic outcomes following the transition.

Several aspects of the secondary education school environment that differ from primary education may have a particular effect on academic achievement following the transition; these include new academic environments (e.g., new, larger schools and classrooms) and different structural demands (e.g., switching classrooms, teachers, and classroom materials for each subject throughout the day). Children must also forge new student-teacher relationships and adjust to changes in teacher expectations and declines in student autonomy.

Although teachers have more control over secondary education classrooms, academic standards tend to be higher in secondary education than in primary, and require more intrinsic motivation from adolescents (Harter et al., 1992). Compared to primary education, secondary education classes place an increased emphasis on grades and teachers' academic expectations of students tend to be higher (Eccles and Midgley, 1989; Wigfield et al., 1991). Moreover, children may perceive classroom goals differently in primary and secondary education. Cross-sectional work indicates that in primary education settings, students report being more *task oriented*, or engaged in academic work for the sake of learning, whereas in secondary education settings children report being more *performance oriented*, or engaged in academic work for the sake of demonstrating ability (Anderman and Midgley, 1997). A longitudinal study found that following a transition from primary to secondary education, children perceived classroom climates to focus more on competence and less on learning (Anderman and Midgley, 1997). These changes subsequently influence individual-level constructs such as adolescents' academic self-concept, interest and engagement (learning schema), and affect toward school (social schema), as discussed in the following sections.

Individual-Level Constructs

Academic Self-Concept

Academic self-concept, or self-perceptions regarding academic topics and learning, has various components, including a cognitive component specific to academic competence and an affective-motivational component (Marsh et al., 1991; Arens et al., 2013a). Studies indicate that academic self-concept decreases between the end of primary and the beginning of secondary education (Wigfield et al., 1991; Arens et al., 2013a). For example, Coelho et al. (2017) found decreases in students' academic self-concept from their last year in primary education to the end of their first year in secondary education, along with lower levels of self-esteem. Although this sample included Portuguese children who transitioned to secondary education 2 years earlier than students in the United Kingdom or the U.S. typically do, these findings are consistent with studies examining children who transition to secondary education at a later age (Wigfield et al., 1991). In addition, Seidman et al. (1994) found that students' academic self-perceptions declined even after adjusting for student age, grade level, and ability level. Together, these findings provide evidence that the transition process itself (i.e., the environment) as well as individual factors (e.g., developmental changes), likely play a role in changing children's academic self-concept.

However, there is inconsistency in the literature with not all studies finding a decline in perceived academic competence after the transition to secondary education. For example, Harter et al. (1992) found no significant differences between children's perceptions of scholastic competence following the transition to secondary education compared to children who did not transition. There are also studies demonstrating *increases*, not decreases, in academic self-efficacy (Zimmerman and Martinez-Pons, 1990; Midgley et al., 1995). The variance in observed changes in perceptions of academic competence across the transition period must be explained by other factors, including how much children value a particular academic domain and their interest in it. Moreover, we might expect changes in academic self-concept to differ by discipline. For example, Wigfield et al. (1991) found significant declines in children's perceived competence in English following the transition to secondary education, but only marginal declines in mathematics. In the Section "Learning Schema," we discuss student attitudes and interest in a select few academic domains.

Learning Schema

Students tend to hold more negative attitudes toward certain academic domains including mathematics and science, compared to others, and to academic achievement, more broadly (Eccles et al., 1984). Student self-perceptions about their own abilities in and attitudes toward maths and science tend to decrease as children progress in school, and especially during the transition to secondary education (Eccles et al., 1984; Midgley et al., 1989a). For example, a cross-sectional study by Barth et al. (2011) found that children's attitudes toward and self-efficacy in mathematics

and science declined during the transition. Similarly, student interest in mathematics and science were lower after, rather than prior to, the transition to secondary education. Furthermore, Australian students reported less involvement in the classroom and declining enjoyment and attitudes toward maths following the transition relative to those yet to make the move over to secondary education (Deieso and Fraser, 2018).

Differences in learning experiences surrounding science and mathematics before and after the primary-to-secondary transition may also influence changes in students' academic attitudes and interests. Prior to the transition, for example, students do not have a choice in the type of science or mathematics courses in which they enroll and instruction in these arenas is standardized across students. Following the transition to secondary education, students have more agency in the number and type of mathematics and science courses they choose. Moreover, student ability in these domains becomes more salient, and students tend to get grouped into courses with students who have similar abilities to their own. Moreover, as children progress through school, teacher support decreases. Barth et al. (2011) investigated whether the role of teaching effectiveness and student perceptions of positive teaching strategies (i.e., teacher support, engaging instruction) contributed to decreases in student interest and attitudes toward maths and science. Findings indicated that effective teaching and student perceptions of positive teaching strategies strongly predicted changes in student interest and self-efficacy in mathematics and science, particularly during the transition to secondary education. Thus, one way that negative attitudes toward and low self-efficacy and interest in mathematics and science across the transition period may be counteracted is via teacher support.

The transition to secondary education also affects engagement and perceived control in learning. A study by Rudolph et al. (2001) examined whether student perceptions of control over their academic outcomes as well as student investments in academic success influenced their ability to successfully transition from primary to secondary education. The researchers expected to find that high perceptions of control and personal investment in academic success would encourage academic engagement and ultimately, academic achievement. Conversely, they expected that low levels of control and investment would promote academic disengagement and hinder academic achievement. Results indicated that, compared to students who did not transition from primary to secondary education, students who experienced a transition and reported lower levels of perceptions of control and personal investment in school also reported higher levels of stress and depressive symptoms. The authors suggest that students with lower levels of perceived control over and personal investment in academic pursuits are more likely to become disengaged from school and to find it easier to feel overwhelmed or particularly sensitive to any school-related issues.

Social Schema

Student feelings of "belongingness" at school and how much they enjoy school may also be impacted by school transitions and affect child achievement. Because intervention research suggests that a positive school climate can benefit children's mental health and academic outcomes, several studies have investigated whether changes in the school climate between primary and secondary education contributes to declines in academic outcomes post-transition (Battistich et al., 2004). Illustratively, Riglin et al. (2013) examined bidirectional associations between young adolescents' (M_{age} = 11.78 years) affect toward school and their academic achievement using a prospective, longitudinal design. They found reciprocal associations between school liking and academic achievement at the beginning and end of the first year of secondary education. However, after controlling for conduct problems, degree of liking school predicted later academic achievement, but early achievement no longer predicted later school liking. These findings support the notion that affect toward school and a sense of belonging to school are linked with academic achievement (Resnick et al., 1997; Roeser et al., 2000; McLaughlin and Clarke, 2010). However, some studies have not found evidence to suggest that children's perceptions of the school climate differ prior to and following the school transition (Thornburg and Glider, 1984; Fenzel and Blyth, 1986; Hirsch and Rapkin, 1987; Crockett et al., 1989; Harter et al., 1992), and other studies report positive child perceptions of the school climate post-transition (Schulenberg et al., 1984; Nottelmann, 1987; Berndt and Mekos, 1995). These findings indicate a need for more research to investigate links between the school climate before and after the primary-to-secondary education transition and its effects on academic achievement in early adolescence and beyond.

Interplay Between Individual-Level Constructs

It is important to understand the interplay between academic achievement, social schema, learning schema, and academic self-concept because doing so provides clear target areas to help children to maintain academic achievement across the transition to secondary education. The way that students cope with changes in academic achievement after the transition may have long-term consequences for future achievement. If initial decreases in grades or achievement post-transition leads some students to alter their academic self-concept, they may become more disengaged with school and have more negative feelings toward school, or increased feelings of disconnectedness. In turn, teachers may interact with students in a more negative way and these effects can snowball and lead to future decreases in student achievement or engagement (Eccles et al., 1993; Fenzel, 2000). Conversely, it is also possible that for students with more resources and personal investments in learning, initial declines in grades following the transition may motivate them to become more engaged at school and work harder to bring up their grades. Thus, the ability of a young adolescent to continue doing well academically following a school transition is likely to depend on both the interplay between the individual-level factors and the environment-level factors that influence them.

Contextual Variables

So far, we have reviewed the environment- and individual-level factors affecting the transition from primary to secondary education. However, a range of contextual variables have been

identified as predictors of academic performance across the transition to secondary education. For example, pubertal status has been linked to changes in academic self-concept and self-representation, both of which are important for academic achievement (Schaffhuser et al., 2017). This section summarizes what we know about some of the contextual variables identified in **Figure 1**.

Gender

Few studies examining the school transition have reported consistent evidence of gender differences impacting future academic outcomes (Wigfield et al., 1991; Harter et al., 1992; Seidman et al., 1994). For example, Seidman et al. (1994) found that children's grades declined following the transition regardless of gender. Studies examining motivation, attitudes toward, and self-concepts in specific academic domains have found that boys tend to have more positive attitudes toward and higher self-concepts in maths than girls, whereas girls tend to have more positive attitudes toward and higher self-concept in English than boys (Eccles et al., 1984; Marsh, 1989). However, research findings regarding effects of gender on self-concepts and attitudes toward academic achievement, and how these characteristics vary by gender across the transition period, are inconsistent.

Cognitive and Emotional Traits

Studies have reported a number of cognitive or emotional traits that influenced findings regarding the school transition and academic outcomes (Petrides et al., 2004). For example, a longitudinal study examined the development of self-control during early adolescence, as children transitioned from primary to secondary education, and found that students with higher levels of self-control adjusted better following a school transition, receiving higher grades in English, maths, and science courses (Ng-Knight et al., 2016).

Several studies suggest that how well children adapt to a new school environment and perform academically may depend on ability level in academic domains prior to a transition. For example, Wigfield et al. (1991) examined students' academic self-concept in mathematics prior to and following a secondary education transition, and found that children's mathematics self-concept following a school transition varied by level of mathematics ability. For students with high mathematics ability, mathematics self-concepts declined over time following the transition, while students with low mathematics ability experienced slight increases in their mathematics self-concepts following the transition. Other studies have also reported that academic ability level can help explain effects of school transitions on young adolescents' academic-related outcomes (Midgley et al., 1989a,b; Anderman, 1998). For example, in a longitudinal study (Midgley et al., 1989a) teacher influences on student perceptions of the importance of mathematics before and after the secondary transition depended on student mathematics achievement. Results indicated that, compared to high achieving students, low achieving students had steeper declines in perceptions of mathematics importance if they switched from more supportive teachers before the transition to less supportive teachers following the transition.

With respect to emotional traits, Qualter et al. (2007) found that compared to students with below average emotional intelligence, those with average or higher levels of emotional intelligence received better grades in school, and had fewer teacher concerns regarding effort following the transition to secondary education (age 11–12).

SES and Ethnicity

Because youth of lower socioeconomic status (SES) tend to have lower academic achievement than higher SES youth (McLoyd, 1998), it is possible that the primary-to-secondary education transition is especially stressful for this group of children. Moreover, because far more ethnic/racial minorities tend to live in poverty (Brooks-Gunn et al., 1996), it is also pertinent to consider how the transition may impact ethnic and racial minorities' academic achievement. Illustratively, Simmons et al. (1991) found that grades of African American students were extremely low following the secondary education transition, even though all students grades declined. Serbin et al. (2013) investigated academic achievement across the secondary transition in an "at risk" sample of children from lower income families. Findings indicated that family resources and child gender mattered: children from families with fewer resources had lower achievement than those from families with more resources following the transition, and girls had higher grades than boys following the transition. Moreover, multiple mediation analyses demonstrated that the link between gender and achievement was mediated by children's social and academic skills (i.e., spelling), as well as the degree of support they received from parents prior to the transition. Thus, social skills, academic skills, and support from parents prior to the transition contributed to differences in boys' and girls' achievement following the transition into secondary education. Future work should focus on prevention and intervention efforts for populations of children that may especially need help to navigate the secondary education transition and to excel in school.

THE EFFECTS OF THE TRANSITION TO SECONDARY EDUCATION ON EMOTIONAL HEALTH

The second key indicator of a successful transition to secondary education in **Figure 1** is emotional health. Adolescence is a significant period for the development of mental health disorders with symptoms often increasing during this time (e.g., Kessler et al., 2005). A report by the Office for National Statistics states the prevalence of mental health disorders to be 12% in children aged 11–16, compared to 8% of those aged 5–10 (see Green et al., 2005). The Australian National Survey of Mental Health and Well-Being supports this figure reporting that at least 14% of adolescents younger than 18 were diagnosable with a mental disorder (Sawyer et al., 2001). Given the high frequency of disorders within this age range, it seems likely that the primary-to-secondary education transition could contribute to mental health issues among young adolescents. In this section, we review this possibility.

What Do We Mean by Emotional Health?

If we consider emotional health in terms of constructs identified by mental health practitioners (APA, 2017a), then there are broadly two categories of symptom clusters to consider: symptoms that are largely internal to the person (manifest in psychological constructs such as anxiety and depression) and those that are external to the person (manifest in constructs such as conduct problems and attention-deficit and hyperactivity). Before looking at predictors of these symptoms related to the transition to secondary education, we will review these symptom clusters.

Internalizing Symptoms

One of the most common childhood disorders is anxiety. Anxiety disorders can take many forms and are generally characterized as feelings of tension and worrisome thoughts as well as physiological changes including an increased heart rate, increased perspiration and trembling among others (APA, 2017a). Anxiety is reported to be the earliest disorder to emerge in childhood, with 50% of anxiety disorders beginning by age 6 in affected adolescents (Merikangas et al., 2010). Additionally, when averaged across all subtypes of anxiety disorders, the median age of onset is 11 years (Kessler et al., 2005). Furthermore, it is one of the most common disorders faced by children; one meta-analysis of 41 studies spanning 27 countries conducted between 1985 and 2012 estimated the worldwide prevalence of any anxiety disorder to be 6.5% (Polanczyk et al., 2015). Moreover, the lifetime prevalence of any anxiety disorder appears to be a staggering 31.9% (Merikangas et al., 2010). Childhood anxiety also has a higher prevalence than depression, and is diagnosed more frequently than behavioral issues such as conduct disorder (Cartwright-Hatton et al., 2006).

Most anxiety disorders are already established by early adolescence (Kessler et al., 2005) with little change in frequency from age 13/14 up to age 17/18 (Merikangas et al., 2010). The transition to secondary education typically occurs just before this period of a child's life and is arguably particularly important in this process. For example, students experiencing greater worries concerning the school environment and relationships over the transition typically have heightened anxiety symptoms (Arowosafe and Irvin, 1992; Harter et al., 1992; Lucey and Reay, 2000; Akos and Galassi, 2004). Greater school transition concerns both prior to and following the move have been associated with increased anxiety (Rice et al., 2011), though research to date has been somewhat sparse and inconsistent.

A longitudinal study of U.S. schoolchildren aged 11–13, showed a decrease in anxiety symptoms following the move to secondary education (Grills-Taquechel et al., 2010). This decrease in social anxiety was significant only in males. Furthermore, anxiety symptoms were predicted by global self-worth and social acceptance, with higher levels of both predicting greater decreases in anxiety, with males again showing greater declines. This finding suggests the transition could be particularly beneficial for male students in reducing their anxiety. One reason proposed to explain this gender difference is that females tend to participate in "relational" forms of bullying such as gossiping, spreading rumors, and excluding peers (Crick and Grotpeter, 1995; Murray-Close et al., 2007). This may be an underlying mechanism of why girls experience greater social anxiety compared to boys, given females place greater value on close friendships, and greater fear of rejection and the loss of relationships (for a review, see Rose and Rudolph, 2006). Additionally, Grills-Taquechel et al. (2010) reported lessened impact of the transition on individuals with high self-worth and those who felt more socially accepted by their peers. Meanwhile, there also appears to be links between anxiety, stress, and the transition. Zandstra et al. (2015) reported a negative transition experience was associated with declines in mental health well-being, evident only in individuals with high awakening cortisol, a hormone important for stress reactivity. This association suggests that some individuals may be predisposed to greater emotional responses following a negative event such as the secondary education transition. This may help to explain why some individuals transition successfully, while others do not.

In a Canadian cohort of 11-year-old pupils, Duchesne et al. (2009) found that anxiety predicted both academic and teacher worries preceding the transition to middle school. Further analysis suggests girls perceived themselves as being more anxious and also reported greater worries about meeting academic demands and establishing relationships with teachers. However, attachment predicted anxiety levels, with individuals reporting more 'secure' attachments showing lower anxiety levels. Alternatively, another study of over 200 English schoolchildren (age 11) found similar levels of anxiety both at the start of secondary education and at the end of their first year (Riglin et al., 2013). There were further gender differences with females experiencing higher general anxiety and school anxiety, greater school concerns, and increased school engagement compared to males, whereas, conduct disorder was higher in males than females. However, there were no measures prior to the transition in this study (e.g., in Year 6) making it impossible to draw conclusions about the effect of the transition.

Where evidence is inconsistent concerning the emergence of general anxiety following the transition to secondary education, there are links between the changeover and the development of one domain-specific type of anxiety: maths anxiety. Maths anxiety is often defined as feelings of tension, apprehension, or fear that may interfere with maths performance (Ashcraft, 2002). Maths anxiety has been found to increase at the time of the changeover for students that transitioned to a new secondary school compared to those that did not, and increased especially in females and high-achievers (Madjar et al., 2016). Their analysis suggests there is a significant increase in maths anxiety toward to end of primary education, which remains high for some time, before decreasing at the end of their first year in secondary education back to initial levels. This suggests that the transition to secondary education may be an important period for interventions for these groups because maths anxiety has been linked to GPA and maths ability (Madjar et al., 2016).

A second kind of internalizing disorder is depression. Depression is closely associated with anxiety that manifests in several symptoms most commonly including feelings of sadness, lack of interest and pleasure in activities, lack of energy and concentration, feelings of worthlessness, and recurrent thoughts

of suicide (APA, 2017b). The prevalence of major depressive disorder (MDD) by age 14 is 8.4% (Merikangas et al., 2010), and a figure that almost doubles to 15.4% from age 13–14 to age 17–18 suggesting that adolescence is a critical period for developing depression. Further support for this argument comes from reported increases in suicidal ideation at a similar age to the transition to secondary education (Adrian et al., 2016).

Similar to the evidence regarding the transition to secondary education and anxiety symptoms, research on depression in this context is also somewhat sparse. Nevertheless, depressive symptomology is highly stable throughout adolescence, however, stability significantly drops during the transition from 6th to 7th grade coinciding with the transition from primary to secondary education (Tram and Cole, 2006). Rice et al. (2011) further report positive associations between depression and post-transition school concerns.

Additionally, in a study of over 2000 Scottish pupils, West et al. (2010) reported that poorer transitions at age 11 (including both school and peer concerns, such as increased workload and bullying) predicted depression at age 13 and 15, while peer concerns at age 13 was weakly associated with psychological distress at age 18 (OR = 1.19). Their results contradict Kingery et al. (2011) data showing depression significantly decreases following the transition. However, the sample in Kingery et al.'s (2011) study included mostly Caucasian children residing in small, rural, suburban communities which may make generalizability to children studying in urban districts, or those from ethnically diverse backgrounds, problematic.

While the conclusion is somewhat unclear, depressive symptoms are important to keep in mind because Riglin et al. (2013) reported greater levels of depression at age 11 predicted academic achievement at the end of individuals' first year of secondary education. However, when controlling for conduct disorder, this effect was no longer significant. Additional gender effects were evident with depression being significantly associated with poorer academic achievement for males only. The mediating effect of conduct disorder between depression and achievement further highlights that emotional problems and academic achievement are not independent outcomes, and that declines in one area often coincides with declines in other domains.

Although the evidence linking the transition to secondary education to mental health outcomes is sparse, there is a larger body of research linking it to psychological attributes such as self-esteem, self-efficacy, and self-concept (e.g., Coelho et al., 2017). Though there are slight differences in meaning, these variables can be broadly defined as attitudes, beliefs, and models of a person's own abilities, and their capability to perform such behaviors in a given situation (APA, 2017c). These concepts may be informative with respect to mental health outcomes because they have been linked to well-being, academic achievement, and other educational benefits (e.g., Diener and Diener, 1995; Marsh and Craven, 2006).

In a study of over 1100 Portuguese students, Coelho et al. (2017) reported decreases in academic self-concept, physical self-concept, and self-esteem after the primary-secondary education transition. The effect remained significant when controlling for gender. However, the school transition occurs slightly earlier in Portugal: as young as 9 years old. Additionally, self-esteem has been found to decrease during transitionary years and continues to decline post-transition (Seidman et al., 2003; Arens et al., 2013b). This decline is supported by Schaffhuser et al. (2017) who also reported decreases in self-esteem as well as academic and behavioral self-concepts over the transition. Moreover, student self-efficacy appears to be positively associated with teacher-rated overall school adjustment, as well as pupil-rated post-transition relationships with teachers (Bailey and Baines, 2012). In addition, West et al. (2010) indicated self-esteem may act as a predictor of adjustment, with individuals low in self-esteem prior to the transfer experiencing a poorer transition to secondary education with greater school and peer concerns. Despite a general consistency in the transition having a negative effect on self-esteem, Kingery et al. (2011) report the opposite: self-esteem *increased* following the transition.

To summarize, the evidence concerning the impact of the transition on psychological outcomes has been inconsistent. While some researchers have concluded the transition is detrimental to emotional well-being and psychological attributes, others disagree. One consistent finding across domains is the effect of the transition is heightened for individuals expressing greater concerns before the changeover. It appears that adolescents who express more worries regarding the transition are more likely to suffer poorer transitions compared to their peers. In addition, compared to boys, girls have been reported to experience a poorer transition, with heightened levels of anxiety, and greater concerns over relationships and workload (e.g., Duchesne et al., 2009; Riglin et al., 2013). In the Section "Externalizing Symptoms and Anti-Social Behaviors," we describe a separate category of emotional health symptoms, externalizing symptoms, and predictors of these symptoms that relate to the transition to secondary education.

Externalizing Symptoms and Anti-social Behaviors

Externalizing disorders can include a range of disruptive behaviors including conduct disorder, aggression, attention deficit hyperactivity disorder (ADHD), and oppositional behavior. Although such issues can often be disruptive to the learning environment in the classroom itself, they are also related to negative outcomes for the individual including low achievement, school dropout, and non-completion of further education (Adams et al., 1999; McLeod and Kaiser, 2004; Reid et al., 2004; Finn et al., 2008).

There is a lack of research examining externalizing disorders and anti-social behaviors resulting from the primary-secondary education transition, although evidence suggests that the transition is an important event that may exacerbate the effects of externalizing disorders on educational outcomes. For example, Palmu et al. (2017) reported associations between conduct disorder and ADHD on academic performance during the transition to secondary education. In a study of over 300 12- to 13-year-old pupils in Finland, their results found externalizing behaviors were associated with a decrease in GPA, particularly, ADHD before the transition negatively affected GPA post-transition. Riglin et al. (2013) support this link with conduct

problems prior to the transition associating with academic achievement post-transition. Additional analyses suggested that conduct problems pre-transition were also associated with a decrease in school liking following the move.

West et al. (2010) found higher levels of aggression were associated with poorer school transitions, but better peer transitions. Furthermore, aggressive behavior predicted academic expectations for secondary education as well as academic functioning post-transition (Cillessen and Mayeux, 2007). Aggression appeared to interact with peer status such that there was no significant effect of aggressive behavior on academic functioning in individuals with high popularity. Conversely, adolescents with low popularity and high aggressive behavior were more likely to experience lower academic functioning.

It is evident that there are individual differences. For example, three types of aggressive behavior trajectories have been identified over the transition including low-stable, decreasing, and increasing (Malti et al., 2015). Membership to a group was altered by the child's views on friendships. Specifically, those who had less of an understanding of the value of trust and reciprocity within friendships were more likely to be in the increasing trajectory group. This highlights the importance of relationships with other individuals around the time of the school transition and may be a protecting factor against maladaptive outcomes.

Predictors of Emotional Health

The review above demonstrates that the school transition impacts a wide range of emotional health outcomes and adolescent behaviors; however, the success of the transition can also be influenced by a number of other factors under the categories identified in **Figure 1**. These additional influences can increase or decrease the risk of a poor transition and include the individual's social network (family, peers, and teachers), special educational needs (SEN), as well as gender and pubertal status. Generally, the children most at risk of poor transitions are children recognized as SEN and those with a poor social network.

Environment-Level Predictors

As children progress to secondary education, they often face a substantially different environment compared to the one that they have been used to. This environment includes larger classrooms and school buildings to navigate, and different social networks. The move to secondary education also leads to changes in the educational goal structure toward performance-based goals (Madjar et al., 2018). In a study of 415 schoolchildren (aged 11–12), Madjar et al. (2018) investigated goal orientations following the transition to secondary education. At present there are three commonly identified academic goals including: mastery-approach, which involves learning to acquire knowledge and skills; performance-approach, which involves demonstrating greater skills relative to others; and performance-avoidance, which involves avoiding demonstrating such skills. Madjar et al. (2018) argue that the transition from primary to secondary education coincides with a change from a mastery goal structure, to a performance goal structure post-transition. Further research provides evidence for performance goal structures being detrimental to school engagement (Madjar and Chohat, 2017). These results suggest that the school transition may increase competition between individuals, and not always for the better (see Johnson et al., 1981). Transitioning schools could focus more on continuing to provide a mastery goal structure given its importance for engagement, school performance, and general learning (see Kaplan and Maehr, 2007). Otherwise, this change in goal structure may increase the risk of school disengagement post-transition, which can already be a common issue as teens grow older.

Duineveld et al. (2017), who studied the secondary education transition in Finland, reported decreased depressive symptoms, decreased life satisfaction, and increased emotional exhaustion following the transition. In terms of the home environment, they found that mothers provided greater autonomy support (i.e., supporting the child's self-governance and control over their life; Keller, 2016) compared to fathers prior to the transition. Moreover, Duineveld et al. (2017) reported greater levels of autonomy support before the transition significantly predicted a decline in depression after children moved to secondary education. This finding indicates that autonomous, supportive parenting that encourages independence may protect children from developing mental health disorders during the transition to secondary education.

Related evidence provides support for child-mother attachment predicting perceived academic competence and anxiety during the middle school transition (Maltais et al., 2017). The protective power of attachment has also been argued to moderate the relationship between a social comparison learning environment in the classroom on anxiety symptoms (Maltais et al., 2015). Furthermore, in a study of transitioning students, Booth-LaForce et al. (2012) reported that high-increasing growth in anxious withdrawal was predicted by low parental autonomy, low time spent with the mother, both restrictive and nurturing parenting, and peer exclusion. These findings further support the links between a positive, supportive social network, and adolescents' behavioral outcomes during the transition.

Individual-Level Predictors

Social support is vital for early development, learning, and psychological well-being (e.g., Demaray and Malecki, 2002). Perceived social support can be very important during adolescence where individuals experience rapid changes biologically, emotionally, and socially. In addition, a positive social support network can also be protective of issues arising during the transition to secondary education. As we have mentioned above, parental support may buffer children from the emotional effects of the transition to secondary education (presumably through positive effects on the child's social schema). The vast majority of research looking at the emotional impacts of the transition to secondary education has looked at variables that we have clustered as indicators of a child's *social schema* in **Figure 1**.

First, peer relationships facilitate a positive transition on a range of adaptation measures. For example, Kingery et al. (2011) found that pre-transition positive peer relationships (e.g., peer acceptance, friendship quality, number of friends) predicted

various positive post-transition well-being measures including academic achievement, loneliness (or lack of), self-esteem, and school involvement. Cantin and Boivin (2004) reported the transition to secondary education was associated with an increase of perceived social acceptance, as well as an increase in supportive relationships with their school friends. The increases reported were related to friends providing greater instrumental support, informational support, and emotional support. The effects remained in the following 2 years of school following the move. These findings further highlight the importance of friendships and peer relationships during the progression to secondary education.

In addition to the reorganization of children's friendship networks, there is also evidence that the transition may provide new opportunities for victimized children. Wang et al. (2016) argued that victimization decreased for females following the school transition compared to girls that did not transition. Though, transition status made no difference in male victimization between the two time points. Additionally, exclusion and victimization have been argued to decrease following the transition on average, with those recognized as anxious-solitary youth experiencing greater relative declines (Shell et al., 2014). This idea supports the notion of secondary education providing a chance for children to alter their identity as a victim which they may have been associated with in primary school, and also provides the opportunity for children to find new friends or change social groups to one which is more positive and supportive. Cantin and Boivin (2004) also state that around 61% of school peer ties identified prior to the transition no longer remained following the move, further reinforcing the idea that children renegotiate their social network.

Overall, there is general support that a positive social network is important for children's well-being during the transition to secondary education, but children also require support from their teachers and school to feel more secure in their new environment.

A second protective factor against negative emotional outcomes includes school connectedness and belongingness (*affect to school* in **Figure 1**). For example, Vaz et al. (2014a) studied 266 Australian pupils, and reported increases in school belongingness resulted in decreases in mental health problems, even when controlling for prior mental health. Moreover, in a comparison study between transitioning and non-transitioning schools in Australia and Denmark, respectively, Nielsen et al. (2017) reported no significant difference in school connectedness in transitioning schools as pupils aged, whereas schools that did not transition experienced significant decreases in school connectedness over time. However, it may be important to highlight that although the number of "disconnected" students in the transitioning sample was similar across all age groups, this was close to significance in the transition year with increased odds of disconnectedness. This means that, although not statistically significant, there was a trend toward disconnectedness increasing during the transition year.

A third aspect of social schema is the relationship to teachers. After the transition to secondary education, children tend to have different teachers for each discipline, compared to having a single teacher in primary education. It can be difficult for children to form relationships with their new teachers as strong as those held previously. This change in their social network may be detrimental given preadolescents' need for guidance and support during this time (Eccles and Roeser, 2009). In addition, students have been found to possess a greater reliance on teacher support and a preference for external direction following the transition to secondary education (Robbers et al., 2018). This change in the type of relationship with teachers has been notably recognized as one of the concerns amongst children moving into secondary education (Duchesne et al., 2009).

Research findings concerning teacher relationships have been somewhat mixed. Martínez et al. (2011) describes how both social and teacher support significantly decline over the transition. Bru et al. (2010) also reported a general decline in perceived teacher support over the school years, nevertheless, they argue there is no obvious abrupt change during the time between primary and secondary education and criticize previous studies for not accounting for age-related differences. Despite mixed findings, teachers are likely to be an important part of the child's social and support network, which we have seen is important for promoting well-being. Future research could therefore do more to look at the role of teachers within the child's support network. For example, it would be beneficial to have research evaluating whether making student-teacher relationships and student-teacher support networks similar to those experienced in primary education leads to improved outcomes after the transition to secondary education.

Contextual Predictors

The previously described issues of declining social support and the different school climate are faced by every student. However, it is clear some students face additional difficulties when adjusting to secondary education, this includes children with SEN. SEN refers to children who have learning problems or disabilities that may make it difficult to learn relative to other children their age. This can include difficulties in reading and writing, behavioral issues, difficulty understanding or expressing themselves, as well as physical ability issues which may affect them while in school.

The school transition can be especially problematic for children with SEN. For children with sensory or mobility difficulties, solely moving between classes can be challenging, especially so in an unfamiliar environment such as a large, novel secondary school. Children with behavioral or emotional issues may have difficulty establishing relationships with teachers and peers, leaving them feeling isolated. With high importance placed on discipline and obedience to authority in secondary education, children with behavioral or emotional difficulties may be perceived by teachers as acting out or "troublemakers" when in fact they have different needs and requirements.

Fortunately, recent research has attempted to investigate the effects of the school transition more thoroughly for children with SEN, with the aim of identifying the most common issues and difficulties they may encounter during this change. In a systematic review examining the effects of the school transition for children with SEN, Hughes et al. (2013) investigated psychosocial functioning including internalizing functioning, self-concept, self-esteem, self-confidence, externalizing

functioning, and social functioning. They identified key findings of a higher likelihood of victimization and bullying, poorer social adjustment (i.e., loneliness) and lower levels of perceived social support relative to typically developing children. Furthermore, children reported additional concerns and worries. These concerns referred to the provision for special needs in their new school, the ability to make friends, increased workload, and greater worries of bullying relative to their peers without SEN.

Since Hughes et al. (2013) conducted their review, a number of additional studies have been published finding similar results. First, Akos et al. (2015) reported less growth in both maths and reading during the transition year for SEN students despite having the largest year-to-year growth in the year prior to the changeover. Further research also reports individuals with disabilities display significantly lower academic competence compared to their typically developing peers pre- and post-transition (Vaz et al., 2014b). Though interestingly, adolescents with a disability showed an improvement in academic competence over the transition compared with other pupils. Conversely, disability status was linked to decreased mental health functioning pre- and post-transition. It is evident that adolescents with SEN have different requirements when moving to secondary education to ensure a successful transition. Neal et al. (2016) endorse a personal approach when designing transition strategies especially for children with SEN.

With respect to other potential contextual variables, gender has been found to predict adaptation to secondary education. This finding is not surprising given that (1) males and females develop at different rates during adolescence; and (2) internalizing disorders are more prevalent in females than to males (Kessler et al., 2005; Merikangas et al., 2010). Coelho and Romão (2016) found that females experienced significantly higher academic and peer-related stress during the school transition compared to their male peers, whereas males reported higher stress regarding teachers and rules. Furthermore, females had significantly greater increases in peer-related stress during the transition. Grills-Taquechel et al. (2010) supported this conclusion with results suggesting that males experienced a significant decrease in anxiety during the transition to secondary education whereas girls did not. In addition, girls experienced significantly greater general and school anxiety pre- and post-transition. Females also reported a higher number of school concerns, but greater school liking and fewer conduct problems pre- and post-transition (Riglin et al., 2013). Rice et al. (2011) also found school concerns were higher for females both prior to and following the transition. This finding is also supported by Smyth (2016) who reported that girls were more likely than boys to experience transition difficulties.

Furthermore, girls are more likely to experience maths anxiety over the transition to middle school. Madjar et al. (2016) found that girls reported higher maths anxiety following the transition to secondary education which later decreased to initial levels 1-year post-transition, whereas maths anxiety reported by boys remained stable during this time. This is an important finding as maths anxiety has been argued to have a bidirectional relationship with maths performance (Carey et al., 2015). Consequently, if maths anxiety increases for girls during this time it may also impact their later performance, which in turn may increase their anxiety toward maths. Schaffhuser et al. (2017) also argued females are more negatively impacted by the transition compared to males. However, it is not entirely negative for females whereby girls in fact report higher academic and social functioning post-transition relative to boys (Cillessen and Mayeux, 2007). On the other hand, Kingery et al. (2011) reported no gender differences in the overall adjustment to secondary education.

In addition, females tend to experience pubertal onset earlier than males (Lee, 1980) which can have interesting interactions with the effect of the school transition. As described above, females tend to experience greater stress levels around the transition which is also around the time of pubertal onset. Koenig and Gladstone (1998) reported higher rates of depression among developing females (i.e., those that had started or in the latter stages of pubertal development) during the transition years, whereas rates among males were stable over time. However, it is important to note that this was examined in a high school sample as opposed to the earlier transition of middle school/secondary education. By the time of the transition in this sample, a large number of females had already fully developed.

DISCUSSION

The aim of this review was to assimilate the findings to date concerning the impact of the primary-to-secondary education transition on both academic and psychological outcomes. Overall, there appears to be some negative impacts of the transition, though it is difficult to conclude definitively because there are many inconsistencies in the data. These conflicts are not unexpected given the multitude of interacting factors that exacerbate or mitigate the impact of the transition. However, there are still some findings worth noting.

Firstly, the transition to secondary education appears to have some negative consequences for academic achievement (Felner et al., 1981; Alspaugh and Harting, 1995; Alspaugh, 1998; Gutman and Midgley, 2000). Upon transitioning, students must adjust to larger schools and class sizes, greater academic independence, navigating new teacher and peer relationships, higher teacher expectations, and a bigger emphasis on grades and performance. These differences require children to adjust to new academic expectations, norms, and evaluation criteria. These differences can adversely impact young adolescents' academic motivation and engagement, academic self-concept or competence, affect toward school and learning, and their intrinsic interest in school (Harter, 1981; Eccles et al., 1984; Eccles and Midgley, 1989; Skinner et al., 1998). Individual difference factors including cognitive and emotional ability levels, gender, and SES can moderate associations between these factors and future academic achievement following the secondary education transition.

With respect to children's emotional health, the evidence was inconsistent. Some researchers found significant negative impacts on emotional well-being post-transition, while others

found positive outcomes, or negligible results. Clearly, we need a better understanding of the interplay between the constructs identified in **Figure 1** to get a handle on what moderates the effect of the transition on emotional health.

Several risk and protecting factors were identified to play an important role in the transition. First, things likely to affect the child's social schema were found to be particularly important over the transition, including social support received from parents, teachers, and peers. During the transition, children often renegotiate their friendship groups and report decreased general social support during this time. Cohen and Wills (1985) reviewed two main explanations for the role of social support during stressful situations: first, that social support acts as a buffer against stress and second, that solely being part of a social network is helpful for the individual. Their review found support for both explanations, suggesting social support provides various benefits during stressful events and daily life. These ideas may also support the evidence discussed in relation to the importance of social networks around the transition to secondary education. Due to the heightened stress felt by children during this time, social support may help them feel more secure and socially accepted. Parents and teachers should be made aware of the perceived decline in social support reported by adolescents and aim to provide additional support when required to allow for the best outcomes. Despite perceived declines in parental support and perceived increases in peer support during the transition, it is parental support that most accurately indicates emotional difficulties in adolescents (Helsen et al., 2000). Waters et al. (2014) support this finding, concluding that parental presence at home before and after school is the most significant predictor of a positive transition experience.

Additionally, the school and class environment can elicit negative outcomes. For example, children report higher performance-based goals in secondary education compared to the mastery approach in primary education. A performance-approach increases competition between individuals whereas a mastery approach focuses on learning and working with the purpose of gaining knowledge. This change can be harmful to engagement which is an important aspect to sustain during the transition.

Furthermore, some individuals are more "at-risk" of a poor transition relative to their peers. Those most affected include children with SEN. First, children with SEN may face additional difficulties during the move, including matters that may be seemingly straightforward such as transport and mobility, an issue that is usually not as applicable to typically developing children. Furthermore, the findings suggest children with SEN overall report higher victimization, poorer adjustment, lower levels of social support, and reduced academic growth during the transitional year. There are also noteworthy gender differences. The research suggests that females are arguably more affected by the transfer. Girls report higher rates of school concerns, as well as experiencing higher levels of anxiety and depression (in line with other research findings of higher rates of emotional and mood disorders in the adult population among females). Conversely, boys report higher concerns regarding rules and teachers, as well as higher rates of behavioral and conduct problems compared to females.

Theoretical Explanations

Ideally, we need a theoretical model to explain how environment-level constructs create changes in the child's individual-level schema, how environment-level constructs directly affect academic and emotional outcomes, and how individual-level schema affect academic and emotional outcomes. It is a tall order. There are too many potentially relevant theoretical frameworks to cover in one paper, but we can use the example of anxiety to look at how theories of emotion might prove useful.

First, we can look to these models to explain why the transition to secondary education might increase anxiety. Recent research has found very little evidence for the genetic transmission of anxiety, which implies that most risk comes from environmental transmission (Eley et al., 2015). Given that children spend a considerable proportion of their day in school, the school environment is likely to be a potential anxiety trigger. Learning theories suggest that anxiety is acquired through an association-based system in which stimuli and situations come to evoke fear through direct association with fear-evoking experiences, verbal threat information, and observational learning (Mineka and Zinbarg, 2006; Field and Purkis, 2011). The aforementioned shift to performance-based goals in secondary education, heightened teacher expectations, and lower teacher support may be associated with more verbal threat information ("if you don't perform well, you won't get a good job"), more direct negative experiences (e.g., being told off, or social humiliation, when performance is below what is expected), and more observational threat learning (observing others being told off or humiliated when they perform below expectations). Research supports the idea of performance-goal structures creating anxiety: goal structure has been linked to maths anxiety (Federici et al., 2015; Skaalvik et al., 2017) and Baudoin and Galand (2017) reported that performance-based goal structures were associated with feelings of shame and anxiety in schoolchildren. These heightened expectations and associated threat messages at school may be mirrored in the home environment, and may be exacerbated by certain parenting styles known to increase anxiety, such as over-critical parenting (Creswell et al., 2010).

Given that there is a theoretical route through which the transition could create anxiety, then we can look at the effect that this anxiety might have on the individual-level constructs. Heightened anxiety is associated with patterns of information processing (Hadwin and Field, 2010) such as a tendency to interpret ambiguity in a threatening way (*interpretation bias*) and a tendency to attend to threat in the environment (*attentional bias to threat*). As such, once anxiety is heightened students may attend more to both negative feedback about performance (which may negatively affect learning schema and academic self-concept) and negative social cues (which will affect social schema). Equally, ambiguity about academic and social matters may be interpreted more negatively. In short, the knock-on

effect of a transition that creates anxiety will be a processing style that is likely to impact social schema, learning schema, and academic self-concept. Those already prone to anxiety are most likely to experience more anxiety, and greater biases in their information processing, which would lead to more anxiety. This idea is supported by Lester et al. (unpublished) who found that children with greater interpretation bias toward threat experienced higher levels of anxiety before transitioning to secondary education. Of course, this theory also explains variance in the levels of anxiety following the transition (e.g., Grills-Taquechel et al., 2010; Madjar et al., 2016; Lester et al., unpublished), because there will be variance in the negativity in secondary environments and variance in children's risk for anxiety.

For children for whom the transition creates anxiety (and shifts in their schema and information processing), the attentional control theory, which suggests that anxiety impairs goal-directed attentional systems, offers a theoretical mechanism for why academic performance would be affected (Eysenck et al., 2007). One key assumption of this theory is that anxiety increases the attentional allocation toward threat-related stimuli including both external and internal stimuli (i.e., worrisome thoughts). This theory can explain why the anxiety-inducing transition impairs academic outcomes by reducing the attentional capacity available for cognitive tasks. For example, a child experiencing anxiety because of the transition will allocate less attention to tasks in the lesson, and more attention toward worrisome thoughts, and as a result will perform worse in class. This model has been supported by research conducted on maths anxiety and performance (e.g., Carey et al., 2017). Maths performance is arguably more affected by anxiety as it requires significant executive function skills (Cragg and Gilmore, 2014), and as anxiety takes up the allocation available, the executive function systems required to perform maths tasks efficiently are put under strain and performance on the task diminishes, resulting in poorer academic achievement. The attentional control theory also supports the links found between emotional well-being and academic performance.

The theories of anxiety we have used are illustrative of how psychological theory can and, probably, should be used to try to construct parsimonious theoretical frameworks for the effects of the transition to secondary education. Of course, the theories we chose offer little explanation of depressive symptoms, conduct problems and so on. The point is simply that it is possible to build on well-established psychological theory to explain the interplay between the constructs reviewed in this paper.

Implications for School Intervention Strategies

The above findings have implications for school-based intervention programs that target the primary-to-secondary education transition. At present, these programs are free to vary between schools and districts and often attempt to improve self-confidence and problem-solving (e.g., Shepherd and Roker, 2005). To date, a few studies have examined the impact of different school programs over the transition to investigate whether this makes the transfer easier for students. One study found systemic strategies (e.g., group work on projects with future classmates and modules taught continuously over the transition) were associated with lower school anxiety, though only in typically developing children (Neal et al., 2016). In addition, Rosenblatt and Elias (2008) found that U.S. children who took part in an intervention focusing on social-emotional learning before transitioning had a smaller decline in GPA when receiving higher dosages of the intervention compared to a low dosage group. Furthermore, Shepherd and Roker (2005) investigated a project run after-school which aimed to build self-esteem and resilience in particularly withdrawn and shy children and found improvements in both self-esteem and social skills and fewer school concerns.

While several interventions focus on social-emotional development and improving social skills, only a small number of studies have investigated ways to improve educational achievement. One study conducted by Siddiqui et al. (2016) evaluated a reading program following the transition that was undertaken by pupils who had not reached the expected level for English in their final year of primary education. Their results found that children receiving the intervention had higher reading scores compared to a control group. However, in an earlier study, Siddiqui et al. (2014) evaluated a summer school program that focused on literacy and numeracy skills and found it was not effective in improving the educational achievement of "at-risk" students.

While it is clear some of these programs have benefits for students, much more research is needed to assess the effectiveness of different types of intervention programs with greater sample sizes and longitudinal investigation. Based on the evidence presented, future programs should focus on increasing perceived social support (including that given by parents, teachers, and peers), continuation of academic study, such as introducing topics in the final year of primary education that are continued through to secondary education, and developing social-emotional interventions that can be administered nationwide which are effective for typically developing children and those with SEN. In addition, the difficulties associated with the transitional period could be eased by preparing children for the change in goal structure, or by secondary schools adopting a mastery environment, which is arguably more beneficial for children's learning (Meece et al., 2006).

Limitations

Many of the studies presented here were conducted several years ago, often using longitudinal data collected years prior, which may decrease the relevance to education and schools today. This limitation highlights the need for more research to examine how the changes in our educational systems and the advancements made particularly in schooling and technology may impact both the well-being of students and their learning environment during the transition to secondary education. For example, in comparison to transitional students

that participated in studies conducted in the early 2000s, it is now the norm for adolescents to own, or have access to a mobile phone, computer, or tablet (Ofcom, 2017). To date, very few studies have investigated the use of the internet in transition interventions (e.g., Maher, 2010), and it appears there is a lack of investigation into the effects of technology on well-being and achievement during the transitional years. Current investigation into this area is important for a number of reasons. One example to illustrate this is bullying. Advancements in technology have made bullying an online activity resulting in around 49% of children being victims of cyberbullying (Raskauskas and Stoltz, 2007). As discussed previously, the transition may help victimized children renegotiate their social network to no longer be victims of bullying (e.g., Shell et al., 2014; Wang et al., 2016). However, it could be speculated that if evidence of the bullying that occurred during primary education was online, the renegotiation of their social network would not be able to occur, and as such, victimized children would continue to experience bullying throughout secondary education. Another example is the use of the internet to facilitate the transition in a practical manner, i.e., showing interactive maps of the school environment and classrooms to prospective students. An online, interactive map may be beneficial as one of the worries reported by transitional students was being lost (Zeedyk et al., 2003). Another potential use of technology is inviting classroom peers to get to know each other by using a monitored forum where children may introduce themselves and ask their new teacher and a few current students any questions they may have. Additional homework to be completed over the summer prior to the transition could be made available on such a forum to help decrease the interruption in achievement found during the transitional years (Akos et al., 2015). While the above points made are based on speculation alone, future research examining some of these ideas could provide interesting insights into the use of technology during the transition year to help facilitate a successful transition in terms of student well-being, social interaction, academic growth, and environmental practicalities.

Another limitation is the lack of cultural diversity within the research discussed. The studies presented here have focused on particularly "western systems" such as those in America, Europe and Australia. One reason for the lack of diversity is the differences found in systems around the world. For example, children attending schools in places such as Mexico, Africa, or the Middle East, are less likely to attend school past the age of 11 (UNESCO Institute for Statistics, 2010; Gibbs and Heaton, 2014), therefore making the secondary education transition a non-event. However, one of the Sustainable Development Goals set out to achieve by 2030 by the United Nations is to ensure all children complete primary and secondary education. Hopefully, this increase in attendance worldwide allows for comparisons of the transition to be made in the future, allowing for research from a range of culturally diverse countries to examine the issues children encounter during this time, and whether they differ between nations.

CONCLUSION

The importance of emotional well-being, specifically within schools, has been acknowledged by the British Psychological Society in a recent briefing paper (BPS, 2017). It is reported that one in four children and adolescents display signs of a mental health difficulty, with up to three children in every classroom experiencing a mental health issue that can be treated. Furthermore, only 25–40% of the young people affected by these issues receive support from a mental health professional early enough in their development, if they receive any help at all. As most of the disorders experienced in childhood and adolescence continue into adulthood, it is beneficial for everyone involved to ensure interventions are administered as early as possible not only for better emotional well-being but also because of the associations with academic achievement and social functioning, all of which are important for a successful transition. To help during this time, parents and schools could aim to provide more social support during and following the transition to increase the perceived support felt by adolescents. Schools could also provide transition strategies that focus on the worries of children such as being lost or being bullied. In addition, schools could teach topics that can be carried on from primary to secondary education to help with the interruption of achievement. Furthermore, children with SEN should have additional support and provisions in place to ensure they transition with as few difficulties as possible.

Despite all the evidence presented, there are still gaps in the literature. The research investigating internalizing and externalizing disorders is particularly sparse and should be the focus for future exploration. Furthermore, researchers should pilot transition strategies in schools based on the recommendations above. Additional research should aim to utilize longitudinal designs measuring a wide range of factors to accurately assess the impact of the school transition on several outcomes including academic achievement and emotional well-being. Hopefully, future research will overcome the inconsistent findings to date and will reliably identify factors that ensure children become well-adjusted to their new environment. By identifying predictive factors of importance for the primary-to-secondary school transition, researchers can help enable every child to have the opportunity to make a successful transition to secondary education and continue to develop academically, socially, and emotionally.

AUTHOR CONTRIBUTIONS

All authors contributed to the inception of the paper. DE took the lead on the writing overall (notably the sections "Introduction," "Discussion," and the section "The Effects of the Transition to Secondary Education on Emotional Health"), did the initial planning, and coordinated the authors. GB took the lead on writing the section "The Effects of the Transition to Secondary Education on Academic Achievement" and had input on all drafts. AF supervised the project, commented on and edited the first submission, and restructured and edited the revised version by introducing the conceptual framework in **Figure 1**.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 24 September 2018
doi: 10.3389/feduc.2018.00083

School-Related Social Support Is Associated With School Engagement, Self-Competence and Health-Related Quality of Life (HRQoL) in Turkish Immigrant Students

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This study examines how school-related social support from teachers and classmates is related to the health-related quality of life (HRQoL), school engagement, and self-competence of Turkish immigrant students in Germany. We used data from the SIMCUR study with a longitudinal and cohort-sequential design. The study included a total of 216 Turkish immigrant children and adolescents. Complete longitudinal data was available for 161 participants. Students rated their perceived teachers and classmate support, HRQoL, school engagement, and self-competence in math and reading in 4th ($n = 136$), 5th ($n = 110$), and 6th grades ($n = 100$) (middle/ M-cohort), or in 7th ($n = 73$) and 8th ($n = 69$) grades (older/ O-cohort). Multiple regression analysis revealed that school-related social support had positive effects on all outcomes in 4th grade. In 5, 6, and 7th grades, higher classmate support was associated with higher HRQoL but not with school engagement and self-competence, whereas higher teacher support was associated with higher school engagement and self-competence but not with HRQoL. In 8th grade, only a positive effect of teacher support on school engagement was found. Girls were more likely to report higher school-related social support, but this reached significance only for the M-cohort. Boys in 5, 7, and 8th grades reported higher self-competence in math than girls. We found hardly any effects of maternal education level on HRQoL and school outcomes of students. Only for 4th grade students was higher maternal education level associated with higher school engagement. Our findings indicate that for younger children especially in elementary school, teacher, and classmate support has positive effects on both HRQoL and school-related variables; for students at the beginning of middle school, classmate support only has an influence on HRQoL. Regarding school matters, students in these grades profit from teacher support as from classmates. During adolescence, school-related social support loses significance in terms of HRQoL and self-competence. However, teacher support still seems to have a significant impact on students' school-engagement. From an applied perspective, interventions aimed at HRQoL and academic achievement of children and adolescents should include a focus on social support by teachers and classmates.

Keywords: Turkish immigrant children and adolescents, school-related social support, teacher and classmate support, health-related quality of life (HRQoL), KINDL-R, school engagement, perceived self-competence

OPEN ACCESS

Edited by:
J. E. Hall,
University of Southampton,
United Kingdom

Reviewed by:
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *13 March 2018*
Accepted: *05 September 2018*
Published: *24 September 2018*

Citation:
Demir M and Leyendecker B (2018) School-Related Social Support Is Associated With School Engagement, Self-Competence and Health-Related Quality of Life (HRQoL) in Turkish Immigrant Students. Front. Educ. 3:83. doi: 10.3389/feduc.2018.00083

INTRODUCTION

Children's and adolescents' perceived social support represents an important resource in their lives and is associated with a wide range of psychological outcomes (Aydin et al., 2016; Münzer et al., 2017). Malecki and Demaray defined social support as "an individual's perceptions of general support or specific supportive behaviors (available or enacted upon) from people in their social network, which enhances their functioning and/or may buffer them from adverse outcomes" (Malecki and Demaray, 2002, p. 2).

Among the most important settings in childhood and adolescence are schools and classrooms, where social interactions with teachers and classmates take place. School-related social support (i.e., social support from teachers and classmates) influences the perception of school lives directly. Students' perceived school-related social support was found to be associated with their academic initiative (Danielsen et al., 2010), short- and long-term school satisfaction (Jiang et al., 2013; Liu et al., 2016), school-related subjective well-being (Tian et al., 2016), and intrinsic valuation of school work, school adjustment, motivation, academic self-efficacy, as well as academic efforts for learning and mastery orientation (Vedder et al., 2005; Wentzel et al., 2017).

Perceived school-related social support can also influence the individual development and well-being of students. It has been found that school-related social support has a direct effect on school-related stress and an indirect effect on global health, with higher perceived support predicting lower levels of stress and higher global health (García-Moya et al., 2013). High levels of school-related social support can have positive effects on students' adaptive and social skills, self-concept, internalizing, and externalizing behavior problems, and life satisfaction (Demaray and Malecki, 2002; Stewart and Suldo, 2011). An additional important finding is that low levels of support from classmates are associated with higher levels of depression and social anxiety, lower levels of self-esteem (Wit et al., 2011), and higher risk of emotional and conduct problems (Noam et al., 2014). Furthermore, perceived school-related social support can protect adolescents from health-related risk behaviors such as cigarette smoking, marijuana use, drinking until getting drunk, and weapon-related violence (McNeely and Falci, 2004; Hargreaves, 2012).

School-related social support seems to be one of the most important resources in the positive development of children and adolescents. In this regard, it is especially important to consider that immigrant children and adolescents reported lower levels of social support and higher psychological distress and mental health disorders when compared to their native peers (Janssen et al., 2004; Oppedal and Røysamb, 2004; Frankenberg et al., 2013). A study with 10-13 year old Turkish and Moroccan immigrant students in the Netherlands showed that emotional support from teachers was positively associated with students' school adjustment (Vedder et al., 2005). A further finding is that school stress and low school-related social support is associated with emotional and conduct problems for immigrant and non-immigrant students (Noam et al., 2014). In addition, school-related social support was found to be directly connected to mental health outcomes and risk-taking behavior in immigrant students when compared to native students (Walsh et al., 2010). Teacher and peer support was also related to academic motivation in Latino immigrant students in the USA (Stanton-Salazar and Tai, 2001; Alfaro et al., 2006).

In the current study, we focus on the effects of perceived school-related social support on Turkish immigrant students' health-related quality of life (HRQoL), as well as on their school engagement and perceived self-competence.

HRQoL is defined as perceived health and is not only understood as the absence of somatic diseases but comprises physical, emotional, mental, social, and behavioral aspects of well-being and functioning (World Health Organization, 1948; Ravens-Sieberer et al., 2007). Previous studies with immigrants in Germany have found that when compared to natives, immigrant children and adolescents show lower levels of HRQoL (Ravens-Sieberer et al., 2008). In addition, compared to native German students, immigrant students show less academic achievement (Riphahn, 2003), score lower on performance tests (Müller and Stanat, 2006), and have a higher probability of attending lower middle school types (Bos et al., 2003). The low educational achievement of immigrants in Germany has a lifelong impact causing lower social status later in life and is passed on to the next generation (Frick and Wagner, 2001). In addition to these results, recent studies found high academic aspirations in Turkish immigrant students and their parents, in some cases even higher than for native Germans or for other immigrant minorities (Kristen and Dollmann, 2010; Relikowski et al., 2012; Salikutluk, 2016). The discrepancy between the high academic aspirations and the overall lower educational status of the Turkish minority seems to be due to the lack of support, participation, and responsibility of parents in students' scholastic lives (Kohl et al., 2014). Parental support is restricted by low level of knowledge about the German educational system, the parents' own low education level, and insufficient language skills (Relikowski et al., 2012; Kohl et al., 2014). Therefore, the school-related social support of immigrant students is of particular importance in reducing the discrepancy between high academic aspirations and low academic achievement.

Turkish immigrant children and adolescents are part of the largest minority population in Germany. In the 1960s, laborers migrated from Turkey to Germany until the official moratorium on labor immigration in 1973. Many of these immigrant workers also began bringing their families, which led to a growing number of Turkish immigrants in Germany. Today, Turkish immigrants comprise about 2.86 million people and represent 16.7% of the immigrant population in Germany (Bundesministerium des Innern, 2016). In comparison to the non-immigrant population, this population is more likely to be younger on average (Destatis, 2011). Furthermore, 31% of the students in Germany have a migrational background with Turkish students representing the largest minority at 7% (Krüger-Hemmer, 2016). Therefore, a closer examination of their psychological well-being and functioning is warranted.

Even though the relationship between school-related social support and well-being and academic outcomes is well-documented, no longitudinal data on the effects of

school-related social support on school engagement, perceived self-competence, and HRQoL exists for Turkish immigrant children and adolescents in Germany. In this study, we address the question of whether or not school-related social support has an impact on school engagement, perceived self-competence, and HRQoL of Turkish immigrant students. We examined two cohorts of children and adolescents: a middle cohort (M-cohort, 9–12 years) and an older cohort (O-cohort, 12–14 years). With regard to related studies, we expected (1) that students with higher school-related social support would report higher HRQoL, higher school engagement, and higher perceived self-competence, and (2) effects of gender, i.e., girls to have higher scores on school-related social support (Bokhorst et al., 2010). In addition, our aim was (3) to investigate whether maternal level of education as an indicator of the socioeconomic status (SES) would be a protective factor and increase children's and adolescents' HRQoL, school engagement, and perceived self-competence (Rajmil et al., 2014).

METHOD

Procedure

Turkish immigrant families were recruited through the longitudinal and cross-sectional project SIMCUR (Social Integration of Migrant Children—Uncovering Family and School Factors Promoting Resilience), which was carried out in the Ruhr area, an industrialized area in the northwestern region of Germany. To distribute information about the project, school administrations were asked for permission. We attended formal and informal meetings with parents in order to increase the acceptance of the project. Additionally, posters, information stands, articles in German and Turkish-language newspapers, leaflets in the offices of pediatricians, and presentations in mosques and at meetings of associations of Turkish parents were provided in order to familiarize the target population with the project and to gain their acceptance of it. We also asked community leaders and organizations for their endorsements. Because parents heard of the project through multiple channels and repeatedly, it is difficult to identify how exactly families were recruited.

Participants were screened via telephone by bilingual research assistants. The inclusion criteria were: (1) students' mother, father, or grandparents had been born in Turkey, (2) students had to be born after 32 weeks of gestational age, (3) could not be living in a foster family, (4) could not have a referral to a special needs school. Data were assessed by bilingual research assistants in the families' homes or at the Ruhr University in Bochum. Students were interviewed and asked to fill out questionnaires in German. Confidentiality was ensured, and consent forms were signed by both the student and at least one of the student's parents. Families received €25 compensation.

Study Sample

A total of 216 Turkish students participated in the study. We differentiated between the middle/ M- cohort ($n = 141$) and older/ O-cohort ($n = 75$). Longitudinal data was available for 94 students of M-cohort and for 67 students of O-cohort. The participating students were between 9 and 15 years of age. Data from the M-cohort were collected at the end of 4th grade (T1), 5th grade (T2), and 6th grade (T3). Data from the O-cohort were collected at the end of 7th grade (T1) and 8th grade (T2). See **Table 1** for sample sizes by point-in-time and sociodemographic information.

Study Measures

School-Related Social Support

Students' perceived teacher support was measured by means of the teacher subscale of the Child and Adolescent Social Support Scale (CASSS, Malecki and Demaray, 2002). The questionnaire consists of seven items measuring perceived emotional, informational, appraisal, and instrumental teacher support. Each item (e.g., "My teacher spends time when I need help.") is scored on a five-point Likert-type scale ranging from 1 = *never* to 5 = *always* ($\alpha = 0.86$).

Students' perceived support by classmates was measured by eight items which were adapted from the social support scale of Ystgaard (1997). These items (e.g., "My classmates accept me as I am.") are each scored on a four-point Likert-type scale ranging from 1 = *totally disagree* to 4 = *totally agree* ($\alpha = 0.88$).

HRQoL

Students' health-related quality of life was measured by means of the KINDL-R questionnaire (Ravens-Sieberer and Bullinger, 2003). Students self-reported via the questionnaire. It consists of 24 items referring to the last week and measuring physical well-being (e.g., "I felt sick."), emotional well-being (e.g., "I felt fearful or insecure."), self-esteem (e.g., "I was happy with myself."), well-being in family (e.g., "I felt comfortable at home."), well-being related to friends/ peers (e.g., " I got along with friends."), and school-related well-being (e.g., "I was afraid of getting bad grades."). The items are each scored on a five-point Likert-type scale ranging from 1 = *never* to 5 = *always* ($\alpha = 0.79$). We calculated the mean scores of all items for both cohorts and all time points.

School Engagement

The 15-item-scale "What I think about school" from the NICHD Study of Early Child Care and Youth Development (Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2010) was used to assess students' perceived school competence and their school-related motivation. Items (e.g., "I like going to school") were scored on a 4-point Likert scale ranging from 1 = *not at all true* to 4 = *very true* ($\alpha = 0.80$). We formed the means of all items for both cohorts and all time points.

Perceived Self-Competence

The 10-item-scale "How I do in math/reading" (Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2010) was used to assess students' perception of efficacy and competence in math (5 items, $\alpha = 0.74$) and reading (5 items, $\alpha = 0.73$). The scale focuses on their perceived current skills, expectations for success, and the subjective value they assigned to both subjects. Items (e.g., "I am good at

TABLE 1 | Demographic characteristics of the study participants.

	M-cohort (grade 4-6)			O-cohort (grade 7–8)	
	t1, *n* = 136	**t2, *n* = 110**	**t3, *n* = 100**	**t1, *n* = 73**	**t2, *n* = 69**
Students' gender (male)	64 (47.1%)	50 (45.5)	46 (46.0%)	27 (37.0%)	27 (39.1%)
Age of child at t1 (years)	9.98 (.58)	9.99 (.60)	10.01 (.58)	12.99 (.63)	13.01 (.68)
Mothers' education level					
lower	110 (80.9%)	87 (79.1%)	79 (79.0%)	58 (79.5%)	56 (81.2%)
higher	26 (19.1%)	23 (20.9%)	21 (21.0%)	15 (20.5%)	13 (18.8%)

Data is presented as mean (SD) for continuous variables and frequencies (%) for categorical variables.

TABLE 2 | School support measures by cohort and gender.

Cohort and scales		**t1**	**t2**	**t3**
M-Cohort (*n* = 94)				
Teacher Support	Male (*n* = 43)	4.17 (0.81)	4.13 (0.92)	3.99 (0.89)
	Female (*n* = 51)	4.45 (0.57)	4.48 (0.57)	4.35 (0.63)
	Total (*n* = 94)	4.32 (0.70)	4.32 (0.77)	4.18 (0.78)
Classmate Support	Male (*n* = 43)	3.31 (0.56)	3.39 (0.62)	3.36 (0.52)
	Female (*n* = 51)	3.60 (0.37)	3.55 (0.50)	3.52 (0.51)
	Total (*n* = 94)	3.46 (0.49)	3.47 (0.56)	3.45 (0.52)
O-Cohort (*n* = 67)				
Teacher Support	Male (*n* = 25)	4.09 (0.69)	3.93 (0.69)	-
	Female (*n* = 42)	4.33 (0.56)	4.10 (0.59)	-
	Total (*n* = 67)	4.24 (0.62)	4.04 (0.63)	-
Classmate Support	Male (*n* = 25)	3.54 (0.44)	3.44 (0.48)	-
	Female (*n* = 42)	3.45 (0.50)	3.51 (0.55)	-
	Total (*n* = 67)	3.49 (0.48)	3.48 (0.52)	-

Data is presented as mean (SD).

math/reading") were scored on a 5-point Likert scale ranging from 1 = *not at all true* to 5 = *very true*. We formed the means of all items for both cohorts and all time points.

Maternal Education Level

The distribution of educational attainment was based on the International Standard of Classification of Education (ISCED; UNESCO, 2006). 6.9% of the mothers had no degree; 27.3% had primary education; 46.8% had lower secondary education (*Hauptschule*, *Realschule*, *Lise*); 13% had upper secondary education; 6% had tertiary education (university). For the regression analysis, mothers were categorized into just about evenly divided groups of either lower education (primary education or *Hauptschule* indicating up to 9 years of schooling) or higher education (*Realschule*, *Lise,* or higher indicating at least 10 years of schooling). In Germany, *Hauptschule* is the lowest school track, whereas *Realschule* is the more demanding intermediate school track. According to this definition, 81% of the mothers were lower-educated.

Statistical Analyses

All statistical analyses were performed using SPSS 24 for Windows. The expectation maximization technique was used to impute missing data as it produces more accurate and efficient parameter estimates than list-wise deletion (SPSS version 24, Missing Value Analysis, SPSS Inc. Chicago, IL). This method computes missing values based on maximum-likelihood estimates by using observed data in an iterative process (Dempster et al., 1977). The total percentage of imputed missing data was 0.50%.

First, we examined students' school-related social support over the time points and between gender via repeated-measures ANOVAs. Next, we analyzed the effect of school-related social support on Turkish immigrant students' HRQoL, school engagement, and perceived self-competence. For this analysis, multivariate linear regression models were conducted. We included students' gender and maternal education level in these analyses as well.

RESULTS

Students' School-Related Social Support

For the M-cohort, students' perceived support was relatively stable over time. However, we found a significant decrease in teacher support within the O-cohort between T1 and T2 [$F_{(1,\ 65)} = 6.38$, $p = 0.014$, $\eta p^2 = 0.089$]. In addition, girls

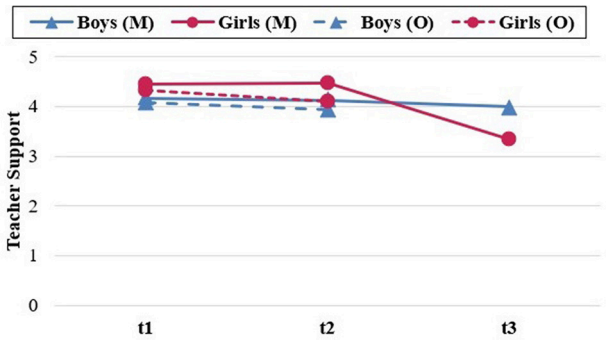

FIGURE 1 | Turkish students' teacher support over time separated by cohort and gender.

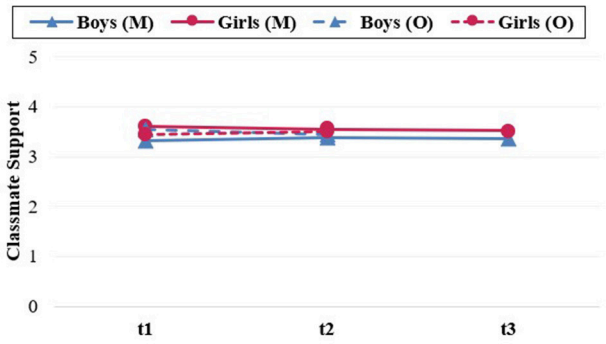

FIGURE 2 | Turkish students' classmate support over time separated by cohort and gender.

reported overall higher levels of school-related social support (teacher/classmate) than did boys. Within the M-cohort, these gender differences were significant for teacher support in T2 and T3. Descriptive statistics for social support scales are presented for all cohorts and all time points in **Table 2**. Gender effects are illustrated in **Figures 1**, **2**.

Effects of School-Related Social Support on HRQoL, School Engagement, and Self-Competence

Overall, students with higher school-related social support scored higher on total KINDL-R score, school engagement, and self-competence. In contrast, we found only few effects of students' genders and maternal education levels (see **Table 3**). **Figure 3** illustrates the contributions each individual factor made to explain variance in students' total KINDL-R scores.

M-cohort

At T1, students with higher teacher and classmate support reported significantly higher scores on the KINDL-R total score, on school engagement, and on self-competence in math and reading. At T2 and T3, higher classmate support is only associated with higher KINDL-R scores, whereas higher teacher support is associated with higher school engagement and self-competence in math and reading.

In addition, at T1, higher maternal education is associated with higher school engagement in students. The results showed gender effects only at T2 for self-competence in math, with boys having higher scores than girls did.

O-cohort

At T1, students with higher classmate support reported significantly higher levels on the KINDL-R score, and students with higher teacher support reported higher school engagement and self- competence in math. At T2, teacher support only had a significant effect on school engagement.

Parallel to the M-cohort, we found only a few effects of students' gender with boys reporting higher self-competence in math than girls did. In the O-cohort, we found no effects of maternal education level.

DISCUSSION

The present study investigated the association between perceived school-related social support and HRQoL, school engagement, and perceived self-competence within a large sample of two cohorts of Turkish immigrant students in Germany. The cohort sequential design included students from 4 to 8th grades.

Effects of School Support

Our results show that elementary school teacher support has a positive impact on quality of life as well as on school-related engagement and self-concept. In contrast, for middle school students, teacher support is found to have an effect only on school-related factors. These results can be attributed to the fact that in elementary school the class teacher principle applies. Class teachers teach most of the subjects and are predominantly present for the students for 4 years and thus are influential figures for students. In contrast, in middle school, the subject teacher principle applies. This structure means that different subjects are usually taught by different teachers. Thus, class teachers are less present, teach fewer subjects, and play less prominent roles in students' lives. Therefore, the teacher-student relationship in elementary school is more pronounced than in middle school, and teachers, as important role models, can have a greater impact on students' general life quality. Furthermore, teacher support, both in primary and secondary education, is a relevant resource for school-related engagement and in the self-concept of the students. These findings are in line with previous studies (see meta-analysis by Roorda et al., 2011), which show that the student-teacher relationship has a positive impact on students' development in school performance, academic self-concept, and motivation. However, teacher support was not significantly associated with school engagement and self-competence in 8th grade. These findings suggest that teacher support might be better suited to serve as a protective factor for younger than for older students.

Furthermore, our results indicate that classmate support in elementary school has positive effects on quality of life as well as on school-related engagement and self-concept. However, in

TABLE 3 | Results of multivariate regression analyses predicting students' HRQoL and school outcomes.

	KINDL-R		School engagement		Math self-competence		Reading self-competence	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
M-COHORT								
***t*1 (*n* = 136)**								
Teacher support	0.41	0.000	0.39	0.000	0.29	0.002	0.21	0.033
Classmate support	0.24	0.008	0.34	0.000	0.27	0.004	0.22	0.029
Gender	−0.08	0.253	0.09	0.162	−0.09	0.226	0.08	0.396
Maternal Education	−0.06	0.425	0.20	0.003	0.11	0.157	0.13	0.101
R^2	0.34		0.46		0.24		0.17	
F	16.61	0.000	27.83	0.000	10.45	0.000	6.56	0.000
***t*2 (*n* = 110)**								
Teacher support	0.23	0.074	0.51	0.000	0.47	0.000	0.40	0.002
Classmate support	0.32	0.012	0.19	0.093	0.14	0.250	0.02	0.865
Gender	−0.13	0.126	0.01	0.932	−0.22	0.010	0.09	0.304
Maternal Education	−0.03	0.151	0.01	0.859	−0.03	0.710	−0.02	0.865
R^2	0.26		0.43		0.33		0.20	
F	9.05	0.000	19.58	0.000	12.92	0.000	6.73	0.000
***t*3 (*n* = 100)**								
Teacher support	0.20	0.070	0.51	0.000	0.47	0.000	0.25	0.058
Classmate support	0.47	0.000	0.06	0.625	−0.03	0.839	0.13	0.312
Gender	−0.05	0.568	0.09	0.273	−0.15	0.112	0.18	0.066
Maternal Education	−0.02	0.779	−0.04	0.630	−0.10	0.260	0.17	0.075
R^2	0.39		0.34		0.22		0.19	
F	14.87	0.000	12.00	0.000	6.65	0.000	5.54	0.000
O-COHORT								
***t*1 (*n* = 73)**								
Teacher support	0.08	0.517	0.47	0.000	0.37	0.005	0.11	0.452
Classmate support	0.48	0.000	0.02	0.866	0.00	0.996	0.15	0.286
Gender	−0.16	0.125	−0.09	0.410	−0.24	0.041	0.04	0.778
Maternal Education	0.20	0.071	0.19	0.099	−0.02	0.878	0.07	0.575
R^2	0.30		0.21		0.18		0.04	
F	7.17	0.000	4.42	0.003	3.70	0.009	0.76	0.557
***t*2 (*n* = 69)**								
Teacher support	0.24	0.71	0.43	0.001	0.13	0.313	0.14	0.311
Classmate support	0.13	0.353	−0.19	0.153	0.05	0.695	0.04	0.782
Gender	−0.18	0.154	−0.12	0.304	−0.25	0.047	0.06	0.634
Maternal Education	0.08	0.541	0.03	0.785	−0.02	0.892	0.13	0.331
R^2	0.11		0.16		0.08		0.04	
F	1.90	0.122	3.04	0.023	1.41	0.240	0.71	0.588

Data is presented as β coefficient unless indicated otherwise.
Gender (0 = male, 1 = female), maternal education (0 = low, 1 = high).

middle school, this support only has a positive impact on quality of life and has no significant impact on school-related factors. One possible explanation may be the change in friendships during the transition from elementary school to middle school. The restructuring of the class community and the loss of the elementary school class association is an importantadjustment for pupils. The transition from elementary to middle school is characterized as a break in social relations (Hardy et al., 2002). Peer relationships are challenging for students during this transitional period (Sirsch, 2000). Above all, for students with a migrational background, this change in social contacts represents a greater burden. A study by Rahn and Chassé (2009) shows that children from socially disadvantaged families find it harder to make new friends. At the same time, peer relationships at this age are quite fluid and linked to the intensity of contact. This characteristic makes it possible for most children to make new friends in their new classes, even if old peer relationships from elementary school subside (Krüger et al., 2007). Our results make it clear that along with the change in school and the change in the friendship structure, there is another relationship quality of

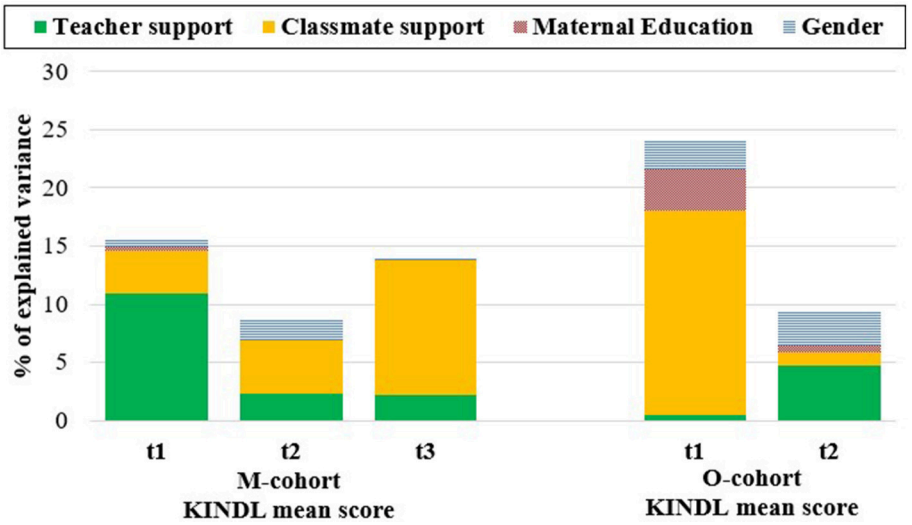

FIGURE 3 | Unique percentage of variance explained in Turkish students' total KINDL-R scores by teacher support, classmate support, maternal education and child gender.

the student-classmate relationship. All in all, this factor seems to influence quality of life but has no effect on school-related factors. Eighth grade students differed from students in all other grades in that classmate support was found to have no effect. Possibly at these ages other factors outside of the school gain importance in their lives. Furthermore, the sample size in this group is smaller so that possible effects could not be illustrated in this study.

All in all, our findings are partly in line with previous studies, which show that school-related social support has a positive impact on children's and adolescents' life satisfaction (DuBois and Silverthorn, 2005) and mental health (Wit et al., 2011). In addition to previous findings, our study reveals the relationship between school-related social support and HRQoL, which comprises various aspects of well-being and its functioning. Regarding the increased risk of immigrant children developing mental health problems and lower well-being with lifelong impacts (e.g., Janssen et al., 2004; Frankenberg et al., 2013), social support from teachers and classmates seems to be an important protective factor in the positive development of immigrant children and adolescents.

Furthermore, we found that higher teacher support was associated with higher levels of school engagement and perceived self-competence in math and reading. This pattern of results is partly in line with previous findings (Vedder et al., 2005; Wentzel et al., 2017) demonstrating the positive effects of teacher and classmate support on various school-related aspects, i.e., intrinsic valuation of schoolwork, adjustment, motivation, self-efficacy, and efforts toward learning and mastery orientation. These relationships seem to hold true for the Turkish immigrant population in Germany as well. A study by Distelbrink and Pels (2000) showed that, related to school matters, Turkish immigrant students in the Netherlands felt more supported by their teachers and peers than by their parents. This perception may be due to parents' limited knowledge about the host school system and to the language difficulties these families encounter. Nonetheless, our findings suggest that school-related social support can act as a protective factor in school matters and promote better academic engagement and self-competence for children and adolescents from immigrant families.

Effects of Gender and Maternal Education

As described in the introduction, previous studies reported relationships between children's and adolescents' gender (Helseth et al., 2015), SES, and HRQoL (Rajmil et al., 2014). Our results reveal no gender effects and thus are not in line with other findings indicating that boys show higher HRQoL than girls (Helseth et al., 2015). To investigate the role of SES on students' HRQoL, we relied on mothers' level of education as an indicator of SES. We found no relationship between maternal education level and children's HRQoL in either cohort. However, around 81% of the mothers had a low education level, so the lack of statistical significance between mothers' education and children's HRQoL must be interpreted carefully. Nevertheless, these findings suggest that school-related social support can act as a protective factor and promote well-being, irrespective of students' SES.

We also examined the effects of students' gender and maternal education on school-related engagement and self-competence. We found no gender effects on school-engagement. However, in 5, 7, and 8th grades, gender was a significant predictor of self-competence in math; boys reported higher self-competence in math than did girls. These gender effects are in keeping with previous studies showing that boys report higher self-competence in math than girls (Passolunghi et al., 2014). Maternal education level has a significant effect on students' school engagement only in 4th grade, as demonstrated by the finding that students with high maternal education reported higher school engagement than students with medium/low

maternal education. Considering the school transition after 4th grade, this result reveals an important resource for children since transitional times are marked by school stress, for example, due to difficult curricula or higher expectations from teachers and parents (Suldo et al., 2009). In addition, students' perceived self-competence in math and reading was not affected by maternal education level. This result is in line with findings of Ammermueller (2007) who reported that parental education could not explain the gap between German and immigrant students in PISA test scores.

Effects of Gender on School-Related Social Support

As found in previous studies (Bokhorst et al., 2010), girls reported higher school-related social support than did boys. However, we found significant effects only in teacher support. These findings became only marginally significant for students in 4th grade and significant in 5 and 6th grades (M-Cohort) but not for girls in 7 and 8th grades (O-cohort). Possible explanations for this finding could be either that in the O-cohort the school-related social support scores were lower in general so that gender differences disappeared or that the protective factor, school-related social support, applies to younger girls but loses importance in adolescence.

Strengths, Limitations, and Future Directions

Overall, our longitudinal, cohort-sectional study shows that school-related social support by teachers and classmates contribute to the HRQoL of students, as well as to their school engagement and perceived self-competence in math and reading. We relied on widely established measurements. Nevertheless, some limitations of the study should be acknowledged. One limitation concerns the sample sizes of both cohorts. A larger sample size would have allowed for investigation of longitudinal effects with more sophisticated statistical models. Another limitation concerns the amount of contextual variables. Information from teachers (e.g., gender of teacher) or socio-demographic data on peers and on target students' social networks, both within and outside of the classroom, were not included in the study. For future research, it would be interesting to investigate whether such factors mediate students' perceived school-related social support or HRQoL and school-related factors. In addition, we only used self-reports from students in order to measure their HRQoL, and we don't know how accurately they described their well-being. We relied on students' self-reports because studies with parents suggest that they tend to overestimate children's and adolescents' HRQoL (Upton et al., 2008; Ellert et al., 2011). Another limitation of the study is that we used self-reports concerning school-related factors. It would be interesting to collect students' exam grades in math and language as more objective data instead of self-reported self-competence.

To the best of our knowledge, the present study represents the first longitudinal study to date that uncovers cumulative school-related factors supporting HRQoL, school engagement, and competence of Turkish immigrant children and adolescents in Germany. A particular strength of the study is the cross-sectional and longitudinal design within two different cohorts, which investigates cross-sectional and developmental differences. Above all, immigrants are likely to face greater burdens (Morrison and Bennett, 2012) and yet to have lesser resources, both in terms of quality and quantity (Wiking et al., 2004). Therefore, it is important to uncover factors supporting the individual development of immigrant children and adolescents. Early adolescence may be an especially advantageous time to enhance well-being and to prevent negative outcomes in later stages of life. Our study shows that school-related social support is a relevant protective factor for immigrant children's and adolescents' overall well-being since it seems to be relatively stable over time and explains variance in total HRQoL of about 12% on average. Schools, and especially classrooms, are one of the most important places social interactions take place, and perceived social support from teachers and classmates influences a large part of students' well-being and academic achievement. From an applied perspective, our data suggest that it is essential to ensure that children and adolescents grow up in encouraging and supportive school environments.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the ethical guidelines of the DGPs (German Psychological Society). The protocol was approved by the ethics committee of the DGPs. All research participants and their parents/legal guardians gave written informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

MD analyzed the data and wrote the paper. BL was responsible for the design of the SIMCUR study and collaborated in the writing and editing of the final manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

This study was supported by NORFACE grant no. 292 to BL.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 27 November 2018
doi: 10.3389/feduc.2018.00093

An Evaluation of a Mental Health Promotion Programme to Improve Emotional, Social and Coping Skills in Children and Young People Attending Special Schools

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OPEN ACCESS

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Reviewed by:
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University of Science, Malaysia
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *10 July 2018*
Accepted: *10 October 2018*
Published: *27 November 2018*

Citation:
Unwin GL, Stenfert Kroese B and Blumson J (2018) An Evaluation of a Mental Health Promotion Programme to Improve Emotional, Social and Coping Skills in Children and Young People Attending Special Schools. Front. Educ. 3:93. doi: 10.3389/feduc.2018.00093

Background: Research evidence suggests that a child's emotional, social and psychological well-being influences their future health, education and social prospects, and that positive, well-developed coping skills and high emotional literacy lead to improved self-esteem, reduced stress, and reduced incidence of serious emotional problems in later life. Children with special educational needs and disabilities (SEND) are at a disadvantage as they tend to have lower levels of emotional literacy and may have limited opportunities or capacity to develop coping skills. Few targeted, evidence-based programmes aimed at improving emotional literacy and coping skills are currently available for use in SEND schools.

Aims: To evaluate the effectiveness, acceptability and feasibility of the school-based mental health promotion programme Zippy's Friends in SEND schools. The study concentrated on the first three modules of the programme, implemented over the course of an academic year in a cohort of children and young people with SEND.

Methods: Fifty-three children and young people attending eight SEND schools participated in the educational programme and study. Quantitative and qualitative data were collected using standardized assessment scales, purposed-designed questionnaires, emotion recognition tasks and interviews to assess typical and maximal behavior of the children as well feedback on the programme. Data were collected from children, parents/guardians/care givers, and teachers before and after the intervention. The results of the qualitative data will be presented elsewhere.

Results: Teachers' ratings indicated that the children's and young people's social skills, emotional literacy, and emotional recognition improved over the course of the study. Significant improvements were observed in teachers' ratings of communication, cooperation, assertion, responsibility, and self-awareness. Parental ratings did not change over time.

Conclusions: This small-scale study indicates that the Zippy's Friends programme is feasible and may lead to improved emotional literacy. However, further research is needed that uses a comparison group to isolate the effects of the programme from factors such as age-related maturation, development, and usual school-based learning.

Keywords: special needs, emotional literacy, mental health promotion, children, intellectual disabilities, schools, special education

INTRODUCTION

Research evidence suggests that a child's emotional, social and psychological well-being influences their future health, education, and social prospects. Children who experience emotional and social problems are more likely in later life to misuse drugs and alcohol, have teenage pregnancies, lower educational attainment, be untrained, unemployed, and involved in crime or violence (Adi et al., 2007a,b). Children with mental health and behavioral problems are also more likely to have mental health problems as adults (Price and Robins, 1991; Caspi et al., 1996). Furthermore, adults who exhibited "troubled behavior" in childhood account for 10 times the cost to public services as adults compared with those with no such problems in childhood (Donovan and Spence, 2000).

The World Health Organization recognizes the importance of coping skills for mental well-being (World Health Organization, 2001). Ineffective coping skills can lead to problems in psychological development, including depressive symptoms (Herman-Stabl et al., 1995; Kraag et al., 2006). Conversely, developing adaptive coping skills can improve self-esteem, prevent dysfunctional stress reactions, and reduce incidence of serious emotional problems (Mantzicopoulos, 1997; Sandler et al., 2000; Spence et al., 2003). Coping with stress "refers to changing cognitive and behavioral efforts to manage specific demands that are appraised as taxing or exceeding the resources of the person" (Lazarus and Folkman, 1984). There is evidence that children and adults with a wider repertoire of coping strategies experience fewer negative consequences from stressful situations, both in the short and long term (Mishara, 2007).

Clinically diagnosed mental disorders may affect 10% of children and young people (Green et al., 2004; Emerson and Hatton, 2007) with the incidence of mental health problems among children and adolescents with intellectual disabilities (ID) increasing to 36%. Epidemiological research has also found evidence that children and young people with ID have higher levels of social and emotional problems than typically developing children and as many as 50% of those with ID have clinically significant problems (Dekker et al., 2002). The high prevalence of mental health and behavioral problems in children as well as adults with ID (e.g., Deb et al., 2001; Cooper et al., 2007; Lundqvist, 2013) indicates that teaching emotional management and coping skills are components of the SEND syllabus that are as yet under-emphasized.

The National Institute for Health and Care Excellence in the UK (National Institute for Health Care Excellence, 2008) published guidelines to promote social and emotional well-being in primary school education. NICE recommends that help should be provided for those most at risk, or already showing signs, of social, emotional and behavioral problems, and that schools should be equipped to deliver programmes to develop children's social and emotional skills. Such skills include problem solving, coping with stress, conflict management/resolution, and understanding and managing feelings. The UK Government also recognizes the importance of promoting social and emotional well-being in their National Initiative, Social and Emotional Aspects of Learning (SEAL; Department for Children Schools and Families, 2007) but, as yet, there are no adaptations for children with SEND. More recently, the UK Department of Health (2015) published a report which promotes building resilience, preventative methods, and early intervention for mental health and well-being of children and young people. The report implicates universal services, such as schools, in supporting children and young people's well-being through delivering mental health promotion and prevention activities which are best provided on a whole-system basis. The school environment may be especially suited to mental health promotion activities as it is a place of learning and the acquisition of new skills (Ladd et al., 2002) and it can overcome barriers associated with clinic-based treatment such as transportation, cost, timing, location and stigmatization (Masia-Warner et al., 2006). There are thousands of such school-based interventions across the world and different terminology has been used to describe their content such as mental health, social and emotional learning, emotional literacy, emotional intelligence, resilience, and life skills (Weare, 2010).

A number of systematic reviews have been conducted to evaluate the effectiveness of school-based mental health interventions and Weare and Nind (2011) undertook an extensive review of those reviews. They found that teaching social and emotional skills and developing competence were central parts to effective interventions and that these programmes resulted in a wide range of specific outcomes such positive youth development and reduced depression, anxiety, conduct disorders, bullying, conflict and anger. They also found that emotional literacy interventions were more effective when teachers reinforced programme content in all classroom interactions and an interactive, experiential format was used which included games, activities, and group work.

Zippy's Friends is a preventative educational programme for children aged 5-7 years. It has been used in mainstream schools since 2002 and is currently implemented in over 29 countries. The programme was developed by Mishara and colleagues as a

universal, low-cost programme that is flexible and not resource intensive so it can be delivered in schools worldwide, regardless of culture or language (Mishara and Bale, 2004). The programme is currently co-ordinated by Partnership for Children, a charity based in the UK. Partnership for Children promotes mental well-being in children across the world and has more recently developed a SEND supplement with adapted resources for use with children with SEND of primary and secondary school age.

Zippy's Friends is focussed on improving emotional literacy to enable children to develop skills that can lead to improved adjustment to social stressors and to psychological well-being in later life. Emotional literacy is defined as the ability to recognize, understand, manage, and express emotions (Sharp, 2001). Salovey and Mayer (1990) identify five domains, namely, self-awareness, ability to manage emotions, self-motivation, empathy, and relationship skills. The aim of Zippy's Friends is to support children to develop skills relating to these five domains with a focus on problem solving and expanding their repertoire of coping skills (Mishara and Bale, 2004; Partnership for Children, 2007). Furthermore, improving adaptive skills to appraise situations and evaluate the relative utility of coping strategies is central to the programme (Mishara, 2007). The programme takes a positive, solution-focussed approach to emphasize positive emotions, strengths and sources of support.

A systematic review found support for the effectiveness of Zippy's Friends in relation to children's use of coping skills, increased emotional vocabulary and positive behaviors (Wills, 2010). The review identified four English-language controlled studies, conducted in England, Denmark and Lithuania between 2000 and 2010. Since Wills' review, Clarke and Barry's 2010 research on the effect of Zippy's Friends on the emotional well-being of 523 primary school children in 'disadvantaged' schools in Ireland found a significant positive effect of Zippy's Friends on emotional literacy, with significant increases in self-awareness, self-regulation, motivation, empathy, and social skills. No programme effects were found, however, for behavioral problems as measured by the Strengths and Difficulties Questionnaire, which is made up of four subscales: emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems. In a follow-up, Clarke et al. (2014) reported that the significant increase in emotional literacy in the intervention group was maintained after 12-months. Holen et al. (2012) conducted a large randomized controlled trial with 1483 7-8 years old children in Norway. They found the Zippy programme to have a significant positive impact on coping and mental health outcomes. Coping improved more significantly in girls, whereas mental health improved more in boys. One limitation of these studies is that they rely on informant measures from teachers who are not blind to the status of the participants or the aims of the research, so there is a risk of response bias.

Zippy's Friends for pupils with SEND was developed by Partnership for Children as a supplement to the mainstream version to address the paucity of resources specifically designed for improving emotional literacy and coping skills amongst children with SEND. Owing to the increased vulnerability to psychological stress and mental health problems amongst children with SEND and later, adults with ID, investment in such programmes is warranted. Zippy's Friends for children with SEND has not yet been formally evaluated, so this study aimed to investigate the feasibility, acceptability, and effectiveness of the SEND programme.

Aims

1. To evaluate the effectiveness of Zippy's Friends (restricted to modules 1–3 to ensure the study could be completed within one academic year; see section on Zippy's Friends) as an intervention for improving social skills, coping skills, and emotional literacy in pupils with SEND.
2. To assess the feasibility of the research methods, including provision of the intervention, recruitment and assessment procedures.
3. To investigate process issues in the implementation of the intervention, including fidelity, mechanisms of impact and effect of context.
4. To explore the experience and acceptability of the intervention to children and young people, parents/guardians, and teachers (including assistants).
5. To ensure that issues of diversity (gender, ethnicity, age, and ability) are considered in data collection, analysis, and discussion.

In this paper, only the quantitative data will be reported and discussed. For this reason only Aims 1, 2, and 5 will be addressed here. The qualitative component of the study that was designed to address Aims 3 and 4 are reported elsewhere (Unwin and Stenfert Kroese, 2016).

MATERIALS AND METHODS

A repeated measures study of children and young people with SEND who participated in the Zippy's Friends for SEND programme (modules 1-3). Participating schools started the programme between November 2014 and January 2015. Quantitative data collection included testing children and young people (to assess maximal behavior) and questionnaires completed by informants (teachers/teaching assistants and parents/guardians/caregivers to assess typical behavior) administered at baseline, prior to the intervention (October–December 2014) and at end-point (May–August 2015). Qualitative interviews with teachers at mid- (January–May 2015) and end-point (May–July 2015) were also conducted and a sub-sample of parents and children were interviewed after completion of the programme (August–September 2015). The methods for and results of these interviews are presented elsewhere (Unwin and Stenfert Kroese, 2016).

The Mental Health Promotion Intervention: Zippy's Friends for SEND

Zippy's Friends, coordinated by the charity Partnership for Children (www.partnershipforchildren.org.uk) is a manualised, educational, mental health-promotion package comprising six modules. It takes a socio-ecological approach, recognizing the child as part of a family, peer group and school system. It is based around a set of six illustrated stories about a stick insect

called "Zippy" and his friends (a group of young children). Each story involves Zippy and his friends confronting issues that are familiar to young children including friendship, communication, feeling lonely, bullying, dealing with change and loss, and making a new start (module titles: Feelings, Communication, Making and Breaking Relationships, Conflict Resolution, Dealing with Change and Loss, and Coping).

The programme is delivered by teachers and teaching assistants during routine classroom time, typically over a 24-weeks period with one 45-min session per week (four sessions per module, 24 sessions in total). Each session begins with a review of what pupils learned the previous week. The teacher then reads part of the story followed by the pupils participating in two activities such as playing games, drawing or discussion. Repetition is a key feature of the programme to reinforce key messages and embed learning.

The SEND programme closely aligns with the mainstream programme but has additional resources and supplements to facilitate the implementation of the programme to children with a wide range of abilities. The SEND programme provides a selection of alternative activities (around five for each of the mainstream activities), and the stories have been adapted at four different ability levels using WIDGIT symbols (www.widgit.com; 2002). The activities include craft sessions, completion of worksheets, role-plays, discussion and use of metaphors.

Whilst the mainstream programme was developed for children aged 5-7 years, the SEND programme was designed to be appropriate for a wider age range to include those in primary and secondary education. Teachers are advised to take a flexible approach to make the programme suitable for their pupils. Owing to the increased complexity of running the programme with SEND pupils, completion may take longer to allow for shorter sessions, repetition of sessions, or completion of a range of activities attached to each session before moving onto the next. Therefore, this study evaluated the first three modules to ensure adequate time for completion within one academic year, and allowing time for end-point data collection. The first module aims to improve the ability to recognize difficult feelings and to use coping strategies to deal with those feelings. The second module aims to improve the ability to communicate feelings and more general communication with others. The third module aims to improve the ability to make friends and to cope with rejection and loneliness.

Prior to running the programme, teachers attended a 1-day training course. Teachers also received standard support and supervision through direct observation of one session and attendance at two support meetings. Additional telephone and email support was available upon the request of the teacher. All training and support was provided by Partnership for Children.

Participants and Recruitment

Schools were recruited from three locations in England, namely the West Midlands, Northamptonshire and the South-East. SEND schools were identified from those known to the research team, those known to Partnership for Children, internet searching, Local Authority lists of special schools and through networks of special schools. Websites of potentially eligible schools were screened for relevance: those specializing in education for pupils with profound and multiple intellectual disabilities, sensory needs, or ages below 6 or above 15 years were not contacted.

Forty-three schools representing a range of independent, local authority, primary, secondary, co-educational, urban, rural, faith and non-faith schools were contacted by email and phone. Interested schools were provided with information packs. Recruitment closed when the target number of schools had been reached and schools were closing for the 2014 summer break.

Ten community day (non-residential) SEND schools were recruited. Two schools subsequently withdrew due to a lack of capacity and changes in circumstances, leaving a sample of eight schools. Seven schools were local authority maintained and one was independent. All schools were mixed gender and provided education exclusively to pupils with SEND; one school was a specialist school for pupils with autism. Three were primary schools (pupils aged 3–11 years), two were secondary with colleges (pupils aged 11–19 years) and three were all-age for pupils aged up to 19 years.

A teacher in each school was selected to coordinate the programme. Teachers were selected through discussion with Head Teachers or other school representatives based on their motivation and openness to the approach. Schools were offered flexibility in how they implemented the programme: six schools chose to involve an existing class and two schools formed a class specifically for the programme, drawing pupils from multiple classes to ensure that at least five pupils met the eligibility criteria described below.

Eligibility Criteria for Individual Children and Young People:

- Aged 5 to 15 years
- Performance (P) level for Personal, Social and Health Education (PSHE) between 5 and 8, based on the most recent assessment
- Performance (P) level for English Speaking of at least 4 (to indicate presence of communication through at least single words, signing or symbolic communication)
- Absence of significant hearing or visual impairments that may limit the child's access to the programme (determined through discussion with the teacher, on a case-by-case basis).

The Performance (P) Scales (Qualifications and Curriculum Authority, 2009) are statutory assessment scales in the UK used when reporting attainment for pupils with SEND who are working below Level 1 of the National Curriculum. P level assessment is not compulsory for Personal, Social and Health Education (PSHE), but is commonly assessed in schools toward the end of each academic year. The assessment carried out at the end of the academic year 2013-2014 was used to screen potential child participants. A P level 4-5 for PSHE indicates that the child can maintain interactions in small groups with some support and can combine two elements of communication to express feelings, needs and choices. A P level of 8 indicates that the child demonstrates autonomy and awareness of others. P levels for

PSHE were not available for one school so the teacher was asked to provide estimations.

Parental/guardian consent was sought using postal recruitment packs sent to the parents/guardians of each eligible child in the identified class. A letter of invitation, information sheet, reply slip, and pre-paid envelope were included in each pack. The packs were sent out by administrators on each school so that personal information was not transferred until after parents/guardians had been provided with sufficient time to opt out. An opt-out system for recruitment was selected to minimize any burden on parents/guardians and because the intervention closely aligned to usual teaching practice, all research activities were conducted within school premises and hours, and teachers are legally competent to give consent in loco parentis for children in their care for school-like activities. Parents/guardians were given over 2 weeks to respond and only one parent returned a reply slip to decline participation.

Assessments and Outcome Measures

A range of measures was used to assess typical and maximal behavior of the child participants (see **Table 1**). These measures were selected as they sought to measure constructs aligning with the aforementioned five domains of emotional literacy. Emotional Literacy Assessment and Intervention (EL; Southampton Psychology Service, 2003) has five domains directly relating to those proposed by Salovey and Mayer (1990). The Social Skills Improvement Rating Scale (SSiS; Gresham and Elliott, 2008) broadly covers these domains, but is organized into different subscales which have more of a focus on social skills. The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) measures prosocial behavior as well emotional, interpersonal and behavioral difficulties. Informant-rated social, emotional and coping skills and problem behavior were assessed at baseline (defined as 1–12 weeks prior to the intervention and at least 8 weeks into the start of the academic year to allow children to settle) and end-point (3–8 weeks after completion of the third module). Self-complete, postal questionnaires were sent to parents/guardians and teachers who were asked to rate each child participant for the previous 6 months period at baseline (or the period they had known the child if less than 6 months) and the previous 1 month period at end-point. Parents/guardians were offered the option of completing the questionnaire as a telephone interview and reminder letters were sent to those not responding.

The measures of maximal behavior sought to assess emotional literacy directly through emotional recognition tasks with children. Emotion recognition tasks were conducted at baseline and end-point with a sub-sample ($N = 25$) of children (child

TABLE 1 | Summary of measures.

Measure, author/publisher	Respondent	Subscales	Items	Scoring and direction
MEASURES OF TYPICAL BEHAVIOR				
Emotional Literacy Assessment and Intervention (EL) Southampton Psychology Service (2003)	Teacher	Self-awareness Self-regulation Motivation Empathy Social skills	Total: 20 4 items per subscale	1-4 per item Total 4-16 for each subscale Subscale scores can be totalled to provide an overall emotional literacy score of 20-80 Higher scores indicate higher levels of emotional literacy
Strengths and Difficulties Questionnaire (SDQ) Goodman (1997)	Teacher Parent	Emotional symptoms Conduct problems Hyperactivity/inattention Peer relationship problems Prosocial behavior	Total: 25 5 items per subscale	0-2 per item Total 0-10 for each subscale Subscale scores (excluding prosocial behavior) can be totalled to provide an overall difficulties score of 0-40 Higher scores for the difficulty items indicate increased difficulties. Higher scores for the prosocial behavior subscale indicate higher levels of prosocial behavior
Social Skills Improvement Rating Scale (SSiS) Gresham and Elliott (2008)	Teacher Parent	Communication Co-operation Assertion Responsibility Empathy Engagement Self-control	Total: 46 6–7 items per subscale	0–3 per item Total 0-18/21 for each subscale Subscale scores can be totalled to provide an overall social skills score of 0-138. Higher scores indicate higher levels of social skills
MEASURES OF MAXIMAL BEHAVIOR				
Emotion recognition tasks	Children and young people	Emotion recognition in symbols Emotion recognition in photographs Emotion naming in symbols Linking emotions and activating events Control task	Total: 25 5 items per task	1 point per correct response Total 0-5 for each task Scores for the emotion tasks (excluding the control task) can be totalled to provide an overall emotion recognition score of 0-16.

participants in two West Midlands schools were invited to take part). The tasks were designed by the research team and are based on those used in previous research by Dagnan and Proudlove (1997) and Reed and Clements (1989). All assessments were conducted at school, by a member of the research team, in a quiet room or a quiet space within the classroom. The order of the tasks and items within each task were randomized across participants to control for order effects and participants were not given any feedback on the accuracy of their responses.

Demographic information relating to the child participants was collected from teachers at baseline using a self-complete questionnaire (date of birth; gender; ethnicity; cultural/religious affiliations; living arrangements; expressive verbal communication; comorbid diagnoses, including autism spectrum conditions, mental health conditions, genetic conditions, physical health conditions, physical disabilities, and sensory impairments; family structure; current interventions, including medication and psychological and medication).

Emotional Literacy: Assessment and Intervention (EL)

Emotional Literacy: Assessment and Intervention (EL; Southampton Psychology Service, 2003) measures strengths and weaknesses in emotional literacy and facilitates the identification of areas for intervention. It was designed to be used in school settings and there are two versions: a Primary version for children aged 7–11 years and a Secondary version for children aged 11–16 years. The measure was specifically designed to screen pupils with problems with emotional literacy and is therefore more sensitive to differences between low scorers than high scorers. Standardized pupil, teacher and parent questionnaires are provided to assess individual children and young people, which can be used for re-assessment to monitor progress. Only the teacher assessment questionnaires were used in the present study to minimize burden on parents. The pupil assessment was not used as it was felt that the child participants in this study would be unable to respond to the questions. The version corresponding with each child participant's age was used.

Strengths and Difficulties Questionnaire (SDQ)

The Strength and Difficulties Questionnaire (SDQ; Goodman, 1997) can be used with children aged 3–16 years and has different versions to be completed by teachers, parents/guardians/care givers or the young person themselves. Follow-up questionnaires are provided to rate the impact of interventions. The teacher-completed and parent-completed pre-intervention and follow-up questionnaires, were used in this study.

Social Skills Improvement Rating Scale (SSiS)

The Social Skills Improvement Rating Scale (SSiS; Gresham and Elliott, 2008) evaluates social skills functioning across seven domains and competing problem behaviors across five domains: Teacher, parent and student versions are available with the teacher version also assessing academic competence: reading achievement, maths achievement and motivation to learn. The SSIRS can be used to assess children aged three to 18 years.

In the teacher and parent versions, 46 behaviors are rated for on a 4-point scale and perceived level of importance of social skills on a 3-point scale (not important, important, and critical). The scale can be used to monitor progress and assess the effects of interventions. This study used the social skills functioning domains from the teacher-completed and parent-completed versions rated only for frequency. To reduce the burden on respondents, only the SSiS social skill functioning domains were used in this study, the problem behaviors and academic competence subscales were omitted as these were covered by the SDQ or were not reflective of the aims of the intervention.

Measures of Maximal Behavior

Emotion recognition in symbols task

The emotion recognition in symbols task measured the participants' ability to identify facial expressions of emotions, without the need for expressive verbal communication. It was based on a task reported by Dagnan and Proudlove (1997) in which five pictorial facial expressions are presented, arranged in a pentagon on a sheet of A4 paper, each measuring 4 cm in length. Dagnan and Proudlove (1997) used Makaton symbols in their task, however, WIDGIT symbols were used in this study as they are used throughout the Zippy's Friends programme. Furthermore, larger images were used to allow for visual impairments. The symbols used by Dagnan and Proudlove (1997) represent the emotions of happy, sad, frightened (scared), anxious (worried) and angry. As frightened and anxious are not covered in the Zippy's Friends programme and "nervous" is used instead, these four emotions were used in the task. During the task, the researcher read out an emotion word (for example, happy) and asked the participant to indicate which symbol represented the emotion that was read out. One point was given for each correct response to provide a score of 0–4.

Emotion recognition in photographed faces task

The emotion recognition in symbols task was adapted to assess whether learning to recognize facial expressions generalized beyond symbols. The same procedure was used, but with photograph of faces (portraits of head and shoulders) in place of the symbols. The photographs were selected by the research team to represent a range of ages, ethnicities and genders. One point was given for each correct response to provide a score of 0–4.

Emotion naming in symbols task

The emotion naming in symbols task was designed to assess ability to use of emotional vocabulary. A similar procedure to the emotion recognition in symbols task was used: the researcher pointed to one of the WIDGIT symbols and asked the child participant to name the emotion. This task was always performed last so that all participants had the same level of exposure to the emotion words, provided as part of the instructions for the other tasks. One point was given for each correct response to provide a score of 0–4.

Linking activating events and emotions task

This task measured the ability of participants to make associations between activating events and subsequent emotions. Reed and Clements (1989) first designed this task in which

participants are presented with six different scenarios and asked whether the protagonist of each scenario feels happy or sad and why. Participants can respond verbally or point to a face that best represents the emotion of the protagonist. This study used the same procedure, but included gender-specific pictorial prompts to illustrate the scenario. Four scenarios were presented, such as "John take his dog for a walk, the dog breaks the lead. He has lost his dog." Participants were asked to justify their answer. The justification was taken into account when scoring so that atypical responses, but with appropriate justification, were scored as correct. One point was given for each correct response to provide a score of 0–4.

Non-emotion control task

A non-emotion control task was included to determine whether the performance on the emotion tasks was a function of cognitive demands or its affective content. The procedure for the emotion recognition in photographs task was followed, but participants were asked to identify a non-emotional element of the photographs, for example, participants were asked to "point to someone wearing a hat." One point was given for each correct response to provide a score of 0-4.

Ethical Considerations

Ethical approval was obtained from the University of Birmingham Ethical Review Committee prior to recruitment of participants. Parental/guardian consent was obtained for each child participant. Assessments with child participants were conducted in the presence of a teacher. Teachers and teaching assistants advised on whether child participants would be able to tolerate assessments, including how they would respond to strangers and any changes to routine. Verbal agreement was obtained from child participants prior to any assessment.

Data Analysis

All quantitative data were entered into and analyzed using IBM SPSS Version 22. Missing values for items on the teacher and parent questionnaires were replaced with the mean score for the subscale, based on available ratings for that participant. The distributions of the data (total scores and subscale scores) were explored using Shapiro-Wilk tests (as recommended by Ghasemi and Zahediasl, 2012) and plots. Parametric and non-parametric tests were used depending on whether the data conformed to the assumptions of a parametric test.

Analyses were performed using subscale and total scores to examine the changes in typical and maximal behavior from baseline to end-point; and the effect of demographic variables (age, gender, ethnicity, expressive verbal communication, presence of ASD, PSHE level, and English speaking level) on change in typical behavior over time. The categories of some demographic variables were collapsed for some analyses to provide more power to these analyses: age was dichotomised into younger and older based on a mean split; ethnicity was dichotomised into White British and Minority ethnic; expressive verbal communication was reduced to three levels (non-verbal/symbolic communication/single words, single words and phrases, and full sentences); and PSHE and English speaking levels were dichotomised into higher and lower ability based on mean splits. In the spirit of intention to treat analysis, baseline to end-point analyses were performed including child participants from the class which stopped the programme before completion. Analyses were also performed to investigate whether results were maintained when this class was omitted from analyses.

Dependent t-Tests and Wilcoxon Signed-Rank Tests were used to detect changes in typical and maximal behavior over time. The interactions between change in typical behavior and demographic variables were examined using Two-way mixed ANOVAs. Cohen's d was used to estimate effect size for *t*-tests. For Wilcoxon signed rank tests, effect size (r) was calculated by dividing the Z-statistic by the square root of the number of pairs. Partial eta squared was used for effect size of interaction effects in the two-way mixed ANOVAs. The "*p*-level" was set at 0.01.

RESULTS

Fifty-three children and young people were recruited to take part in the study. **Table 2** presents the demographic profile of the sample. The ranges of P Levels for PSHE and English speaking indicate that the inclusion criteria were not strictly applied by teachers. One participant with a P Level of 3 in PSHE and four participants with a Level of 3 in English speaking were included in the study as their teachers felt that they were appropriate for inclusion despite their assessed P Levels.

TABLE 2 | Demographic profile of the child participants ($N = 53$).

Type of school attended ($N = 8$)	35.8% Primary 34.0% All age 30.2% Secondary
Age at baseline	Mean (*SD*): 9.93 years (2.59) Range: 5–14 years
Gender	75.5% male
Ethnicity	48.1% White British 21.2% Pakistani 9.6% White 'Other' 7.7% Indian 3.8% Asian 'Other' 3.8% Black 'Other' 1.9% Bangladeshi 1.9% African 1.9% Chinese
Residence	97.8% Family home (with birth parents) 2.2% Family home (with grandparents)
Autism spectrum disorder	47.2% Present
Expressive verbal communication	9.4% Non-verbal (with/out symbolic communication) 5.7% Single words 49.1% Words and phrases 35.8% Full sentences
Behavior problems	48% Present
Sensory impairments	18% Present
Physical disabilities	30% Present
P level for PSHE	Mean (*SD*): 6.97 (1.20) Range: *P* level 3-8
P level for English Speaking	Mean (*SD*): 7.57 (1.59) Range: *P* level 3 to National Curriculum level 2

Progress With the Programme

The schools took a mean of 7 sessions (range: 4–9 sessions) to complete module 1 (based on feedback from 7 schools), 5 sessions (range: 4–6 sessions) to complete module 2 (based on feedback from 5 schools) and 5 sessions (range: 4–7 sessions) to complete module 3 (based on feedback from 5 schools). A mean of 16 sessions (range: 12–21 sessions) were needed to complete the first three modules (based on feedback from 5 schools). Classes spent less time on the later modules. This increased pace may reflect expedited learning by the students as they were familiarized with the programme or reflect the teachers' desire to complete the modules by the end of the academic year, in line with the research protocol. The classes tended to need more than the standard four sessions per module suggesting the progress was slower than in mainstream schools.

Attrition

One child was withdrawn from the study as their teacher felt the programme was unsuitable, and another participant moved classes half way through the programme for reasons unrelated to the programme. Additionally, one school ceased the programme early (after 12 sessions; $n = 6$ child participants) because the teacher felt that it was unsuitable for the pupils. End-point data were collected for this school and the reasons for termination were explored in the teacher interview. The demographic profile and baseline teacher scores for the child participants in this class were compared to the other classes. The demographic profile was similar to other classes, however, there was a larger proportion of non-verbal pupils in the class which left the programme early compared to the other classes (33.3% compared to 6.4%). The class that left the programme early also had significantly lower scores than the rest of the classes on the SSiS Responsibility and Engagement subscales and higher SDQ peer relationship problem scores.

Change in Typical Behavior From Baseline to End-Point: Teacher Assessment

Table 3 shows the descriptive statistics for each of the measures at baseline and end-point. Data were available for 43 of the 53 child participants at end-point. One teacher, although completing the three modules with her class, did not return the end-point questionnaires ($n = 8$) and two children had left their class by the time of end-point data collection and so are not included in these analyses.

Figure 1 shows the mean scores at baseline and end-point on the SSiS for each of the subscales. Scores improved for all the subscales with Communication [$t_{(42)} = -4.20$, $d = -0.24$], Cooperation [$t_{(42)} = -3.55$, $d = -0.49$], Assertion [$t_{(42)} = -4.01$, $d = -0.42$], Responsibility [$t_{(42)} = -2.67$, $d = -0.28$], and Total Social Skills [$t_{(42)} = -3.88$, $d = -0.44$] scores showing a statistically significant improvement ($p \leq 0.01$). **Figure 2** shows the mean scores at baseline and end-point on the EL. Across the sample, Self-awareness [$t_{(42)} = -5.68$, $d = -1.06$], Social Skills [$t_{(42)} = -3.56$, $d = -0.49$] and Total Emotional Literacy [$t_{(42)} = -2.67$, $d = -0.43$] scores improved significantly ($p \leq 0.01$). **Figure 3** shows the mean scores at baseline and end-point on the SDQ. None of the changes were statistically significant.

TABLE 3 | Descriptive statistics for the measures at baseline and endpoint.

Measure	Subscales	Baseline Mean (*SD*)	Endpoint Mean (*SD*)
TEACHER-RATED			
Social Skills Improvement Rating Scale (SSiS)	Communication	11.00 (3.84)	13.37 (3.51)*
	Co-operation	9.79 (3.00)	11.26 (3.03)*
	Assertion	8.19 (4.61)	10.14 (4.66)*
	Responsibility	8.40 (3.60)	9.40 (3.59)*
	Empathy	8.14 (3.78)	9.16 (4.84)
	Engagement	9.88 (4.25)	10.81 (4.47)
	Self-control	8.81 (3.67)	9.67 (3.71)
	Total	64.21 (20.26)	73.81 (23.23)*
Emotional Literacy Assessment and Intervention (EL)	Self-awareness	8.81 (2.11)	10.77 (1.54)*
	Self-regulation	10.37 (3.68)	10.44 (3.04)
	Motivation	9.65 (2.49)	10.28 (2.15)
	Empathy	11.42 (2.41)	11.23 (2.05)
	Social skills	12.49 (2.25)	13.53 (1.98)*
	Total	52.74 (9.35)	56.26 (6.99)*
Strengths and Difficulties Questionnaire (SDQ)	Emotional symptoms	2.81 (2.18)	3.24 (2.51)
	Conduct problems	2.40 (2.21)	2.48 (2.10)
	Hyperactivity/inattention	6.26 (2.93)	5.90 (2.75)
	Peer relationship problems	4.24 (2.46)	4.31 (2.31)
	Total difficulties	15.71 (6.46)	15.93 (6.54)
	Prosocial behavior	4.21 (2.74)	4.74 (2.79)
PARENT-RATED			
Social Skills Improvement Rating Scale (SSiS)	Communication	11.20 (5.73)	11.00 (5.06)
	Co-operation	11.40 (3.45)	11.30 (3.34)
	Assertion	8.90 (6.05)	9.90 (5.00)
	Responsibility	8.60 (4.53)	8.60 (3.66)
	Empathy	8.90 (5.20)	9.00 (4.70)
	Engagement	9.60 (6.50)	11.00 (5.85)
	Self-control	9.20 (5.37)	9.80 (4.92)
	Total	67.80 (31.63)	70.60 (27.55)
Strengths and Difficulties Questionnaire (SDQ)	Emotional symptoms	3.70 (3.13)	2.90 (2.85)
	Conduct problems	2.20 (1.40)	1.90 (1.66)
	Hyperactivity/inattention	7.20 (3.16)	6.50 (2.80)
	Peer relationship problems	4.20 (2.00)	3.90 (2.51)
	Total difficulties	17.30 (7.80)	15.20 (7.22)
	Prosocial behavior	5.40 (2.80)	5.40 (3.00)
MAXIMAL BEHAVIOR			
Emotion recognition tasks	Emotion recognition in symbols	3.30 (0.88)	3.65 (0.65)
		2.57 (1.16)	3.30 (0.82)
	Emotion recognition in photographs	2.95 (0.78)	3.37 (0.46)*
		3.16 (0.94)	3.68 (0.85)
	Emotion naming in symbols	12.09 (2.45)	14.45 (1.68)*
	Linking emotions and activating events	3.04 (0.83)	3.70 (0.56)
	Overall emotional recognition		
	Control task		

*$p \leq 0.01$.

Interactions With Child Participant- and School-Related Factors

Tests for interaction effects of demographic variables on change over time were performed. There were no interaction effects for gender, ethnicity or baseline PSHE level (lower vs. higher

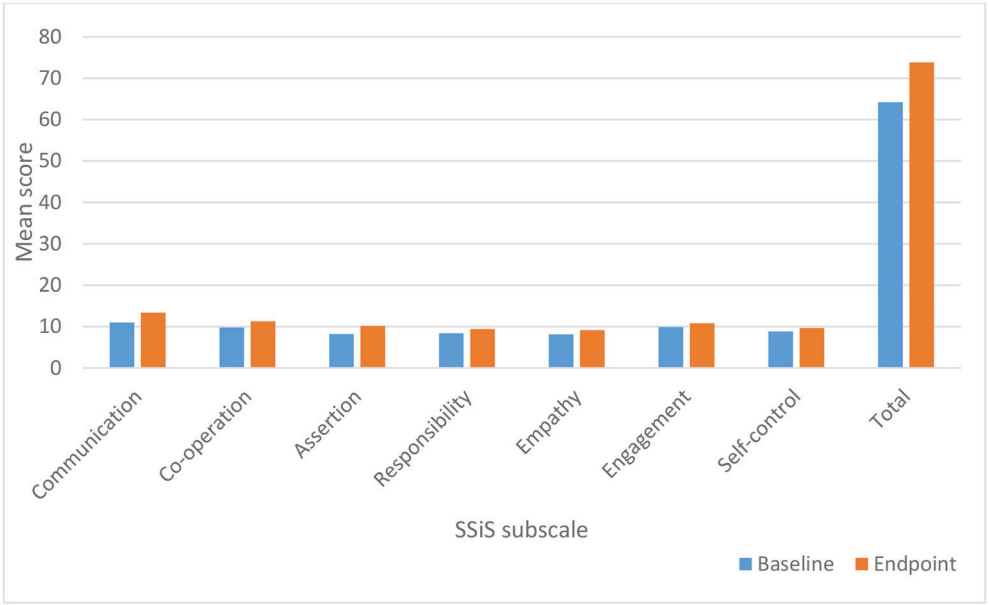

FIGURE 1 | Mean scores on the Teacher SSiS: Before and after Zippy's Friends.

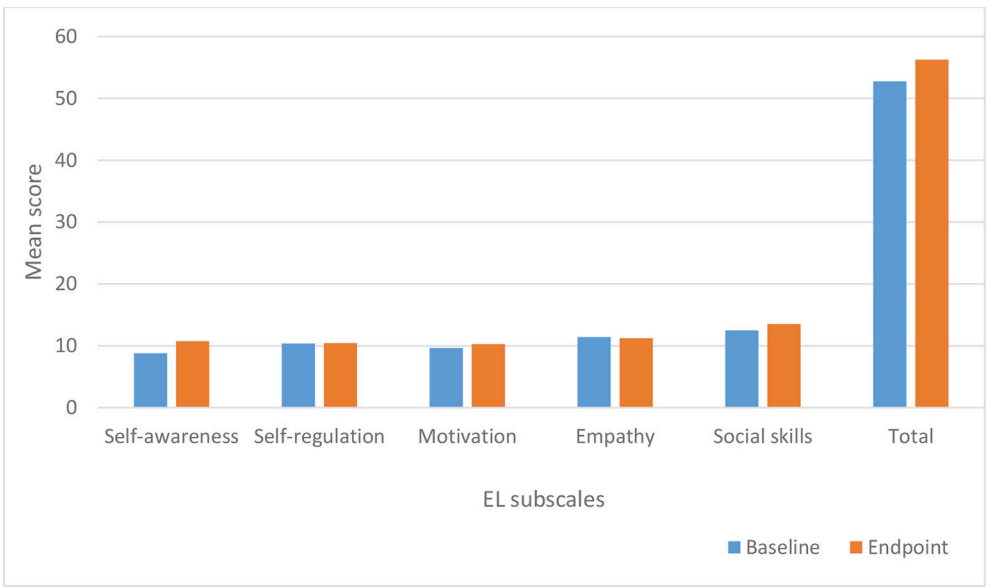

FIGURE 2 | Mean scores on the Teacher EL: Before and after Zippy's Friends.

ability). There was a statistically significant interaction between time and age (younger vs. older) on the SSiS Empathy subscales [$F_{(1, 34)} = 7.63$, $p \leq 0.01$, partial eta$^s = 0.18$]: only younger children showed a significant improvement in empathy; the scores of older children remained stable over time. Baseline English speaking educational level (lower vs. higher ability) interacted with change in SDQ Prosocial behavior [$F_{(1, 32)} = 8.84$, $p \leq 0.01$, partial eta$^2 = 0.22$] and SSiS Self-control [$F_{(1, 33)} = 18.84$; $p \leq 0.01$, partial eta$^2 = 0.36$]. The higher ability children improved more in terms of pro-social behavior and self-control than the lower ability children.

Change in Typical Behavior From Baseline to End-Point: Parent Assessment

Eighteen parent questionnaires were received at baseline and 11 at end-point. Ten parents returned questionnaires at both baseline and end-point, representing around 20% of the sample.

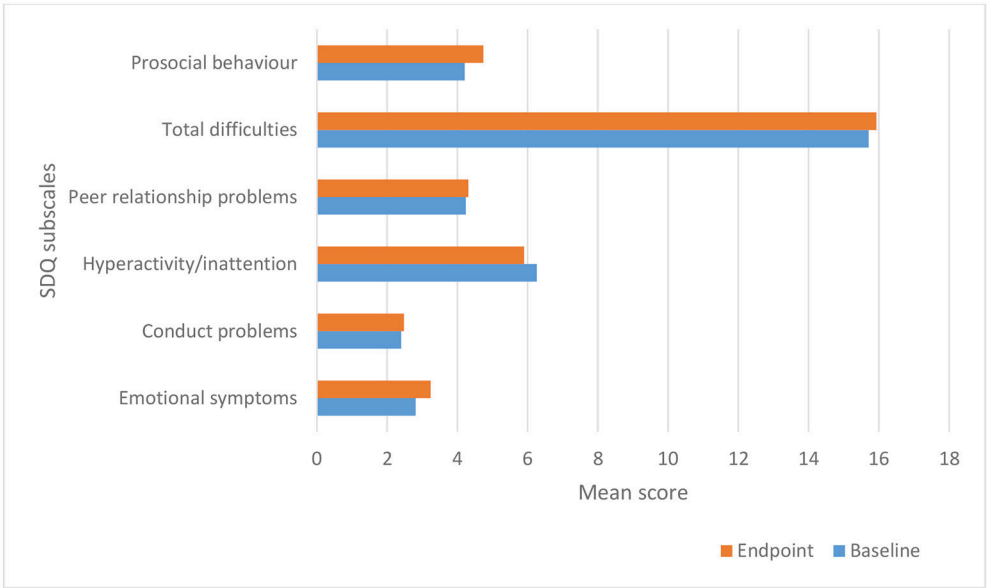

FIGURE 3 | Mean scores on the Teacher SDQ: Before and after Zippy's Friends.

TABLE 4 | Demographic profile of child participants for whom parent questionnaires were returned at baseline and end-point ($N = 10$).

Age at baseline	Mean (*SD*): 10.20 years (2.62) Range: 5–14
Gender	60% male
Ethnicity	60% White British
Residence	100% Family home
Autism spectrum disorder	50% Present
Expressive verbal communication	30% Non-verbal, symbolic communication or single words 40% Words and phrases 30% Full sentences
Behavior problems	50% Present
P level for PSHE[a]	Mean (*SD*): 7.00 (.93) Range: 6 to 8
P level for English Speaking[b]	Mean (*SD*): 7.44 (1.33) Range: 6 to National Curriculum Level 1

[a]*Data were not available for 2 participants.*
[b]*Data were not available for 1 participant.*

The demographic profile of these 10 child participants is presented in **Table 4**. Questionnaires were received from parents of children across all of the schools at baseline. The 10 paired assessments include pupils from seven of the eight schools and two questionnaires from parents of children in the class which terminated the programme early. The profile of the children for whom parent assessments were received was similar to that of the whole sample.

Table 3 and **Figures 4**, **5** show the mean scores for the parent measures at each time point. All problem scores on the SDQ reduced (improved) over time and pro-social behavior remained stable. Four of the subscales on the SSiS increased over time (indicating improvement). However, statistical comparisons of baseline and end-point scores revealed no significant differences between any of the SSiS Social Skills or SDQ subscales. Owing to the small number of participants, analyses for interaction effects with demographics were not performed.

Change in Maximal Behavior From Baseline to End-Point: Child Assessment

All 27 child participants based in the West Midlands participated in the emotion recognition tasks. The tasks could not be completed with two participants at end-point: one participant had moved school before the assessment and a further participant was unavailable. **Table 3** and **Figure 6** show the mean scores at baseline and end-point on each of the emotional recognition tasks. Performance improved on all tasks with significant improvements ($p \leq 0.01$) in overall emotion recognition ($Z = -3.02$, $r = -0.46$) and emotion naming from symbols ($Z = -3.08$, $r = -0.47$). There was no significant improvement on the control task.

DISCUSSION

The children and young people with SEND showed improvements in terms of teachers' ratings of their social skills, emotional literacy, and emotional recognition. Significant improvements were observed in the total score for social skills as measured by the SSiS and on its subscales measuring communication, cooperation, assertion, and responsibility (but not on the subscales that measure empathy, engagement and self-control). The teachers' scores also indicate significant improvements in the children's overall emotional literacy

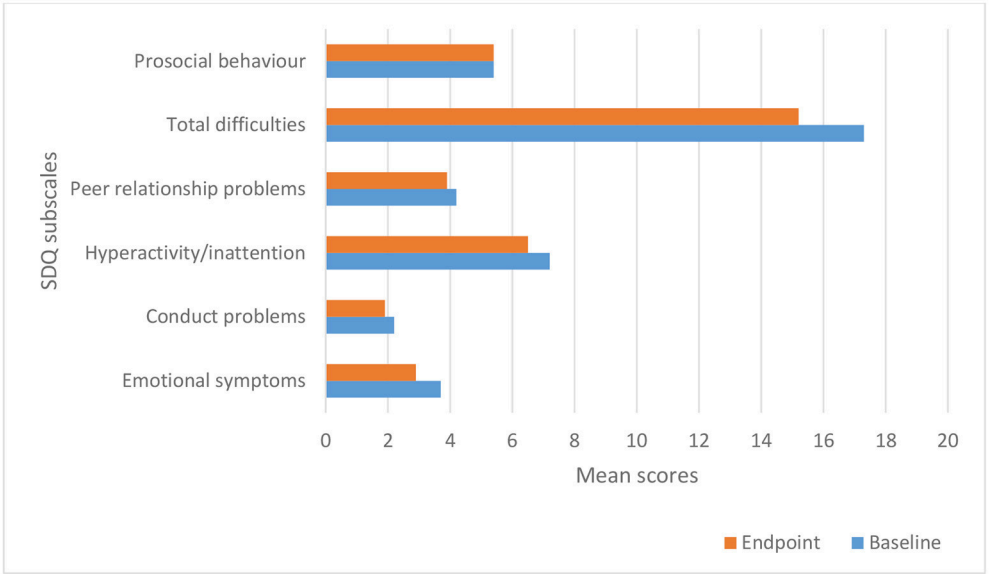

FIGURE 4 | Mean scores on the parent SDQ: Before and after Zippy's Friends.

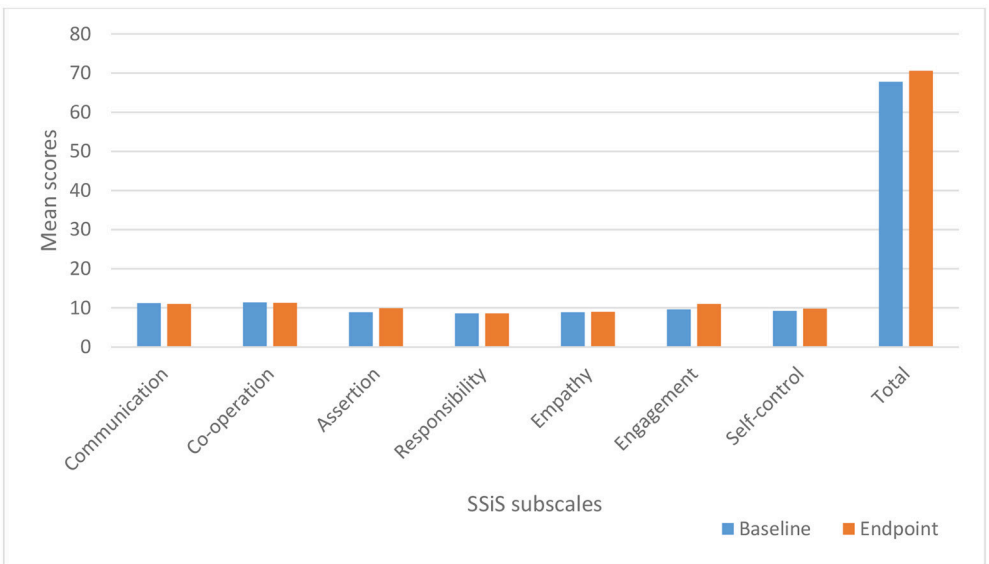

FIGURE 5 | Mean scores on the Parent SSiS: Before and after Zippy's.

as measured by the EL. Taken together, these two outcome measures suggest that three of the five domains identified by Salovey and Mayer (1990) as core to emotional literacy, namely self-awareness, ability to manage emotions and relationship skills, improved in the pupils who took part in this study.

This small-scale feasibility study did not include a control condition and the results must be interpreted with caution. In the absence of a control condition, the trend toward improvements may relate to factors such as maturation over the period of the study and not to the Zippy's Friends programme. In an extensive review of reviews of school-based mental health interventions, Weare and Nind (2011) also highlight problems of lack of control group, lack of randomization, short duration, missing data and small numbers across the literature. This study suffered from issues around missing data, especially in relation to the low response rate from parents, as discussed in more detail later. However, Weare and Nind (2011) suggest that methodological weaknesses may not affect the results, positively or negatively, as evidenced in one of the reviews described in their paper (Wilson and Lipsey, 2006) which

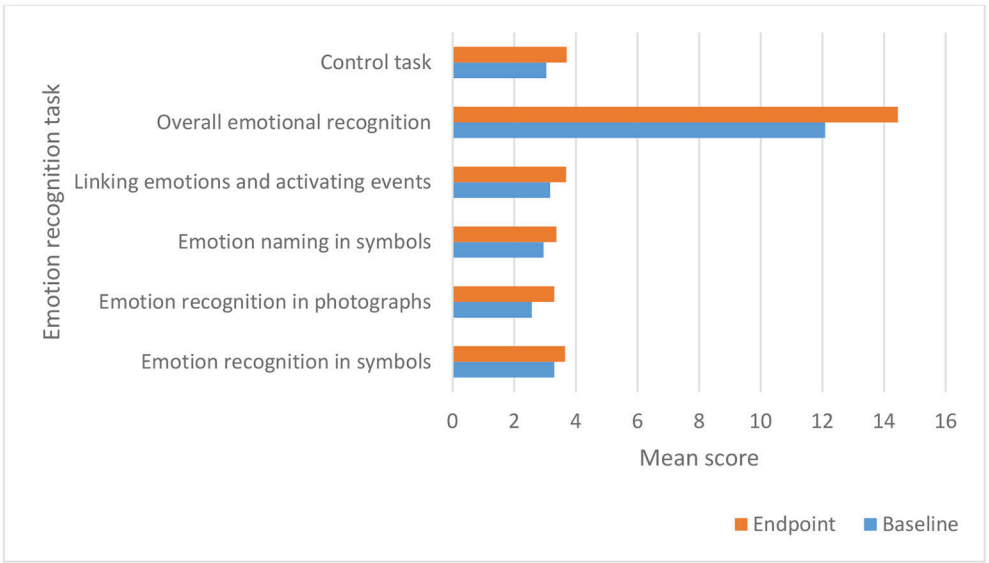

FIGURE 6 | Mean scores on the emotion recognition tasks: Before and after Zippy's.

found no differences in outcome for higher or lower quality studies.

Despite weaknesses in the design, the findings of the current study suggest that the adapted version of the Zippy's Friends mental health promotion programme may have beneficial effects for children with SEND, particularly in the areas of self-awareness, ability to regulate emotions, recognition of emotion and relationship skills. Furthermore, a strength of this study is the use of measures of both maximal and typical behavior as most studies only use teacher-rated measures of typical behavior (Cheney et al., 2014). Measures of typical behavior are obtained through self- and informant- report and are based on respondents making a judgment about how the child usually behaves. Measures of maximal behavior require respondents to complete a task, designed to tap into the underlying construct in question. Measures of maximal behavior are considered to be a more 'direct' measure of emotional literacy and are not subject to the high levels of bias and social desirability inherent in typical measures (Wigelsworth et al., 2010).

Motivation and empathy scores did not improve and this may relate to the challenges in measuring these concepts using informant report; both are subjective and personal experiences and may not be amenable to direct observation by others. Problem behavior did not change significantly either. Whether this lack of change is due to the lack of focus of the programme on problem behavior or the lack of sensitivity of the measure will need to be addressed by further research. This study only used the first half of the Zippy's Friends programme; the second half addresses conflict resolution, coping skills, and dealing with change which may have had more impact on problem behavior exhibited by children with ID (Tustin et al., 1997) than the modules covered here. (Haney and Durlak, 1998) found that targeted interventions are more effective than universal programmes so perhaps, given the high rate of behavioral problems amongst children with ID, a more targeted intervention subsequent to the group work is required for some children. Furthermore, motivation and empathy are not specifically covered in the intervention so perhaps it could be anticipated that these would not change.

There were no changes in SDQ scores pre- and post-intervention. In their systematic review, Cheney et al. (2014) found different results were reported for different measures in the same study: more equivocal results were reported for the SDQ compared with other measures. Other researchers (e.g., Clarke and Barry, 2010) have commented on the apparent lack of sensitivity of this measure and we do not recommend the SDQ for future research. There is currently a lack of literature to assist with the selection of outcome measures for use with children with SEND. Future research may consider using the Social Skills Improvement Rating Scale (SSiS) as a primary outcome measure as the SSiS demonstrated face validity and was sensitive to change over time in this study.

Positive changes in behavior were not identified from the parent measures, although parents did provide some anecdotal evidence for this during the qualitative interviews. This lack of significant improvement reported by parents (as compared to the significant results found for the teacher-informed measures) may suggest that changes in behavior were specific to the school environment and did not generalize to the home environment. Shucksmith et al. (2007) highlighted the importance of parental involvement so that parents can support and reinforce messages learned at school in the home environment. Furthermore, Bernstein et al. (2005) found that the most successful interventions were those which emphasized

collaboration between children, parents and teachers. In this study, parents were not involved in the intervention. Other studies have shown that parental involvement increases the effectiveness of mental health promotion and emotional literacy interventions (Wells et al., 2003; Adi et al., 2007a). As only a small proportion of parents (around 20%) returned questionnaires, these analyses may not have been adequately powered to detect differences. Future research should employ methods to improve parent engagement in the study and therefore response rate. Improved parental engagement may also facilitate transfer of learning to home environments.

Few of the child characteristics were related to change from baseline to end-point. Weare and Nind (2011) also addressed this issue in their review and found inconclusive results. In another review, Adi et al. (2007a) found no effects according to gender, age, ethnic or social group. However, in this study those with higher abilities in English speaking demonstrated improved pro-social behavior and self-control whereas these remained stable in lower ability children. It must be noted that the higher ability children had lower scores on self-control at baseline compared to their less able peers. It may be that the children with more expressive communication demonstrated more lapses in self-control as measured by responses to interpersonal conflict whereas the lower ability children had fewer peer-to-peer interactions and therefore less potential for interpersonal conflict. In this way, the higher ability children also had more potential for change. Weare and Nind (2011) also found that the impact of interventions on higher risk children was generally greater than for children with milder problems.

The subsample ($N = 25$) demonstrated improved emotion recognition skills after completing the intervention. More specifically, they demonstrated improved emotion naming when presented with symbols. This positive finding indicates that these children became better at naming emotions from symbols, suggesting an improvement in use of emotional vocabulary. However, whether this improved ability will generalize to more "real-life" scenarios requires further investigation. Scotland et al. (2015) reviewed the literature on emotional recognition abilities in adults with ID and those without ID and found that adults with ID have impairments in emotional recognition in faces highlighting the potential importance of improving these abilities in childhood. The review authors also comment on the infrequent inclusion of control tasks: only two studies out of nine used a control task to investigate whether impairments related to general information processing or whether they were specific to emotional information (Rojahn et al., 1995a,b). This study included a control task as part of the assessment of emotional recognition in faces and found no difference over time in the task suggesting that improvements over time were specific to emotional recognition rather than understanding and following the task procedures.

One class terminated the programme early as the teacher felt it was unsuitable for her pupils. This class included a larger proportion of non-verbal children and the class teacher cited this as the primary reason for her decision to cease the programme. The programme may therefore require some further development to improve its suitability for children with limited expressive verbal communication. Baseline levels of engagement were lower and peer relationship problems were higher in this class compared to the others and this may have impacted on the implementation of the programme. The SSiS Engagement subscale includes items which relate to expressive verbal communication (e.g., starting conversations with peers and teachers, introducing self to others) and participation in group activities (e.g., joining activities, interacting well with other children). Further, the SDQ peer relationship problems relates to interactions with peers and friendships. The programme is built around group activities and peer-to-peer learning and therefore the lower levels of engagement and peer relationships problems may also have contributed.

Limitations and Recommendations for Future Research

Limitations of this study include: lack of control group, small sample size with smaller sub-sample for maximal behavior measures, short duration and no follow-up, risk of response bias as teachers were aware of the aims of the study, missing data, attrition ($n = 8$) and low parental response rate (20%). Further controlled research involving larger samples and with a longer duration is required to establish efficacy of the whole programme (this study evaluated the first half of the programme only). The latter part of the programme focuses on improving problem solving skills which could be assessed using tests of maximal behavior and direct observation to gather evidence of problem solving. Further research should also include a post-intervention follow-up period to investigate whether positive outcomes are maintained after the programme and involve parents more actively (e.g., holding parents' evenings at the participating schools) to improve response rate for the parent measures. The Zippy's programme aims to support children in developing their own coping strategies rather than prescribing specific coping strategies and it is important that work continues to develop and evaluate such mental health promotion interventions for children and young people with SEND. Further research should investigate how teachers implement this problem solving element of the programme, establish whether it is effective and whether, according to behavioral outcome measures, such an approach is superior to a prescriptive "rulebook" approach for children with SEND.

FUNDING

This project was funded by the Judith Trust.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

ACKNOWLEDGMENTS

Thank you to Partnership for Children who provided the Zippy's programme, including resources, training, and supervision to the teachers involved in this project. Thanks to Kelly Tipton for her research support on the project whilst on placement for her Masters degree. Ioanna Tsimopoulou contributed to the data entry and analysis. Finally, thanks to the teachers who facilitated the programme—without their support and enthusiasm, the evaluation would not have been possible.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 14 June 2019
doi: 10.3389/feduc.2019.00057

School Peer Non-academic Skills and Academic Performance in High School

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Research shows that students' non-academic attributes, such as forms of engagement, dispositions, and social and emotional skills, are associated with a range of outcomes—including academic performance. However, little research has investigated the effects of school peer non-academic attributes on academic performance. This study begins to address this gap in the research literature by examining the effects of 10 measures of school peer non-academic attributes. Importantly, most of the non-academic attributes examined in this study are malleable through school-based interventions. The results show that five measures of school peer attributes have medium to large effects on academic performance, including collaboration skills (a social-emotional characteristic), conscientiousness and belonging (dispositions), and cognitive and behavioral engagement. In contrast, the corresponding effects of students' own non-academic attributes were uniformly smaller. These findings indicate that the non-academic attributes of one's school peers play an important role in academic performance above and beyond one's own non-academic attributes. These results suggest that school-wide interventions and instructional practices designed to improve the non-academic skills of all students will provide additional benefits compared with interventions focusing on students with the most under-developed non-academic attributes.

Keywords: school composition effects, peer influences, non-academic skills, non-cognitive skills, social-emotional skills, school engagement, student dispositions, academic performance

OPEN ACCESS

Edited by:
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University of Southampton,
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Reviewed by:
Geoff Anthony Lindsay,
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United Kingdom
Antonio Valle,
University of A Coruña, Spain

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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *06 August 2018*
Accepted: *28 May 2019*
Published: *14 June 2019*

Citation:
Palardy GJ (2019) School Peer Non-academic Skills and Academic Performance in High School. Front. Educ. 4:57. doi: 10.3389/feduc.2019.00057

INTRODUCTION

Research shows that students' non-academic attributes, also referred to as non-cognitive skills and twenty-first century skills, are associated with academic performance (Durlak et al., 2011; Farrington et al., 2012; OECD, 2013, 2015). Other research shows that the student composition of the school one attends, especially socioeconomic composition, can influence a range of student outcomes (Palardy, 2008, 2013, 2015b, in press; Borman and Dowling, 2010; Perry and McConney, 2010; Van Ewijk and Sleegers, 2010; Konstantopoulos and Borman, 2011). However, little research has specifically examined the associations between school peers' non-academic attributes and academic performance. This is a noteworthy gap in the literature because research suggests that school peers influence a range of student attitudes, aspirations, and outcomes, including behavior, academic performance, educational aspirations, and drug use (Hallinan and Williams, 1990; Mounts and Steinberg, 1995; Jang, 2002; Cook et al., 2007; Palardy, 2013). In addition to peer influences on one another through direct interactions, non-academic attributes of the student

body may also contribute to student outcomes indirectly through various mechanisms, such as teachers' expectations, choices of instructional practices, academic culture, and disciplinary climate and practices (Coleman et al., 1966; Thrupp, 1999; Jussim and Harber, 2005; Palardy et al., 2015; Berkowitz et al., 2017).

The student and school non-academic risk factors examined in the present study include forms of student engagement at school, student dispositions, and student interpersonal and intrapersonal skills. Research suggests that these student skills tend to be malleable (Farrington et al., 2012; Gutman and Schoon, 2013). A recent study by Loeb et al. (2019) found that the growth rate of these skills varies substantially across schools, suggesting that schools play a central role in their development. Furthermore, the growth in these skills among schools is correlated with growth in achievement, suggesting that certain non-academic skills facilitate achievement (West et al., 2018). They also tend to impact educational and life outcomes (Heckman and Kautz, 2014). Malleability and impact make them excellent targets for interventions to reduce student risks.

LITERATURE REVIEW

This section outlines two research literatures. The first is on peer composition effects at school. Because very little research has focused specifically on peer non-academic attribute composition, this literature is general. The second literature on the associations between non-academic attributes and academic performance at school. While individual student attributes are not the primary focus of the current study, this literature is well-established and provides a context for interest in their peer composition effects.

Peer Composition Effects

The effects of peer composition at school has been an enduring topic in educational effectiveness and sociology of education studies for over 50 years (Coleman et al., 1966; Erbring and Young, 1979; Firebaugh, 1979; Willms, 1986; Harker and Tymms, 2004; Rumberger and Palardy, 2005; Ludtke et al., 2008; Perry and McConney, 2010; Van Ewijk and Sleegers, 2010; Konstantopoulos and Borman, 2011; Palardy and Rumberger, 2019; Palardy, in press). Peer composition effects, which are also referred to as school composition effects in the research literature, are conceptualized as being above and beyond or "controlling for" the students' own backgrounds (Willms, 1986; Raudenbush and Willms, 1995). Hence, these effects occur when the group mean of an individual measure is associated with an outcome even after controlling for individual effect (Firebaugh, 1979).

The associations between peer composition and student outcomes may be due to direct peer interactions at school or to indirect mechanisms such as teacher and school practices that tend to be concomitant with certain peer composition measures (Palardy, 2015a). Within the theoretical literature on child and adolescent development, peer composition at school can be considered a social or environmental factor within Bronfenbrenner's (1979) ecological framework. Because youths spend considerable time in schools, peer composition may influence a range of developmental outcomes. This is particularly the case in middle and high school, when peer effects tend to peak (Jang, 2002; Reynolds et al., 2014; Patacchini et al., 2017).

The literature on compositional effects has two intertwined strands. One strand focuses on theoretical and empirical work describing mechanisms through which school peer composition influences individual outcomes. The other strand focuses on methodological issues related to the measurement and statistical modeling of peer composition effects. The following sections reviews both of these strands.

Mechanisms Through Which Peer Composition Impacts Outcomes

The research literature on student body compositional effects in schools began with the landmark Coleman Report in 1966, which concluded that the mean socioeconomic status (SES) of the school had the largest effect on student achievement of any school factor (Coleman, 1990).[1] Since then, a number of recent studies have drawn similar conclusions as the Coleman Report, including two recent reanalyses of Coleman's data using more sophisticated statistical models (Rumberger and Palardy, 2005; Borman and Dowling, 2010; Perry and McConney, 2010; Van Ewijk and Sleegers, 2010; Konstantopoulos and Borman, 2011; Palardy, 2013, in press).

There are two leading theories for the mechanisms through which peer composition impacts student outcomes. The first is through social interaction or peer influences at school (Erbring and Young, 1979; Willms, 1986). That is, peers tend to influence each other's attitudes and values, motivations and behaviors, and academic achievement and performance (Dreeben and Barr, 1988; Jencks and Mayer, 1990). Peer composition effects may also work through differential access to school resources, such as effective teachers, school structures (e.g., small classes), and school practices (e.g., academic press and disciplinary practices) (Willms, 1986; Dreeben and Barr, 1988; Greenwald et al., 1996; Lee and Smith, 1999; Rumberger and Palardy, 2005). Bowles and Gintis (1976) contend that schools tend to organize around their student composition, which plays a role in non-academic skill development that perpetuates social reproduction. For example, schools serving low-SES students tend to put a greater emphasis on conforming to rules and procedures and obedience to authority, whereas schools serving middle- and high-SES students put a greater emphasis on student initiative and creativity. These differential emphases tend to impair educational and career prospects in low-SES schools and enhance them in medium- and high SES schools (Bowles and Gintis, 1976; Thrupp, 1999; Palardy, 2013). Bowles and Gintis (1976) argue that, due in large part to this school composition-based organization, schooling tends to impact students' future employment opportunity and success more through the development of non-academic skills than cognitive skills. However, it is unclear whether the peer composition effects of non-academic factors are associated with academic performance, which is a focus of the current study.

[1]Socioeconomic or racial peer composition are often framed in terms of school segregation.

Methodological Literature on Peer Composition

There is debate on the best approach for estimating peer composition effects. There is a consensus that model specification plays a central role in the magnitude and direction of estimates. Indeed, some have argued that the magnitude of composition effects tends to be overestimated and, in some cases, is a "phantom effect" due to model misspecification (Harker and Tymms, 2004). One issue that can lead to these problems is unreliability measurement of the corresponding student variable (e.g., unreliable measure of student SES when modeling peer composition SES). When reliability is low, the effect of the student measure on the outcome tends to be underestimated, which typically results in an overestimation of the peer composition effect. That is because the compositional effect is supposed to be above and beyond the student effect and a reliable measure of the student variable is needed to adequately control for the student effect. When it does not serve that role adequately, the part of the student effect that is unaccounted for is largely subsumed by the compositional effect. Marsh and his associates developed doubly latent models to overcome this issue, but the models require multiple measures of each student and compositional variable being tested (Ludtke et al., 2008; Marsh et al., 2009), and the complexity of these models often results in estimation problems (e.g., failure to reach convergence criteria).

Another model methodological issue that can result in inflated peer composition effects is not including a lagged covariate of the outcome in the model. That is because compositional effects are supposed to capture aspects of the school environment that impact the outcome, but student levels on the outcome upon entering the school cannot be attributed to the school environment. Using a lagged measure of the outcome to control for the outcome when students entered the school addresses this issue (Harker and Tymms, 2004).

Gap in the Literature

Few studies have examined the effect of non-academic compositional effects on achievement, grades, or other measures of academic performance. One study examining elementary school classrooms found that peer externalizing behaviors impact achievement (Neidell and Waldfogel, 2010). In a study substantively close to the current study, West et al. (2016) found that some school aggregate measures of student non-academic skills are associated with mean school achievement in a sample of eighth graders attending Boston public schools. Furthermore, some of these compositional effects were much larger than the student-level effect, including growth mindset, suspension rate, and absence rate. These findings support the notion that peer composition measures of non-academic skills can impact student achievement and, in some cases, are larger than the corresponding student effect.

Non-academic Attributes and Academic Performance

Bowles and Gintis (1976) provided the early conceptualization and supporting research for how non-academic attributes influence educational and labor market success. They concluded that while an adequate level of cognitive skills is necessary, once reached, non-academic attributes are more essential. Over the past 40 years, a large body of research crosscutting education, economics, psychology, and other social sciences has documented a range of non-academic attributes that impact educational or life outcomes. This research largely supports Bowles and Gintis's conclusions (Farkas et al., 1990; Dweck, 1999; Bowles et al., 2001; Farkas, 2003; Cunha and Heckman, 2007; Duckworth et al., 2007; National Research Council, 2012). This review focuses on three types of non-academic attributes or skills that research suggests are most critical to academic performance at school: engagement, social, and emotional skills, and dispositions.

Engagement: Behavioral, Cognitive, and Emotional

Engagement at school is a multifaceted construction typically consisting of three major components: behavioral, cognitive, and emotional engagement (Fredricks et al., 2004). Each component has been defined and measured in various ways. This review focuses on the most common usages in the research literature.

Behavioral engagement most generally refers to student behavior and conduct at school related to conforming to norms, adhering to school rules, and exhibiting "problem behaviors," such as getting in trouble, being late, and skipping school without permission (Finn, 1993; Finn et al., 1995; Finn and Rock, 1997; Palardy et al., 2015). Behavioral Engagement is predictive of achievement, grades, and high school completion (Finn, 1993; Finn et al., 1995; Fredricks et al., 2004; Gutman and Schoon, 2013). Fredricks et al. (2004, p. 70) concluded that "there is a consistent association between teacher and student reports of behavioral engagement and achievement across a variety of samples." With regard to grades, however, the direct effect of behavioral engagement on academic performance may be overestimated because part of that effect is due to teachers punishing disruptive students by reducing their grade. That is, the total effect of behavioral engagement on grades consists of the direct effect of the behaviors (e.g., if a student is disruptive in class they may miss an opportunity to learn, which results in lower achievement and grades) and the indirect effect of punitive actions taken by the teacher (in addition to missing an opportunity to learn, the teacher punishes the student for disrupting class by lowering his or her grade).

Cognitive engagement pertains to efforts expended and strategies used to learn academic content and develop academic skills, particularly on complex content and skills that are difficult to master (Wang et al., 2011; Li and Lerner, 2013). Several studies have linked Cognitive Engagement with achievement. Specifically, students who use metacognitive strategies to regulate attention and effort, such as advanced organizers to relate new curricular content with prior knowledge, tend to exhibit higher achievement (Zimmerman, 1990; Boekaerts et al., 2000). Cognitive Engagement is also predictive of grades (Fredricks et al., 2004); however, as was the case for Behavioral Engagement, that effect may be overestimated because teachers often grade in part on effort and persistence, which are elements of Cognitive Engagement.

According to Fredricks et al. (2004, p. 60), "Emotional Engagement encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do the work." Students may exhibit their level of Emotional Engagement through outward expressions (e.g., of interest, boredom, enthusiasm, etc.). Of the three forms of engagement, Emotional Engagement has by far the weakest link with academic outcomes. According to Fredricks et al. (2004), the studies that do find significant links tend to have measurement concerns, such as combining elements of emotional and behavioral engagement in the same measure. Emotional Engagement is predictive of dropout, however (Rumberger, 1987; Alexander et al., 1997).

Dispositions

Research has linked student dispositions (e.g., self-efficacy, sense of belonging, hope, and purpose) with academic performance. Self-efficacy is perhaps the most extensively studied of these. Bandura (1997) defined self-efficacy as the "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (p. 2). It is associated with motivation, academic choices (e.g., whether to take courses or major in subjects perceived to be challenging), and achievement (Pajares, 1996). Sense of Belonging is the degree to which students feel accepted, respected, and supported in the school social environment (Goodenow and Grady, 1993). It has been linked with student grades, which may be due in part to its association with effort (Goodenow, 1993). Hope or optimism about the future is associated with a range of other dispositions and educational outcomes and is predictive of achievement even after controlling for other factors, such as intelligence, grades, and self-esteem (Snyder et al., 1997; Snyder, 2002). It is also predictive of well-being (Gilman et al., 2006). Damon et al. (2003) defined Sense of Purpose to be a stable intention to accomplish something that is both personally meaningful and has perceived impacts beyond oneself. It is associated with student achievement, an effect that seems to work through students' future orientation and coping strategies, although these mechanisms are not well-understood (Damon, 2008).

Social and Emotional Skills

Interpersonal or social skills are "learned behaviors that enable a person to interact effectively with others" (Gresham and Elliott, 1990, p. 1). This includes a variety of skills, many of which center around communication or facilitate gainful collaboration. Most of the research on the effects of interpersonal skills on student performance is in the broader area of social and emotional skills. However, few studies have examined the effects of individual facets of interpersonal skills, such as communication or collaboration skills (Gutman and Schoon, 2013). Intrapersonal skills are the self-directed mechanisms within a person's mind that facilitate self-regulation, planning, and awareness. One of the most studied of these is Conscientiousness—the tendency to be responsible, hardworking, organized, and punctual. A review of the research literature on non-academic skills concluded that, of the Big Five personality traits, Conscientiousness is the most strongly predictive of educational attainment, job performance, longevity, and delinquency (negative association) (Kautz et al., 2014). This literature also includes a substantial body of research specifically examining the association between Conscientiousness and academic performance. For example, recent meta-analyses found that the effect of conscientiousness on academic performance is both largely independent of intelligence and has a comparable effect on academic performance as intelligence (Poropat, 2009). Also, a review of the postsecondary research literature concluded that, of the Big Five personality traits, conscientiousness is the strongest predictor of academic performance in college (Trapmann et al., 2007).

As insinuated in this review, non-academic skills tend to be intercorrelated (Gutman and Schoon, 2013; Kautz et al., 2014). Hence, examining one skill at a time results in inflated estimates of the effects of individual factors on outcomes. Despite this methodological concern, very little correlational research has been conducted that estimates the effects of individual factors while controlling for the intercorrelations of others (Gutman and Schoon, 2013). Moreover, there are serious design challenges in conducting randomized experiments to estimate the causal effects of non-academic factors on outcomes. Therefore, more correlational work that examines individual factors while controlling for the intercorrelations of other factors is needed.

Research Questions

The present study uses a sample of students and schools from Sacramento, California, to estimate the effect size of 10 different student and corresponding peer composition non-academic risk factors on Academic Performance. The following research questions are addressed:

1 Do the effects of student's non-academic skills on Academic Performance vary across schools? This question addresses the degree to which the effects of non-academic skills on Academic Performance depends on the school one attends.
2 How does the magnitude of the effects of the student's own non-academic skills on Academic Performance compare with the magnitude of the effects of corresponding peer composition measures?

METHODS

Data

This study uses a sample of 2,541 students attending 25 high schools in Sacramento, California. All students were tenth graders in 2014. This sample is part of the International Study of City Youth (ISCY), which was designed to examine school effectiveness in several cities worldwide (Lamb et al., 2015).[2] Tenth graders were drawn from a representative sample of schools in Sacramento to facilitate student- and school-level analyses. In 2014, students were administered online versions of the Programme for International Student Assessment (PISA)

[2]The author acknowledges Professor Russell Rumberger for his generosity in providing the data used in this study. The data are not currently available for public use but may be in the future.

TABLE 1 | Racial/ethnic breakdown of 10th grade population vs. sample.

Ethnic group	Four districts	Sample
African american	18.3%	11.4%
Asian	18.0%	24.7%
Latino (of any race)	30.3%	33.7%
Native american	0.7%	0.7%
Pacific Islander	5.4%	3.5%
White	22.2%	14.7%
Two or more races (non-Latino)	4.3%	11.4%
Not reported	0.7%	12.3%
Total percent	100.0%	100.0%
Total number	11,155	2,541

achievement tests for reading and math as well as a questionnaire that with items focusing on non-academic skills, grades, plans, views, and outlooks.

Sacramento is served by five school districts, some of which include parts of surrounding suburbs. All five districts were asked to participate, and four agreed. ISCY staff provided districts with letters of introduction to students, parents, teachers, and school administrators, as well as permission forms, and the districts then recruited participants for the study. Some schools and students that were recruited elected not to participate. The final sample included 25 schools (18 traditional, 3 alternative, 2 charter, 1 magnet, and 1 private) and 2,541 students. The within-school samples ranged from 2 to 309 students. The final sample is fairly representative of the entire tenth-grade population in the four districts regarding race/ethnicity, with white and African American students being underrepresented, Asians and multiracial students overrepresented, and 12.3% of the students not reporting their race/ethnicity (see **Table 1**).

This study is based solely on secondary data collected online by the ISCY staff and the staff of participating districts. Both written and informed consent was obtained from all participants and from the parents of non-adult participants, and data were groomed to maintain confidentiality. Ethics approval was not required for research using secondary data with these characteristics per the University of California—Riverside guidelines and national regulations.

Measures

The outcome variable measures student Academic Performance in terms of academic achievement and course grades. It was constructed using factor analysis from three measures: PISA reading and math achievement test scores and student's self-reported expectations for course grades. While self-reported grade expectations are subjective, meta-analyses shown they are the most potent predictor of future grades, even more so than actual grades (Hattie, 2008). However, other meta-analyses have found that the validity of self-reported grades depends in part on cognitive ability (Kuncel et al., 2005). Also, estimates of the effects of non-academic skills on Academic Performance based on grades alone can be biased because teachers often assign grades in part based on non-academic skills (e.g., classroom behavior, attitudes, and effort) rather than strictly on Academic Performance (Fredricks et al., 2004). Hence, including both types of measures in this latent variable alleviates some concerns about self-reported grades while creating a more holistic measure of Academic Performance. The factor loadings, shown in **Table 2**, indicate that achievement test scores are more strongly associated with Academic Performance than self-reported grade expectations (i.e., 0.83 vs. 0.62).

ISCY staff collected a large number of survey items related to non-academic skills, many of which were borrowed from PISA or other large-scale survey programs (Lamb et al., 2015). Principle component analysis (PCA) was used by ISCY staff to consolidate items into ten scales, each having three to five associated survey items. These scales are summarized in **Table 2**. The 10 non-academic scales measuring aspects of the student's disposition (Belonging, Self-efficacy, Hope, and Purpose), engagement (cognitive, behavioral, and emotional), intra-personal skills (Conscientiousness), interpersonal skills (Collaboration and Communication) and are similar to many of the scales discussed in the literature review section of this paper. SES was constructed by ISCY staff from student survey responses using the method outlined by Ganzeboom et al. (1992). It is based on parental reports of their educational attainment, income, and occupation and is highly similar to SES measures used in PISA and NCES databases. Cronbach's alpha for all but one scale was within the recommended range (0.7–0.9) (Streiner, 2003). The exception, Conscientiousness, was very close, with an alpha of 0.69. It would be substantially higher if the Homework Time variable were removed. However, it was retained because time spent on homework is considered an important aspect of consciousness related to schooling.

All 12 latent variables used in this study (10 non-academic measures, SES, and Academic Performance) were standardized to have a mean of zero and a standard deviation of one. Therefore, the effects of the non-academic measures on Academic Performance are in units of standard deviations. That is, the effects can be interpreted as the expected standard deviation change in Academic Performance per one standard deviation change in the non-academic measure, holding constant the other covariates in the model. This type of coefficient is referred to as a standardized effect size (ES) or beta coefficient. Some have suggested that the commonly used criteria for classifying strength of correlation coefficients is also applicable for classifying standardized effect sizes (i.e., small/weak < 0.2; $0.2 <$ medium/moderate < 0.5; $0.5 <$ large/strong) (see for example, Acock, 2014, p. 272). However, ESs vary considerably across academic disciplines and tend to be small for educational outcomes. Hence, it helps to interpret ESs relative to the effects of commonly used measures or well-documented interventions (e.g., in comparison to the effect of SES or class size reduction).

SES, ethnicity, and gender are used as control variables for student inputs. These demographic measures can vary considerably across schools, and research shows they are associated with student achievement and grades (Palardy, 2008; Borman and Dowling, 2010). Statistically controlling for student inputs serves the dual purposes of partialling out the effects of student background from the effects of the non-academic skills

TABLE 2 | Principal component item loadings for ISCY measure models.

Items	Academic performance	Behavioral engagement	Cognitive engagement	Emotional engagement	Conscientiousness	Hope	Purpose	Belonging	Self-efficacy	Collaboration	Communication
Reading achievement	0.84										
Math achievement	0.83										
Self-reported grades	0.62										
Skipped a class without permission		0.85									
Been absent from school for a day without permission		0.82									
Been in trouble with a teacher because of behavior		0.47									
Arrived late at school		0.66									
I get into trouble frequently at school		0.27									
In class, I try to work as hard as possible			0.83								
In class, I put in my best effort			0.81								
In class, I keep working even if the material is difficult			0.79								
School is often a waste of time				0.31							
I get a feeling of satisfaction from what I do in class				−0.39							
High level of interest in schoolwork				−0.31							
I find most school work boring				0.56							
Hours of homework					0.45						
I always try to do my best					0.88						
I always get work in on time					0.80						
I persevere with a job until it is done					0.74						
I am a hard-working student					0.70						
I am confident of finding a good job when I finish my studies						−0.50					
Happy with future						−0.53					
There is little that can prevent me from reaching my goals						−0.68					

(Continued)

TABLE 2 | Continued

Items	Academic performance	Behavioral engagement	Cognitive engagement	Emotional engagement	Conscientiousness	Hope	Purpose	Belonging	Self-efficacy	Collaboration	Communication
Working hard in school matters for success in the workforce							0.88				
What we learn in class is necessary for success in the future							0.80				
School teaches me valuable skills							0.74				
My classes give me useful preparation for what I plan to do in life							0.70				
I feel safe at school								−0.64			
I will leave this school with good memories								−0.61			
Happy with life at school								−0.66			
I like being at school								−0.65			
Right now I see myself as being pretty successful as a student									−0.52		
I can think of many ways to reach my current goals									−0.75		
There are lots of ways around any problem that I am facing now									−0.79		
I am confident of doing well in school									−0.53		
I understand how others are feeling										0.66	
I get along well with others										0.66	
I work well in groups										0.65	
I treat others fairly										0.55	
I take time to help others										0.49	
I express ideas clearly in oral presentations											−0.71
I express ideas clearly in written text											−0.61
I am good at getting ideas across in discussions											−0.74
I am good at leading others											−0.60
Cronbach's alpha	0.72	0.70	0.82	0.71	0.69	0.71	0.81	0.74	0.78	0.77	0.74

Reproduced from Lamb et al. (2015).

TABLE 3 | Variable descriptions.

Variable name	Mean	SD	Variable label
STUDENT (*N* = 2,541)			
Academic performance	0.00	1.00	PCA
African american	0.10	—	African American race
Asian	0.22	—	Asian American race
Latino	0.32	—	Latino ethnic group
Other	0.14	—	American Indian or Pacific Islander
Male	0.45	—	Indicator of male gender
SES	0.00	1.00	ISCY PCA
Remedial math	0.09	—	Remedial math to improve basic skills
Remedial english	0.07	—	Remedial english to improve basic skills
Behavioral engagement	0.00	1.00	ISCY PCA
Cognitive engagement	0.00	1.00	ISCY PCA
Emotional engagement	0.00	1.00	ISCY PCA
Hope	0.00	1.00	ISCY PCA
Purpose	0.00	1.00	ISCY PCA
Belonging	0.00	1.00	ISCY PCA
Self-efficacy	0.00	1.00	ISCY PCA
Conscientiousness	0.00	1.00	ISCY PCA
Communication	0.00	1.00	ISCY PCA
Collaboration	0.00	1.00	ISCY PCA
PEER COMPOSITION (*N* = 25)			
Academic performance composition	−0.05	0.46	School mean of academic performance
SES composition	−0.12	0.49	School mean of SES
Behavioral engagement composition	−0.07	0.43	School mean of behavioral engagement
Cognitive engagement composition	0.01	0.33	School mean of cognitive engagement
Emotional engagement composition	−0.02	0.32	School mean of emotional engagement
Hope composition	−0.02	0.28	School mean of hope
Purpose composition	−0.04	0.29	School mean of purpose
Belonging composition	−0.00	0.33	School mean of belonging
Self-efficacy composition	−0.04	0.30	School mean of self-efficacy
Conscientiousness composition	−0.05	0.36	School mean of conscientiousness
Communication composition	−0.10	0.47	School mean of communication
Collaboration composition	−0.02	0.24	School mean of collaboration

*Principal component analysis (PCA) was used to construct the Academic Performance outcome, SES, and 10 non-academic scales, which were standardized to a mean of zero and standard deviation of 1.0 (see **Tables 2**, **3** for measurement details). The peer composition measures are the school means (aggregate) of the student measures. They are on the same scale as the student measures and were not re-standardized.*

and also statistically equalizing schools on student inputs when modeling peer composition effects. **Table 3** provides a lists of the variables used in this study, their labels, and descriptive statistics.

Statistical Modeling

The statistical models are specified to address the research questions and the nested structure of the data. Multilevel models (MLMs) are used because they are ideally suited for analyzing educational data that are hierarchical in structure, that is, students are nested in schools (Raudenbush and Bryk, 2002; Snijders and Bosker, 2012). When analyzed using traditional methods, nested data violate the assumption of statistical independence, which can lead to aggregation biases and tend to produce biased standard errors. The models used in this study have two levels. Level 1 is the within-school or student level for modeling the student non-academic effects on Academic Performance. Level 2 is the between-school level for modeling peer composition effects on Academic Performance. The following section outlines the model specifications used to address each research question.

Multilevel Equations

Research question 1 (RQ 1) is addressed using random coefficient models. The model includes only one student non-academic measure at a time to test whether the effect of each measure on Academic Performance varies among the sample of schools. The model can be represented by the following set of equations.

Level 1: Student Effects

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\mathrm{X_{ij}} - \overline{\mathrm{X}}_{..}) + \mathrm{r}_{ij}\,\sigma_{ij} \sim N\left(0, \sigma_{ij}\right)$$

Level 2: School Effects

$$\beta_{0j} = \gamma_{00} + u_{0j} \;\; u_{0j} \sim N\left(0, \tau_{00}\right)$$
$$\beta_{1j} = \gamma_{10} + u_{1j} \;\; u_{1j} \sim N\left(0, \tau_{11}\right).$$

Y_{ij} represents the Academic Performance outcome that was described previously. The subscripts denote the nested structure of the data, where *i* students are nested in *j* schools. β_{0j} represents the random intercepts for each of the *j* schools, which is the school mean for Academic Performance adjusted for X_{ij}, the non-academic measure in the model (note that all continuous level 1 variables were grand mean centered). β_{1j} represents the linear relationship between the non-academic measure and Academic Performance. r_{ij} represents the student residuals, which are expected to be normally distributed with a mean of zero and a variance of σ_{ij}.

At level 2, β_{0j} and β_{1j} are now the outcomes. γ_{00} represents the grand mean of the Academic Performance outcome adjusted for X_{ij}, and u_{0j} represents the residuals for the school means, which are expected to have a mean of zero, be normally distributed, and have a variance of τ_{00}. γ_{10} is the mean of the *j* school slopes, and u_{1j} is the residuals of those slopes, which is also expected to have a mean of zero and be normally distributed with a variance of τ_{11}. The objective of this model is to test whether τ_{11} is significantly greater than zero. That tests whether the effects of student non-academic measures on Academic Performance vary across schools, which is RQ 1. This addresses whether some aspect of the schools likely moderates this association. For example, it could be that the association between student Behavioral Engagement and Academic Performance depends in part of the disciplinary policy of the school.

Addressing RQ 2 is the main objective of this study and addressing it requires running a series of models. The equation

for the base model is provided here, while the extensions to the base model needed for the subsequent models are described. The methodological literature suggests that models that use unreliable measures of student non-academic risk factors and insufficient controls for student inputs tend to overestimate the compositional measures (Harker and Tymms, 2004). As mentioned earlier, non-academic measures have Cronbach's alpha levels ranging from 0.69 to 0.82, which correspond to acceptable-to-good internal consistency or reliability. However, this model does not include any control variables other than the student measure of the non-academic skill being tested. Therefore, the base model estimates of the non-academic effects are likely inflated and should be considered the upper boundaries of the effect sizes. As was the case for RQ 1, each model was repeatedly run—once for each non-academic compositional measure being tested.

Level 1: Student Model

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\mathrm{X_{ij}} - \overline{\mathrm{X}}_{..}) + \mathrm{r}_{ij} \quad \sigma_{ij} \sim N\left(0, \sigma_{ij}\right)$$

Level 2: School Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\overline{\mathrm{X}}_{.j} + u_{0j} \; u_{0j} \sim N\left(0, \tau_{00}\right),$$
$$\beta_{1j} = \gamma_{10}$$

At level 1 the equation is the same as for RQ 1, described previously. At level 2 the intercept model now includes the compositional variable, $X_{.j}$, which is the school mean for the student non-academic measure being tested. γ_{01} represents the linear relationship between the compositional measure and mean Academic Performance adjusted for the student non-academic measure in the level 1 model. The slopes are now fixed to be equal and therefore have zero residual variance. This is apparent in the equations because the residual term (u_{1j}) is omitted. The reason for this specification is that the results for RQ 1 showed that none of the student non-academic measures varied significantly among the sample of schools. To address RQ 2, the magnitudes of β_{1j} and γ_{01} are compared. The magnitudes of their effects are directly comparable because of the standardization method used, albeit, the effects or also sensitive to model specification.

Three subsequent models were fit, each with additional student covariate controls, which tend to reduce the effect size of both the non-academic student and peer composition effects. The first model in this sequence controls for student demographics (race/ethnicity, SES, and gender) and whether the student took or is taking remedial math or English coursework to improve basic skills. The remedial coursework indicators are included as proxies for prior achievement because the data source does not include actual measures. The controls included in this model are generally considered adequate for estimating the compositional effects. The second model in the sequence adds all the non-academic measures at the student-level. This can be considered extensive student controls and may result in conservative estimates of the individual non-academic effects at level 1 and the compositional non-academic effects at level 2. The third model in the sequence adds school-level SES composition. That is, the model includes all the demographic controls, all the student non-academic measures, and school SES composition. This third and last model is used to address RQ 2.

Missing Values

The percentage of missingness on the variables used in this study ranged from 0 to 14%. Missing values were imputed using the expectation maximization (EM) method (Little and Rubin, 1987). This method assumes a distribution for missing observations and imputes values based on the likelihood under that distribution, given all intercorrelations between the variables in the data set.

RESULTS

Before addressing the research questions, it is instructive to examine the descriptive statistics. **Table 3** shows that the sample of students is ethnically diverse, with 87% of the students being non-white, including 32% Latinx, 22% Asian, 10% African American, and 13% Native American or Pacific Islander. This level of ethnic diversity is typical of urban school populations in California, where white students have long been a minority group, Latinxs have the highest representation, and Asian Americans often make up a substantial proportion of the student population.

Another preliminary result is for the unconditional model, which is useful for ascertaining whether the school means for Academic Performance vary significantly among the sample of schools and for generating the intra-class correlation coefficient (ICC) for the outcome. The results of the unconditional model indicate the school means vary significantly ($\tau_{00} = 0.18$, $p < 0.00$). The ICC is 0.18, which means that 18.0% of the variance in Academic Performance is between school and 82% is among students within the same schools. This figure is consistent with achievement outcomes described in previous research (Raudenbush and Bryk, 2002; Snijders and Bosker, 2012).

Research Question 1

RQ 1 is addressed using random coefficient models. The results are not presented in any table because none of the non-academic skill effects varied across the sample of schools. This indicates those effects are quite similar among the schools used in this study and suggests that they are not moderated by school factors. It is worth noting that schools used in this study are similar in terms of the student bodies they serve. Furthermore, all schools are under the jurisdiction of the State of California, which regulates the curriculum and various school practices. These sample characteristics probably reduce variation in the non-academic effects among the schools. However, the sample also has a major strength for modeling school effects in that there is an average of over 100 students per school. That is substantially higher than most large-scale school databases collected by the National Center for Educational Statistics (NCES). For example, the National Educational Longitudinal Study (NELS: 1988), Educational Longitudinal Study (ELS: 2001), High School Longitudinal Study (HSLS: 2009), and Early Childhood Longitudinal Study (ECLS: 1998; ECLS: 2010), which have been widely used to study school effects, average 15–25

TABLE 4 | Student and peer composition effects on academic performance, no control covariates.

Variables	Effect size		Variance Explained	
	Student	Composition	Student	School
Behavioral engagement	0.20**	0.82**	0.05**	0.61**
Cognitive engagement	0.17**	0.97**	0.04**	0.50**
Emotional engagement	0.10**	0.31	0.01**	0.05
Hope	0.05**	−0.08	0.00	0.00
Purpose	0.08**	0.35	0.01*	0.06
Belonging	0.09**	0.60*	0.01*	0.22
Self-efficacy	0.19**	0.33	0.05**	0.06
Conscientiousness	0.21**	0.92**	0.05**	0.60**
Communication	0.10**	0.15	0.01**	0.03
Collaboration	0.09**	1.36**	0.01*	0.53**

*$p < 0.05$; **$p < 0.01$. *This table provides the results for ten different models. Each model included two predictor variables: a student non-academic measure and its corresponding school mean. The student variance explained is the proportion of the within-school variance explained by the single student predictor in the model. The school variance explained pertains only to the variance explained by the peer composition measure in the model, not the student measures.*

students per school. Research suggests that within-school sample sizes should be at least 30 to reliably estimate random slopes and variance components, which are two objectives of the present study (Kreft and De Leeuw, 1998; Maas and Hox, 2005).

Research Question 2

RQ 2 is addressed through a series of models summarized in **Tables 4–6**. **Table 4** compares the student and peer composition effects with no control covariates in the model. Therefore, these estimates are likely inflated and should be considered an upper boundary in terms of effect sizes and statistical significance. All ten of the student measures are significantly associated with Academic Performance. The effect sizes (ESs) are relatively small, ranging from 0.05 to 0.21. Individually, the student measures account for small proportions of the variation in Academic Performance within schools (0–5%). Hence, it can be said that the student's non-academic skills are associated with their Academic Performance, but even at the upper boundaries, the ESs are small.

In general, the peer composition measures have much larger effects, but lower levels of statistical significance. This paradox is due to the fairly small sample of schools used in this study ($N = 25$), and hence, far lower statistical power compared with the student effects. Five of the ten peer composition measures are statistically significant. Of those, the ESs range from medium for Belonging (ES = 0.60) to large for Collaboration (ES = 1.36). The significant peer composition variables accounted for 22–61% of the between-school variance. While these estimates are likely inflated, they suggest the peer composition effects tend to be much larger than the student effects.

Table 5 shows the results for the models controlling for student demographics, including race/ethnicity, SES, and gender, and also remedial coursework in math and English. These controls account for 9% of the variance in Academic Performance among students attending the same school (i.e., the percentage

TABLE 5 | Student and peer composition effects on academic performance, controlling for student demographics.

Variables	Effect size		Variance explained	
	Student	Composition	Student	School
STUDENT BACKGROUND MEASURES				
SES	0.23** to 0.27**	—	0.09**	—
African American	−0.23** to −0.26**	—	0.09**	—
Asian American	0.10** to 0.16**	—	0.09**	—
Latino	−0.04 to −0.05	—	0.09**	—
Other	0.02 to 0.03	—	0.09**	—
Male	0.06* to 0.11**	—	0.09**	—
Socioeconomic Status	0.22** to 0.24**	—	0.09**	—
Remedial Math	−0.12 to −0.19	—	0.09**	—
Remedial English	−0.22 to −0.26*	—	0.09**	—
NON-ACADEMIC MEASURES				
Behavioral engagement	0.18**	0.68**	0.13**	0.62**
Cognitive engagement	0.16**	0.90**	0.13**	0.60**
Emotional engagement	0.09**	0.35	0.10**	0.11
Hope	0.04*	−0.06	0.09**	0.00
Purpose	0.07**	0.41	0.10**	0.12
Belonging	0.08**	0.60*	0.10**	0.33
Self-efficacy	0.17**	0.28	0.13**	0.06
Conscientiousness	0.18**	0.80**	0.13**	0.66**
Communication	0.08**	0.10	0.10**	0.02
Collaboration	0.07**	1.16**	0.10**	0.56**

*$p < 0.05$; **$p < 0.01$. *This table shows the results of 10 different models, one for each of the non-academic skills that had a statistically significant student or peer composition effect in **Table 4**. Each model includes one measure of student non-academic skills, the peer composition for that measure, and the set of student demographic control variables (race/ethnicity, gender, and SES) and remedial courses. The effects of the demographic control variables varied slightly across models, which is why those results provide a range of values.*

of the within-school variance explained) and 37.3% of the variance between the school means. The first figure is similar to the percentage reported in a recent study using the Educational Longitudinal Study (ELS) of 2002 (11.6%), a nationally representative database of American high school students, but the second figure is substantially lower than for ELS (70.7%) (Palardy et al., 2015). That difference is likely due to the greater heterogeneity in student demographics among the schools in ELS.

While all the same variables remain statistically significant after controlling for student demographics and remedial coursework, the ES of most student non-academic measures are reduced by about 10% (i.e., **Table 5** results compared with **Table 4**). Controlling for student demographics reduces the effect sizes for the compositional measures by a greater percentage (∼15–20%, on average). However, the ES for the significant compositional measures remains several times larger than for the corresponding student measures (0.04 to 0.18 vs. 0.60 to 1.16).

Table 6 shows the results after controlling for the student demographic variables and all ten student non-academic measures. The specification of this model represents an extension in the research literature on the effects of non-academic skills,

TABLE 6 | Student and peer composition effects on academic performance, controlling for student demographics and all other non-academic variables.

Variables	Effect size		Variance explained	
	Student	Composition	Student	School
STUDENT BACKGROUND MEASURES				
SES	0.23**	—	0.19**	—
African American	−0.17**	—	0.19**	—
Asian American	0.06	—	0.19**	—
Latino	0.02	—	0.19**	—
Other	0.04	—	0.19**	—
Male	0.10**	—	0.19**	—
Socioeconomic status	0.21**	—	0.19**	—
Remedial math	0.10	—	0.19**	—
Remedial English	0.24	—	0.19**	—
NON-ACADEMIC MEASURES				
Behavioral engagement	0.12**	0.61**	0.19**	0.60**
Cognitive engagement	0.05*	0.80**	0.19**	0.59**
Emotional engagement	−0.04	0.09	0.19**	0.08
Hope	−0.07*	−0.07	0.19**	0.00
Purpose	−0.02	0.37	0.19**	0.13
Belonging	0.02	0.51*	0.19**	0.31
Self-efficacy	0.20**	0.30	0.19**	0.09
Conscientiousness	0.12**	0.72**	0.19**	0.63**
Communication	0.04	0.12	0.19**	0.04
Collaboration	−0.02	1.05**	0.19**	0.59**

*$p < 0.05$; **$p < 0.01$. *The table shows the results, controlling for student demographics, remedial course taking, and all 10 student non-academic variables. The models in this table are the same as the models in* ***Table 5*** *except they control all 10 of the student non-academic variables instead of just one for each model. The non-academic peer composition effects are tested one at a time with these student controls. That is necessary due to collinearity between the compositional variables.*

as there was a call for work examining multiple non-academic skills at once to parse out their intercorrelations (Gutman and Schoon, 2013). This model does exactly that. The model also represents extensive controls for differences in student inputs, which account for 19% of the variance within schools and 54% between schools (the 54% figure is not shown in **Table 6**). The addition of the set of non-academic student controls further reduced the effect sizes for most student and peer composition measures on Academic Performance. Now only five of the ten student non-academic measures are significant at the student level, and the ESs were reduced by at least 15% for each measure and over 50% for most. Indeed, in three cases, the sign on the effect changed (e.g., from positive to negative) compared with the previously significant estimate shown in **Table 5**. These substantial changes in the effects due to controlling for all non-academic measures is not surprising, because their correlations range from 0.2 to 0.7. However, these intercorrelations raise concerns of collinearity when all measures are in the model together. To examine whether that was potentially biasing results, the variance inflation factor (VIF) was computed for each student covariate and all were <2.0, suggesting little concern for collinearity.

For this model, only three non-academic student measures have ESs >0.10; Behavioral Engagement (ES = 0.12; $p < 0.01$), Self-efficacy (ES = 0.20; $p < 0.01$), and Conscientiousness (ES = 0.12; $p < 0.01$). Note that, while small, these ESs are not dismissible in education, as most student characteristics have small effects on outcomes. For example, the ES for SES, which is commonly considered the most robust demographic predictor of educational outcomes, is 0.20.

Among the peer composition measures, the same five variables were statistically significant as shown in **Tables 5**, **6**, but all had reductions in their ESs within the 10–20% range. Although 54% of the between-school variance in Academic Performance was accounted for by the student variables, none of the compositional effects changed substantially when the set of student non-academic measures was added to the model, and all ESs remained medium to large (0.51 to 1.05). The compositional measures now account for 31 to 63% of the between-school variance after controlling for the student variables.

In comparing the effect sizes of the student non-academic risk factors and peer composition effects, one issue is that there are no school-level control variables. One may argue that there should be controls for the intercorrelations between the compositional effects. To that end, the model with all five significant peer composition measures was run, but there was severe collinearity among the effects, with all variables having VIF values between 6 and 12. The intercorrelations between the five significant peer composition measures range from 0.4 to 0.9. With only 25 schools and most of the between-school variance accounted for by extensive student controls, including all the significant compositional effects is impractical for this database.

Addressing RQ 2, compared with the magnitude of their student effects, all the non-academic measures have a compositional effect several times larger. Even if the student ESs from **Table 4**, which tested only one student measure at a time, are compared with the peer composition ESs in **Table 6**, which controls for a large number of student measures, the peer composition ESs are still several times larger.

DISCUSSION

Of the 10 non-academic measures considered in the study, five were significantly associated with Academic Performance: Behavioral Engagement, Cognitive Engagement, Conscientiousness, Self-efficacy, and Hope (see **Table 6**). Those estimates control demographic background, low prior achievement, and the other non-academic skills. However, the sign on the effect for Hope switched to negative after controlling for the other non-academic risk factors, suggesting its effect is unstable and unreliable. Students with attendance and disciplinary problems (low Behavioral Engagement), students who do not try hard or who quit when facing challenges or frustration, or who turn in work late (low Cognitive Engagement and Conscientiousness), and students who lack confidence in their ability to resolve problems and do well in school (low Self-efficacy), are all at risk for poor Academic Performance. These findings are supported by previous research (see Farrington

et al., 2012 and Gutman and Schoon, 2013, for recent summaries of the research literature).

A challenge in comparing the magnitude of the effects found in this study with previous research is that measures of non-academic skills and Academic Performance outcomes vary across studies, and studies report widely varying effect sizes for the same non-academic skill. For example, in their summary of the effect of academic perseverance (a construct similar to grit) on grades, Farrington et al. (2012) reported that correlations ranged from very weak (0.06) to moderate (0.38) across studies cited. Moreover, the association between non-academic skills and grades tends to be stronger than between non-academic skills and achievement test scores (Farrington et al., 2012). These issues confound ES comparisons with the present study. However, one recent study of non-academic effects had similarities to the present study in terms of sample, measures, and outcome (West et al., 2016). That study examined the effects of a range of self-reported ratings of non-academic skills on achievement for a large sample (N=1,368) of urban eighth graders attending 32 public schools in Boston. While slightly different measures of non-academic skills were used compared with the current study, the results are remarkably similar, with effect sizes all in the range of 0.07-0.17 compared to 0.05–0.21[3]. The similarity in the effect sizes from these two studies lends credibility to the student estimates of non-academic effects in the present study.

Of the ten compositional measures considered, five also had significant associations with Academic Performance: Behavioral and Cognitive Engagement, Belonging, Conscientiousness, and Collaboration (see **Table 6**). In each case, the effect size of the compositional measure is several times larger than the individual effect. West et al. (2016) also estimated aggregate school effects of their non-academic factors. Their results again show similarities with the findings of the present study. For example, the school aggregate of attendance rate, which is a component of the Behavioral Engagement measure used in the present study, and school aggregate of growth mindset both have effects several times larger than the effect of the corresponding student measure[4]. These results suggest it is plausible that non-academic compositional effects are much larger than their corresponding individual effect for at least some measures.

Interpreting the Peer Composition Effects

The results suggest that the non-academic skills of one's school peers have a stronger association with Academic Performance than one's own level of non-academic skills. This means that attending a school where the student body is highly rated in terms of Collaboration, Conscientiousness, Behavioral Engagement, Cognitive Engagement, and Belonging matters more to a student's Academic Performance than his or her own levels on those and other non-academic skills.

Collaboration had the largest effect on Academic Performance of the five significant non-academic compositional measures (ES = 1.05, see **Table 6**). The items of the measurement model for Collaboration (see **Table 2**) consist of working well with others, understanding others, being fair, and helping others. Note that these behaviors are not associated with individual students' Academic Performance (ES = −0.02, $p > 0.10$); however, as a collective student body behavior—a school culture, if you will—it has a large impact on Academic Performance. That suggests that being collaborative is only beneficial when peers and coworkers are also collaborative. The underlying mechanism for this effect may be relational trust, which tends to have positive effects on academic and social outcomes in schools (Bryk and Schneider, 2002). Within an organization, the essence of relational trust is the level of confidence individuals have that others will meet role expectations (Couch and Jones, 1997). Without sufficient confidence that others will fulfill role expectations, students may perceive collaboration at school as being burdened with additional group work without reciprocal benefits. An antecedent for relational trust is a common understanding of role expectations (Couch and Jones, 1997). This suggests that student and teacher role expectations related to collaborative work must be clear and widely accepted for a productive collaborative school environment to take hold.

Belonging pertains to feeling safe, happy, and liked at school. High values on the peer composition measure for Belonging reflect schools where higher percentages of the students want to be there for social reasons. Rotermund (2010) found that Belonging is an antecedent for other non-academic effects at the individual level, such as engagement. It may play a similar role as a peer composition effect, as it is highly correlated with the peer composition for Cognitive Engagement ($r = 0.61$). That is, schools with a low mean on Belonging may have difficulty facilitating Collaboration and Cognitive Engagement because students do not feel accepted. A *post-hoc* analysis also showed that the peer composition measure of Belonging is a statistically significant antecedent of Collaboration ($r = 0.83$) and Conscientiousness ($r = 0.62$). More research is needed to better understand the mediating and moderating relationships among these peer composition measures and Academic Performance.

Conscientiousness is a Big Five personality trait that implies a persistent desire to do tasks well and take obligations seriously. In the school context, it concerns the degree to which students make an effort to learn in class, persist when the material becomes difficult, and turn assignments in on time. Of the Big Five traits, research has found it to have the largest effect on academic performance in school (Trapmann et al., 2007; Poropat, 2009; Kautz et al., 2014). Yet, the peer composition effect appears to be substantially larger than the robust individual effect. The large compositional effect is likely due to both peer and school effects. There is likely a direct effect in that students tend to adopt the attitudes and behaviors of their peers. However, the student-level results for Conscientiousness show that raising one's level of Conscientiousness has only

[3]The results from West et al. (2016) that are being compared are summarized in their **Table 6**, column 3, on page 157. Their estimates are based on separate regressions for each non-academic skill on student achievement with school fixed effects and no student control covariates. Given their model specification, their student non-academic ESs are most comparable to column 1 of **Table 4** in the present study.

[4]West et al. (2016) did not control for the individual effect of the non-academic measures or other aspects of student background when estimating peer composition effects. Hence, compositional effects may be overestimated. However, the authors of that study did not claim to be estimating compositional effects. This model specification issue is noted as a caveat for comparisons between the studies.

a moderate effect on Academic Performance, so there must be more to the peer composition effect than just raising individual Conscientiousness. There is also likely an indirect effect for Conscientiousness peer composition in that schools that are high on the compositional measure can provide more advanced curricula and use more rigorous instructional practices because conscientious students are equipped to respond well to and benefit from those academic challenges. Conversely, at schools low on Conscientiousness composition, imposing advanced curricula and rigorous instructional practices may be counterproductive, leading to student resistance and teacher frustration that tends to undermine academic performance (Thrupp, 1999; Kautz et al., 2014).

Behavioral Engagement pertains to the degree to which students avoid problem behaviors at school, such as being late for school, skipping school without permission, and getting into trouble at school. As is the case with the other measures of peer composition, the total effect likely has direct and indirect components. There is likely a direct peer influence, as students tend to adopt the behaviors and attitudes of their peers. Another direct peer influence is Behavioral Engagement peer composition because disengageed and disruptive peers tend to interfer with learning among their classmates. There is also likely an indirect school effect in that schools with low Behavioral Engagement composition tend to emphasize reducing the disorder, which will require disciplinary attention from school personnel, drawing time and energy away from academic activities. That is, schools that are rated low on Behavioral Engagement composition may respond with policies and practices that emphasize order and discipline over the development of academic and non-academic skills (Bowles and Gintis, 1976; Thrupp, 1999).

Implications for Educational Research, Policy, and Practice

Previous research has identified a substantial number of non-academic risk factors that are associated with student academic performance and other outcomes. The substantial number of risk factors that have been identified makes it impractical for schools to address but a small fraction of them. Moreover, many non-academic skills have conceptual and measurement overlap. For research on non-academic skills to be useful for informing policy and practice, a small number of malleable skills with the largest effects must be identified, along with effective interventions for improving them. Unfortunately, research on the effects of non-academic skills tends to model one skill at a time, which likely results in inflated estimates of the effects and provides little guidance for policy and practice regarding which skills matter most when all are considered at once (Gutman and Schoon, 2013). This study represents a departure from that norm, as student non-academic skills were modeled both individually and together, controlling for their intercorrelations. The results suggest that three individual measures have the strongest associations with Academic Performance: Behavioral Engagement (ES = 0.12), Self-efficacy (ES = 0.20), and Conscientiousness (ES = 0.12). Past research shows these three factors are malleable and may be improved through school interventions (Farrington et al., 2012; Gutman and Schoon, 2013). Therefore, the results of this study suggest that effective interventions targeting these factors will have the greatest impact on Academic Performance.

The magnitude of the peer composition effects relative to the individual effects suggests that raising the school averages should be the primary objective of any policy or intervention. That objective can be accomplished be focusing the greatest attention on efforts to improve students with the most underdeveloped non-academic skills. However, focusing only on underdeveloped students is unlikely to be optimal, as it neglects to improve the non-academic skills of the majority of the students. A more effective method for raising the school averages is a school-wide and multi-tiered approach that provides supports for improvement to all students, while matching the intensity with student needs. This approach is consistent with the model of school-wide positive behavioral support (Durlak et al., 2010, 2011; see Bradshaw et al., 2010). Additionally, the results of this study suggest that programs and interventions that focus on creating a school culture that values Collaboration, Conscientiousness, Behavioral Engagement, Cognitive Engagement, and Belonging are likely to be most effective for raising Academic Performance.

Limitations of the Study

The data sample used in this study has strengths and weaknesses for addressing the objectives of the study. One strength is the wide range of non-academic factors that were reliably measured. Another strength is the size of the within-school sample, averaging over 100 students per school. That is several times the average in large-scale high school databases collected by the U.S. government (e.g., ELS: 2002). The larger within-school sample size provides the higher statistical power needed to test whether effects vary across schools, which is the objective for research question 1 of this study. However, the small number of schools (N = 25) is a limitation. While the sample represents excellent coverage of high schools in Sacramento, it has limitations with regard to the statistical power of the peer composition effects, which may result in false negatives on statistical tests. This could be why two peer composition measures (Purpose and Self-efficacy) have non-significant effects even though their effect sizes are medium (0.37 and 0.30). It is important to note that despite this limitation, 5 of the 10 peer composition effects are statistically significant due to their substantial effect sizes.

The moderate school sample size prevented the modeling of all peer compositional effects simultaneously, which may have resulted in inflated effects due to the intercorrelations between the peer composition measures. One specific case, the overlap in peer composition measures of Conscientiousness and Cognitive Engagement, merits elaboration because their distinctness is questionable. Conscientiousness generally applies to a person's behaviors and attitudes, while Cognitive Engagement pertains specifically to academic behaviors at school. However, when Conscientiousness is measured in the school context, the distinction between the two constructs becomes subtle, as their measurement items are similar (see **Table 2**). Additionally, the strength of their correlation is high at the compositional level, higher than at the individual level (0.85 vs. 0.66), further supporting the notion of less distinction at the compositional

level in school settings. This calls into question whether both compositional measures are necessary, which is particularly important when moving from research to policy and practice because the fewer compositional factors a school needs to be concerned with, the easier it is to focus on improving them.

Table 1 shows that the sample characteristics are quite similar to the student populations of the four Sacramento districts from which they were drawn. Furthermore, the sample is similar to many urban districts in Western and Southwest United States, especially urban districts in California. Therefore, the results are most applicable to students and schools in those settings. However, it is unclear whether the results generalize to the broader population of U.S. high schools, schools serving lower grade levels, or schools in other countries.

SUMMARY AND CONCLUSIONS

A generation ago, Bowles and Gintis (1976) concluded that non-academic risk factors tend to have a greater effect on employment, well-being, and other life outcomes than do academic skills. They also argued that schools play a greater role in impacting life outcomes through socialization processes that impact non-academic development than through academic development. Over the past generation, a body of research has accumulated largely supporting Bowles and Gintis's contentions (Farrington et al., 2012; Gutman and Schoon, 2013; Kautz et al., 2014). The present study contributes to this body of work by exploring a range of non-academic compositional risk factors and indexing their effect sizes relative to student non-academic factors.

The results show a distinct pattern of much larger effects for peer composition than for individual non-academic attributes. Five compositional risk factors (Collaboration, Cognitive Engagement, Conscientiousness, Behavioral Engagement, and Belonging) were found to have medium-to-large effects on Academic Performance, whereas all student risk factors were small (ES $<$ 0.2) or not statistically significant.

These findings are consistent with developmental theory positing that context plays a central role in child development (Bronfenbrenner, 1979; Reschly and Coolong-Chaffin, 2016). Namely, interventions that focus solely on students with the lowest non-academic skills are unlikely to be optimally effective for raising student academic performance. That is because such interventions are not optimal for improving the school context as captured by school means on peer non-academic attributes. Multi-tiered interventions that focus on raising school-wide peer composition on non-academic attributes are likely to be most effective for improving academic performance. The findings also help establish which individual and peer composition attributes matter most to academic performance and therefore should be targeted for interventions. That is important because of the substantial number of non-academic risk factors that have been identified in the research literature.

AUTHOR CONTRIBUTIONS

GP is the sole author and wrote the entire manuscript and conducted all data analyses.

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Conflict of Interest Statement: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 12 December 2018
doi: 10.3389/feduc.2018.00108

Bad Boys and Mean Girls: Callous-Unemotional Traits, Management of Disruptive Behavior in School, the Teacher-Student Relationship and Academic Motivation

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Callous-unemotional (CU) traits comprise a temperament dimension characterized by low empathy, interpersonal callousness, restricted affect and a lack of concern for performance. CU traits are the hallmark feature of psychopathy in youth and are associated with more varied, severe and stable antisocial behavior. However, little is known about the presentation, impact and correlates of CU traits in schools. We conducted a mixed methods study investigating the relationships between CU traits, student disruptive behavior, responses to classroom management strategies, teacher-student relationship quality and academic motivation. Participants comprised 437 children aged 11–14 years ($M = 12.5$ years, 51% female) and 12 teachers recruited from a state school in England. Teacher participants consisted of 8 women and 4 men aged 23–51 ($M = 35.27$ years, $SD = 10.43$). Children completed the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004). Teachers then completed an interview and questionnaires for a randomly selected subsample of students who (i) scored in the top 25% on student report of CU traits ($n = 24$), and (ii) scored below the median ($n = 23$). Thematic analysis of teacher interviews revealed that high CU children display more frequent, severe antisocial behavior in school. Teachers reported that high CU students were resistant to teacher discipline strategies, often showing intense displays of anger in response to their attempts to set limits. High CU students appeared to be less responsive to social rewards (e.g., praise). Encouragingly, some teachers reported a good relationship with a child identified as high in CU traits, despite recognizing that this student's behavior made it difficult for other teachers to maintain a harmonious classroom environment. Teachers attributed the poor academic performance of children high in CU traits to a lack of motivation, reporting the need for intense monitoring and feedback to ensure that these students completed schoolwork. Findings suggest that risk pathways for poor school outcomes may differ for antisocial children high and low in CU traits, and emphasize the need to modify existing school-based interventions to promote academic engagement and prosocial behavior in this high-risk subgroup of antisocial children.

Keywords: psychopathy, antisocial behavior, teacher-child relationship, academic motivation, classroom management, discipline, teacher-child interaction, callous-unemotional (CU) traits

OPEN ACCESS

Edited by:
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University of Southampton,
United Kingdom

Reviewed by:
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Australia
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *08 August 2018*
Accepted: *21 November 2018*
Published: *12 December 2018*

Citation:
Allen JL, Bird E and Chhoa CY (2018) Bad Boys and Mean Girls: Callous-Unemotional Traits, Management of Disruptive Behavior in School, the Teacher-Student Relationship and Academic Motivation. Front. Educ. 3:108. doi: 10.3389/feduc.2018.00108

INTRODUCTION

Disruptive behavior in schools has a strong negative impact on student academic engagement and achievement, classroom functioning and interpersonal relationships in school (Herrero et al., 2006; Thomas et al., 2011; McEachern and Snyder, 2012). Antisocial behavior is a major contributor to teacher stress and burnout, due to the strain of managing disruptive behavior and even student aggression directed toward teachers (Espelage et al., 2013; Friedman-Krauss et al., 2014; Longobardi et al., 2018). Disruptive behaviors predict school dropout, truancy, school exclusion and are the most common reason for referral to special education and mental health services (Kim-Cohen et al., 2005; Department for Education, 2010). In the longer-term, antisocial behavior can lead to violence and criminal offending, unemployment, relationship instability, health problems and early mortality (Moffitt, 2018), In terms of economic burden, evidence indicates that the greatest cost of externalizing problems appears to be borne by education services (Snell et al., 2013).

There is an abundance of evidence that subtyping antisocial youth on the basis of callous-unemotional (CU) traits has substantial utility in elucidating the differing developmental pathways for antisocial behavior (Frick and Morris, 2004). CU traits are a temperament dimension characterized by low empathy, guilt, emotionality and a lack of concern for performance (Frick et al., 2014a,b). CU traits are considered to be the core feature of psychopathic traits in youth, and are related to a more varied, severe and chronic trajectory of antisocial behavior (Frick et al., 2003; McMahon et al., 2010). Youth high in CU traits are motivated by social dominance, viewing aggression as an effective means of achieving their desired goals and lacking concern about the consequences of their behavior for themselves or others, including anticipated disciplinary action, feelings of guilt or victim distress (Pardini and Byrd, 2012). In addition, youth with CU traits show reduced recognition and responsiveness to nonverbal punishment cues including fearful facial expressions, vocal tones and body postures (Blair et al., 2005; Jones et al., 2009; Muñoz, 2009). These unique correlate and poor prognosis have resulted in the inclusion of CU traits as a specifier for Conduct Disorder in the most recent edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association, 2013), under the term "limited prosocial emotions."

While the vast majority of research on contextual factors and CU traits has focused on the family environment, emerging evidence suggests that their unique emotional, cognitive, social and motivational style may also place children with CU traits at risk for poor outcomes in the school domain. CU traits are associated with more severe disruptive behavior in the classroom and hence more frequent discipline at school (Waschbusch and Willoughby, 2008; Ciucci et al., 2014; Waschbusch et al., 2015), direct and indirect bullying toward peers (Muñoz et al., 2011; Ciucci et al., 2014; Thornberg and Jungert, 2017), and low levels of peer support and school connectedness (Fanti et al., 2017; Haas et al., 2018). One rich potential source of information concerning contextual risks and assets for youth high in CU traits is the nature and quality of teacher-student interaction and relationships. Discipline and reward-based classroom management strategies and teacher-student relationship quality are a common focus of teacher education and training programmes aimed at promoting prosocial behavior and school engagement (e.g., Emmer and Stough, 2001; Anderson et al., 2004). A deeper understanding of the influence of teacher-child interaction and relationships in developmentally important areas for children high in CU traits, as well as how these factors may be intertwined, is therefore likely to be invaluable for informing school-based intervention.

The potential impact of the punishment insensitivity that characterizes youth with CU traits on their interactions and relationships with teachers has received little attention. Punishment insensitivity is associated with impaired associative learning, with others' distress or disapproval failing to elicit a negative emotional response (Kochanska, 1994; Blair, 1995). A conditioned association is therefore not formed between misbehavior and the negative emotional consequences of punishment (e.g., guilt, shame), increasing the likelihood that the child will repeat the misbehavior in future. CU traits is linked to reduced emotional arousal in response to others' distress cues or to punishment-oriented socialization techniques (Pardini and Frick, 2013). High levels of temperamental fearlessness, a precursor to CU traits, are believed to impair the development of emotions (e.g., empathy, guilt) related to optimal conscience development (Fowles and Kochanska, 2000). Therefore, fearlessness may lead to the development of antisocial behavior and CU traits due to an insensitivity to punishment-oriented moral and social norms conveyed by significant others in the child's world, including parents, peers and teachers.

Models of the development of CU traits have also highlighted the role of impaired reward processing (e.g., Newman et al., 1997; Frick et al., 2014b). Children high in CU traits have been described as possessing a "reward-dominant" behavioral style, where youth will pursue a goal despite the risk of negative consequences for themselves or others (O'Brien and Frick, 1996; Fisher and Blair, 1998). However, there is also evidence suggesting that youth high in CU traits show reduced reward sensitivity (Marini and Stickle, 2010; Centifanti and Modecki, 2013). The reasons for these inconsistent findings are unclear, but one possibility is that children with CU traits show differential responding to different types of reward (Waller et al., 2013). For example, there is some evidence that children with CU traits may be more responsive to tangible rewards and to social rewards that enhance their social status or opportunities for social dominance (Pardini et al., 2003; Lorber et al., 2011). In contrast, youth high in CU traits may be less responsive to rewards that involve social approval and social connection, in the form of close, positive relationships with others (Frederickson et al., 2013).

Only a small number of studies have investigated responses to teacher discipline and reward-based strategies in youth with CU traits. A mixed methods study conducted by Allen et al. (2016) indicated that teachers viewed high CU children as either unresponsive or negative in their responses to nonverbal reward and punishment cues (e.g., smiling, frowns) and tangible rewards. Teacher attempts at discipline were either ignored or responded to with disproportionate levels of verbal aggression;

sending the student out of class was the only discipline strategy teachers viewed as effective. High CU students appeared to enjoy praise and being awarded a position of responsibility, but with unintended side effect of then using these rewards to "show off" to their peers or abusing their new-found position of responsibility. However, other teachers viewed praise as helpful for promoting prosocial behavior in high CU children. It should be noted that this study featured a small, boys-only sample ($N = 39$) and interviews elicited teacher views in response to a general description of youth high in CU traits, rather than asking teachers to report on specific children. Another innovative study personalized school-based intervention for children with CU traits by emphasizing reward-based strategies and de-emphasizing discipline strategies, achieving significant reductions in conduct problems and CU traits (Frederickson et al., 2013). While this study was conducted in one special education school ($N = 29$) and lacked a control condition, findings provide optimism for discipline and reward-based classroom management strategies as an intervention target for students high in CU traits.

The influence of teacher-student relationship quality for high CU children has also received little attention, but the limited available evidence shows strong relationships between CU traits, greater teacher-child conflict and less closeness (Crum et al., 2016; Horan et al., 2016). While it may be difficult to form a close relationship with children high in CU traits given their challenging temperament profile, longitudinal research emphasizes the benefits of positive relationships with parents and peers in the form of significant decreases in CU traits and conduct problems over time (Pardini et al., 2007; Hawes et al., 2011; Fanti et al., 2017). Emotional support from teachers has been shown to be important in the middle school period, with teachers who convey warmth, acceptance and who strive to develop student interest in academic and social pursuits producing positive benefits in terms of student behavior, motivation and academic performance (Wentzel, 1998). Positive relationships with teachers at this developmental stage may be particularly salient for students with problematic relationships with parents and peers (Harter, 1996).

Promoting positive teacher-student relationships as a means of increasing academic engagement may be particularly important for high CU children given increasing evidence for a link between CU traits and poor academic achievement, even when controlling for IQ levels, conduct problems and inattention/hyperactivity (DeLisi et al., 2011; Vaughn et al., 2011; Horan et al., 2016). Indeed, CU traits in antisocial youth are unrelated to deficits in verbal ability (Allen et al., 2013), commonly cited as a major factor contributing to school failure in antisocial youth (Moffitt, 1993). It has therefore been suggested that youth high in CU traits perform poorly despite possessing a similar IQ to their same-age peers due to low intrinsic motivation and therefore engagement with school work (DeLisi et al., 2011; Ciucci et al., 2014). Reciprocal relations between CU traits and teacher-child interaction have also been identified as potential causes of low grades, with DeLisi et al. (2011) suggesting that high CU children may showing reduced responsivity to teacher practices that facilitate prosocial behavior and engagement in learning. Conversely, children with CU traits may elicit harsh responses from teachers, coupled with less encouragement and feedback placing them at an academic disadvantage (Horan et al., 2016). However, as far as we are aware, no studies have examined how teacher-child interaction/relationship quality relates to disruptive behavior, academic motivation and engagement of youth high in CU traits.

Quantitative Investigation of CU Traits, Child Adjustment and Teacher-Student Relationship Quality

The aim of this study was to examine the relationship between CU traits, punishment and reward sensitivity and teacher-student relationship quality using a multi-informant, mixed-methods approach. It was predicted that CU traits would be significantly related to poor child adjustment, reduced reward sensitivity, greater punishment insensitivity and poorer quality teacher-student relationships (i.e., greater conflict, less closeness). We also hypothesized that children high in CU traits would demonstrate significantly less responsivity to rewards, greater punishment insensitivity and have poorer quality teacher-student relationships than children low in CU traits.

MATERIALS AND METHODS

Participants

Student Participants

Student participants included 437 children in years 7, 8 and 9 from a state secondary school in the East of England. Of the 503 children approached, 66 declined, giving a participation rate of 87%. Children were aged 11–14 years (51% girls; $M = 12.50$ years, $SD = 0.96$). Most children self-identified as White (85%), with the remainder ($n = 64$) identifying as follows: Black, Mixed Black and White, Asian, or Mixed White and Asian. Most children belonged to an original two-parent family (60%), followed by a step/blended family (21%), with the remainder living in a single parent household (16%), or with extended family (3%). English was an additional language for ∼25% of the sample ($n = 99$) and 11% were eligible for free school meals ($n = 46$).

Teacher Participants

Twelve teachers participated, consisting of eight women and four men aged 23–51 years ($M = 35.27$, $SD = 10.43$). Teachers taught English ($n = 5$), Maths ($n = 2$), or Science ($n = 5$), reporting an average of 7.45 years teaching experience ($SD = 5.32$ years; range 1–15 years). All teachers except one identified as White.

Child Selected Sample

Teachers completed an interview for a subset of students randomly selected from those who (i) scored in the top 25% of the student-report total ICU score ($n = 24$) and (ii) who scored below the median on total ICU score ($n = 23$). The aim of this smaller selected sample was to obtain more in-depth information about CU traits in the school context, while ensuring that the assessment protocol did not place an undue burden on teachers. Given the overlap between CU traits and autism in presentation and correlates (Jones et al., 2010), teachers completed an autism

symptom measure for the child selected sample. All children fell below the clinical cut-off for autism and therefore all were included in the analyses.

Measures

Child Background Questionnaire

A brief child-report questionnaire assessed child age, gender, ethnicity, eligibility for free school meals, English as an additional language and family structure.

Teacher Background Questionnaire

This questionnaire assessed teacher report of age, gender, ethnicity and years teaching experience.

Inventory of Callous-Unemotional Traits (ICU; Frick, 2004)

Teacher and child report of callous-unemotional (CU) traits was assessed using the ICU. The ICU consists of 24 items rated on 4-point scale from 0 "not at all true" to 3 "definitely true." The reliability, validity and factor structure of the teacher and child report versions of the ICU has been supported in adolescent samples (Essau et al., 2006; Roose et al., 2010; Ciucci et al., 2014). The best fitting factor structure is a general callous-unemotional factor and three subfactors: callousness (11 items: e.g., "*I am concerned about the feeling of others,*" unemotional (5 items: *"I express my feelings openly"* and uncaring (8 items: *"I try not to hurt others' feelings"*). In the current sample, alphas were 0.77 for ICU total scores (student report) and 0.90 for ICU total scores (teacher report).

Social Responsiveness Scale–Brief (SRS-Brief; Moul et al., 2015)

The brief, 16-item version of the SRS was used to assess teacher report of child autism symptoms for the child selected sample. Responses are reported on a 4-point Likert scale (0 = "not true" to 3 = "almost always true"). Moul et al. found that the SRS-brief has good reliability and validity when compared to the original, 60-item SRS (Constantino et al., 2000). Alpha was 0.92 for the SRS-brief total score.

Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997)

The teacher-report version of the SDQ was used to assess child adjustment and prosocial behavior. The SDQ has five scales, comprising five items each: conduct problems, hyperactivity, emotional problems, peer problems and prosocial behavior. Teachers rate the accuracy of statements on a 3-point scale from 0 "not true" to 2 "certainly true." The SDQ has shown good reliability and validity (Goodman, 2001). Alphas for SDQ scales were 0.57 for emotional symptoms, 0.62 for peer problems, 0.90 for conduct problems, 0.90 for hyperactivity, and 0.93 for prosocial behavior.

Multidimensional Assessment Profile of Disruptive Behavior (MAP-DB; Wakschlag et al., 2010)

The punishment insensitivity scale of the MAP-DB was completed by teachers and children. This 7-item scale is rated on a 6-point Likert scale (0 = "never" to 5 = "all the time"). The punishment insensitivity scale of the MAP-DB has good reliability and validity (Nichols et al., 2015). Alphas were 0.93 for child and 0.98 for teacher report.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire for Children (SPSRQ-C; Colder and Connor, 2004)

The revised SPSRQ-C was used to assess child report of reward sensitivity. Items are rated on a 5-point scale (1 = "strongly disagree" to 5 = "strongly agree"). Only the reward sensitivity scales were used given that the punishment sensitivity subscale of the SPSRQ-C conceptualizes punishment sensitivity as anxiety symptoms or shy/inhibited traits rather than responses to discipline which forms the focus of the present study. The SPSRQ-C has good reliability and validity (Colder and Connor, 2004; Luman et al., 2012). Alpha was 0.75 for child report of reward sensitivity.

Teacher-Student Relationship Quality

The short form of the Student-Teacher Relationship Scale (STRS; Pianta, 2001) was used to obtain teachers' views of the quality of the student-teacher relationship. The 15-item STRS consists of two scales assessing teacher-child closeness (7 items) and conflict (8 items). Teachers rate each item on a 5-point scale from 1 "definitely does not apply" to 5 "definitely applies." The short form of the STRS has good reliability and validity (Rudasill et al., 2010; Drugli et al., 2011). Alphas were 0.85 for closeness and 0.95 for conflict.

PROCEDURE

Permission to approach teachers and students to participate in the study was sought from the school following the receipt of university ethics board approval. All teachers provided informed written consent prior to their participation. Information sheets and opt-out consent forms and reply slips were then mailed to parents of all pupils in years 7, 8, and 9. Parents were given a week to return the reply forms if they did not wish for their child to take part. No reply slips were returned. Parent opt-out consent helps to avoid low response rates and biased samples that are not representative of the community of interest, leading to incomplete and potentially misleading findings. This research aims to examine antisocial behavior and academic motivation in children, so an opt-in sample is likely to have skewed toward fewer children with higher levels of antisocial behavior, social disadvantage and poor academic performance; the very behaviors and characteristics needed to investigate our stated aim and hypotheses. The study took place during regular lesson time in class groups over a 1-week period. The investigator informed pupils that the study focused on the behaviors and attitudes of young people at school toward peers and teachers. Students were given the opportunity to ask questions about the research prior to consenting to participate. Students were informed that their responses were confidential, and that they could leave the questionnaires uncompleted or omit items without giving a reason. Students completed the questionnaires individually under exam conditions and were instructed to raise their

hand if they did not understand any of the items so that the investigator could provide assistance. Following the completion of questionnaires, students were given the opportunity to ask questions about the study.

Once all data was collected from participating students, children with high vs. low levels of CU traits were identified and the second phase of data collection commenced. Teachers completed questionnaires and interviews about children in the selected sample following the receipt of their written informed consent. Teachers completed the assessment protocol for a range from 2 to 10 children ($M = 5.83$, $SD = 3.01$), depending on how many children in the student selected sample attended their classes. Note that some students were reported on by multiple teachers as if they attended classes taught by more than one teacher who participated in this study, with 70 teacher interviews conducted in total. Teachers completed a brief interview (∼5–10 min per student) with the second author during school hours in a private room. The interview comprised set questions concerning their views on the target child's disruptive behavior in school, response to classroom management strategies, academic motivation, teacher-student relationship quality, and how it related to the student' academic progress. Teacher were blind to the child's CU status based on child self-report on the ICU (Frick, 2004). The interviewer was unaware of teacher questionnaire responses when conducting the interviews and was therefore blind to the child's CU status. Teachers were interviewed in the second term of the academic year to allow sufficient time for teachers to observe student behavior and to develop a relationship with their students.

RESULTS

Relationships Between CU Traits, Conduct Problems, Teacher-Student Relationship Quality, Punishment and Reward Sensitivity

Descriptive statistics and correlations for the main study variables are presented in **Table 1** for the whole sample. Teacher and child report were significantly positively related for total ICU scores, and for the Callousness and Uncaring scales. However, there was no significant association between teacher and child report on the Unemotional scale. Teacher and child report of CU traits (ICU total, Callousness, Uncaring, but not Unemotional scale scores) were significantly related to more severe conduct problems. Less teacher-child closeness was significantly associated with teacher report of CU traits (ICU total, Callousness, Uncaring, Unemotional), but not child-reported CU traits. Greater teacher-child conflict was significantly related to teacher total ICU, Callousness and Uncaring, and to child report of ICU total and callousness. Greater teacher-child conflict was related to more severe conduct problems. Teacher report of punishment insensitivity was also significantly associated with teacher-reported ICU total and Callousness, child-reported punishment insensitivity, ICU total, Callousness and Uncaring, less closeness and greater conflict. Child report of punishment insensitivity was also significantly associated with teacher and child report of CU traits (ICU total, Callousness, Uncaring,

TABLE 1 | Descriptive statistics and correlations for CU traits, conduct problems and teacher-student relationship quality.

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CHILD REPORT *N* = 437																
ICU total	23.83	8.04	–	0.75**	0.81**	0.48**	0.59**	0.09	0.48**	0.33*	0.52**	0.31	0.39*	0.41**	−0.25	0.37*
Callousness	7.61	4.16		–	0.38**	0.07	0.62**	0.20**	0.44**	0.38*	0.47**	0.12	0.47**	0.42**	−0.13	0.43**
Uncaring	8.23	4.41			–	0.19**	0.47**	0.07	0.41*	0.21	0.47**	0.38*	0.28	0.34*	−0.25	0.27
Unemotional	7.98	2.75				–	0.02	−0.14	0.31	0.22	0.30	0.30	0.17	0.21	−0.28	0.15
Punishment Insensitivity	14.54	6.55					–	0.38**	0.64**	0.57**	0.65**	0.18	0.63**	0.73**	−0.27	0.61**
Reward Sensitivity	53.48	9.34						–	0.25	0.34*	0.20	−0.09	0.28	0.25	0.04	0.31
TEACHER REPORT *N* = 47																
ICU total	25.76	15.12							–	0.90**	0.93**	0.47**	0.87**	0.84**	−0.58**	0.84**
Callousness	7.47	7.82								–	0.73**	0.17	0.92**	0.84**	−0.35*	0.90**
Uncaring	12.32	7.25									–	0.40*	0.76**	0.75**	−0.56**	0.73**
Unemotional	5.97	7.86										–	0.17	0.23	−0.71**	0.12
Punishment Insensitivity	12.63	9.33											–	0.86**	−0.36*	0.92**
Conduct Problems	1.74	2.76												–	−0.28	0.91**
Closeness	24.08	6.23													–	−0.24
Conflict	15.44	7.83														–

ICU, Inventory of Callous-Unemotional Traits; CP, conduct problems. $^{*}p < 0.05$. $^{**}p < 0.01$. *Two-tailed.*

TABLE 2 | Demographic and adjustment data for children high vs. low in self-reported CU traits.

	Low CU $n = 23$	High CU $n = 24$	Statistic χ^2/F	p
% Male gender	52.2	45.8	0.189	0.773
% English first language	72.7	82.6	0.635	0.491
% Child minority ethnicity	21.7	16.7	0.195	0.724
% Eligible for free school meals	9.1	26.1	2.222	0.243
% Single-parent family	13.0	21.7	0.605	0.699
% Parent ≤ 16 years education	13.3	40.0	2.727	0.215
Child age: Mean (SD)	12.39 (0.94)	12.58 (1.06)	0.691	0.421
Conduct problems	0.63 (1.54)	2.70 (3.29)	5.378	0.027
Emotional problems	0.94 (1.39)	1.50 (1.47)	1.367	0.250
Hyperactivity	1.69 (2.02)	4.05 (3.55)	5.615	0.024
Peer problems	1.13 (1.26)	2.60 (2.16)	5.842	0.021
Prosocial behavior	1.50 (0.61)	0.76 (0.62)	12.801	0.001
Autism symptoms	1.44 (2.66)	6.60 (7.51)	6.833	0.013
ICU total score (teacher)	17.44 (13.26)	32.35 (14.23)	10.371	0.003
Punishment Insensitivity (child)	11.88 (5.07)	21.75(9.55)	13.918	0.001
Punishment Insensitivity (teacher)	8.88 (4.44)	15.95 (11.35)	5.516	0.025
Reward Sensitivity (child)	53.95 (8.98)	50.70	1.056	0.311
Closeness	25.63 (7.46)	22.30 (4.62)	2.690	0.110
Conflict	12.75 (4.95)	18.15 (9.32)	4.368	0.044

ICU, Inventory of Callous-Unemotional Traits; Two-tailed.

Unemotional), conduct problems and teacher-child conflict. Reward sensitivity was significantly related to Callousness. No other associations between main study variables were significant.

Group Differences in Sociodemographic Characteristics, Child Adjustment, Teacher-Student Relationship Quality and Punishment and Reward Sensitivity

Children high and low in self-reported CU traits were compared on sociodemographic measures using chi-square analysis and on adjustment variables using two-tailed between-subjects analysis of variance (ANOVA). Descriptives and findings for the high and low CU group comparisons are presented in **Table 2**. Exploratory data analysis on the high and low CU groups revealed that assumptions for normality were violated for several variables. Therefore, non-linear regression using bootstrapping at 1,000 resamples (Field, 2013) was used in the group comparisons on child adjustment variables and teacher-student relationship quality to ensure that relationships were statistically robust. Groups did not differ significantly for any sociodemographic variables. Two-tailed between-subjects analysis of variance (ANOVA) revealed that teachers reported significantly poorer adjustment for high CU children compared to low CU children on all measures except for emotional problems (**Table 2**). There was no significant group differences in teacher-reported closeness or child-reported reward sensitivity. However, significantly greater teacher-child conflict and punishment insensitivity was evident for high CU traits compared to low CU children.

A Check on Potential Confounds to the Relationship Between CU Traits and Teacher-Student Conflict

Partial correlations were used to check for potential confounds to the significant association between teacher report of CU traits and teacher-student conflict. These included child age, minority ethnicity status, gender, child adjustment variables, punishment and reward sensitivity. The relationship between CU traits and teacher-student conflict remained significant when controlling for these potentially confounding variables, with the exception of teacher report of punishment sensitivity (**Table 3**).

Qualitative Investigation of Teacher Perspectives

The aim of the qualitative component of this study was to obtain teacher perspectives on students high vs. low in CU traits in terms of disruptive behavior, responses to classroom management strategies, academic motivation, the quality of the teacher-student relationship and how this relates to student academic engagement, progress and behavior. A qualitative approach is particularly useful for this topic given that research CU traits in the school setting is at a very early stage—thus our study findings have the potential to increase our understanding of teacher-student relationship processes and complex contextual factors relating to the disruptive behavior, academic engagement and motivation of high CU children in school.

We aim to answer the following research questions:

1. How do CU traits present in the school setting from a teacher perspective?

TABLE 3 | Partial correlations between CU Traits and Teacher-Child Conflict, Controlling for Potential Confounds.

	Controlled variable	Partial correlations
Teacher-child conflict	Child age	0.85***
	Child gender	0.78***
	Child minority ethnicity	0.84***
	Conduct problems	0.38*
	Emotional problems	0.84***
	Peer problems	0.81***
	Hyperactivity	0.61***
	Autism	0.77***
	Punishment insensitivity (child)	0.75***
	Punishment insensitivity (teacher)	0.23
	Reward sensitivity (child)	0.84***

Covariates: Callous-unemotional (CU) traits and teacher-child conflict. $^{*}p < 0.05$. $^{***}p < 0.001$. *Two-tailed.*

2. How do the disruptive behaviors of children high in CU traits vary to those shown by children low in CU traits in type, frequency and severity?
3. How do students with high levels of CU traits respond to teacher reward and discipline strategies compared to students low in CU traits?
4. How does the quality of the teacher-student relationship differ for students with high vs. low levels of CU traits, and how does it relate to their behavior?
5. What are teachers' views on the academic motivation of children high vs. low in CU traits, and how does the quality of the teacher-student relationship relate to child academic motivation?

Data Collection

Semi-structured interviews were conducted with teachers following the completion of questionnaires to obtain their views on student disruptive behavior, response to classroom management strategies, academic motivation, the quality of the teacher-student relationship and how it relates to academic progress of students who high versus low in CU traits (see Appendix for interview questions).

Data Analysis

All interviews were audio-recorded and transcribed verbatim by the interviewer (second author) and the last author. Interviews were analyzed using deductive thematic analysis in NVivo 12, following the process and recommendations outlined by Braun and Clarke (2006). The identification of themes was guided by theory and research on student responses to classroom management strategies, teacher-student relationship quality, motivation and their relationship to both academic and behavioral outcomes. This extended to the literature on CU traits and parent-child interaction/relationships given the limited available research on this topic in the school context. Engagement with relevant literature prior to coding is viewed as a means of sensitizing coders to more subtle features of interview data (Tuckett, 2005). Themes were identified and coded by the first and second authors (JA and EB) on the basis of their importance in relation to the research questions and potential theoretical interest rather than their prevalence within each interview or even across the entire data set. Coding was based on information gathered from the interviews as a whole rather than restricted to answers to a specific question. Codes were also generated when data included inconsistencies across and within interviews or were at odds with the literature, to ensure that data of theoretical relevance that departed from the dominant story were not overlooked. To ensure reliability a randomly selected 20% of interviews were coded independently by the third author (CC) using the coding scheme developed by the first and second authors. No additional codes or themes were identified through this process. There was good agreement between coders (kappa = 0.92). Any disagreements were resolved through discussion. Interviews were coded prior to analysis of quantitative data in order to ensure that all coders were blind to the child's self-reported CU status. Once coding was completed, blinding was removed to enable the analysis of similarities and differences between teachers' accounts for students high vs. low in CU traits. **Tables 4**, **5** shows themes, sub-themes and accompanying examples for students low and high in CU traits.

Callous-Unemotional (CU) Traits and Disruptive Behavior in School

Teachers recounted examples of behaviors that fit with the conceptualization of CU traits, including interpersonal callousness and lack of guilt:

> "He doesn't feel guilty for anything that he does. He takes no responsibility for his behaviour. And he in fact puts that responsibility on other people, so as in'I haven't done anything wrong, you're just doing it to me. It's your fault, it's nothing to do with me'. So lack of guilt definitely with him."

> "He doesn't seem to be very threatened by anything, he's not afraid. If he's called out on anything, he's not bothered by it and doesn't react to other children's aggression."

Another theme that was developed related to emotionality, and appeared to contradict the "unemotional" aspect of CU traits:

> "She is less reactive to any situation, but she does get emotional. I can see her get very angry sometimes, I can see it, but she doesn't do anything, she holds it all in."

> "He likes new and dangerous things. Does have emotions, he shows emotions quite a lot."

> "I think she's emotional, definitely got the emotions there. She's not unemotional. And she would probably go for exciting activities just because there might be boys there."

Thus students high in CU traits were reported to display negative emotions, particularly anger. In addition to displays of positive emotions when engaging in dangerous and thrill-seeking activities, teachers also reported enjoyment of others' distress:

TABLE 4 | Qualitative findings for CU traits, disruptive behavior, response to rewards and discipline, academic motivation, and teacher-student relationship quality in low CU students.

Theme	Sub-theme	Description
Disruptive behavior	None or 'low level'	None reported or only behaviors that are low in severity and frequency, e.g., chatting
	Overt disruptive behavior in class	Shouting, frequent talking, refusal to work, throwing things, using a mobile phone, "aggravating others" by e.g., pulling hair, poking
Positive Response to Discipline		Accepts discipline, shown by apologizing, ceasing misbehavior and/or resuming school work
Negative emotional or behavioral responses to discipline	Self-referential negative emotion	Guilt, disappointment in oneself, shame or embarrassment in response to discipline or limit-setting
	Negative emotional responses	Being "defensive," "taking it personally," crying
No response to rewards		Not driven or encouraged by rewards
Response to rewards	Social Rewards	Positive response to social rewards, e.g., praise
	Tangible rewards	Motivated by tangible rewards e.g., school points system, sweets
Academic motivation	High intrinsic motivation	Poor motivation and lack of engagement attributed to a lack of intrinsic motivation
		Good quality teacher-student relationship important contributor to academic motivation
		May be highly motivated despite low ability
Quality of TSR	Good quality TSR	TSR described as "good" or "positive"; characterized by student confiding and help-seeking when appropriate, trust, respect, understanding and enjoyment of interactions with the teacher
	Mixed quality TSR	TSR described as possessing both negative and positive features.
	Academic motivation	Negative impact of poor quality TSR on academic motivation and engagement

CU traits, callous-unemotional traits; TSR, teacher-student relationship.

> "It's her picking her moments and picking what she says to somebody to get a reaction out of them because she finds some sort of joy in doing it."

We also examined teacher perspectives on disruptive behaviors shown by students high vs. low in CU traits. For low CU children, teachers often reported that the child was "rarely" or "never" disruptive. When disruptive behavior did occur, it was described as "low level" (e.g., infrequent chatting):

> "It is just the odd time where there is a bit of chat, but like I said once you say to her, 'stay on task', she'll generally come back."

All types of reported overt and covert disruptive behaviors were more frequent and severe for high CU students, often exerting a negative impact on classroom functioning:

> "He has done anything and everything to be disruptive. He is disruptive to other people, and he doesn't care how much he destroys the lesson."

Furthermore, teachers viewed detentions as having a detrimental effect on the academic performance of high CU students:

> "He's missing one lesson a week at the moment which is having a huge effect on his academic progress."

Few covert disruptive behaviors were reported for the sample as a whole, but those that were referred to students in the high CU group:

> "He is very competitive, he likes to get the top marks, and will cheat to win"

> "I think she finds it funny to see this girl kind of lose her temper… and she can't technically get in trouble for it because she's not the one who's reacting."

CU Traits and Response to Teacher Discipline Strategies

Teachers reported not needing to discipline several well-behaved children, thus themes relating to response to discipline were "not applicable" for these students ($n = 9$ low CU group, $n = 3$ high CU group). One theme identified referred to positive responses to discipline, with teachers reporting that some children accepted their attempts to set limits, often ceasing misbehavior, apologizing and resuming their school work:

> "He's fine... he'll just sort of say, 'I'm really sorry, Miss', and then get on with it."

Surprisingly, this response was evenly distributed among students in the high and low CU groups.

We then identified themes relating to responses that are reflective of self-referential negative emotions associated with optimal development of conscience (e.g., embarrassment, guilt, disappointment), and negative responses associated with poor conscience development (e.g., anger, "sulking," arguing back, lack of remorse or uncaring responses). Self-referential emotions were predominantly reported for students low in CU traits, for example:

TABLE 5 | Qualitative findings for CU traits, disruptive behavior, response to rewards and discipline, academic motivation, and teacher-student relationship quality in high CU students.

Theme	Sub-theme	Description
Psychopathic traits	Interpersonal callousness	Lack of concern for the impact of their behavior on others
	Lack of guilt	Does not show guilt or remorse for misbehavior Blames others for misbehavior
	Emotionality	Intense displays of anger in response to discipline Enjoyment of others' distress Enjoyment of novel and dangerous activities
Disruptive behaviour	Covert disruptive behavior in class	Cheating Social manipulation
	Overt disruptive behavior in class	Shouting, frequent talking, refusal to work, throwing things, using a mobile phone, "aggravating others" by e.g., pulling hair, poking
Positive Response to Discipline		Accepts discipline, shown by apologizing, ceasing misbehavior and/or resuming school work
Negative responses to discipline	Negative emotional responses	Sulking, being "defensive," "taking it personally," crying
	Uncaring response	Described as uncaring, unreactive or "not threatened" in response to discipline
	Aggressive or confrontational responses	Intense displays of anger in response to discipline Arguing with the teacher or "back-answering" Refusal to comply with discipline
No response to rewards		Not driven or encouraged by rewards
Response to rewards	Social Rewards	Less responsive to social rewards, e.g., praise
	Tangible rewards	Motivated by tangible rewards e.g., school points system, sweets
Academic motivation	Low intrinsic motivation	Poor motivation and lack of engagement attributed to a lack of intrinsic motivation
		Good quality teacher-student relationship important contributor to academic motivation
		Low motivation despite possessing the ability to do well
	Needs to be "pushed"	Intense, frequent monitoring and encouragement needed for student to engage in school work
Quality of TSR	Good quality TSR but recognize student 'difficult' for other staff	TSR described as "good" or "positive"; characterized by student confiding and help-seeking when appropriate, trust, respect, understanding and enjoyment of interactions with the teacher
	Poor quality TSR	TSR described as "poor," "bad," or "not good"; characterized by student disrespect toward the teacher, student dislike of the teacher and conflict
	Mixed quality TSR	TSR described as possessing the negative and positive features described in the above two categories
	Academic motivation	Negative impact of poor quality TSR on academic motivation and engagement

CU traits, callous-unemotional traits; TSR, teacher-student relationship.

> "Embarrassed.... he'll be like 'I'm really sorry' and he'll go red."

In contrast, negative emotional responses associated with poor conscience development were frequent for students who self-reported as high in CU traits:

> "Badly. He can become very, very defensive. If you do reprimand him for something, it's generally a 'I wasn't even doing anything' or 'This or other person is doing it'."

> "Every lesson she'll be asked to stop talking and she'll answer back, and that's the problem. She'll argue back and be very vocal about being told off."

Two subthemes were identified within the broader theme of negative responses to discipline for the high CU group: (i) uncaring responses and (ii) aggressive or confrontational responses. Slightly more high CU students were reported as uncaring in response to discipline:

> "When he gets in trouble he doesn't seem to care… he doesn't seem to show a lot of remorse or empathy. There have been times when he's acted out and apologized but not usually he normally laughs it off"

and the following somewhat contradictory statement:

> "He doesn't respond, it is water off a ducks' back, he doesn't care.I If I have to send him out, he will go kicking and screaming."

A theme that commonly applied to students in the high CU group was an aggressive or confrontational response to discipline. This brings us to the earlier theme of emotionality in high CU students. Examples belonging to this theme appeared predominantly in response to probes about student disruptive behavior and response to discipline.

> "Things like sanctions, he'll hit the roof, 'I didn't do anything! I didn't do it!'… Yeah, he's emotional. It can be a real mix when you

discipline him between, 'Yes, miss, really sorry, miss', being that kind of contrite student that we get. Or it can be quite aggressive or quite, you know, 'No, didn't do that' and gets quite affronted when you say to him 'Look you need to take time outside to calm down'."

CU Traits and Response to Teacher Reward Strategies

Two main themes were identified in relation to rewards: (i) no response to reward, and (ii) positive responses to rewards, further subdivided into positive responses to social vs. tangible rewards. Teachers reported little or no response to reward for a similar number of low and high CU students:

"It doesn't make much difference to him at all, rewards don't drive him. I just think he doesn't care."

"Doesn't affect her at all really, to be honest. She's very insular, she's very in herself. Nothing outside of her seems to affect anything, so rewards don't seem to work with her at all."

Teachers viewed most children as responsive to rewards regardless of CU status, and expressed the benefits of rewards for promoting prosocial behavior, confidence, motivation and a positive teacher-student relationship:

"Confidence is key with her, when she is patted on the back with a 'well done' it brings her out of her shell and she gets more involved."

"I give her a lot of praise as I know she can be difficult, and I think she likes that."

The theme of positive responses to tangible rewards applied equally to high and low CU groups. In contrast, teachers were more likely to view low CU students as more responsive to social rewards than high CU students, with praise the most frequent form of social reward mentioned.

Callous-Unemotional (CU) Traits and Academic Motivation

Teachers primarily attributed positive engagement in school work to students' intrinsic motivation rather than external factors (e.g., enjoyment of the subject, positive family or teacher influence), with more low CU students identified as self-motivated than the high CU group. Teachers viewed a good quality teacher-student relationship as an important contributor to academic motivation regardless of CU status:

"If a student trusts you and they know how you're going to react and there's a good relationship there, I think that has a positive impact on how they will behave towards you and your subject and your work. And they often want to please, they want to do well, because they want to show you what they can do and he's one of those."

One theme that was prominent for children with high CU traits was the need to be "pushed," with these students appearing to lack intrinsic motivation despite possessing the ability to do well:

"He is cleverer than he thinks…..he is one that you need to keep pushing."
"She does have ability, but will just coast along and not push herself."

Teachers also recognized the impact of low motivation and lack of response to teacher encouragement on the academic achievement of high CU students:

"I think he is bright, but he is not performing as he should, it doesn't seem to matter what you do with him".

Callous-Unemotional (CU) Traits and Teacher-Student Relationship Quality

Most teachers reported positive relationships with low CU students, with a small minority reporting their relationship with a low CU student as "mixed" in that it featured both positive and negative aspects. No teachers described their relationship with a low CU student as negative (i.e., relationships characterized by dislike, conflict and disrespect). In contrast, several teachers described their relationship with students in the high CU group in negative terms:

"I'd say it's not good, he doesn't like the fact that I will keep on at him to settle down and get on with his work."
"I wouldn't say that he likes me, he isn't the most respectful of students."

Some teachers also noted the impact of a poor TSR on the academic engagement of high CU students:

"He isn't academic either and does not care…. It may be the subject, it may be a bad relationship between him and I."

Surprisingly, teachers tended to describe their relationship with most high CU students in positive terms. However, closer examination indicated that these teachers recognized the need to be firm with high CU students even when a good relationship was present:

"Quite good…. But there are times when he just pushes the boundaries and I have to be really strict which I don't like."
"She has bad anger issues, but in these classes, she will accept that she is not allowed to show these, and her behaviour will not be excused."

Furthermore, it was noted by several teachers that these children behaved differently for other teachers:

"I think because she likes me I don't have to send her out the class."
"I think it does matter with him, because … I have seen him in other lessons just sit there and not want to take part in anything

at all. And you can tell that there is a frosty relationship between him and some of his teachers."

DISCUSSION

In support of our hypothesis, there were significant relationships between CU traits and more severe conduct problems, hyperactivity and autism symptoms. This is consistent with the previous evidence for an association between CU traits and a broad range of emotional and behavioral difficulties (Jones et al., 2010; Ciucci et al., 2014). Thematic analysis of teacher interviews also highlighted a greater variety and severity of overt and covert disruptive behaviors along with the pursuit of novel, dangerous activities as characteristic of high CU students, consistent with past research and the conceptualization of psychopathic traits in youth (see Frick et al., 2014a). Teachers also emphasized the callous disregard and lack of remorse shown by high CU students for the impact of their disruptive behavior on others in the classroom. This is consistent with evidence for the negative impact of disruptive behavior on classmates and classroom functioning (Herrero et al., 2006; Thomas et al., 2011); and highlights the importance of CU traits as a target for school-based intervention. One teacher identified frequent removal from class as a contributor to the poor academic performance of high CU students. While this discipline strategy is one of very few viewed as effective by teachers for high CU students, its potential impact on school performance was also raised as a concern by teachers in previous qualitative research (Allen et al., 2016). Antisocial behavior and the resultant discipline and exclusionary procedures employed to manage them in school have shown to damaging effects, including increased grade failure, school dropout, poor academic achievement and involvement in the juvenile justice system (Malecki and Elliot, 2002; Dishion and Dodge, 2005; Department for Education, 2010). Therefore, a promising line of enquiry for future research is to investigate the impact of different forms of disciplinary measures on the academic achievement and attainment of antisocial students with CU traits.

Consistent with our predictions and past research (Ciucci et al., 2014; Allen et al., 2016), students high in CU traits showed greater punishment insensitivity and reduced reward sensitivity. Consistent with developmental theory and past research (Kochanska, 1994; Blair, 1995), teachers reported that high CU students were more likely to display uncaring responses to discipline and less likely to display negative emotion related to conscience, such as shame, guilt and disappointment in oneself. This lack of uncomfortable emotional experience in response to transgression is believed to lead to increased CU traits and antisocial behavior (Kochanska, 1994), and may prevent children high in CU traits from trying to seek forgiveness and repair their relationships with others (Warren et al., 2015). Present study results suggest that the findings of the literature on parental discipline concerning the role of punishment insensitivity in the development of antisocial behavior and CU traits (e.g., Wootton et al., 1997; Oxford et al., 2003) may also be applicable to teacher-child interaction, a topic which warrants further examination utilizing a longitudinal design.

Our hypothesis that students high in CU traits would show reduced reward sensitivity was supported by our quantitative and qualitative findings, consistent with past research (Marini and Stickle, 2010; Centifanti and Modecki, 2013; Allen et al., 2016). However, we used the SPSRQ-C reward sensitivity scale encompasses a range of different types of rewards, including praise and social approval, tangible rewards impulsive fun-seeking, and competitive drive. Our qualitative interviews suggested that the reduced sensitivity was most evident for social reward (e.g., teacher praise), with tangible rewards viewed as effective for students high and low in CU traits. This contrasts with past research showing links between CU traits and increased responsivity to tangible rewards (Pardini et al., 2003; Lorber et al., 2011). The school in the current study utilized a points system which could be traded in for purchases at retail stores—a system that was identified as extremely popular by teachers. It is possible that the high desirability of this reward produced a ceiling effect, preventing the identification of differences for students high vs. low in CU traits. However, a recent review by Byrd et al. (2014) concluded that children high in CU do not show impaired reward processing when examined in isolation from punishment. Furthermore, most research on reward dominance has employed competitive, computer-based experimental paradigms, and as such these findings lack ecological validity. Thus, tangible rewards may either not be differentially reinforcing for high vs. low CU children, or their motivating value may be limited to competitive contexts which enable high CU children to obtain social status or social dominance (e.g., Pardini and Byrd, 2012). Future research should employ assessment methods that differentiate between tangible and social rewards and investigate the potential influence of the differing contexts in which rewards are received, such as in the presence or absence of peers (e.g., Centifanti and Modecki, 2013).

One unexpected theme that was identified related to the expression of emotions for high CU students. By definition, CU traits are viewed as characterized by a reduced capacity for emotional experience, and therefore emotional expressivity and responsiveness. However, in the present study, teachers provided numerous examples of when students high in CU traits displayed intense positive and negative emotions. The main contexts that elicited positive emotional expression were joy or happiness in causing distress to others, and when in the pursuit of novel, dangerous thrill-seeking activities. The presence of positive emotions during risk-taking is consistent with trait models of aggression emphasizing sensation-seeking, surgency/extraversion and behavioral approach, with increasing evidence for the importance of positive emotions in driving and reinforcing both proactive and reactive aggression (Chester, 2017). In the adult literature, a relationship has been noted between psychopathic traits and feelings of contempt for others, with this "contemptuous delight" feeding into a sadistic tendency to derive pleasure from demeaning and hurtful interactions (Foulkes et al., 2014). Our findings suggest that this phenomenon may also be present in youth high in CU traits. Finally, teacher interviews revealed that discipline or limit setting often elicited displays of anger from high CU students, namely verbal aggression - consistent with past qualitative findings (Allen et al.,

2016). There are several different possible explanations for this. First of all, models of the development of CU traits highlight impairments in fear, sadness and more recently, happiness rather than anger (Frick and Morris, 2004; Blair, 2005). It has been suggested that psychopathic traits may be related to lower levels of self-directed negative emotions related to the experience of personal distress (e.g., fear, sadness) or the development of conscience (e.g., shame, guilt), but to higher levels of other-directed negative emotions such as anger, contempt or spitefulness (Benning, 2013; Garafolo et al., 2018). Indeed, research in adults has shown links between psychopathic traits and greater levels of anger (Jackson et al., 2007; Hoppenbrouwers et al., 2016). Another possibility is that the anger was "fake" rather than "felt," with the display of anger used as a means to intimidate others and reduce the likelihood of punishment being initiated or enacted, consistent with the limited prosocial emotions specifier (American Psychiatric Association, 2013). Another alternative is that the display of anger may be driven by narcissism rather than CU traits, as a threat to self-esteem such as discipline from an authority figure is consistent with recognized triggers for "narcissistic rage" (Krizan and Johar, 2015). Future research examining emotional responses to discipline should include a measure of narcissism to test this possibility.

In partial support of our predictions, CU traits were related to greater teacher-child conflict and less closeness, consistent with past research in elementary schools (Crum et al., 2016; Horan et al., 2016). However, group comparisons did not reach significance with teachers reporting significantly more conflict, but not less closeness in their relationships with high-CU compared to low-CU students. This is most likely due to a lack of power due to our relatively small sample for quantitative analysis ($N = 47$), although teacher-child conflict typically shows stronger links with externalizing behaviors than low closeness (Myers and Pianta, 2008). It should be noted that the high and low CU groups were formed on the basis of student report. The nonsignificant group difference for closeness may therefore be attributable to teachers' lack of agreement with student perception of self-reported CU traits. CU traits may occur in the absence of antisocial behavior (Rutter, 2012), and teachers tended to report closer relationships with students they viewed as displaying no or low-level disruptive behavior. Therefore, present findings for CU traits and low closeness may be due to the absence of perceived comorbid behavior problems. These possibilities could be teased apart using a quantitative study including both teacher and student report of CU traits, the teacher-student relationship and conduct problems.

The association between CU traits and greater teacher-child conflict appears to be quite robust, remaining after controlling for child sociodemographic characteristics, reward sensitivity and behavioral adjustment. Interestingly, the association disappeared when accounting for teacher, but not child report of punishment insensitivity. It may be that the perceived punishment insensitivity characteristic of students with CU traits that teachers find most aggravating, and therefore the greatest source of conflict. Encouragingly, qualitative analysis revealed that while more teacher identified poor relationships for high CU students, most teachers described their relationship in positive terms. As indicated in our qualitative findings, teacher-student relationships are multifaceted and complex, and it is therefore possible to view a relationship as positive overall despite the presence of conflict.

Teachers viewed high CU students as low in intrinsic motivation for school work despite possessing the ability to do well. This is consistent with the view that youth with CU traits perform poorly at school because their callous and uncaring interpersonal style extends to school performance, with poor academic outcomes reflecting low intrinsic motivation despite possessing a similar IQ to their same-age peers (DeLisi et al., 2011). Consistent with this view, teachers reported the need for intense, regular monitoring and feedback to encourage high CU students to engage with school work. Qualitative findings revealed that a poor-quality relationship was viewed by teachers as having a negative impact on the academic motivation and engagement of high CU students, while a good quality relationship was identified as an important contributor to academic motivation, irrespective of the presence of CU traits. Thus, qualitative findings suggest that investigation of the interrelationships between CU traits and intrinsic and extrinsic forms of motivation are a fruitful avenue for identifying risk and protective factors for poor academic outcomes in high-CU children.

This study possesses several limitations which should be acknowledged. First, the sample consisted of non-referred White middle-class students attending a secondary school in the United Kingdom. It is not clear whether our quantitative findings would generalize to children of minority ethnicity, those living in disadvantaged neighborhoods or who meet criteria for an externalizing disorder. However, qualitative research differs from quantitative in that the focus is on capturing the diversity of participant experience rather than the generalizability of findings. The sample size for the quantitative analyses for the high and low CU groups was small, with different teachers reporting on different students. Another issue to bear in mind is that children were classified as high or low in CU traits on the basis of student self-report. Thus, it is important to interpret current findings as reflecting teacher perspectives on students who self-identified as high in CU traits. The present study would be enhanced by including both student and teacher perspectives, particularly as research on CU traits and teacher-child interaction to date has predominantly relied on teacher questionnaire report (e.g., Crum et al., 2016; Horan et al., 2016). This study employed a cross-sectional design, preventing any conclusions about the direction of relationships between main study variables. Future research employing a longitudinal design could examine potential reciprocal relationships between CU traits, disruptive behavior teacher-student interaction/relationship quality and academic motivation. Finally, we relied on questionnaire and interviews, assessment methods which are open to biases relating to mood, memory and personality. However, the methods employed in the present study have been useful in highlighting areas that warrant greater research attention using more resource-intensive methods such as classroom observation that enable a more objective assessment of teacher-student interaction.

This study also possesses considerable strengths, as it is one of few studies examine the presentation, impact and correlates of CU traits in school, and one of even fewer studies to employ a mixed methods design. Given that very little is known about CU traits in the school context, our qualitative findings provide important leads on the relationships between teacher-student relationship quality, intrinsic motivation and the responsiveness of high CU students to classroom discipline and reward-based strategies—all factors that have been identified as potential mediators of the relationship between CU traits and poor behavioral and academic adjustment (e.g., DeLisi et al., 2011; Ciucci et al., 2014; Horan et al., 2016), as well as providing a richer, deeper account of emotional responding to teacher rewards and discipline. This study improves on previous mixed methods research on response to teacher rewards and discipline in students high and low in CU traits (Allen et al., 2016) by using a larger sample of male and female students and interviewing teachers about specific students rather than responding to a generic description of a child with CU traits, enabling teacher report to be linked to child outcomes. Finally, our selection strategy ensured that there was no bias related to teacher perceptions in terms of the student sample randomly selected for the teacher assessment protocol.

Our qualitative findings are consistent with the view that risk pathways for poor academic outcomes may differ for antisocial youth high and low in CU traits, such that antisocial youth low in CU traits perform poorly due to deficits in verbal ability, and high CU youth perform poorly due to low intrinsic motivation (DeLisi et al., 2011). As such, current study findings suggest that school-based interventions aimed at promoting academic performance by targeting verbal ability are unlikely to be effective with high CU students. Consistent with previous research (Allen et al., 2016), current results suggest that teachers are likely to need extra support to implement discipline and reward-based strategies effectively. Consistent with past research on interpersonal relationships in schools (e.g., Crum et al., 2016; Horan et al., 2016; Thornberg and Jungert, 2017), our findings suggest that developing positive relationships between teachers and students may be more likely to be beneficial for promoting prosocial behavior, academic motivation and school engagement in this high-risk group of antisocial children. Future research could examine whether interventions focused on promoting positive teacher-student interactions and relationships are beneficial for antisocial students high in CU traits across social, behavioral, motivational and academic domains.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the UCL Institute of Education ethics board. The protocol was approved by the UCL Institute of Education ethics board. All subjects gave written informed consent in accordance with British Psychological Society guidelines and the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

EB collected the data and conceived of this study under the supervision of JA for her Masters' dissertation. JA drafted the manuscript. JA, EB, and CC conducted and wrote the qualitative analysis. All authors provided critical input for intellectual content, contributed to manuscript revisions, and read and approved the submitted version.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

Interview Questions

1. What types of reward techniques do you use in your classes? 2. What types of discipline techniques do you use?

The following questions are administered for each target child identified as attending the teachers' classes:

The following questions are about [target child].

1. How does [target child's name] respond when you have disciplined them? [skip following prompt if teacher reports never any need for discipline]
   i) Why do you think s/he responded this way?
2. How does [target child's name] respond when you reward them?
   i) Why do you think s/he responded this way?
3. How often is [target child] disruptive?
   [administer the following items if the teacher reports disruptive behavior, otherwise skip to question 5]
4. Tell me about when [target child] is disruptive in school.
   i) What disruptive behaviors does [target child] show?
   ii) ….. and in what circumstances?
5. What do you think are the reasons for [target child's] disruptive behavior? Repeat each example provided by the teacher and clarify their views on the motivation underlying the child's behavior].
6. Tell me about [target child]'s motivation for school work. {if no/little information provided, administer following prompts: do you find that [target child] tries to make an effort with their work? do they show these behaviors often, do they try to work on their own or do they need reminding?}
7. How would you describe your relationship with [target child]?
8. What are you views on how [target child's] behaviors and attitudes toward you influences her/his academic progress?

frontiers in Psychology

ORIGINAL RESEARCH
published: 19 September 2018
doi: 10.3389/fpsyg.2018.01757

Shyness and Learning Adjustment in Senior High School Students: Mediating Roles of Goal Orientation and Academic Help Seeking

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Learning maladjustment is a common phenomenon in the context of examination-oriented education system in china, especially among high school students who experience intense pressure when preparing for the national college entrance examination. Previous literature suggests that shyness may negatively affect ones' cognition, emotion, and behavioral performance and lead to academic and social maladjustment. Therefore, learning adjustment among shy high school students is a critical and practical point of inquiry. With a sample of 677 Chinese senior high school students, this study aims to assess the association between shyness and learning adjustment and related mechanisms of goal orientation (i.e., mastery-approach goals, mastery-avoid goals, performance-approach goals, and performance-avoid goals) and academic help seeking (i.e., instrumental help seeking from teacher, instrumental help seeking from classmate, executive help seeking, and avoidance of help seeking). Self-report measures were adopted to collect information on: demographic characteristics, the level of shyness, goal orientation, academic help seeking, and learning adjustment. Results indicated that shyness was negatively correlated with learning adjustment, and this association was mediated by the dimensions of goal orientation and dimensions of academic help seeking. Specifically, shyness not only predicted learning adjustment through mastery-approach goals, and instrumental help seeking (teachers) but also predicted learning adjustment through the multiple mediating effects of the dimensions of goal orientation and the dimensions of academic help seeking (i.e., mastery-approach goals and instrumental help seeking from teachers, mastery-approach goals and executive help seeking, mastery-avoid goals and instrumental help seeking from classmates, mastery-avoid goals and executive help seeking, and performance-avoid goals and executive help seeking). Identifying these mediators further enables us to work out effective measures to promote shy high school students' learning adjustment.

Keywords: shyness, goal orientation, academic help seeking, learning adjustment, senior high school student

OPEN ACCESS

Edited by:
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University of Southampton,
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Reviewed by:
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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *06 June 2018*
Accepted: *30 August 2018*
Published: *19 September 2018*

Citation:
Chen Y, Li L, Wang X, Li Y and Gao F (2018) Shyness and Learning Adjustment in Senior High School Students: Mediating Roles of Goal Orientation and Academic Help Seeking. Front. Psychol. 9:1757. doi: 10.3389/fpsyg.2018.01757

INTRODUCTION

Senior high school education is a key stage laying a solid foundation for students' lifelong development. High school students are going to face many adaptative and developmental tasks in this stage, while adaptation and development in learning field is one of the most important development tasks (Deb et al., 2015). The extent to which adolescents succeed in learning adjustment critically influences their academic achievement, peer relationship, and even

subsequent educational opportunities and choices (Farmer et al., 2009; Ryan, 2011), which in turn might facilitate adolescents' adjustment and mental well-being in this period of life.

Learning adjustment refers to the process through which students make efforts to achieve balance in their learning environment and improve their academic performance (Nie et al., 2004), consisting of learning habits, utilization of learning resources, learning motivations, learning satisfactions, learning styles, etc. In the context of examination-oriented education systems, learning maladjustment is a common phenomenon, especially among Chinese high school students who experience intense pressure when preparing for the national college entrance examination (Kuperminc et al., 2008; Liu and Chen, 2010; Yüksel, 2016). Learning maladjustment may adversely affect Chinese high school students' aspects of school adaptation as well as their future development (Song, 2015; Longobardi et al., 2016).

Shyness and Learning Adjustment

Reciprocal interaction theory (Bandura, 1976) stressed the influence of a reciprocal interaction between environmental, personal, and behavioral factors on individual developments, with particular emphasis on the influence of personal factors. According to Bronfenbrenner (1979), individual factors refer to individuals characteristics (gender, race, age, experience, personality, etc.); environmental factors refer to the environmental characteristics of individual survival and development, including macro-environment (socio-cultural background, socio-economic development, etc.) and micro-environment (family, teachers, peers, etc.). In the literature, identified factors that affect learning adjustment among high school students include environmental factors (e.g., family socioeconomic status, parenting style, teacher support, peer friendship, and social environment) (Hair and Graziano, 2003; Verner-Filion and Gaudreau, 2010; Butler, 2011; Garg et al., 2016) and individual factors (e.g., personality, intelligence, achievement motivation, and academic self-efficacy) (Powers et al., 2005; Gunnoe, 2013; Shin and Ryan, 2014; Larose et al., 2018). In all personal variables, researchers have found that shyness as a personality trait affected individuals' learning adjustment (Chen et al., 1995; Liu et al., 2012; Yang et al., 2015; Coplan et al., 2017). Shyness refers to behavioral responses such as inhibition and withdrawal in response to social and novel situations. Shyness can stem from fear of negative evaluation and may be accompanied by emotional distress or inhibition; thus, shyness can interfere with desired participation in activities and the pursuit of personal and professional goals (Henderson and Zimbardo, 2001). High school is a key period in social and personality development among teenagers, whose internalization of difficulties (e.g., shyness, social anxiety, and depression) is especially serious (Hu et al., 2015). Intense shyness may negatively affect an individual's cognition, emotions, and behavioral performance and lead to learning and social maladjustment (Liu et al., 2012, 2014, 2015; Ponti and Tani, 2015). Moreover, previous studies have found shyness predicted poor learning adjustment among junior high school students (Chen et al., 2017; Coplan et al., 2017).

Although shyness has been associated with learning maladjustment in considerable research conducted in China (Chen et al., 1995, 2011; Yang et al., 2015; Coplan et al., 2017), to date insufficient interest has been devoted to studying the mechanisms that underlie this relation. Moreover, most studies on shyness and learning adjustment have focused on children; so far, only a few studies have investigated related mechanisms (e.g., self-esteem, coping style, and teacher–student relationship) on the association between shyness and learning adjustment in high school students (Feng et al., 2014; Wu, 2015; Chen et al., 2017); thus, findings are of limited significance. Therefore, the mechanism of the effect of shyness on learning adjustment among high school students warrants investigation. In this study, multiple mediation analysis was adopted to investigate the mechanisms through which shyness leads to learning maladjustment.

Shyness, Academic Help Seeking, and Learning Adjustment

Academic help seeking is a two-part process that supports successful learning outcomes (Karabenick and Newman, 2006; Barnard et al., 2008). First, students must recognize the need for help, and then must decide whether to actually request help (Ryan and Pintrich, 1997). According to Karabenick and Newman (2006), academic help seeking include instrumental help seeking from teacher (students ask for the help needed from teacher in order to learn independently), instrumental help seeking from classmate (students ask for the help needed from classmates in order to learn independently), executive help seeking (students attempt to avoid work by asking others for answers to problems), and avoidance of help seeking (students would rather write an answer than asking others for the answer to the problem). Previous research has reported that academic help seeking explains the internal mechanism of students' learning adjustment. When students solve their academic problems by asking for help from others, thereby enhancing their understanding, they exhibit adaptive academic behavior (Chen et al., 2018).

Holt (2014) argued that academic help seeking mediates the association between parent attachment and learning adjustment; close parent–child relationships are associated with less shame and embarrassment on the part of the child with respect to obtaining academic assistance; this attitude predicts other positive academic behavior, including organization, preparation, and classroom engagement. However, highly shy students who are extremely concerned about how others view them tend to restrain their behavior and may not communicate effectively with others. When they ask help from others, they may feel more shameful and embarrassed. These personality characteristics may inhibit a shy individual from seeking help from others (such individuals may engage in negative help-seeking methods or avoid help seeking altogether) upon encountering academic difficulties; consequently, problems may not be solved promptly or effectively, thereby leading to the student in question experiencing learning maladjustment. Yap et al. (2013) argued that embarrassment or shyness was the most frequently occurring

barrier to seeking help among people aged 15–25 years. Shy individuals seek help less frequently (or avoid seeking help) and take substantially more time to seek help than those with low shyness with respect to task completion challenges (Horsch, 2006). Another line of research suggested that shyness may affect individuals' academic help-seeking behavior, higher levels of shyness corresponded with more passive academic help-seeking behavior (executive help seeking, avoidance of help seeking), whereas lower levels of shyness corresponded with active academic help-seeking behavior (instrumental help seeking) (Dou et al., 2015). As a consequence, highly shy students are prone to adopt passive academic help-seeking behavior rather than active academic help-seeking behavior, thereby resulting in learning maladjustment. These findings suggest that the negative association between shyness and learning adjustment can be partly accounted for by academic help seeking.

Shyness, Goal Orientation, and Learning Adjustment

Goal orientation refers to an individual's plan for processes that determine cognitive, emotional, and behavioral outcomes (Feltman and Elliot, 2012; Eder et al., 2013). In the influential individual-level 2 × 2 framework (Elliot and McGregor, 2001), four distinct types of achievement goals are identified: mastery approach goals (focused on developing competence and learning new things), mastery avoid goals (focused on avoiding incompetence relative to absolute or interpersonal standards), performance-approach goals (focused on demonstrating competence), and performance-avoid goals (focused on avoiding demonstrations of incompetence). Mastery goals (mastery-approach and mastery-avoid goals) correspond with incremental views of ability; individuals believe that they can improve their abilities by mastering knowledge. By contrast, performance goals (performance-approach and performance-avoid goals) correspond to entity-based views of ability, namely, the belief that people's abilities are fixed and they may complete tasks merely to prove their abilities (Elliot and McGregor, 2001; Eder et al., 2013). Studies have demonstrated that achievement goal orientation can influence students' learning adjustment (Verner-Filion and Gaudreau, 2010; Tuominen-Soini et al., 2012). High-performance goals and low mastery goals may lead to poor academic satisfaction (Verner-Filion and Gaudreau, 2010); mastery-oriented students were highly engaged in their studies and perceived their schoolwork as meaningful (Tuominen-Soini et al., 2012).

According to achievement goal theory (Elliot and Thrash, 2002), individuals with a higher propensity toward mastery goals often compare their current state with that of their previous selves. Such individuals repeatedly perform difficult tasks to improve their abilities (mastery approach) or strive to accomplish tasks and master knowledge (mastery avoid); their progress and mastery of knowledge serve as motivators (Elliot and Thrash, 2002; Mierlo, 2015). By contrast, individuals with a higher propensity toward performance goals often compare themselves with others. Such individuals strive to exhibit performance superior to others (performance approach) or avoid performing in a manner inferior to others (performance avoid), and are motivated by positive external feedback (Elliot and Thrash, 2002; Mierlo, 2015; Sharma and Nasa, 2016). This feedback-based motivation is similar to the fear of negative evaluation (Henderson and Zimbardo, 2001). Empirical studies have explored the association between shyness and goal orientation. For example, Fallah (2014) found that the willingness of shy students to communicate in English was mediated by their motivation, perhaps one way to increase shy students' willingness to communicate in English is to enhance their motivation. Another study explored the relation between shyness and language learning motivation (Mohammadian, 2013), and found language learning motivation mediated the relation between shyness and language learning tasks; this study has further shown that individuals with a high level of task orientation (e.g., mastery-approach goals and mastery-avoid goals) use more active cognitive strategies and self-constraints in their learning; however, individual with a high level of ego orientation (e.g., performance-approach goals and performance-avoid goals) use more motivational strategies, that is, to surpass others and avoid being negatively evaluated by others (consistent with shyness). Therefore, in order to prevent future possible failures and negative evaluations, these individuals continue to try to use these motivational strategies (Elliot et al., 1999; Riveiro, 2001). Based on these findings, this study posits that higher levels of shyness may have higher performance goals and lower mastery goals, resulting in learning maladjustment, that is, the negative effect of shyness on learning adjustment may be partly mediated by goal orientation.

Goal Orientation and Academic Help Seeking

Numerous studies have indicated that differences in goal orientation influence students' different academic help-seeking behavior. For example, Nosaki (2003) found that mastery goal orientation indirectly influenced adaptive help seeking because the observed students felt useless. Conversely, performance goal orientation indirectly influenced dependent help seeking and avoidance of help seeking because the observed students felt uncertain or inferior with respect to their competence. Additional studies have reported that task-based goals (mastery goals) are positively associated with adaptive help-seeking behavior (instrumental help seeking) and negatively associated with maladaptive help-seeking behavior (executive help seeking and avoidance of help seeking). By contrast, performance-avoid goals are positively associated with maladaptive help seeking and negatively associated with adaptive help seeking (Oberman, 2002; Cheong et al., 2004). In addition, Newman (2002) indicated that adaptive help seeking (e.g., instrumental help seeking) is a strategy based on self-regulated learning. Specifically, when independently engaged in difficult tasks, students require initial motivation to assess their status and situation and must realize that a problem can be solved before initiating help-seeking behavior. Based on the above research, this study posits that students with

higher performance goals (performance-approach goals and performance-avoid goals) and lower mastery goals (mastery-approach goals and mastery-avoid goals) may have higher maladaptive help-seeking behavior (executive help seeking and avoidance of help seeking) and lower adaptive help-seeking behavior (instrumental help seeking from teacher or classmate). In view of the association between shyness, goal orientation, academic help seeking, and learning adjustment that has been deduced, this study attempts to explore the multiple mediating role of goal orientation and academic help seeking in the association between shyness and learning adjustment.

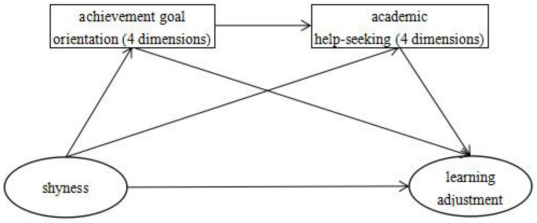

FIGURE 1 | The conceptual model of this study.

The Present Study

In the context of examination-oriented education systems, learning maladjustment is a common phenomenon, especially among Chinese high school students who experience intense pressure when preparing for the national college entrance examination (Kuperminc et al., 2008; Liu and Chen, 2010; Yüksel, 2016). Shyness is an unfavorable factor in individual socialization (Joiner, 1997; Besic et al., 2009). Intense shyness may negatively affect an individual's cognition, emotions, and behavioral performance and lead to learning and social maladjustment (Liu et al., 2012, 2014, 2015; Ponti and Tani, 2015). Therefore, learning adjustment among shy high school students is a critical and practical point of inquiry. To enhance the literature, this study investigated the influence of goal orientation and academic help seeking (independent contribution and concurrent contribution) on the association between shyness and learning adjustment in a sample of Chinese high schools students.

Based on the literature review, the following hypotheses were proposed:

H1. Shyness negatively predicts learning adjustment.

H2. The negative effect of shyness on learning adjustment may be mediated by the dimensions of goal orientation (i.e., mastery-approach goals, mastery-avoid goals, performance-approach goals, and performance-avoid goals).

H3. The negative effect of shyness on learning adjustment may be mediated by the dimensions of academic help seeking (i.e., instrumental help seeking toward teachers or classmates, executive help seeking, and avoidance of help seeking).

H4. Shyness predicts learning adjustment through the multiple mediating roles of the dimensions of goal orientation and dimensions of academic help seeking (see **Figure 1**).

MATERIALS AND METHODS

Ethics Statement

This study was carried out in accordance with the recommendations of Ethics Committee of Shandong Normal University, Shandong, China. The protocol was approved by the Ethics Committee of Shandong Normal University. Permission for this study was obtained from parents, school authorities, and principals, and all participants and their parents/legal guardians had signed the informed consent in accordance with the Declaration of Helsinki.

Participants and Procedure

This study was randomly selected participants from two public secondary schools in Weifang in Shandong province in Mainland China. The participants completed the corresponding questionnaires in the classroom in groups of 20–25 students, on a regular school day, in the presence of an experienced research assistant, and the survey lasted for about 30 min. Finally, 700 students returned the questionnaires and 23 students were excluded because their questionnaires answered regularly or had one or more scales unfinished. Therefore, this study got a final sample of 677 (10th to 12th grade). The participants ranged in age from 15 to 20, 220 were in grade 1, 230 were in grade 2, and 227 were in grade 3. Gender Distribution was 45.20% males and 54.80% females.

Measure

Shyness

The 31-item Shyness Scale for Chinese Middle School Student (SS-CMSS; Chen, 2013) was used to assess the level of shyness of middle school students. This scale, consisting of self-expression shyness (seven items), shyness toward novelty (six items), shyness for negative social evaluation (six items), shyness toward the opposite sex (seven items), unassuming shyness (five items), is scored on a 5-point scale (1 = totally disagree to 5 = totally agree). Sample items include, "I usually hide in a corner when I take part in group activities (self-expression shyness)," "I feel nervous and embarrassed when I stay with someone I don't know (shyness toward novelty)," "I feel awkward and uncomfortable even with a little criticism from the teacher (shyness for negative social evaluation)," "I blush and feel embarrassed when the opposite sex focus on me (shyness toward the opposite sex)," and "I do things more low-key, I don't like to be in the limelight (unassuming shyness)." In this study, Cronbach's alphas for five dimensions ranged from 0.60 to 0.87, and 0.92 for the whole scale. The fit indices from a confirmatory factor analysis were adequate, χ^2/df = 2.698, GFI = 0.905, TLI = 0.909, and RMSEA = 0.050.

Goal Orientation

The 29-item Four Point Goal Orientation Scale (FPAGOS; Liu, 2003) was used to assess the level of goal orientation of high school students. This scale, consisting of mastery approach goal (nine items), mastery-avoid goal (five items), performance approach goal (nine items), and performance avoid goal (six items), is scored on a 5-point scale (1 = totally disagree to 5 = totally agree). Sample items include, "I like learning because it allows me to increase my knowledge (mastery approach goal)," "I often worry about not mastering the knowledge taught by the teacher in class (mastery avoid goal)," "I am very happy when others envy me for my grades (performance approach goal)," and "When speaking freely in class, I often worry that my views are childish and dare not speak (performance avoid goal)." In this study, Cronbach's alphas for five dimensions ranged from 0.79 to 0.84, and 0.86 for the whole scale. The fit indices from a confirmatory factor analysis were adequate, χ^2/df = 2.495, GFI = 0.919, TLI = 0.907, and RMSEA = 0.047.

Academic Help Seeking

The 19-item Academic Help Seeking Behavior Scale in Chinese version (AHBS_C; Li and Zhang, 1999) was used to assess the level of academic help seeking behavior. This scale, consisting of instrumental help seeking from teacher (five items), instrumental help seeking from classmate (five items), executive help seeking (four items), and avoidance of help seeking (five items), is scored on a 5-point scale (1 = totally disagree to 5 = totally agree). Sample items include, "I ask the teacher for advice when I do not understand the meaning of a mathematical problem (instrumental help seeking from teacher)," "I ask my classmates for advice when I do not understand the meaning of a mathematical problem (instrumental help seeking from classmate)," "I copy someone else's answer when I can't solve a mathematical problem (executive help seeking)," and "I would rather write an answer than ask a teacher or classmate when I can't solve a mathematical problem (avoidance of help seeking)." In this study, Cronbach's alphas for four dimensions ranged from 0.65 to 0.87, and 0.70 for the whole scale. The fit indices from a confirmatory factor analysis were adequate, χ^2/df = 3.157, GFI = 0.933, TLI = 0.927, and RMSEA = 0.056.

Learning Adjustment Behavior

The 30-item Learning Adaptive Behavior Scale in Chinese version of Social Adaptive Behavior Scale (SABS_C; Nie, 2005) was used to assess the level of learning adjustment behavior. This scale, consisting of learning habits (six items), utilization of learning resources (five items), learning motivations (six items), learning satisfactions (six items), and learning styles (seven items), is scored on a 2-point scale (1 = totally disagree to 2 = totally agree), there is one reverse scoring question in this sub-scale, with higher score indicating higher learning adjustment behavior. Sample items include, "I think positively about the problems in study (learning habits)," "I like to think independently and finish learning tasks (learning styles)," "I use learning reference books (such as dictionaries, reference material) (utilization of learning resources)," "I think the purpose of study is to get a good university and a good job in the future (learning motivations)," and "I am happy when I study (learning satisfactions)." In this study, Cronbach's alphas for five dimensions ranged from 0.59 to 0.70, and 0.69 for the whole scale. The fit indices from a confirmatory factor analysis were adequate, χ^2/df = 2.552, GFI = 0.946, TLI = 0.907, and RMSEA = 0.039.

RESULTS

Common-Method Bias

Since the data were collected in a single instrument from a single respondent from each organization, the threat of common-method bias to the validity of the data was checked using Izenman et al. (1978) one-factor test. The resulting principal component analysis returned 28 distinct factors with eigenvalues greater than 1, which accounted for 59.90% of the variance; the first factor accounted for only 11.46% of the variance. Results indicated that common-method bias was not contaminating the associations between research variables.

Descriptive Statistics and Correlation Analysis

Appendix Table A1 summarizes the Pearson bivariate correlations among the variables in the structural models, as well as the mean and standard deviation of each measure. Shyness was significantly related to learning adjustment.

Mastery-approach, mastery-avoid, and performance-approach goals were significantly related to learning adjustment ($p < 0.01$ for all). No significant correlation was observed between performance-avoid goals and learning adjustment ($p > 0.05$). Instrumental help seeking (teachers), instrumental help seeking (classmates), executive help seeking, and avoidance of help seeking were significantly related to learning adjustment ($p < 0.01$ for all).

Mastery-approach, mastery-avoid, and performance-avoid goals were significantly related to shyness ($p < 0.01$ for all); however, no significant correlation was observed between performance-approach goals and shyness ($p > 0.05$). Instrumental help seeking (teachers), executive help seeking, and avoidance of help seeking were significantly related to shyness ($p < 0.01$ for all); however, no significant correlation was observed between instrumental help seeking (classmates) and shyness ($p > 0.05$).

In addition, this study examined gender and grade difference in research variables. Results showed that there was no significant grade difference in any variables in this study. Furthermore, independent sample *t*-tests indicated that there were significant gender difference in instrumental help seeking from classmates, $t(667) = -4.875$, $p < 0.001$, revealing that boys reported lower levels of instrumental help seeking from classmates, *M* (*SD*) = 3.86 (0.80), compared to girls, *M* (*SD*) = 4.13 (0.66), but no significant gender difference in other variables.

Mediation Analyses

AMOS 20.0 was used for a multiple mediation analysis (Preacher and Hayes, 2008). Structural equation models were established

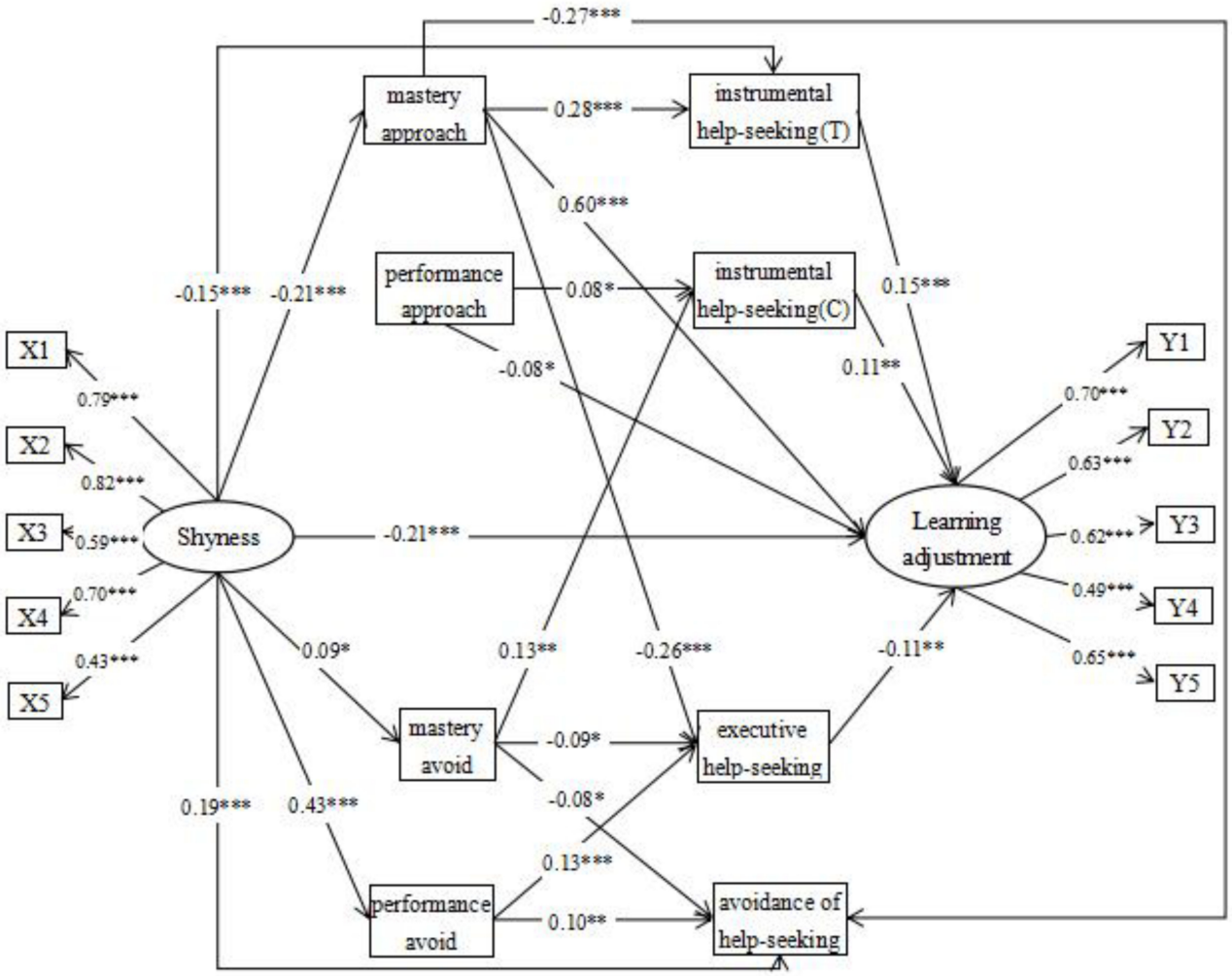

FIGURE 2 | Standardized coefficients in the SEM. X1, self-expression shyness; X2, shyness toward novelty; X3, shyness for negative social evaluation; X4, shyness toward the opposite sex; X5, unassuming shyness; Y1, learning habits; Y2, utilization of learning resources; Y3, learning motivations; Y4, learning satisfactions; Y5, learning styles; instrumental help-seeking (T); instrumental help-seeking from teacher; instrumental help-seeking (C); instrumental help-seeking from classmate. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

to examine shyness as a predictive factor in the levels of influence of the dimensions of achievement goal orientation and academic help seeking on learning adjustment. According to procedures for testing for mediating effects (Wen et al., 2006), we applied an SEM approach to assess the following three models: (a) a direct effect model (model 1) with paths from shyness to learning adjustment; (b) an indirect effect model (model 2), for which we used the initial direct effect model as a basis and added mediators (e.g., dimensions of achievement goal orientation and those of academic help seeking) between shyness and learning adjustment, as well as paths from dimensions of achievement goal orientation to those of academic help seeking; and (c) from the multiple indirect effects model, we deleted distinct paths according to the principle of standardized path coefficient ranking from small to large, resulting in model 3. Besides, following the correlation results, we controlled gender based on model 3, resulting in model 4 (see **Figure 2**). As shown in **Appendix Table A2**, the four model fit indices demonstrate that all models fit the data.

As shown in **Figure 2**, shyness not only directly and negatively predicted learning adjustment ($\beta = -0.21$, $p < 0.001$) but also indirectly predicted learning adjustment through mastery-approach goals and instrumental help seeking (teachers). Moreover, shyness indirectly predicted learning adjustment through chain mediation of the dimensions of goal orientation and those of academic help seeking through the following five paths. (1) Shyness significantly negatively predicted mastery-approach goals ($\beta = -0.21$, $p < 0.001$), mastery-approach goals significantly positively predicted instrumental help seeking (teachers) ($\beta = 0.28$, $p < 0.001$), and instrumental help seeking (teachers) significantly positively

predicted learning adjustment (β = 0.15, $p < 0.001$). (2) Shyness significantly negatively predicted mastery-approach goals (β = −0.21, $p < 0.001$), mastery-approach goals significantly negatively predicted executive help seeking (β = −0.26, $p < 0.001$), and executive help seeking significantly negatively predicted learning adjustment (β = −0.11, $p < 0.01$). (3) Shyness significantly positively predicted mastery-avoid goals (β = 0.09, $p < 0.05$), mastery-avoid goals significantly positively predicted instrumental help seeking (classmates) (β = 0.13, $p < 0.01$), and instrumental help seeking (classmates) significantly positively predicted learning adjustment (β = 0.11, $p < 0.01$). (4) Shyness significantly positively predicted mastery-avoid goals (β = 0.09, $p < 0.05$), mastery-avoid goals significantly negatively predicted executive help seeking (β = −0.09, $p < 0.05$), and executive help seeking significantly negatively predicted learning adjustment (β = −0.11, $p < 0.01$). (5) Shyness significantly positively predicted performance-avoid goals (β = 0.43, $p < 0.001$), performance-avoid goals significantly positively predicted executive help seeking (β = 0.13, $p < 0.001$), and executive help seeking significantly negatively predicted learning adjustment (β = −0.11, $p < 0.01$).

This study used PROCESS (Hayes, 2012) to test the statistical significance of those indirect effects. In this study, we used 5000 resamples in order to estimate 95% confidence intervals (CIs) (MacKinnon et al., 2007; Hayes and Preacher, 2013). If the 95% CI did not include zero, it meant a statistical significant indirect effect, gender was included as a covariate. As shown in **Appendix Table A3**, a bootstrapping analysis indicated that the indirect effects on shyness on learning adjustment were statistical significant.

DISCUSSION

For high school students, especially shy students, learning adjustment is crucial and may affect other adaptive processes in school (Hussain et al., 2008). Therefore, this study aims to investigate factors affecting the learning maladjustment of shy high school students. When these factors are identified, effective measures are further expected to be employed to encourage shy high school students to engage in more learning adjustment behavior and further reduce the emergence of internal and external problems, which may promote their mental health and well-being (Burns et al., 2011; Lai et al., 2015).

In this study, a multiple mediation model was used to examine the mechanism of the effect of shyness on learning adjustment. The results indicated that the dimensions of goal orientation and dimensions of academic help seeking played mediating roles in the relation between shyness and learning adjustment. These findings were helpful for educators to put effective measures to reduce the negative influence of shyness on learning adjustment. Integrating this findings and previous studies (Chen et al., 1995; Liu et al., 2012; Shim and Finch, 2014; Yang et al., 2015), one can opt to influence both directly and indirectly the way shy high school students relate to learning maladjustment topics in an attempt to improve their school adjustment. In this way, high school students, especially shy students, could get through their senior high school stage more smoothly and actively adapt to their school life.

The Association Between Shyness and Learning Adjustment

First, this study found that shyness was negatively associated with learning adjustment, and learning adjustment was negatively predicted by shyness (β = −0.21, $p < 0.001$). This finding suggested that high-shy students were more likely to have problems with learning adjustment; which was consistent with those of previous studies (e.g., Liu et al., 2012; Yang et al., 2015; Coplan et al., 2017) and supported H1. This finding highlighted the negative impacts of shyness as an important personality variable on learning adjustment of high school students. It should arouse the attention of educators to shy high school students' learning adjustment.

Moreover, this study found that shyness not only directly predicted learning adjustment but also indirectly predicted learning adjustment through goal orientation and academic help seeking, that is, the dimensions of goal orientation and dimensions of academic help seeking played mediating roles between shyness and learning adjustment. Specifically, the dimensions of goal orientation and dimensions of academic help seeking played the multiple mediating roles between shyness and learning adjustment.

Shyness Predicted Learning Adjustment Through Mastery-Approach Goals and Instrumental Help Seeking (Teachers)

This study found that learning adjustment was indirectly predicted by shyness through mastery-approach goals and instrumental help seeking (teachers). Specifically, intense shyness may have limited individuals' mastery-approach goals and instrumental help seeking from teachers, resulting in learning maladjustment. Thus, H2 and H3 were partially supported. Shy individuals generally strive to avoid making mistakes and performing tasks poorly, and exert little effort toward acquiring new knowledge or improving their abilities by engaging in challenging tasks; these personality traits can result in learning maladjustment. The fragile theory of academic help seeking suggests that individuals with low self-esteem tend to perceive themselves negatively and are vulnerable when faced with threatening information (Gall, 1985) such as others' negative evaluations of their abilities, which may occur as a result of requests for help. Therefore, individuals with low self-esteem do not often turn to others for help. Shy individuals typically experience low self-esteem and intense concern regarding others' evaluations of them (Cheek and Melchior, 1990; Zhao et al., 2012, 2013). This personality trait leads them to regard seeking help from others as a threat to their own ability upon encountering difficulties in their schoolwork. Therefore, shy individuals seldom regard seeking help from others as a primary problem-solving method. Any subsequent failure

to solve difficult problems independently may result in poor learning adjustment.

These findings highlighted the influence of mastery-approach goals and instrumental help seeking (teachers) on learning adjustment of shy high school students. These findings suggested that shy individuals' correct learning motivation can be cultivated; educators can guide students to improve their abilities by mastering knowledge. Furthermore, when students, especially shy students, asked for help, educators can adopt a supportive and encouraging attitude rather than impatient or ridiculous in order to encourage students form good academic help-seeking habits.

Shyness Predicted Learning Adjustment Through the Multiple Mediating Effects of the Dimensions of Goal Orientation and the Dimensions of Academic Help Seeking

This study found that shyness indirectly influenced learning adjustment through the influence of mastery-approach goals and instrumental help seeking (teachers) ($\beta = -0.21$, $p < 0.001$, $\beta = 0.28$, $p < 0.001$, $\beta = 0.15$, $p < 0.001$, respectively), mastery-approach goals and executive help seeking ($\beta = -0.21$, $p < 0.001$, $\beta = -0.26$, $p < 0.001$, $\beta = -0.11$, $p < 0.01$, respectively), mastery-avoid goals and instrumental help seeking (classmates) ($\beta = 0.09$, $p < 0.05$, $\beta = 0.13$, $p < 0.01$, $\beta = 0.11$, $p < 0.001$, respectively), mastery-avoid goals and executive help seeking ($\beta = 0.09$, $p < 0.05$, $\beta = -0.09$, $p < 0.05$, $\beta = -0.11$, $p < 0.01$, respectively), and performance-avoid goals and executive help seeking ($\beta = 0.43$, $p < 0.001$, $\beta = 0.13$, $p < 0.001$, $\beta = -0.11$, $p < 0.01$, respectively). Thus, H4 was partially supported.

In agreement with previous studies, this study revealed critical links between goal orientation and academic help seeking (Oberman, 2002; Nosaki, 2003; Cheong et al., 2004; Bartels et al., 2011; Okada et al., 2012). Specifically, mastery goals were positively associated with adaptive help-seeking behavior and negatively associated with maladaptive help-seeking behavior. Conversely, performance-avoid goals were positively associated with maladaptive help-seeking behavior and negatively associated with adaptive help-seeking behavior.

The effect sizes of the path through the influence of performance-avoid goals and executive help seeking was the biggest. Shy individuals tend to prioritize task accomplishment and avoid appearing foolish or incapable. Because of their motivation to avoid negative external evaluation, shy individuals are often reluctant to ask teachers for help upon encountering difficulties in their schoolwork. Instead, such individuals often choose to solve difficult problems independently or even to leave problems unsolved. Over time, unsolved problems accumulate and affect shy individuals' learning adjustment. Nicholls (1984) indicated that with respect to task completion, individuals exhibit self-attention tendency and task attention tendency. Self-attention tendency refers to the focus on improving personal ability, whereas task attention tendency refers to the focus on task completion. Differences in motivational tendencies lead to differences in individual academic help-seeking behavior. These findings suggested that educators can pay more attention to shy students and their manifestations and the cause of learning maladjustment in education, and provide psychological counseling intervention for students' shyness thus keeping shyness within a reasonable range and minimizing the direct impact of shyness on learning adjustment. For instance, educators can provide positive information about shy students' performance and achievements, and programs specifically designed to promote shy students' confidence in their abilities rather than avoiding mistakes. Importantly, educators can encourage shy students to overcome the timidity and restrictions that kept them from others and ask others (teachers, classmates, etc.) for help as one of the ways when they faced problems. After solving the problems successfully, students may build their academic efficacy and be motivated to ask for help next time, so as to help them adapt to their studies.

It is worth noting that the goal orientation that characterizes most shy individuals is not completely negative. Shy individuals who strive to achieve mastery-avoid goals tend to ask classmates for help rather than seeking answers independently or avoiding asking for help. Such individuals strive to improve their abilities and successfully complete tasks to avoid the perception of appearing foolish. Because of these behavioral patterns, shyness does not consistently serve as a negative predictor of students' learning adjustment. According to self-determination theory, humans are dynamic organisms with innate potential for psychological growth and development (Deci and Ryan, 2000). Individuals engage in behaviors that are beneficial to their own development and based on self-assessments of personal needs and environmental information.

Limitations and Future Study

This study investigated the relation between shyness and learning adjustment and the potential mechanisms in high school students and found that shyness not only predicted learning maladjustment but indirectly predicted learning maladjustment through the multiple mediating roles of goal orientation and academic help seeking. These findings extend those reported in other studies that have examined the potential effects of shyness on learning adjustment. What's more, this study extended insights from previous studies on learning adjustment by affirming the multiple mediating role of motivation (goal orientation) and behavior strategies (academic help seeking) in the relation between shyness and learning adjustment among high school students. Furthermore, these findings provided a useful reference point for subsequent intervention on learning adjustment of shy high school students.

This study is certainly not without limitations. First, no causal relationships can be drawn due to the cross-sectional design of this study, future experimental studies are expected to be used to replicate this study. Second, this study focuses on the impact of shyness as an individual variable on learning adjustment of high school students, how the environment variable shaped students' shyness has been overlooked. For instance, how the examination-oriented education from kindergarten through high school in China shaped students' shyness, even their learning

adjustment, remains unknown. Future longitudinal studies are expected to extend this study. Third, as far as this study is concerned, the results of this study should be generalized only to the background of oriental culture, whether there are some unique findings differentiating from this study under other culture background need to be further explored. Finally, this study only examined the effect of shyness on learning adjustment and its internal mechanism. However, there may be a more complex two-way association between shyness and learning adjustment, that is, shyness not only affects individuals' learning adjustment. Individual learning adjustment may also affect subsequent level of shyness, which should be investigated in further studies.

AUTHOR CONTRIBUTIONS

LL contributed to writing, data analysis, and the design of the work. XW conducted experiments. YC, YL, and FG contributed in polishing the manuscript.

FUNDING

This study was supported by project of National Social Science Foundation of China (13BSH061) and Humanities and Social Sciences Research Foundation of Ministry of Education of China (17YJA190004).

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

TABLE A1 | Correlations among variables (n = 677).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1																			
2	0.84**	1																		
3	0.86**	0.66**	1																	
4	0.67**	0.44**	0.43**	1																
5	0.82**	0.56**	0.69**	0.42**	1															
6	0.47**	0.38**	0.31**	0.14**	0.23**	1														
7	−0.19**	−0.30**	−0.18**	−0.02	−0.11**	−0.05	1													
8	0.05	−0.10	−0.01	0.38**	0.04	−0.20**	0.37**	1												
9	0.16**	0.04	0.06	0.36**	0.08*	0.03	0.34**	0.45**	1											
10	0.43**	0.37**	0.33**	0.50**	0.33**	−0.03	−0.01	0.38**	0.34**	1										
11	−0.18**	−0.24**	−0.15**	−0.08*	−0.14**	−0.01	0.32**	0.10*	0.09*	−0.08*	1									
12	0.06	−0.01	0.05	−0.08*	−0.14**	−0.01	0.06	0.08*	0.15**	0.04	0.25**	1								
13	0.11**	0.15**	0.13**	0.11**	0.01	0.13**	−0.26**	−0.05	−0.11**	0.13**	−0.20**	−0.07	1							
14	0.25**	0.31**	0.21**	0.07	0.09*	−0.09*	−0.32**	−0.05	−0.10**	0.18**	−0.49**	−0.32**	0.46**	1						
15	−0.26**	−0.34**	−0.22**	0.16	0.19	−0.01	0.57**	0.21**	0.22**	−0.07	0.34**	0.16**	−0.23**	−0.34**	1					
16	−0.21**	−0.26**	−0.18**	−0.09*	−0.19**	0.01	0.42**	0.13**	0.20**	−0.09*	0.29**	0.12**	−0.24**	−0.30**	0.75**	1				
17	−0.22**	−0.21**	−0.19**	−0.11**	−0.19**	−0.07	0.24**	0.03	0.06	−0.06	0.16**	0.10**	−0.05	−0.16**	0.49**	0.20**	1			
18	0.03	−0.07	−0.01	0.21**	0.01	−0.05	0.19**	0.41**	0.29**	0.20**	0.09*	0.12**	0.03	−0.06	0.45**	0.18**	0.08*	1		
19	−0.16**	−0.20**	−0.10*	−0.15**	−0.11**	0.00	0.38**	−0.02	0.01	−0.14**	0.17**	0.02	−0.16**	−0.19**	0.64**	0.34**	0.17**	0.08*	1	
20	−0.24**	−0.29**	−0.20**	−0.13**	−0.16**	−0.04	0.46**	0.12**	0.13**	−0.09*	0.28**	0.13**	−0.23**	−0.28**	0.68**	0.45**	0.18**	0.08*	0.29**	1
M	2.89	2.59	2.55	3.32	2.54	3.65	3.19	3.33	3.54	2.36	3.14	4.01	1.72	2.30	0.65	0.65	0.58	0.77	0.55	0.69
SD	0.63	0.80	0.92	0.87	0.87	0.64	0.67	0.80	0.80	0.82	0.85	0.74	0.61	0.61	0.14	0.25	0.22	0.21	0.24	0.20

*1, shyness; 2, self-expression shyness; 3, shyness toward novelty; 4, shyness for negative social evaluation; 5, shyness toward the opposite sex; 6, unassuming shyness; 7, mastery-approach; 8, performance-approach; 9, mastery-avoid; 10, performance-avoid; 11, instrumental help seeking from teachers; 12, instrumental help seeking from classmates; 13, executive help seeking; 14, avoidance of help seeking; 15, learning adjustment; 16, learning habits; 17, utilization of learning resources; 18, learning motivations; 19, learning satisfactions; 20, learning styles. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.*

TABLE A2 | Model fit indices.

Model	χ^2/df	RMSEA	SRMR	GFI	AGFI	CFI	TLI
Model 1	4.345	0.070	0.056	0.960	0.933	0.931	0.906
Model 2	3.548	0.061	0.051	0.950	0.908	0.932	0.889
Model 3	3.029	0.052	0.036	0.965	0.936	0.943	0.922
Model 4	3.237	0.058	0.049	0.946	0.916	0.930	0.912

TABLE A3 | Bias-corrected bootstrap test on mediating effects.

Independent variable (shyness)	Effects	95% bootstrap CI	
		Low	High
→ Learning adjustment	−0.0300***	−0.0431	−0.0170
→ Mastery approach → learning adjustment	0.0193***	−0.0287	−0.0106
→ Instrumental help-seeking(teacher) → learning adjustment	−0.0057***	−0.0104	−0.0024
→ Mastery approach → avoidance of help seeking	0.0076***	0.0040	0.0123
→ Mastery avoid → avoidance of help seeking	−0.0019*	−0.0050	−0.0001
→ Performance avoid → avoidance of help seeking	0.0089***	0.0028	0.0155
→ Mastery approach → instrumental help seeking(teacher) → learning adjustment	−0.0018*	−0.0035	−0.0009
→ Mastery approach → executive help seeking → learning adjustment	−0.0007*	−0.0018	−0.0001
→ Mastery avoid → instrumental help seeking(classmate) → learning adjustment	0.0006*	0.0002	0.0014
→ Mastery avoid → executive help seeking → learning adjustment	0.0007*	0.0002	0.0018
→ Performance avoid → executive help seeking → learning adjustment	−0.0019*	−0.0041	−0.0002

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

frontiers in Psychology

ORIGINAL RESEARCH
published: 17 August 2018
doi: 10.3389/fpsyg.2018.01466

Beyond Academics: A Model for Simultaneously Advancing Campus-Based Supports for Learning Disabilities, STEM Students' Skills for Self-Regulation, and Mentors' Knowledge for Co-regulating and Guiding

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OPEN ACCESS

Edited by:
Meryem Yilmaz Soylu, University of Nebraska–Lincoln, United States

Reviewed by:
Angela Jocelyn Fawcett, Swansea University, United Kingdom
J. E. Hall, University of Southampton, United Kingdom

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Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 April 2018*
Accepted: *25 July 2018*
Published: *17 August 2018*

Citation:
Kreider CM, Medina S, Lan M-F, Wu C-Y, Percival SS, Byrd CE, Delislie A, Schoenfelder D and Mann WC (2018) Beyond Academics: A Model for Simultaneously Advancing Campus-Based Supports for Learning Disabilities, STEM Students' Skills for Self-Regulation, and Mentors' Knowledge for Co-regulating and Guiding. Front. Psychol. 9:1466. doi: 10.3389/fpsyg.2018.01466

Learning disabilities are highly prevalent on college campuses, yet students with learning disabilities graduate at lower rates than those without disabilities. Academic and psychosocial supports are essential for overcoming challenges and for improving postsecondary educational opportunities for students with learning disabilities. A holistic, multi-level model of campus-based supports was established to facilitate culture and practice changes at the institutional level, while concurrently bolstering mentors' abilities to provide learning disability-knowledgeable support, and simultaneously creating opportunities for students' personal and interpersonal development. Mixed methods were used to investigate implementation of coordinated personal, interpersonal, and institutional level supports for undergraduate science, technology, engineering, and math (STEM) students with learning disabilities. A one-group pre-test post-test strategy was used to examine undergraduate outcomes. Participants included 52 STEM undergraduates with learning disabilities, 57 STEM graduate student mentors, 34 STEM faculty mentors, and 34 university administrators and personnel as members of a university-wide council. Enrolled for 2 years, undergraduates were engaged in group meetings involving psychoeducation and reflective discussions, development of self-advocacy projects, and individual mentorship. Undergraduates reported improved self-efficacy ($p = 0.001$), campus connection ($p < 0.001$), professional development ($p \leq 0.002$), and self-advocacy ($p < 0.001$) after two academic years. Graduate student mentors increased their understanding about learning disabilities and used their understanding to support both their mentees and other students they worked with. Council members identified and created opportunities for delivering learning disability-related trainings to faculty,

mentors and advisors on campus, and for enhancing coordination of student services related to learning and related disorders. Disability-focused activities became integrated in broader campus activities regarding diversity. This research explicates a role that college campuses can play in fostering the wellbeing and the academic and career development of its students with developmental learning and related disorders. It offers an empirically tested campus-based model that is multilevel, holistic, and strengths-based for supporting positive outcomes of young people with learning disabilities in STEM. Moreover, findings advance the knowledge of supports and skills that are important for self-regulating and navigating complex and multi-faceted disability-related challenges within both the postsecondary educational environment and the young adults' sociocultural context.

Keywords: learning disorders, social support, mentors, self-management, self-regulation, young adult, campus community integration, school culture

INTRODUCTION

One category of highly prevalent developmental psychopathologies within educational settings is developmental learning disorders. The term learning disabilities (LDs), or specific learning disabilities, as it is often referred to within educational settings, refers to developmental neuropsychological disorders whose primary difficulties are manifested in the areas of reading, writing, and/or mathematics (American Psychiatric Association, 2013; Scanlon, 2013) but also impact multiple areas of life (Sharfi and Rosenblum, 2014). LDs are highly prevalent on college campuses (Newman et al., 2011) and can pose significant challenges for students with these conditions (Cortiella and Horowitz, 2014). These students enroll in college at rates equal to the general population; however, they graduate at lower rates (38–41%) than those without disabilities (52%) (Lorig and Holman, 2003; Cortiella and Horowitz, 2014; Showers and Kinsman, 2017). College students with disabilities have access to a range of both academic (e.g., writing centers) and disability-related supports (e.g., campus disability support office). However, supports for other aspects of a college student's life, such as social and emotional supports, are also important for bolstering students' abilities to overcome disability-related challenges (Kreider et al., 2015). Moreover, because the range of needed supports and campus-based resources are not typically provided in a coordinated fashion, students often have to seek out and navigate essential supports and campus resources by themselves.

While core manifestations of LDs primarily impact learning, psychosocial problems are also reported (Tanner, 2009; Sharfi and Rosenblum, 2014). Differences in information processing are regarded to be at the core of LDs (Johnson et al., 2010; Scanlon, 2013), which in turn impacts abilities for efficient and/or full participation in various life domains such as interpersonal interactions and daily life activities (Sharfi and Rosenblum, 2014). Cognitive profiles of individuals with LDs often include difficulties with processing speed, working memory, and/or mental flexibility (Hain et al., 2009). Executive function difficulties in LD can interfere with the higher-level skills of organization, abstract reasoning, attention, planning, and/or time management (Moll et al., 2016; Smith-Spark et al., 2016). Such cognitive processing issues pose additional challenges for students with LDs in science, technology, engineering, and math (STEM) fields of study (Asghar et al., 2017). The inquiry-oriented problem-based learning used in STEM instruction places substantial demands on students' cognitive processing and speed (Brigham et al., 2011), which can magnify challenges for students with LDs (Asghar et al., 2017). For undergraduates, the 48% STEM-attrition rate (Chen and Ho, 2012) may further compound concerns regarding college persistence for students with LDs in STEM.

Difficulties stemming from LDs can undermine college success, which requires both adequate academic strategies and life skills such as those needed to function within social, interpersonal, self-care, and work contexts (Kim et al., 2010). Examples of life skills that are essential for all college students include productive time utilization (Macan et al., 1990; Lahmers and Zulauf, 2000), strategic organization (VanZile-Tamsen, 2001), and the management of stress and emotional health (Pritchard and Wilson, 2003). However, these essential skills can pose significant challenges for college students with LDs because of associated cognitive processing difficulties. Moreover, these students require additional disability-related skills that include learning to identify needed disability-related supports and seeking help when necessary (Trainin and Swanson, 2005; Kreider et al., 2015). Within the classroom, help-seeking has been shown to be an important strategy for college students with LDs in compensating for cognitive processing difficulties (Trainin and Swanson, 2005).

Effective self-regulation is a critical skill for youth as they transition to adult roles and contexts and engage in the college process (Murray et al., 2015). Self-regulation refers to the cognitive and emotional processes needed to maintain goal directed behavior in the presence of a challenge or adversity. As such, self-regulation requires effective problem solving, goal setting, flexibility, planning, and decision making. However, due to the nature of disability-related cognitive processing difficulties, youth with LDs can face disability-related challenges to the development of adequate self-regulation abilities needed while in college. College students, as emerging adults, are expected

to navigate increasingly complex life situations. Successful management of the increasingly complex life situations of late adolescence and young adulthood requires adequate abilities for prioritization, task management, and the setting of realistic goals (Murray et al., 2015). Co-regulation refers to the process used by supportive others that fosters the self-regulation abilities of the young person (Murray and Rosanbalm, 2017). Availability of supportive others who can serve as co-regulators is integral to development of strong self-regulation (Murray et al., 2016).

To support the academic and psychosocial needs of undergraduates with LDs, we developed a holistic and multi-level model of campus-based supports referred to as the Comprehensive Support for STEM Students with Learning Disabilities (CS^3LD). The CS^3LD model is a campus-based framework of integrated interventions that target changes at the institutional, personal, and interpersonal levels. Changes at the institutional level are facilitated through the creation of a campus network of LD-knowledgeable personnel, while interventions for supporting students' personal and interpersonal development are concurrently offered. Academic supports include an emphasis on career exploration and mentorship, while psychosocial supports are designed to bolster health and wellbeing. The CS^3LD model is depicted in **Figure 1**; 1A illustrates the CS^3LD conceptual model and 1B shows activities used for implementing the model.

Personal level supports are aimed at fostering the undergraduate's self-awareness and understanding about LDs with an emphasis on identifying and advocating for disability-related strengths. Interpersonal level supports center on learning disability-informed mentorship by a graduate student to cultivate professional enculturation to the student's chosen field of study, with supplementary support for the mentorship from a STEM faculty mentor. Additionally, mentors are assisted in increasing their understanding about LDs. Mentors are also guided in implementation of principles of universal design for learning within their teaching and mentorship. Universal design for learning is an instructional practice that proactively strives to meet the diverse learning needs, strengths, and preferences of all the students who are qualified to enroll in college and the college courses (Burgstahler, 2008). A key institutional level strategy is the creation of a disability-focused Council, referred to as the Partnership Council, to advance a learning disability-aware campus culture.

Integral to the CS^3LD model is the acknowledgment of the interrelated role of the person and the environment in shaping individuals' participation and performance, such as performance of academic, social, and health behaviors within their everyday lives (Bandura, 1986, 1998, 2005; Baum and Law, 1997; World Health Organization, 2007; Moll et al., 2016). The CS^3LD model posits that a student's knowledge and beliefs, together with the university environment, influence participation and behaviors necessary for the student's academic success and overall health and wellbeing. We focused this initial implementation and testing of the CS^3LD model on STEM undergraduates, which was prompted by national prioritization for increasing the number of college graduates who are prepared for the STEM workforce (Chen, 2013). This paper presents the CS^3LD model, its implementation, the outcomes at each level, and its implications for practice and future research.

MATERIALS AND METHODS

Design

Mixed-methods were used to assess implementation of the CS^3LD model during the 4-year timeframe of August 2013 through May 2017. Qualitative data from focused group discussions, participant communications, and individual interviews were combined with quantitative data from outcome surveys and implementation data (e.g., recruitment and project activity records) to describe and understand factors influencing: (1) model implementation, (2) implementation outcomes, and (3) potential for institutional adoption of model activities.

A continuous improvement process of action and analysis was used to refine implementation of model activities at each level (**Figure 2**), which enabled ongoing evaluation of factors affecting model implementation and outcomes (Peters et al., 2013). Feedback was continuously sought from participating undergraduates, mentors, and our institutional level partners to improve CS^3LD activities. This process guided steps taken within the same level of the model as well as refinement of activities at the other levels. The continuous improvement process informed shifts in psychoeducational topical content and emphasis of facilitated discussions with undergraduate participants. The process also enabled us to bring information learned from the undergraduates and mentors to institutional level participants for potential campus-level actions.

A participatory action research approach was used as part of the continuous improvement process to facilitate desired culture changes within the university. Participatory action research entails the active engagement of research participants in the research process with an expressed intent for the actions taken to work toward creating social changes (MacDonald, 2012). Undergraduates created disability-awareness projects, which were designed as content for development of public messaging materials for raising awareness about LDs. Mentors engaged in active learning about LDs and the practices for supporting students with diverse learning styles. Campus partners (i.e., Partnership Council) interpreted insights from the undergraduate participants and the mentors to identify potential solutions for improving relevant campus practices.

A one-group pre-test post-test approach was used to examine undergraduate outcomes.

Subjects and Setting

This study was conducted at the University of Florida, a large research-intensive university in the United States. The study protocol was approved by the University's Health Science Center Institutional Review Board. All personal level (i.e., undergraduates) and interpersonal level (i.e., graduate students and faculty mentors) participants gave written informed consent. Informed oral consent was obtained from institutional level

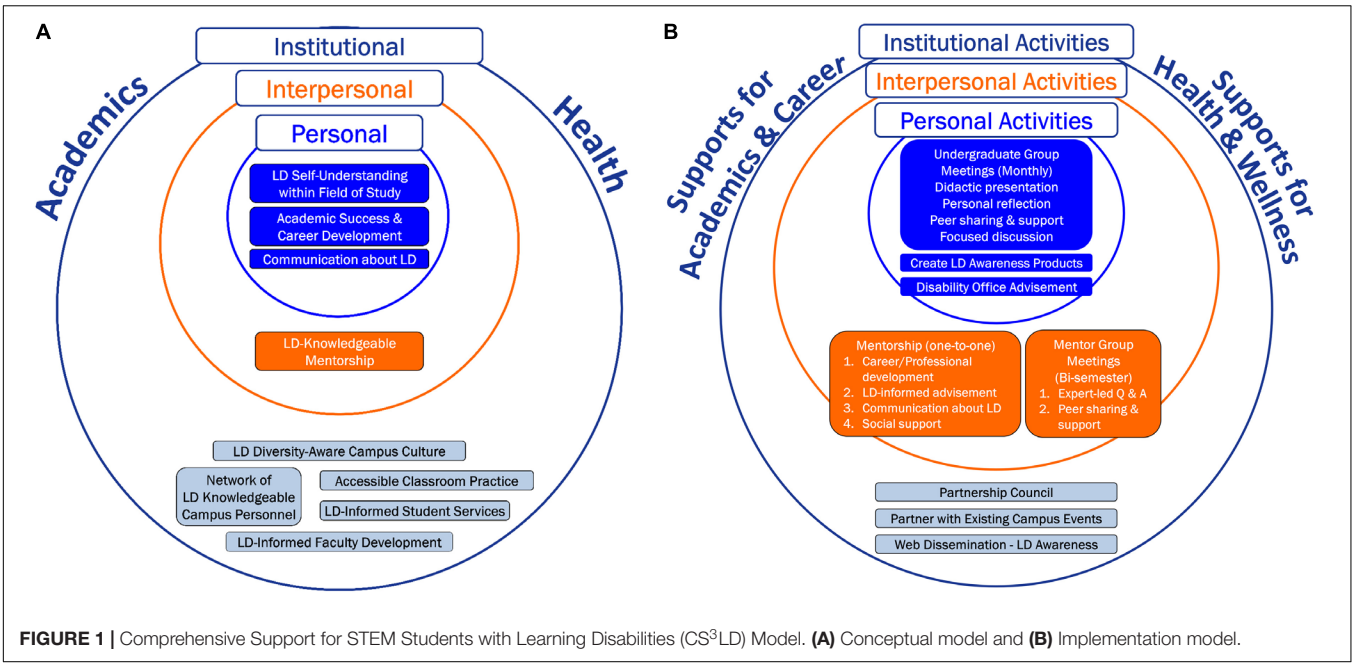


FIGURE 1 | Comprehensive Support for STEM Students with Learning Disabilities (CS^{3}LD) Model. **(A)** Conceptual model and **(B)** Implementation model.

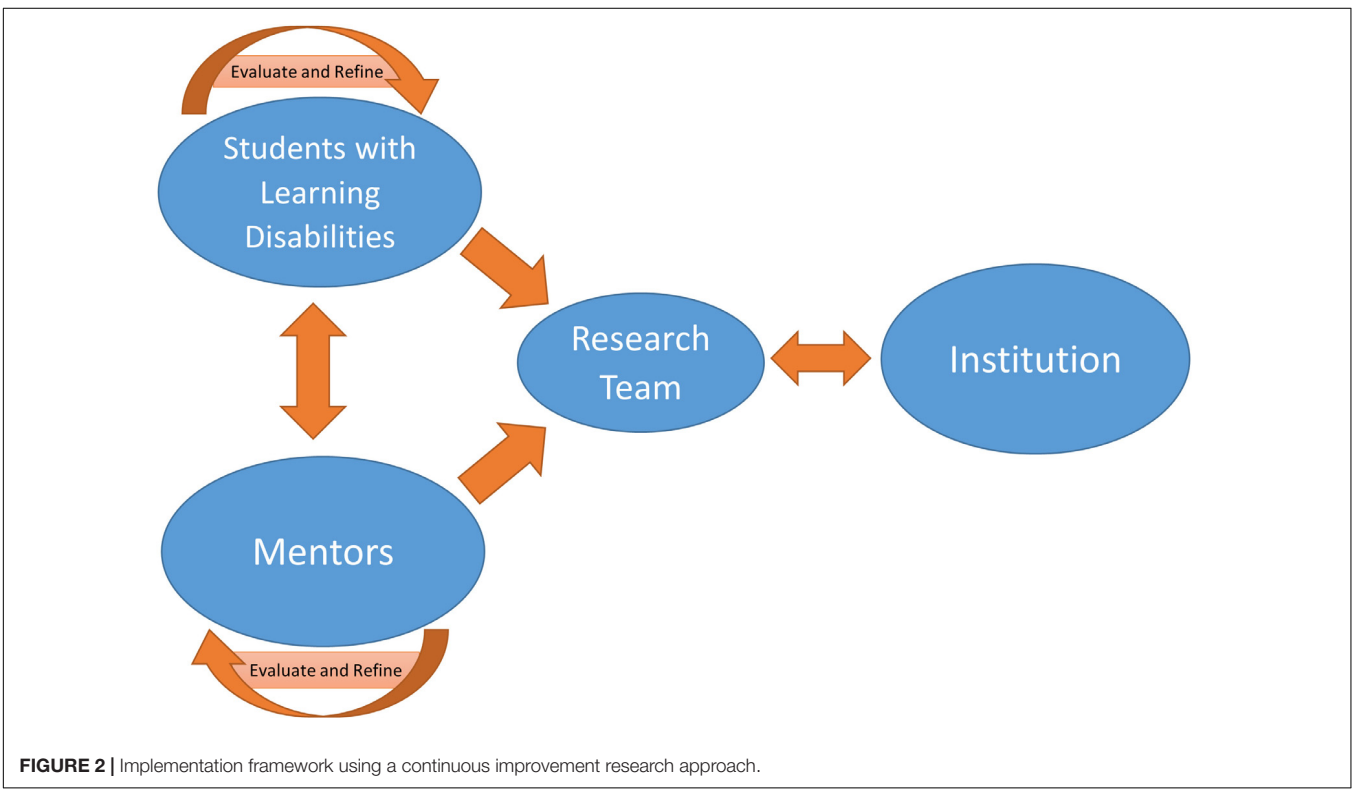


FIGURE 2 | Implementation framework using a continuous improvement research approach.

(i.e., Partnership Council) participants at the beginning of each Partnership Council meeting. Use of oral consent for institutional level participants was approved by the University's ethics committee. No sensitive information was collected from Council participants or discussed at the meetings, and the composition of attendees at each Council meeting varied based on Council members' availability.

Personal-level research participants were 52 undergraduate STEM students who were registered with the campus disability office and eligible to receive academic accommodations related to LDs. Participants were deemed eligible based on the campus disability office's categorization of LDs, which included disorders related to reading, writing, math, coordination, auditory processing, language processing, and/or

attention. Undergraduate participants were not excluded if they had a co-morbid mental health condition. Resultantly, 30% (n = 16) of the study sample reported a mental health diagnosis other than an attention disorder. Mental health conditions included anxiety, depression, and autism spectrum disorder. The primary source of undergraduate recruitment was the campus disability office, which generated LDs specific listservs, shared study information during new student orientations, and posted handouts and recruitment flyers in the disability office and around campus. We used the National Science Foundation's definition of STEM, which also includes the social, behavioral, and economic sciences (National Science, and Board, 2014). Undergraduate participants were enrolled for 2 years (i.e., four consecutive non-summer semesters).

Interpersonal-level research participants included 34 faculty and 57 graduate students, who were recruited as mentors for the undergraduates enrolled in this study. Eligible faculty and graduate student mentors were matched with an undergraduate based on the undergraduate's field of study. Mentors were not expected to have specific knowledge about LDs or disability. Recruitment strategies for faculty and graduate student mentors included word of mouth and campus/department listservs for emailing study advertisements. The campus-wide graduate student listserv was used to recruit our initial wave of graduate student mentors. This recruitment strategy resulted in a large enough pool of potential graduate student mentors, so that subsequent graduate student recruitment only required use of department listservs to target mentors from specific fields of study. Undergraduate and graduate student participants were compensated for each semester that they actively participated in the research activities. **Table 1** reports demographic characteristics of undergraduates with LDs and graduate student and faculty mentors. **Table 2** reports undergraduate participants' diagnostic and symptom characteristics and areas of difficulties.

At the institutional level, we recruited university administrators and personnel (n = 34) from campus academic and student service units to serve on the LD-focused Partnership Council. The interdisciplinary investigative team and the director of the campus disability office used their campus networks to facilitate recruitment of participants for the Council via an introductory email inviting participation. Partnership council meetings were held once each semester (i.e., two to three times each year) at a central location on campus. University personnel (i.e., faculty mentors and Partnership Council members) participated in the study without compensation. **Table 3** details the composition of the Partnership Council.

Data Sources

Qualitative data included meeting notes, written feedback sheets, and audio-recordings taken during group meetings with undergraduates, mentors, and the Partnership Council. Focused discussions specific to evaluation of the model's activities and implementation procedures were held at the end of each academic year. Audio-recordings were transcribed for use in analyses. Instruments used to quantify potential impacts on undergraduate students with LDs included use of the Academic Behavioral Confidence Scale (ABCS) (Sander and Sanders, 2003), the Institutional Integration Scale (IIS) (Pascarella and Terenzini, 1980), the Personal Growth Initiative Scale (PGIS) (Robitschek, 1998), and survey questions developed for this study, which are delineated in **Tables 3**, **4**. Survey questions were assessed to determine face validity and checked for errors such as the presence of double barreled questions and confusing or leading questions. Quantitative instruments were administered at baseline and at the end of each semester for four semesters (i.e., two academic years).

The ABCS is a 24-item self-report questionnaire with adequate reliability and validity in measuring college students' confidence in performing academically related behaviors (Sander and Sanders, 2003, 2006). Each item is scored on a 5-point scale with the rating of one anchored with *Not at All Confident* and five anchored with *Very Confident*. Higher scores indicate better academic self-confidence. The IIS includes 30 self-report items with adequate reliability and validity in assessing the constructs of academic and social integration of college students (Pascarella and Terenzini, 1980). Items are scored on a 5-point scale (5 = *Strongly Agree*, 4 = *Agree*, 3 = *Not Sure*, 2 = *Disagree*, 1 = *Strongly Disagree*) with 10 items requiring reverse scoring. Higher scores indicate better integration. The PGIS is a 9-item self-report instrument rated on a six point scale (1 = *Strongly Disagree* through 6 = *Strongly Agree*). The PGIS has adequate reliability and validity in assessing a person's active and intentional engagement in the process of personal growth during a transitional time period (Robitschek, 1998). Higher scores indicate greater engagement in the personal growth process.

Analysis

Qualitative data were assessed for themes specific to participants' experiences in order to identify salient and actionable aspects of the CS^{3}LD model implementation. An iterative process of ongoing data collection and analysis was used whereby emergent understandings guided subsequent actions and data collections (Richards and Morse, 2013; Richards, 2015). Data were checked immediately for accuracy and completeness, searched for potentially actionable items, and regularly discussed. Decisions regarding refinements to the CS^{3}LD model and/or implementation activities were shared with research participants during the group meetings in order to: (1) verify the accuracy of interpretations of the qualitative data, (2) identify potential barriers to implementation of new or modified activities, and (3) ensure the acceptability of any modification to the activities and/or the model.

Descriptive statistics were used to assess demographic and symptom variables and survey item responses regarding perceived CS^{3}LD impacts. Quantitative data were checked for normality using Shapiro-Wilk tests and visual inspection (e.g., histogram). Resultantly, non-parametric statistics (i.e., Wilcoxon signed-rank tests) were used to test within-subjects differences in the undergraduates' ABCS scores, IIS scores, PGIS scores, STEM professional development

TABLE 1 | Undergraduate student, graduate student, and faculty mentor characteristics.

Participants [*n*]	Gender *n* (%)	Race *n* (%)	Ethnicity *n* (%)	Mean age (SD)	Field of study *n* (%)
Undergraduates with LD [52]	Male 26 (50) Female 24 (46) Not reported 2 (4)	White 37 (71) Black 8 (15) Asian 1 (2) Other 4 (8) Not reported 2 (4)	Hispanic 9 (17) Non-Hispanic 26 (50) Not reported 17 (33)	21.2 (3.5)*	Physical/Biological sciences☼ 20 (38) Social/Behavioral/ Economic Sciences 14 (27) Technology 3 (6) Engineering 12 (23) Mathematics 3 (6)
Graduate student mentors [57]	Male 28 (49) Female 28 (49) Not reported 1 (2)	White 29 (50) Black 6 (11) Asian 13 (22) Other 3 (5) Not reported 6 (11)	Hispanic 5 (9) Non-Hispanic 39 (68) Not reported 13 (23)	24.5 (4.7)†	Physical/Biological Sciences 22 (38) Social/Behavioral/ Economic Sciences 17 (30) Technology 1 (2) Engineering 15 (26) Mathematics 2 (4)
Faculty mentors [34]	Male 19 (56) Female 8 (23) Not reported 8 (21)	White 18 (53) Black 1 (3) Asian 5 (15) Indian 1 (3) Other 2 (6) Not reported 7 (20)	Hispanic 2 (6) Non-Hispanic 31 (91) Not reported 1 (3)	— ¶	Physical/Biological Sciences 11 (32) Social/Behavioral/ Economic Sciences 11 (32) Technology 2 (6) Engineering 8 (24) Mathematics 2 (6)

**n = 51; ☼includes chemistry, physics, astronomy, earth/ocean/atmospheric, agricultural, environmental, life, health sciences; †n = 46; ¶data not collected.*

TABLE 2 | Undergraduate ratings of challenges associated with learning disorders.

Area of difficulty	Overall median rating* (IQR†) *n* = 52	LD only median rating (IQR) *n* = 22	AD only median rating (IQR) *n* = 18	LD/AD median rating (IQR) *n* = 12
Staying focused	75 (62, 94)	63 (49, 85)	90 (73, 98)	75 (67, 89)
Managing time	65 (50, 81)	60 (42, 80)	73 (63, 88)	65 (50, 100)
Extensive writing assignments	65 (31, 85)	58 (26, 84)	65 (31, 75)	80 (56, 89)
Reading comprehension – academic publications	64 (50, 81)	62 (15, 88)	59 (36, 73)	74 (60, 89)
Organization	62 (47, 79)	54 (35, 66)	76 (65, 87)	55 (25, 97)
Memorizing or retrieving information from memory	57 (23, 85)	35 (10, 68)	66 (52, 85)	78 (6, 89)
Following multi-step directions	56 (34, 70)	54 (25, 70)	56 (38, 69)	68 (40, 80)
Expressing thoughts or opinions clearly	52 (22, 71)	40 (13, 70)	53 (23, 60)	68 (57, 79)
Following others speak in conversation	50 (21, 73)	46 (12, 73)	59 (28, 73)	37 (15, 60)
Applying different approaches to one problem	38 (18, 56)	36 (10, 68)	29 (12, 59)	50 (18, 66)
Initiating activities, tasks, or independent ideas	34 (18, 63)	21.5 (9, 50)	52 (30, 70)	34 (5, 56)

**Digital visual analog scale, 0 = no difficulty, 100 = extreme/constant difficulty, †IQR = Interquartile range.*

TABLE 3 | Composition of CS^{3}LD Partnership Council.

Participating entities (*n**)	Representative type *n* (%)
University Offices: Office of the Provost (2), Office of the Dean of Students (1), Office of Faculty Development and Teaching (2) Colleges and Schools: Education (2), Engineering (3$^{\alpha}$), Health and Human Performance (2$^{\alpha}$), Agricultural and Life Sciences (2$^{\alpha}$), Public Health and Health Professions (2$^{\alpha}$), Liberal Arts and Sciences (1), Graduate School (1) University Centers: Disability Resource Center (2), Teaching Center (1), Counseling and Wellness Center (3$^{\alpha}$), GatorWell (3), Career Resource Center (2), International Center (1), Center for Undergraduate Research (1) Academic Programs: Special Education (2), Howard Hughes Medical Institute Science for Life (1) Student Groups: Student Government Disability Affairs Cabinet (4), Gators for All Abilities (2) Personnel Groups: Academic Advisors Council (1)	Administrator¶ 23 (67) Non-administrative faculty 2 (6) Non-administrative staff 5 (15) Undergraduate student leader 4 (12)

**Some representative members represented two entities and are accounted for in both entities. $^{\alpha}$Project investigator included in the count. ¶Administrator = Dean/Assistant Dean, Department Chair, Program Director.*

questionnaire ratings, and self-advocacy questionnaire ratings at baseline and after four semesters (i.e., 2 years). Analyses were run using IBM SPSS Statistics for Windows (Version 24.0, NY: IBM Corp) with two-tailed significance set at the more conservative $\alpha = 0.01$ due to the multiple measures tested.

TABLE 4 | Topics included in 30 undergraduate group meetings held over four academic years.

Topic	Description	Number (%) of meetings the topic was included*
Communication	Information and strategies about how to communicate with people within students' lives	16 (29%)
Advocacy	Information about promoting knowledge about LD** or contributing to a more disability friendly environment	15 (27%)
Stress	Information about how stress presents and strategies for managing stressors	13 (23%)
LD-ADHD† differences	LD/ADHD symptoms, cognitive styles, LD/ADHD brain structure and functioning differences, and strategies for highlighting LD/ADHD strengths	13 (23%)
Misconceptions and stigma	Things they wish others understood, and strategies for promoting understanding and coping with stigma	12 (21%)
Time management	Information and strategies about managing time and tasks	11 (20%)
Strengths and challenges	Knowledge about strengths and challenges, and strategies for highlighting strengths	11 (20%)
LD symptom awareness	Understanding/awareness of how LD impacts life and strategies for preventing LD-related problems	11 (20%)
Accommodations	Information and strategies about how to access academic accommodations	10 (18%)
Health behaviors	Information and strategies about healthy behaviors and developing heath promoting daily routines	9 (16%)
Executive functioning in real life contexts	Information about cognitive processes involved in goal directed behavior within students' everyday life situations and strategies for situational appraisal, prioritization, planning and problem solving within everyday life situations	7 (13%)
Health literacy	Information about general health concepts and strategies for locating and appraising health information	7 (13%)
Self-efficacy	Information and discussions regarding personal judgments in one's abilities to reach goals	6 (11%)
Anticipatory guidance from guests	Guest speakers with LD/ADHD with an established STEM career sharing their experiences and personal insights	4 (7%)
University resources	Information about available university resources	4 (7%)
Disability in the workforce	Information and strategies for how to get accommodations, engage in interviews as an individuals with an invisible disability, and information regarding how disability accommodations in the workplace are similar and different from classroom accommodations	4 (7%)
Mentorship	Reflection/discussions regarding mentorship impacts on college experiences and/or perspectives	4 (7%)
Imparting wisdom for other students	Reflection/discussions regarding information incoming students should know	2 (4%)
Assistive technology	Information about types of assistive technology	1 (2%)
Relationships	Information about interpersonal and professional communication for developing and maintaining relationships	1 (2%)

*Included via presentation slides and/or discussion prompts/probes. **LD = Learning disorder. †ADHD = Attention deficit hyperactivity disorder.

RESULTS

Model Implementation

Personal Level Implementation

Undergraduate group meetings were held monthly during the fall and spring semesters and were led by the study investigators with expertise in disability and LDs. During these group meetings, topical content was provided and followed by focused discussions regarding the students' disability-related experiences specific to the topic. Focused discussions also included strategy sharing, strategy refinement, problem solving for coping with challenges, and problem solving and/or strategizing for preventing future anticipated challenges. Topics were initially informed by the literature and selected from the domains of academics, career, health, and wellness. Undergraduates provided on-going feedback as to the topics selected and the development and refinement of new topics and focused discussions. Topics from the academic and career domains included communication with professors, academic accommodations, assistive technology, and transition to the workplace. Topics from the health and wellness domains included cognitive styles, stress and time management, and communication about LDs to friends and family. Group discussions and participant feedback repeatedly indicated that, although learning and attention disorders are lifelong developmental conditions primarily diagnosed through the health system, our undergraduates with learning disabilities did not view themselves as having a health concern but rather a learning difference. This impacted the content of psychoeducational topics presented within the undergraduate group meetings. Resultantly, health-related topics and group discussions focused on strategies and resources for managing stress and supporting overall wellbeing instead of healthful behaviors, health literacy, or accessing adult system health services. **Table 4** details topics included during monthly undergraduate group meetings. Undergraduate group meetings were held on campus with opportunities offered for making up missed meetings; the overall attendance rate was 85%.

The creation of student-led learning disability-awareness projects evolved from intended plans for the development of a student-led campus-wide learning disability-awareness event, which was not supported by participating undergraduates. We quickly learned that our undergraduates faced additional

diagnostically related time constraints, such as slower reading and slower academic task completion, which prevented them from engaging in leadership of such time-intensive activities. Instead, undergraduates were willing to commit their time to the creation of individually led projects. The projects enabled the undergraduates to engage in a form of advocacy that they could self-manage on their own timeline while also enabling them to take leadership in directing the messaging used to address learning disability-related topics. Engagement in development of these advocacy projects were designed as a tool for encouraging the undergraduate's self-esteem, self-acceptance, and comfort with promoting understanding of the disability in general. **Figure 3** depicts examples of undergraduates' projects and **Figure 4** details topics included in the textual descriptions of the projects as provided or confirmed by the students. Thirty-five undergraduate participants (67%) submitted at least one project.

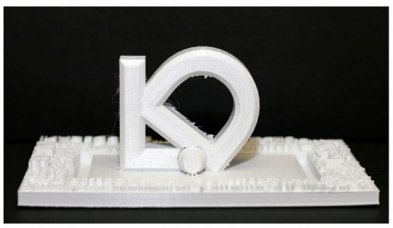
As a means of promoting undergraduates' use and navigation of relevant disability-related services, undergraduates were also

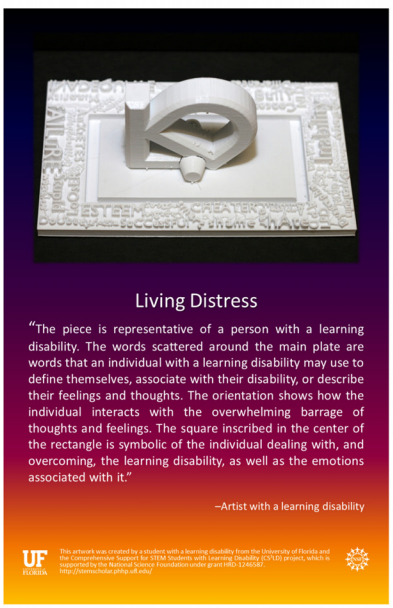
Example 1

Medium: 3-D print

Title: Living Distress

Student's Description: Symbolic of a Learning Disability and how the individual interacts with the overwhelming barrage of thoughts and feelings as well as dealing with, and overcoming, the learning disability.



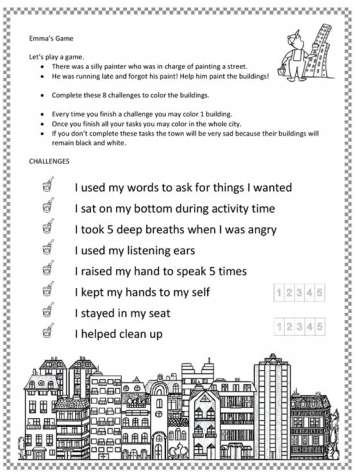


Example 2

Medium: Children's game

Title: Emma's Game

Student's Description: A training tool for a child with ADHD to develop the ability to focus during a non-preferred activity .



Emma's Game- Parent's Explanation

As you know, I am an adult living with ADHD. It's not always easy, but I've found some tricks that help me out and I want to pass them along to Emma. I've created this game to hopefully keep her focused during Girl Scout meetings.

The game's design

- I love to color and studies show that doing something such as coloring during a presentation increases attention and decreases interruptions. A group of 8 college students practice this weekly during our ADHD support group so you're never too old!
  - I designed her game to have many coloring opportunities such as the boarder, the painter at the top, the paint-can bullets, the count to five sections, and of course the buildings.
- Having a clear set of expectations helps keep me in line. I know what other's want from me and can remember to behave within those guidelines.
  - The challenges are based on Emma's behavior in the meetings and are something she can fix on her own.
- An end goal is really important. It incentivizes someone to work with purpose because there is a reward at the end. Despite parenting magazines and society's view I've found nothing wrong with this method. It's how real life works—you must write this paper or you will fail your class.
  - Emma's end goal is to behave and complete her challenges so she can paint the city. The consequence is that the townspeople will be upset if she fails. I didn't want to set a harsh consequence since this is just a pilot activity and may not hold her attention.
- The challenge.
  - I wrote this activity as 'a challenge' because a challenge implies that it can't be done. By challenging Emma, I've created this notion that she can't complete the activity, which we all know is false. These tasks are reasonable and can be attained if she works for them.

Example 3

Medium: Yarn sculpture

Title: Unified Thought

Student's Description: It is well known that students with learning disabilities or differences think in a non-linear fashion but few know that such differences lie in the structure of the brain. Non-linear thinkers view their thoughts in vibrant colors, interacting with one another and compounding the thought process which can be referred to as chaos. On the other side, traditional comprehension is laid out in an orderly fashion with each thought following a rational pattern similar to waiting in line at the bank. I've chosen to display these two systems in a bowl fashion to demonstrate that both mentalities are beautiful and can create functional peace by working together.

FIGURE 3 | Examples of disability advocacy/awareness project mediums, titles, descriptions, and projects as prepared by the student and/or as disseminated as part of institutional level activities.

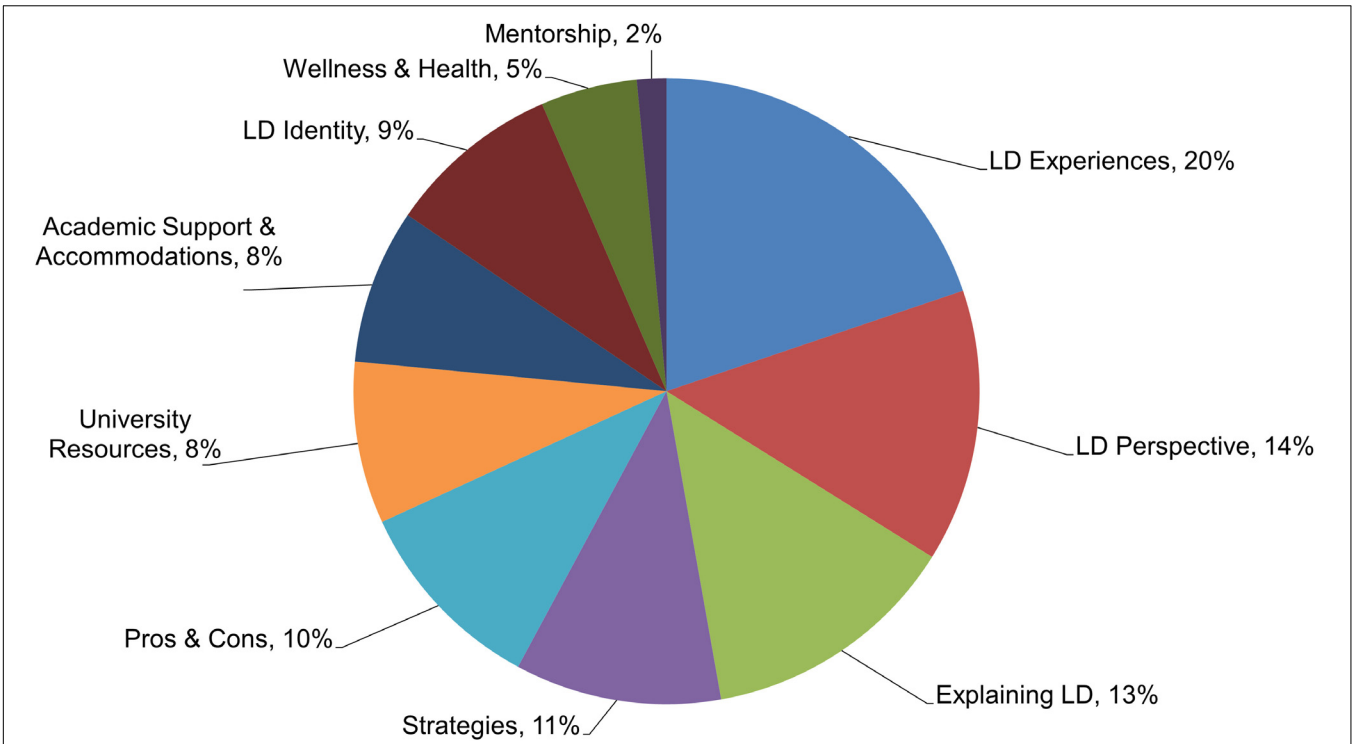


FIGURE 4 | Topics included in undergraduates' projects about learning disabilities (*n* = 102 projects, projects contained multiple topics).

encouraged to meet with their disability office counselor at least once each semester. The disability office counselor meeting rate was 73%.

Interpersonal Level Implementation

Undergraduates met individually with their paired graduate student mentor at least once every other week in the fall and spring semesters for four consecutive non-summer semesters. The primary focus of the mentorship was to facilitate the undergraduate's career development within the student's chosen STEM field of study. On average, undergraduates met with their mentor in person 62% of expected meetings. An additional 19% of mentorship meetings were conducted via phone or video technologies (e.g., FaceTime and WhatsApp).

Mentor group meetings were held two to three times each semester to support mentors' needs for understanding LDs and support mentor skill development, such as communication and coaching strategies and skills. Topical information regarding learning disabilities and universal design for learning were provided at the group meetings. Group meetings were also intended to serve as a forum for focused discussions and for answering mentors' questions. However, as implementation of the CS^{3}LD model evolved, the mentor group meetings also began to serve as a forum for the mentors to share experiences and strategies used in supporting students with LDs. If mentors were not able to attend a group mentor meeting, detailed meeting notes, discussion prompts, and topical information were electronically provided. Mentor group meetings were attended in-person at an average rate of 43% and via asynchronous means averaging 42%.

We originally envisioned the development of multi-disciplinary mentorship teams for each CS^{3}LD undergraduate. Mentorship teams were to include the STEM graduate student/faculty dyad as the primary mentors and would also include other campus personnel who were identified by the undergraduate as important to his or her success (such as an advisor whom the student considered to be a supporter). However, the undergraduates expressed a preference for having only one primary mentor. Undergraduates expressed reluctance for direct mentorship support from the faculty mentor. Only a few ever met with their matched faculty mentor, and none reported meeting more than once. Additionally, graduate student mentors did not utilize the supplementary mentorship support from their paired STEM faculty mentor dyad member. Overall, expectations for the undergraduates to work with multiple mentors proved inefficient and impractical due to the undergraduates' disability-related time constraints.

Institutional Level Implementation

The Partnership Council was the CS^{3}LD model's primary method for discussing, brainstorming, and addressing institutional level concerns regarding students with LDs. The Council was crucial for developing collaborations that facilitated efforts to raise awareness about LDs and principles of universal design for learning. Partnership Council meetings were held once each semester and evolved with only a few modifications. We

originally envisioned that the Council would be composed of university administrators – those in a position to facilitate changes in campus policies. However, we quickly realized that in order to better foster changes in practice, we needed to incorporate both student service providers and student government representatives. Council meetings were initially co-led by the disability office director and the lead investigator who has disability training. Leadership responsibility was eventually assumed by the director of the campus disability office, which represented the institutionalization of the Council.

Outcomes

Undergraduate Personal Level Outcomes

Undergraduates reported improvements in their self-efficacy as college students, their self-advocacy and communication about LDs, and their sense of connection with the campus community. As stated by one participant and reflective of his self-efficacy, "I have noticed that I have gotten a lot of good skills from coming to [the CS^{3}LD group meetings], and my GPA has improved." [U26] Some undergraduate participants attributed their academic success and their ability to graduate from college to the CS^{3}LD supports received. As stated by one undergraduate,

> "CS3LD changed my perspective on disabilities. It taught me to be comfortable in my own skin and to advocate for myself and others.. . . I will be graduating. . . Summa Cum Laude. I think this is all kind of funny. I did not think I would graduate when I was a freshman.. . . I cannot thank [CS3LD] enough for what [it has] done for me personally and academically. . .I hope to be like my mentors and enable others to be the best they can be." [U22].

Two resounding themes, which are foundational to self-advocacy and communication about LDs, repeatedly emerged during the undergraduate group discussions. Firstly, undergraduate participants understood that having a learning disability and using their legally afforded classroom accommodations is not a "cop-out" or an excuse. As stated by one undergraduate, "Some people treat accommodations as an unfair advantage. . .when really it's getting you to where everyone else is."[U1].

Secondly, undergraduate participants were able to view their condition as a difference in thinking and learning rather than a deficiency or disability. "Because we have different ways of learning, it kind of makes us more open, or creative when we [are] approaching what we are doing in life or in school." [U8] Some undergraduates were able to recognize strengths, such those in complex thinking, and could identify situations in which personal differences in their thinking and learning can be an asset. "I love complicated systems and figuring them out and making them efficient." [U33].

Mentorship was an important source of connection to someone in their chosen STEM field. When asked about topics discussed with their mentors, one student responded "classes, research, physics, life, and politics." [U4] For many, their mentor served as an important source of social support and encouragement. "It was a positive experience. [My mentor] helped me think in new ways and do things that I probably would not have done." [U22] Others described developing friendships with their mentors and expressed intentions or desire to maintain a relationship. "[My mentor] was great. I just hope he's still able to meet with me occasionally even though the commitment has ended." [U11].

Quantitative indicators of CS^{3}LD impacts from undergraduates' surveys are summarized in **Tables 5**, **6**; **Table 5** delineates perceived impacts of CS3LD activities, and **Table 6** details changes in ratings specific to STEM professional development and self-advocacy. Undergraduate participants reported positive impacts from receipt of CS^{3}LD supports (**Table 5**), with statistically significant improvements in several self-reported ratings of STEM professional development and self-advocacy (**Table 6**). ABCS scores from 35 undergraduates, and IIS and PGIS scores from 34 undergraduates were available for comparison following four semesters of CS^{3}LD supports. Wilcoxon signed-rank test determined a statistically significant increase in ABCS score (Mdn = 0.380) after four semesters (Mdn = 3.790) compared to baseline scores (Mdn = 3.500), z = 3.252, p = 0.001. A significant increase in IIS score (Mdn = 0.426) was also found following four semesters (Mdn = 3.833) compared to baseline (Mdn = 3.310), z = 3.958, $p < 0.001$. PGIS scores did not significantly change.

Mentor Interpersonal Level Outcomes

Mentors increased their understanding about LDs and used this knowledge to support both their mentees and other students they worked with. The intended career paths of graduate student mentors varied and included intended careers in STEM education, industry, and research. Overwhelmingly, graduate student mentors reported greater appreciation of learning differences within their classrooms and within their research teams.

> "Not only am I much more aware and sensitive to the number of students with LDs, but I have become proficient at recognizing symptoms, allowing me [to] change teaching styles if necessary." [M94].
>
> "I hold myself to a higher standard now when it comes to dealing with students and my [research assistants] more generally. Even something as simple as asking my [research assistants] if the way that I'm training them is working, and how they learn best." [M109].

Mentors also reported gains in their own self-understanding as a result of their involvement in the CS^{3}LD research project.

> "I've become much more aware of how I learn and my own learning limitations, and being open about those so that I can open up a dialog with whoever I'm working with. . . In doing so, it has helped me avoid frustrating situations in all of my working relationships, not just those with LD." [M109].

Another mentor, after gaining understanding of LDs, questioned his own learning challenges and was eventually diagnosed with a learning disorder.

Overall, the interpersonal level mentorship outcomes were positive. When graduate student mentors were surveyed, 33 of 38 respondents (87%) reported being very or extremely satisfied with their involvement in the CS^{3}LD project. All respondents reported

TABLE 5 | Perceived CS^{3}LD Model impacts on undergraduate students with learning disabilities.

Area of perceived impact of CS^{3}LD activities (*n*)	% Moderate or significant positive impact	% Minimal positive impact	% No impact	% Negative* impact	Mode response$^{\alpha}$
Understanding of learning disabilities (LD) (41)	78	20	2	0	Significant positive impact
Ability to articulate about LD in STEM (41)	78	20	2	0	Significant positive impact
Navigation of STEM field (42)	50	33	17	0	Moderate positive impact
Satisfaction with chosen STEM field (42)	57	21	21	0	Significant positive impact
Professional skills (42)	57	26	17	0	Moderate positive impact
Academic self-confidence (42)	62	24	14	0	Moderate positive impact
Connection to campus groups and supports (42)	52	40	7	0	Significant positive impact

**All negative response options are summarized as negative. $^{\alpha}$Survey response options: Significant negative impact, moderate negative impact, minimal negative impact, no impact, minimal positive impact, moderate positive impact, significant positive impact.*

TABLE 6 | Rating changes after four semesters for STEM professional development and self-advocacy within STEM field of study.

Question (*n*)	*Z* statistic	*p*-value* (2-tailed)	Median difference in ratings$^{\alpha}$
Questions about STEM professional development			
I make positive impressions with professional dress, conduct, and speech (34)	−3.119	**0.002**	0
I organize tasks and manage time to complete tasks by deadlines (34)	−2.025	0.043	+1
I respond promptly to phone calls, emails, or letters (34)	−3.073	**0.002**	+0.5
I am satisfied with my exposure to research and/or experiential opportunities in my STEM discipline at the University of Florida (34)	−2.488	0.013	+1
My University of Florida experiences have helped me identify personal strengths and weaknesses with my chosen STEM field (34)	−4.623	**<0.001**	+1
I have been assisted in identifying and overcoming my weaknesses within my STEM discipline (34)	−2.401	0.016	+1
Questions about learning disability (LD) self-advocacy related to academics/STEM field of study			
I know my strengths and limitations in the learning process (31)	−4.213	**<0.001**	+2
I know what accommodations I need to bypass my limitations (33)	−4.275	**<0.001**	+1
I can advocate for my specific LD needs with my instructors (33)	−4.094	**<0.001**	+1
I know about supports at University of Florida specific to LD students (32)	−3.88	**<0.001**	+1
I know how to be clear in requests and be prepared with explanations regarding my LD (33)	−3.716	**<0.001**	+1
I know how to communicate about my LD with others (33)	−3.654	**<0.001**	+1
I prepare ahead for communications about my LD with others (33)	−4.43	**<0.001**	+1
I am comfortable educating others about my LD (33)	−2.185	0.029	0
Questions about learning disability (LD) self-advocacy related to health and wellbeing			
My friends know about my LD and associated limitations (33)	−3.653	**<0.001**	+1
I can ask for help from my friends when faced with limitations (33)	−4.066	**<0.001**	+1
I have sought up-to-date information about my LD by talking to specialists and doing my own research (33)	−3.717	**<0.001**	+1
I understand my LD (33)	−4.351	**<0.001**	+1
I know how LD impacts academic progress and health Behaviors (11)	4.183	0.006	+2
I have an expert on LD on my healthcare team (33)	1.277	0.245	0

**Significance set at $p < 0.003$ using Bonferroni correction of $p < 05/20$. $^{\alpha}$Response options: 5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly disagree.*

positive impacts in their understanding of LDs. "I feel that I am far more understanding and hopefully am able to provide guidance better now that I understand the difficulties associated with many of the LDs." [M56].

Institutional Level Outcomes

At the institutional level, we aimed to change the culture of how students with LDs are supported on our campus. We did this through the creation of a campus-wide network

of administrators, faculty, staff, and graduate students who are knowledgeable and coordinated in supporting the success of undergraduate students with LDs. For study investigators, mentors, and Partnership Council members, a gradual shift occurred in the viewing of LD as a learning difference instead of a health condition or a neurologic disorder.

Members of our Partnership Council identified and created opportunities for us to engage in already existing campus-based mechanisms for faculty and staff training. We used the words and advocacy messaging (i.e., learning disability awareness projects) created by undergraduates to illustrate learning disability-related experiences and to strengthen campus-based trainings. From the 102 learning disabilities-awareness projects created by undergraduate participants, 30 projects were selected for editing and readied for dissemination as public service information and/or training tools. Fourteen art works, five brochures/pamphlets, and eleven videos were disseminated with assistance from the Partnership Council. Disseminated messages covered topics such as the pros and cons of having a learning difference, issues faced by students with disabilities, communicating with professors, and raising awareness that individual with LDs live, study, and work among everyone.

Institutional-level impacts stemming from Partnership Council activities also resulted in enhanced coordination of student services. After undergraduate participants spoke of desires for learning disability-informed support in preparing to transition to the workplace, the University's disability office and career services office partnered to create a series of workshops focusing on disability in the workplace. Additionally, the career services office partnered with the disability office to permanently house a career services advisor within the disability office. Student government involvement in the Partnership Council inspired one representative to spearhead the formation of a new student group. This group became a University sanctioned student group with a goal of empowering students with disabilities by promoting disability advocacy and leadership development opportunities for fostering a more inclusive campus community.

Following the Partnership Council's institutional adoption, it was renamed as the Neurodiversity Council to reflect the evolved focus on supporting students with a broader range of learning styles and strengths. The range of cognitively diverse students on the University's campus are supported by the Council's focus on increasing campus members' understanding of Universal Design for Learning and its application in classrooms, research laboratories, and across student-centered services such as student counseling, wellness services, and career advisement services.

Broader shifts in our campus' understanding and valuation of diversity have also influenced the membership of and discussions within the Council. Specifically, disability is articulated as a type of diversity, which is valued for contributing to the richness of experiences and perspectives afforded from diverse campus members. As such, the Neurodiversity Council includes members from other diversity groups on campus. Disability is now included within broader campus activities and conversations regarding diversity.

Social Validity

Campus Engagement

The social validity of the CS^{3}LD model was evidenced by the high levels of interest during all phases of study recruitment and by participant retention at all levels. Response to recruitment efforts was largely enthusiastic with enrollment in CS^{3}LD activities primarily limited by the study's available resources. No difficulties were encountered in enrolling undergraduate, graduate student, and Partnership Council participants. The number of potential undergraduate and graduate student participants exceeded the targeted recruitment levels during the four cycles of undergraduate student recruitment and in three of four cycles of graduate student recruitment. Recruitment of the faculty mentors required the most effort. Continual expansion of Partnership Council membership occurred over the 4 years and was prompted by Council members' discussions centering on strategies for improving awareness and learning disability-related supports. **Figure 5** details the campus engagement model at our university.

Retention

Of the 52 undergraduates recruited, 46 were enrolled in time to participate for 2 years (i.e., four semesters) with 35 (76%) completing the 2 years. A total of 13 (25%) undergraduates withdrew from the study; six withdrew due to scheduling constraints, three left the university, two withdrew because of poor fit (e.g., did not like group meeting format), and two withdrew for positive opportunities (i.e., paid internship and early graduation). Of the 57 graduate student mentors, 42 (74%) completed mentorship obligations, 14 (24%) withdrew from the study, and 1 (2%) was never matched with an undergraduate mentee. Research participation was complicated for nine international students (i.e., eight graduate students and one undergraduate) by visa restrictions limiting compensation beyond the student's educational program. Of these students, five graduate mentors and one undergraduate chose to participate in the study without compensation. No faculty mentors or Partnership Council members withdrew from project engagement without a change in employment (e.g., left or changed positions within the university, retired). Partnership Council members who left the Council facilitated their own replacement on the Council from alternate or incoming personnel within their unit.

DISCUSSION

This research tested the CS^{3}LD model of campus-based holistic and integrated supports for students with LDs. Findings support the model's strengths in advancing students' self-efficacy, self-advocacy, self-management, STEM career exploration and professional development, and sense of campus connection. These findings are important as postsecondary success for students with disabilities is linked with receipt of non-academic supports, such as supports for building career awareness, self-advocacy, and interpersonal skills (Haber et al., 2016). Individual

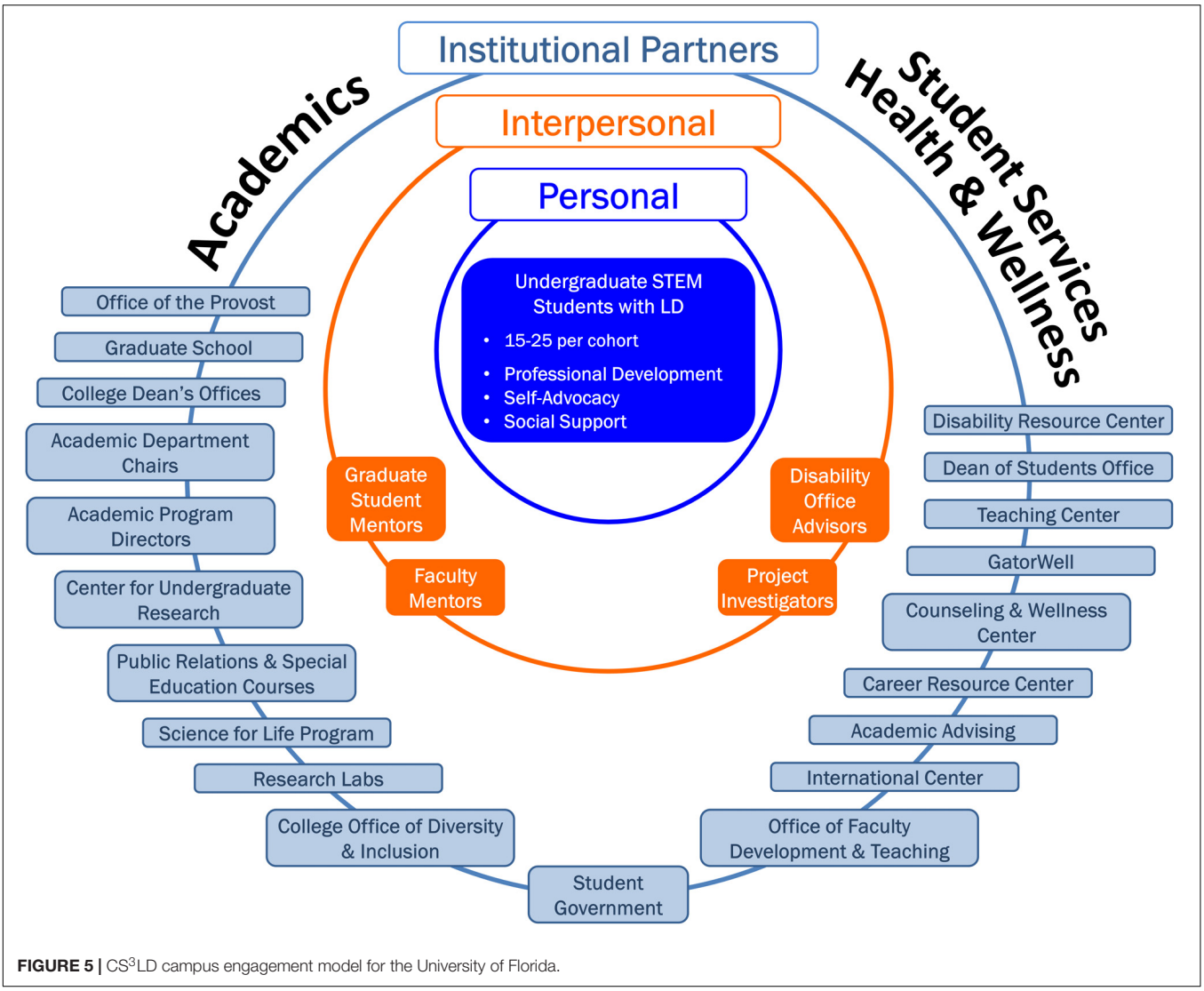


FIGURE 5 | CS^{3}LD campus engagement model for the University of Florida.

factors, such as those found to improve in our study, are important for supporting students' academic satisfaction and success (VanZile-Tamsen, 2001; Pritchard and Wilson, 2003; Kim et al., 2010; Norvilitis and Reid, 2012; Showers and Kinsman, 2017). Study findings contribute evidence for the importance of providing holistic campus-based supports that are delivered in a purposeful and coordinated manner for students with learning and related disorders. Both this finding and the CS^{3}LD model are consistent with contemporary conceptualizations of college success, which incorporate considerations of how well a student adjusts to college life and adapts to its demands within paradigms of success (Norvilitis and Reid, 2012),

The CS^{3}LD model is distinctive in its coordinated provision of multi-level and holistic supports for students with LDs as they progress through college toward development of their desired careers and adult roles. On all levels, CS^{3}LD model activities acknowledged and fostered understanding of challenges associated with LDs and focused on strengths. The CS^{3}LD approach nurtured self-efficacy in the college student role while also promoting connections with supportive disability-informed others on campus. Supports nurtured students' abilities for self-managing actions and societal expectations for independence and self-regulation that extended beyond the classroom to contexts of social activities, everyday life situations, and personal and professional role development.

For undergraduates in the study sample, positive changes were observed on measures of self-efficacy, campus integration, and self-advocacy. These findings contribute evidence that is indicative of the benefits in using a strengths-based approach when providing academic and psychosocial supports for transition-age individuals with developmental learning and related disorders. Personal and interpersonal level activities provided undergraduates with opportunities to interact with others in STEM with similar experiences and understanding of disability-related challenges and strengths. Such interpersonal experiences are important for nurturing personal and career identity development, persistence, and advanced scientific literacy (Lee and Fradd, 1998; Dika and D'Amico, 2016;

Rahm and Moore, 2016). This study provides important insights into important processes which can be promoted by campus-based activities for cultivating the positive academic and psychosocial development of young adults with developmental learning disorders. As such, this study contributes knowledge salient to the fields of positive psychology (Peterson, 2006) and positive youth development (Lerner et al., 2005), disciplines which are believed to be important for lessening the damaging impacts of disability (Gable and Haidt, 2005).

At its core, the key model components of personal and interpersonal level activities were designed to promote the undergraduate's self-regulation abilities. Self-regulation, in its role for supporting goal-directed behavior, is foundational for lifelong functioning and wellbeing (Murray et al., 2015). Importantly, interpersonal level activities extended promotion of undergraduates' self-regulation by simultaneously developing the mentors' capacities for co-regulation. Co-regulation within the CS^{3}LD mentorship refers to the interactive process used by the mentors in supporting the regulation and development of their undergraduate mentee's self-regulation abilities (Rosanbalm and Murray, 2017). Mentors' co-regulation skills were bolstered through the provision of knowledge about LDs and support for mentoring skill and co-regulation strategy development provided within the mentor group meetings.

CS^{3}LD personal and interpersonal activities are promising approaches for nurturing students' self-regulation and for fostering the wellbeing of students with LDs. Several gaps exist within self-regulation intervention research; most notably a lack of young adult interventions, which include both self-regulation and co-regulation components, and evidence for relevant young adult functional outcomes of the self-regulation interventions (Murray and Rosanbalm, 2017). The positive changes observed in the sample's social/campus integration, as measured with the IIS, suggest a potential relevant functional outcome for future self-regulation interventions of young adults with disabilities pursuing higher education. Additionally, this study contributes acutely needed empirically derived insights evidencing the promise of including co-regulation skill development (i.e., learning disability-informed mentorship) within interventions for self-regulation (i.e., group meetings with engagement in a tangible self-advocacy activity) as developed for young adult populations.

Undergraduates preferred mentorship from a more senior student with experience in navigating a path comparable to the one desired by the undergraduate mentee. This aspect of the mentorship, in combination with the mentor's understanding of LDs, represent the key aspects of the mentorship which facilitated the mentee's ability to identify with his or her mentor. This is consistent with mentorship research reporting higher quality learning and better quality mentor-mentee relationships with mentors who are perceived as similar (Allen and Eby, 2003). This finding is important for guiding potential implementation of the CS^{3}LD model on college campuses without or with smaller graduate programs.

CS^{3}LD model is an interdisciplinary approach for holistically supporting student success on college campuses. The incorporation of multiple disciplines within the research team and among all levels of research participants was strength of this study. The wide-ranging disciplinary perspectives served to provide diverse perspectives that bolstered the continuous improvement process used in implementing and refining model activities. The study team was represented by investigators from engineering, life sciences, psychology, health education, and rehabilitation. These varying disciplinary perspectives strengthened the study design, implementation, and interpretation of research findings.

Our combined use of continuous improvement and participatory action research approaches was integral to decisions made in refining and implementing CS^{3}LD model activities. Incorporating the voices of the students with LDs alongside mentor voices was critical in informing institutional level activities and served to strengthen campus-based trainings regarding implementation of universal design for learning created for advisors and instructors. Institutional level activities were aimed at creating a supportive campus environment for students with learning and other disabilities. Shifting the composition of the Partnership Council to include membership of non-administrators helped focus institutional level efforts from potential policy changes to actions for changes in service delivery. Changes resulting from efforts of Partnership Council members had an immediate and direct impact on service delivery/supports for students with LDs. Involvement of representatives from student government and other diversity (e.g., gender diversity and ethnic minority) groups within the Council resulted in framing LDs and disability in general, as a matter of diversity and inclusion.

This study illustrates the use of campus-based processes that were instrumental in facilitating positive changes in culture and practice. The concept of neurodiversity as adopted by the university-wide Council highlights the fact that individuals with LDs, and many other invisible disabilities, contribute diverse experiences and skillsets that serve to enrich the campus environment. Incorporating disability into postsecondary educational institutions' diversity efforts is a key approach for impacting institutional changes. CS^{3}LD model activities are important for their potential to raise awareness and shape social-cultural normative attitudes about disability on college campuses while simultaneously fostering the individual level success of academically and psychosocially vulnerable students.

Limitations

The primary focus of this research was to test the implementation of the CS^{3}LD model of support whereby the means in which the model was implemented were specific to our large research intensive university. Importantly, this study was not designed to test the effectiveness of the interventions implemented, but rather to test the implementation of the model. While overarching lessons can be learned from this implementation, care should be exercised in attempting to generalize implementation strategies described. Future studies should test model implementation at other universities, with other clinical groups, and with students

not engaged in a STEM education. Additional research is needed that enables a statistical multi-level analysis in order to more robustly test the multi-level CS^{3}LD model. Additionally, judicious interpretations of personal level (i.e., undergraduate participant) outcomes should be used as this was a one-group pre-post analysis of data from a small sample of students with LDs. Further investigation is needed to test for treatment effects of the psychoeducational groups and mentorship interventions used within the CS^{3}LD model.

CONCLUSION

The CS^{3}LD model, as a framework for coordinated holistic campus-based interventions, is a promising practice that positively impacted participating students with LDs, mentors, and the campus environment. Implementation of a comprehensive, multi-level, and coordinated model of supports for students with LDs is feasible and was well accepted by students and campus stakeholders for fostering the performance, development, and campus connections of undergraduates with LDs. Mentorship from someone in a similar field of study and who understands LDs as differences in learning, is a key component of the model for better promoting the undergraduates' sense of self-confidence, success, and connectedness. Transforming the understanding of LDs as differences in learning for individuals working and learning on college campuses can be a powerful strategy for harnessing the diverse strengths of students aspiring to join the STEM professional workforce. Multi-level and holistic supports are important for assisting young people in meeting the multifaceted demands associated with striving for college success as an individual with a developmental learning disorder. The continued development and testing of holistic strengths-based interventions that advance the self-regulation abilities of young adult college students with LDs is merited. The proliferation of interdisciplinary, multi-level, and holistic supports is warranted for promoting the wellbeing of students with learning and related disorders and for improving the postsecondary educational opportunities and experiences for these individuals.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of Human Subjects Protection Guidelines, University of Florida Gainesville Health Science Center Institutional Review Board (IRB-01). The protocol was approved by the University of Florida IRB-01. All subjects gave written or oral informed consent, as appropriate, in accordance with the Declaration of Helsinki.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

All authors contributed extensively to the work presented in this paper. CK, C-YW, M-FL, SP, CB, AD, and WM contributed to the study conception and design. SM and DS contributed to acquisition of the data. CK, C-YW, M-FL, SP, CB, and DS contributed to analysis and interpretation of the data. CK, SM, M-FL, and C-YW drafted the work and all authors contributed critical appraisal and revision for important intellectual content. All authors provide final approval of the version submitted for publication and agree to be accountable for all aspects of the work as presented.

FUNDING

This research is based on work supported by the U. S. National Science Foundation under Grant Number HRD-1246587. This work is also supported in part by the NIH National Center Medical Rehabilitation Research (NICHD) and the National Institute of Neurological Disorders and Stroke (K12 HD055929), and the NIH/NCATS Clinical and Translational Science Award to the University of Florida UL1 TR000064. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation or the National Institutes of Health.

ACKNOWLEDGMENTS

The authors thank Dr. Douglas Levy, Mr. James Gorske, and Ms. Meri Nantz for their contributions to the initial conceptualization of this research; Dr. Mary Anne Steinberg, Dr. Anthony DeSantis, and our numerous volunteer student research assistants for their contributions in implementing this research; and our research participants and campus partners for their commitment to this work.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychiatry

ORIGINAL RESEARCH
published: 11 September 2018
doi: 10.3389/fpsyt.2018.00432

Frontal Alpha EEG Asymmetry Before and After Positive Psychological Interventions for Medical Students

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Subjective well-being (SWB) refers to traits concerned with happiness, fulfillment and enrichment and is a substantial predictor of a flourishing life. Interest in the promotion of well-being has blossomed in recent years, and it is widely reported that positive psychological interventions (PPIs) can effectively improve SWB. However, to date, the neural correlates of PPIs remain elusive. Since previous research has suggested that emotion regulation might be the theoretical foundation for potential working mechanisms, here we used electroencephalography (EEG) techniques to identify whether the intentional increase of subjective well-being through PPIs was associated with greater tonic left frontal activation. Fifty-five students met the inclusion criteria and were allocated to a randomized controlled trial that was single blinded. The intervention group received PPIs once a week for 10 weeks (n = 28). Meanwhile, students in a placebo control group (CG, n = 27) were asked to write down early memories every day for 10 weeks and were invited to share voluntarily at the weekly meeting. Measures of subjective well-being, depression and anxiety were assessed at pre-test and post-test. Forty-eight students completed the post-test, and the collected data were analyzed across time (PPIs, n = 25; CG, n = 23). It was found that students undergoing the 10-week PPIs reported larger improvement in SWB, and greater relief in self-rated depression and anxiety from pre-intervention to post-intervention than did those in the control group. As expected, in conjunction with the promotion of subjective well-being and the amelioration of emotional distress from pre- to post-treatment in the intervention group, a significantly increased coefficient of frontal alpha EEG asymmetry was found. In summary, these findings suggest that adaptive emotion regulation, which is characteristic of greater tonic left frontal activation, reflects the efficiency of PPIs and highlights the frontal alpha EEG asymmetry as a neural substrate linking PPIs and mental health.

Clinical Trial Registration Number: ChiCTR-ROC-17012636

Keywords: subjective well-being, positive psychological interventions, frontal alpha EEG asymmetry, emotion regulation, mental health

OPEN ACCESS

Edited by:
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University of Southampton,
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Specialty section:
This article was submitted to Public Mental Health, a section of the journal Frontiers in Psychiatry

Received: *03 April 2018*
Accepted: *21 August 2018*
Published: *11 September 2018*

Citation:
Xu Y-Y, Feng Z-Q, Xie Y-J, Zhang J, Peng S-H, Yu Y-J and Li M (2018) Frontal Alpha EEG Asymmetry Before and After Positive Psychological Interventions for Medical Students. Front. Psychiatry 9:432. doi: 10.3389/fpsyt.2018.00432

INTRODUCTION

Recent years have seen a blossoming interest in the field of human subjective well-being (SWB). SWB refers to a broad category of phenomena that include people's evaluations of their lives (e.g., "life is satisfactory") and emotional responses (e.g., "I am happy") (1). As a predominant positive psychological component, subjective well-being is considered to play a critical role in fostering the quality of people's social lives (1). According to Shin et al. (2), positive affect contributed to the promotion of peer acceptance, teacher-assessed adaptation, and initiating positive relationships with peers among children. As is revealed by Boehm and Lyubomirsky (3), the most popular and likable people are usually those more happier ones. In addition, there are a number of studies on the predictive power of SWB on health and longevity (4). For example, Xu and Roberts studied 6,856 participants from Alameda Countyin California over a period of 28 years (1966 to 1993). The results indicated that positive affects, satisfaction with life, and domain satisfactions are correlated with lower risk of all-cause and natural cause mortality (risk ratios from 0.90 to 0.99). Unnatural-cause mortality can also be predicted by positive affects and satisfaction with life (risk ratios from 0.86 to 0.96) (5). Just as Diener proposed, "subjective well-being is not only a desirable outcome but can also be an important predictor of future life outcomes" (1).

Considering the beneficial effects of SWB, intentionally cultivating SWB through well-being interventions can therefore serve as an antidote to negative emotions and motivates people to seek for rewards in their lives (6). In addition, the frequency of negative affect, behaviors, and thoughts, which are typical features of various risk factors leading to psychopathology, will thus be reduced (7). An ideal way to increase well-being is by means of positive psychological interventions (PPIs) (8, 9). According to Layous et al. "PPIs are treatment methods or intentional activities that aim to cultivate positive feelings, behaviors, or cognitions" (7). They are simple and easy to use, and most are self-administered, with participants accepting unified and normalized training instructions and performing the activities themselves (7). These intentional activities include: *writing about three good things that happened each day*, *making a gratitude visit* or *writing letters of gratitude*, *identifying signature strengths and using them in a new way* (10), *expressing gratefulness for life's blessings* that people experience each day (11), and *imagining the best possible self* (12), etc. All of these exercises underline the cultivation of personal character strengths shared by individuals with a high level of well-being (such as three *good things* [the strength of hope], *gratitude visit* [the strength of gratitude] and *counting kindness* [the strength of kindness]) (13). These diverse PPIs strategies have shown beneficial effects on subjective well-being in general (14, 15) and on symptoms of various mental disorders (16, 17).

The beneficial effects of PPIs are well recognized and certified, while more work needs to be done on the underlying mechanisms of PPIs, particularly the supporting empirical evidence. Considering the improvement in emotional status is one of the most noteworthy benefits of PPIs. It is argued by some researchers (18) that the cultivation of adaptive emotional regulation plays the key role in health promotion; and in their reports, emotion regulation strategies are proposed as the theoretical foundation of possible working mechanisms, which contain "situation selection, situation modification, attentional deployment, cognitive change, and response modulation" (19). A recent study conducted by Wellenzohn et al. (20) tested the proposed mechanisms. In this study, a random division was made among 695 adults, and all the participants were randomly assigned to one of "three funny things" intervention group, which needed they write down three funny things every day in a way to center on the present, the past, or the future, respectively, or a placebo control group (i.e., early memories exercises). The results indicated that the intervention could increase participants' well-being and decrease depression significantly. Moreover, compared with the placebo control group, the intervention groups were more capable in boosting savoring and turning the attentional deployment to the positive (20). This initial study provides the first support for the proposed working mechanisms of effective PPIs. However, studies of the neural correlates of PPIs are remain elusive.

Extensive electroencephalography (EEG) research has shown that emotion-related traits and states are associated with frontal EEG asymmetry and the manipulation of an individual's anterior alpha EEG asymmetry is associated with later emotion regulation and emotion perception (21). For example, Jackson and his colleagues based on 47 adults suggested that greater left superior frontal activation at pre-test was correlated with a lower startle magnitude after the offset of negative stimulus (22). In another EEG study (23), biofeedback training was randomly given to 18 right-handed female participants, which were designed to increase right frontal alpha relative to left frontal alpha (Group A) or in the opposite direction (Group B); before and after the 5-week intervention, three short emotionally evocative silent films (happy, neutral, and sad) were presented. The results demonstrated that participants in group B reported more positive emotions when they watched the happy films and expressed less corrugator activation when they watched the sad films (23).

Although a recent EEG study had found that there was a positive correlation between left-sided frontal activation and the levels of SWB (24), it is not clear whether the intentionally increase of subjective well-being through PPIs was associated with greater tonic left frontal activation. To address this gap in the literature, here we examined the frontal alpha activities before and after PPIs, and we hypothesized that the PPIs might boost an individual's mental well-being to the extent of the improvement of ability to properly regulate emotions, which manifested as an increased coefficient of frontal alpha EEG asymmetry.

MATERIALS AND METHODS

Participants

The study was advertised via a recruitment notice advertisement posted around a medical university. Medical students were chosen because they were believed a more "at risk population" for mental disorders (25). After applying for the training, participants were asked to fill out the screening questionnaires ($n = 116$). We applied the following inclusion criteria: (a) not

having participated in any psychological intervention before the training, (b) not participating in any other psychological intervention during the study, (c) being right-handed individuals, (d) having no history of neurological or psychiatric problems, and (e) having normal visual acuity or corrected visual acuity. Students who met all the inclusion criteria were then offered detailed information about the research target and process. Written informed consent was obtained from all subjects before the intervention. The Satisfaction with Life Scale (SWLS), the Positive Affect, and Negative Affect Schedule (PANAS), the Center for Epidemiological Studies Depression Scale (CES-D), and the State Anxiety Inventory (SAI) were adopted to assess their levels of subjective well-being, depression and anxiety.

Following the provision of signed consent and the completion of the screening questionnaires and pre-assessment, participants ($n = 56$) who met all the inclusion criteria were randomly assigned to the intervention condition ($n = 28$) or to the placebo control condition ($n = 28$) by an online true random-number service independent of the investigators. The regional ethics committee of Army Military Medical University approved this consent procedure and the study protocol.

Procedure

Participants in the intervention group and the control group received strength-based PPIs or the placebo interventions, respectively. To certify the beneficial effects of PPIs on subjective well-being, self-report measures were conducted on the internet before and immediately after the interventions. The programme was set as an optional course named "Psychology and Life" so that the delivery of the programme could fit within the school term and study objectives. Both ten-session interventions were administered in group format by three school psychologists. Although the procedure requires skilful manipulation and was not blinded to the practitioners, students were blinded to the group allocation; thus, the study was a randomized single-blinded control trial.

In addition, students were asked to undergo EEG recordings before and after training (see flow chart in **Figure 1**). For the EEG assessment, students were instructed to sit in a sound-attenuated room and to keep two 2-min intervals for eyes open and for eyes closed respectively in a counterbalanced order across participants. In the eyes open intervals, participants need to have their eyes fixed on a white cross, which was displayed in the center of a computer monitor.

The Well-Being Intervention

Weekly sessions for 10 consecutive weeks were offered. The first session consisted of an introduction to the intervention purpose, in addition to some activities designed to help to enhance participants' interactions and establish a friendly and supportive group environment. Sessions two through nine were structured as 3 parts in line with Seligman's framework (10) and with Suldo's (26) intervention procedures for boosting well-being through intentional activities, consisting of increasing 1. grateful expressions for past events (sessions 2 and 3), 2. satisfaction by means of creative use of significant character strengths (sessions 4, 5, and 6), and 3. positive future-oriented emotions by cultivating a hopeful, optimistic and goal-directed thinking habit (sessions 7, 8, and 9) (26). The last session was centered on reflecting on the practice of learned skills in daily life, including a review of activities and the theoretical framework for increasing well-being. In brief, this 10-week, 2-h-per-week intervention consisted of the following exercises: introduction to gratitude and gratitude letter-writing, gratitude visit, acts of kindness (27), identifying signature strengths (10), use of signature strengths in new ways and savoring (10), stopping worrying (28), three good things, and the best possible self (12), in addition to an introductory (the first meeting) and concluding session (the last meeting) (see **Supplementary Table 1**).

Positive Interpretations of Past Events

The crucial purpose of sessions 2 and 3 was to cultivate a gratitude framework for the explanation of past events. A gratitude-related video was shown as a method of revealing the importance of expressing gratitude and guiding students to understand the correlation between gratitude and well-being. The exercises of the gratitude letter and gratitude visit were administered to focus participants' thoughts on grateful people and events, and to increase the experience of gratitude and subjective well-being by strengthening the association between thoughts, feelings, and actions (26). Students were asked to ①compose a gratitude letter and send the letter to someone (far away from them) whom are extremely grateful, but whom they have never properly thanked; ②visit someone near them who is extremely compassionate.The students were encouraged to share the experience of their gratitude practice at the next session.

Positive Experience of Present Events

"Act of kindness," "identify signature character strengths," and "use signature character strengths creatively" were collected into this topic to promote engagement and satisfaction in daily life. The acts of kindness exercise required that participants do something good (that is, to practice beneficence) and to record the experience (27). From the perspective of emotion regulation, this could influence the students' choices of what situations they might enter and further affect the resulting emotional experience. In addition, participants were invited to identify their signature character strengths through the online Values in Action Inventory of Strengths for Youth (VIA-Youth) (29), and to try to use their top 5 signature strengths in new and different ways. To intensify and savor the experience of flow and satisfaction derived from this activity, the students were required to record the feeling of creatively using these top strengths every day for 1 week.

Positive Framework of Future Events

The main aim of sessions 7–9 was to cultivate a positive framework for consideration of future events. The worry journals were used to change students' existing irrational or negative beliefs and to build reasonable cognition. Students were asked to report the records of "the things you worry about" that they had written down previously and to count how many of these concerns had truly happened (28). The exercise of three good things was intended to develop learned optimism. According

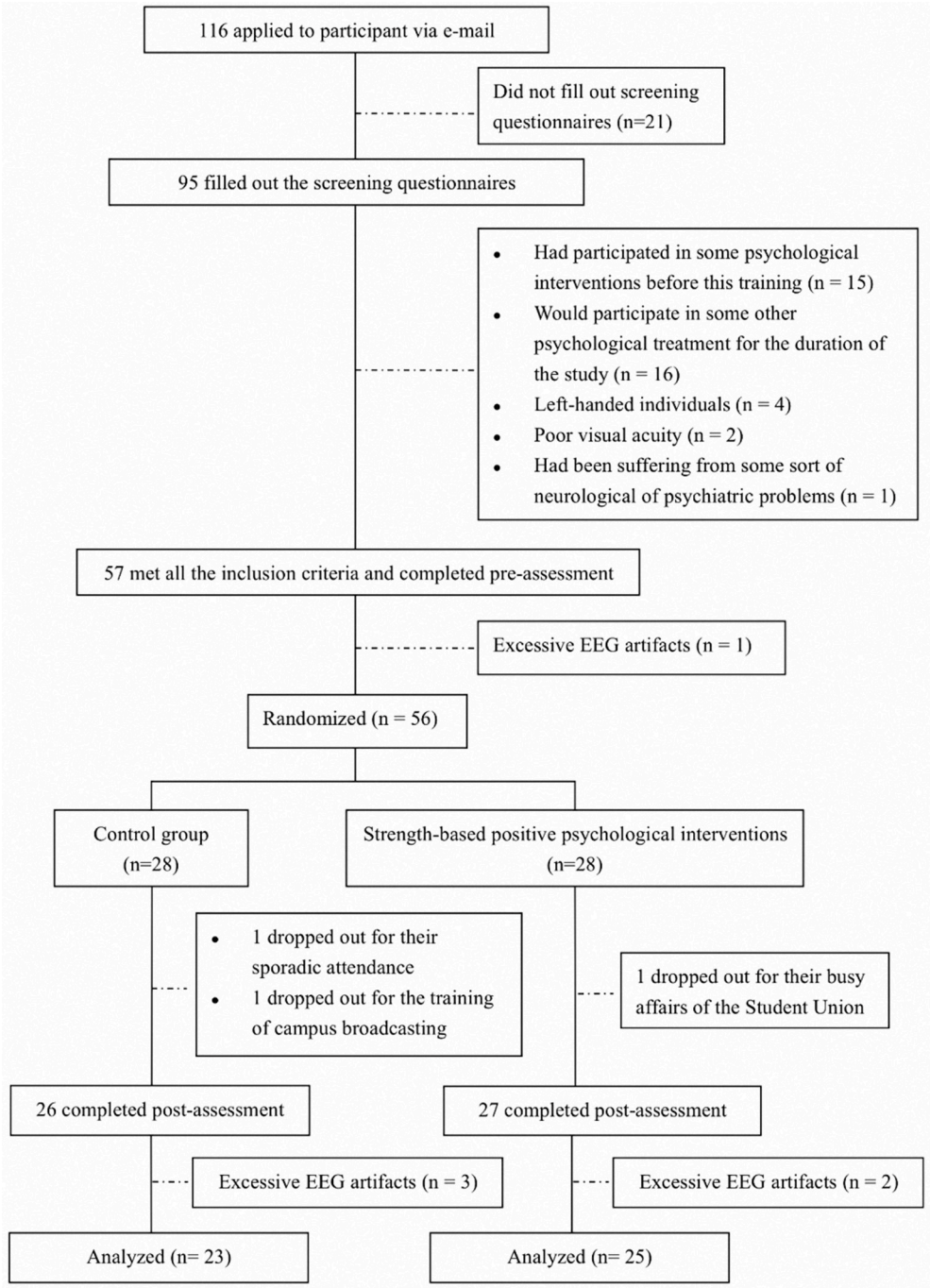

FIGURE 1 | Flow of participants.

to Seligman (10), the act of recording 3 pleasant things was capable of helping participants develop positive attitudes and get into the habit of being aware of the bright aspects of surrounding events, which enabled individuals to stay open-minded in a dilemma and effectively address the predicament. The "best possible self" exercise (12) required students to set a short-term goal and make a practical plan to achieve the goal; according to Snyder's hope theory, the detailed plan must contain ①possible obstructions; ②paths to overcome difficulties and ③motivations for success. In addition to promoting the students' feeling of hope and their resulting sense of well-being, detailed goal mapping could reduce the uncertainty of the future, which was the main risk factor leading to anxiety disorders (30).

The Placebo Control Condition

Participants in the control group received no instruction for the intervention programme. Instead, they were asked to write down something from their early memories every day for 10 weeks and were invited to share voluntarily at the weekly meeting.

Self-Report Measures and Analyses

The intervention was assessed in terms of related changes with the participants' subjective well-being, as well as in terms of traditional negative indicators of mental health (i.e., depression and anxiety), so that the secondary effects of the intervention on psychopathology could be explored.

Subjective Well-Being

Subjective well-being (SWB) is abroad concept that includes experiencing more positive emotions, a high degree of satisfaction with life and low levels of negative moods (31). A measure of SWB was then constructed with the Positive Affect and Negative Affect Schedule (PANAS) (32) and with the SWLS (33) (i.e., PA+SWLS–NA). The PANAS has 20 adjectives that indicate positive and negative affect. A five-point Likert scale ranging from 1(very slightly or not at all) to 5 (extremely) was used to evaluate participants′ mood state during a certain time frame. The internal consistency coefficient of the positive affect subscale and the negative affect subscale for our sample were 0.86 and 0.83, respectively. The SWLS is a 5-item self-report questionnaire. Participants need to evaluate the degree to which they agree or disagree with items such as "In most ways my life is close to my ideal" on a seven-point Likert scale range from 1 (strongly disagree) to 7 (strongly agree). The internal consistency coefficient of SWLS for our sample was 0.96.

Mental Health

Depression was assessed using the Center for Epidemiological Studies Depression Scale (CES-D) (34). Subjects are invited to rate the frequency of occurrence of the symptoms from 0 to 3 (0–occasionally or never, 1—sometimes, 2—often or half of the time, and 3—mostly or continuously). Total scores ranged from 0 to 60, with lower scores indicating less depression. The internal consistency coefficient for our sample was 0.91.

The SAI (35) was administered to assess anxiety. SAI is a 20-item self-report questionnaire designed to measure certain subjective feelings such as nervousness, worries, and fear at present or during a specific period of time. Each question is rated on a four-point Likert scale (1 = not at all, 4 = very much so), with total scores ranging from 20 to 80. The Cronbach alpha estimate for our sample was 0.85.

Statistical Analyses

All analyses were conducted using SPSS19.0. Independent samples *t*-tests and Chi-square tests were conducted to explore the homogeneity of the intervention group and the control group. We conducted repeated measures ANOVA on outcome measures with test time as a within-group factor and condition as a between-group factor. A p-value of < 0.05 with an α-level of 5% was set for statistical significance. Partial η-square values (η_p^2)according to Cohen (36) were calculated for estimating effect sizes.

The purpose of these analyses was to determine the benefits of the intervention on students' well-being, depression and anxiety in the two conditions.

EEG Recording, Reduction, and Analysis

Tin electrodes attached to a stretch-lycra electrode cap were used to record EEG for an 8-min resting period consisting of two eyes-open parts and two eyes-closed parts with a counterbalanced sequence, each 2 min in length. Horizontal electro-oculographic activity was recorded from the epicanthus of each eye and vertical from the supra-and infra-orbital positions of the right eye. Continuous EEG data were collected through a 64-channel NuAmp acquisition system (Neuroscan Inc.) using the International 10–20 system, with a reference at Cz and the area between Fz and Fpz as the ground. All electrode impedances were below 5 kΩ. Offline, a digital average mastoid reference, (M1+M2)/2, was performed.

After the raw EEG data were manually scored for eye movement and muscle artifact, the EEG was reconstructed into non-overlapping epochs of 2 s. After artifact detection, for each channel of each participant, the power spectrum was derived from the Fast Fourier Transform and Hamming window every 2 s in each baseline type (eyes open, eyes closed); thus, each 2 min baseline type contained 60 non-overlapping 2-s epoch, and EEG findings were specific to both open and closed eyes. The average power spectrum for each 2-min period was obtained. The total power in the alpha band (8–13 Hz) was extracted and were then averaged across minutes. In order to obtain normalized data, the power values were natural logarithm (ln) transformed. A measure of frontal EEG asymmetry (i.e., ln [right]–ln [left]) was then derived for the homologous scalp site of interest. Since alpha power is usually considered as inversely proportional to cortical activity, lower value of the index reflects the less left side activity (37).

RESULTS

Descriptive Statistics

Figure 1 presents the subjects' flow chart. Among all the participants, 116 (47 female, mean age = 21.63 ± 3.14) applied for the training. Of the students, 55 were eligible to join in the research and were randomly allocated into the treatment and placebo control groups. Post-test follow-up failed to be made in 7 students causing a 12.73% drop-out rate. **Table 1** shows students' demographic data. According to the results of independent samples *t*-tests and chi-square tests, no significant difference in the demographic variables was found.

Changes in Self-Report Measures

In **Table 2**, the baseline value of the self-report measures for the intervention group and placebo control group are depicted. No significant group differences at pretest were found on any measure.

The results of the repeated measurement ANOVA after splitting the data to analyse PPIs and control group across time

TABLE 1 | Comparisons between the groups regarding demographic data.

	Intervention group $n = 25$		Control group $n = 23$		Total $n = 48$	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age	22.14	1.55	21.92	1.98	22.03	1.75
	n	**%**	***n***	**%**	***n***	**%**
GENDER						
Male	10	40.00	11	47.83	21	43.75
Female	15	60.00	12	52.17	27	56.25
FAMILY STRUCTURE						
Single parent	7	28.00	3	13.04	10	20.83
Two parent	15	60.00	14	60.87	29	60.42
Other conditions	3	12.00	6	26.09	9	18.75
ORIGIN FROM CITY OR COUNTRY						
City	9	36.00	13	56.52	22	45.83
Country	16	64.00	10	43.48	26	54.17

Using Independent samples t-tests and Chi-square tests, there was no significant difference in the demographic variables between the two groups.

TABLE 2 | Means (*M*), Standard Deviations (*SD*) for subjective well-being, depression and anxiety at T1, T2 for the intervention group ($n = 25$) and control group ($n = 23$), and the results of the repeated measures ANOVA after data were split by group.

		T1 *M (SD)*	T2 *M (SD)*
SWB	PPIs	35.84 (15.94)[a]	43.48 (9.23)
	CG	38.00 (12.63)	36.09 (12.18)
CES-D	PPIs	17.72 (8.56) [a]	11.84 (8.79)
	CG	17.74 (8.99)	18.27 (6.43)
SAI	PPIs	36.56 (13.14)[a]	31.72 (10.33)
	CG	36.04 (9.97)	38.43 (8.64)
F8-F7	PPIs	−0.06 (0.18)[a]	0.20 (0.12)
	CG	−0.01 (0.50)	−0.09 (0.78)
F4-F3	PPIs	0.07 (0.13)[a]	0.34 (0.72)
	CG	0.16 (0.48)	0.07 (0.13)
FC6-FC5	PPIs	−0.05 (0.23)	0.07 (0.21)
	CG	0.01 (0.44)	−0.18 (0.66)
FC4-FC3	PPIs	−0.05 (0.17)[a]	0.20 (0.33)
	CG	−0.06 (0.49)	−0.10 (0.42)

PPIs, positive psychological interventions; CG, control group; T1, pre-intervention; T2, post-intervention; SWB, Subjective Well-being; CES-D, Center for Epidemiological Studies Depression Scale; SAI, State Anxiety Inventory. [a]$p < 0.05$ *for repeated measures ANOVA post hoc test for T1-T2.*

(T1–T2) are included in **Table 2**. The table shows that mean levels of subjective well-being increased numerically over the course of time in the intervention group, whereas only subtle changes were observed in the control group. In respect to emotional distress, the intervention participants reported statistically significant decreases in depression and anxiety from T1 to T2, while no significant change was observed in the control group.

Repeated measurement ANOVA results are detailed in **Table 3**. Results showed that within-subject effect of time was significant for SWB but not for anxiety or depression. In addition, there were significant interactions between time and group in terms of SWB, SAI, and CES-D. Further simple effect analysis indicated significant training effects at post test for subjective well-being [$F_{(1, 46)} = 5.67$, $p = 0.02$, $\eta_p^2 = 0.11$], anxiety [$F_{(1, 46)} = 5.91$, $p = 0.02$, $\eta_p^2 = 0.11$], and depression [$F_{(1, 46)} = 8.22$, $p = 0.01$, $\eta_p^2 = 0.15$], with a higher level of well-being and a lower level of depression and anxiety in the intervention group. The results indicated that the strength-based PPIs could contribute to promoting an increase in the individuals' well-being and mitigating mental distress.

Change of Frontal Alpha EEG Asymmetry

The means and standard deviations of the following four alpha asymmetry scores in the PPIs and CG before and after the intervention are presented in **Table 2**: lateral frontal (F8-F7), frontal (F4-F3), fronto-central (FC4-FC3, FC6-FC5) (38). Using the *t*-test, alpha EEG asymmetry baseline measures were not significantly different between the intervention group and the control group. Repeated measurement ANOVA results were detailed in **Table 3**. Results indicated that there was no main effect of time and no main group effect. Significant time (T1 and T2) by group (PPIs and CG) interactions were found for F4-F3 alpha asymmetry and FC4-FC3 alpha asymmetry. Further simple effect analysis indicated significant training effects at post test for F4-F3 alpha asymmetry [$F_{(1, 46)} = 4.51$, $p = 0.04$, $\eta_p^2 = 0.09$] and FC4-FC3 alpha asymmetry [$F_{(1, 46)} = 8.49$, $p = 0.01$, $\eta_p^2 = 0.16$], with a more positive asymmetry score in the intervention group.

Correlations Between Frontal EEG Asymmetry Change and Behavioral Change

According to **Table 4**, the control group exhibited no significant correlations between behavioral changes and EEG changes. However, significant correlations were found between changes of self-reported outcome measures (i.e., subjective well-being and anxiety) and changes of frontal alpha asymmetry (i.e., F4-F3 and FC6-FC5) in the intervention group. In addition, the PPIs sample

TABLE 3 | Repeated measurement analysis of variance on groups (the training group and control group), and time periods (pre-test, post-test) for subjective well-being, depression and anxiety.

	N	Within subject effect			Time × Group			Between subject effect		
		F	*p*	ηp^2	*F*	*p*	ηp^2	*F*	*p*	ηp^2
SWB	48	5.32	0.03	0.10	14.83	<0.01	0.24	0.57	0.45	0.01
CES-D	48	3.53	0.07	0.06	5.04	0.03	0.10	2.82	0.10	0.06
SAI	48	1.21	0.28	0.03	10.57	<0.01	0.19	1.15	0.29	0.02
F8-F7	48	0.99	0.33	0.02	3.54	0.07	0.07	1.36	0.25	0.03
F4-F3	48	0.41	0.53	0.01	5.09	0.03	0.10	1.97	0.17	0.04
FC6-FC5	48	0.16	0.69	<0.01	2.74	0.11	0.06	1.47	0.23	0.03
FC4-FC3	48	2.22	0.14	0.05	4.12	0.04	0.08	3.93	0.06	0.07

SWB, Subjective Well-being; CES-D, Center for Epidemiological Studies Depression Scale; SAI, State Anxiety Inventory.

TABLE 4 | Bivariate correlations between changes of self-reported outcome measures and changes of frontal EEG asymmetry for each group and across all participants.

Group	Measures	Δ(F8-F7)	Δ(F4-F3)	Δ(FC4-FC3)	Δ(FC6-FC5)
PPIs ($n = 25$)	ΔSWB	0.26	0.77**	0.30	0.53**
	ΔCES-D	− 0.15	−0.81**	−0.28	−0.34
	ΔSAI	− 0.36	−0.54**	−0.12	−0.53**
CG ($n = 23$)	ΔSWB	0.30	0.05	0.26	0.22
	ΔCES-D	−0.33	−0.26	−0.22	−0.34
	ΔSAI	−0.15	−0.11	−0.14	−0.20
All ($n = 48$)	ΔSWB	0.33*	0.57**	0.35*	0.29*
	ΔCES-D	−0.32*	−0.61**	−0.29*	−0.34*
	ΔSAI	−0.26	−0.42**	−0.23	−0.27

*ΔSWB, ΔCES-D, ΔSAI, Δ(F8-F7), Δ(F4-F3), Δ(FC4-FC3), Δ(FC6-FC5) represent the discrepancy of subjective well-being, depression, anxiety, and frontal alpha EEG asymmetry between the baselines and post-test (T2-T1), respectively. *$p < 0.05$, **$p < 0.01$.*

also exhibited significant negative correlation between change of depression and change of F4–F3 alpha EEG asymmetry. For all students, changes of F4-F3, F8-F7, FC4-FC3, and FC6-FC5 frontal EEG asymmetry were negatively related to changes of CES-D and SAI scores (only the correlation with change of F4–F3 alpha EEG asymmetry was significant) and were positively related to the change of SWB scores.

DISCUSSION

This study aimed to explore the impact of the PPIs, compare with a placebo control, upon subjective well-being and emotional distress, as well as on the corresponding neural electrical changes. Self-reported results showed that the intervention had significant effects on subjective well-being, depression, and anxiety. First, the data indicated that students participating in the10-week PPIs reported a greater increase in subjective well-being compared to the control participants. Over the 3 months, subjective well-being increased immediately at post-test in the intervention condition, while no significant change was found in the placebo control group. The results parallel the positive correlation documented between well-being and coping capacity and resilience (39) and suggest us that through school interventions, the promoting of well-being could thus improve students' mental toughness, coping styles, and developmental processes (40). Moreover, Ryff et al. proposed that well-being has a meaningful defensive function in aspect of sensitivity to chronic and acute life stresses (41). Consistent with this, participants in the intervention group showed greater relief in depression and anxiety relative to students in the placebo control group from pre- to post-test. The observed effects are worth noting as medical students tend to experience more distress in the middle of the semester, during which exams and assignments come in great number (42). The results thus certify the viewpoint that the PPIs can play an important role if conducted in the middle or the end of the semester, when students are in a more vulnerable psychological state (43).

Although much attention has been directed toward the improvement of human subjective well-being, the neurobiological mechanisms underlying these well-being interventions remain elusive. On the base of Gross's emotion regulation-model, Quoidbach et al. (18) frame different kinds of PPIs and suggested emotion regulation strategies to be the theoretical foundation for potential working mechanisms (20). Based on this, the current study proposed that PPIs might promote a participant's mental well-being to the extent that the ability to properly regulate emotions improved, which was manifested as an increased coefficient of frontal alpha EEG asymmetry. The results align with the initial hypothesis: In conjunction with the promotion of subjective well-being and the amelioration of emotional distress from pre- to post-treatment in the intervention group, obvious electrocortical changes occurred typically with a shift to the greater rest left frontal alpha EEG asymmetry.

According to Beck's generic cognitive model (GCM), individuals with emotional distress are tend to pay more attention to mood—congruent stimuli (44), which facilitates biased interpretation and biased memory, this, in turn, leads to the formation of biased cognitive processing schemas or beliefs (45). In addition, the activated schema could initiate further affective, motivational, and behavioral responses and trigger the downward spirals to mental disorders (39). Previous research has proposed that momentary thought–action repertoires

will be broaden by positive emotions, which could widen the thoughts and actions that pass through the mind (6), and thereby promoting more creative and flexible cognitive associations and appraisals to face emotional situations (46), and create the urge to sit back and enjoy current life circumstances or stimulate people to act and approach rewards in their lives (24). Since the way in which we consider and reflect to the world shapes what we experience, the broadened attention to positive information, a more flexible cognitive association and active coping strategies toward improved well-being (6) could have an adaptive emotion-regulating effect in everyday emotional situations; this would enable people to place the life events in a broader context, reducing the adverse effects of any typical negative event, and thus, countering the downward spirals of negativity (6, 39).

Moreover, benefiting from the scope of attention and cognition broadened by positive emotions, peoples' lasting coping resources would also be augmented through enhancing flexible and creative thinking ability (6); such resources would include lasting social bonds and attachments prompted by play, enduring physical resources promoted by exploring, and improved self-insight and advanced world view prompted by savoring (6).With regards to our intervention, the positive activities such as the gratitude visit, which asked participants to express their appreciation to someone who had done something good for them, or the act of kindness, which required the students to perform a good work and record their feelings, could strengthen interpersonal relationships and optimize their social support networks. When people later faced threatening situations, these greater personal resources would have translated into more adaptive strategies, and in turn, more rational emotional and behavioral responses (6, 39, 45). This virtuous circle could contribute to triggering upward spirals of well-being toward greater adaptation and mental health (39, 47). Taken together, the prefrontal activation in the intervention group is identified to activate the regulatory structures ascribing to the broader, flexible and positive attentional, cognitive, and behavioral repertories.

Some limitations of the current study should be mentioned. One point of concern is the small sample size. The findings were based on 48 medical students, which possibly undermined the significance of several interactive and simple effects, so a larger sampling is needed to replicate these results in future studies. Second, the dropout rate in this study was 12.73%; in order to increase the overall response rate and keep students motivated to remain in the study, upcoming studies might offer more ways to include more students, such as monetary incentives or credits reward. Another limitation of this study is its single-blind nature. A large population study that is blind to both participants and practitioners and long-term follow-up must be considered. Finally, in addition to recording the frontal alpha activity at rest before and after the well-being intervention, future studies should detect participants' continuous brain electrical activities as they process emotional stimuli; this could help uncover the possible effects of subjective well-being on different stages of emotion regulation, such as initial attentional bias, later cognitive process, and behavioral responses.

CONCLUSION

Above all, the data from this study have shown that strength-based PPIs can effectively improve young adults' subjective well-being and mitigate the symptoms of depression and anxiety. Crucially, the process of adaptive emotion regulation might be the potential mechanisms by which PPIs brought benefits. Our findings may have clinical implications for providing potential biomarkers for the early prevention of mental disorders. Furthermore, beyond psychological interventions related to well-being, the neurofeedback training of subjective well-being can be developed to improve levels of health.

DATA AVAILABILITY STATEMENT

The datasets Analysis data for this study can be found in the Baidu Netdisk https://pan.baidu.com/s/12E7Bw0EBabFXhAPT3hrXdw.

ETHICS STATEMENT

This study was carried out in accordance with the Declaration of Helsinki. The protocol was approved by the regional ethics committee of Army Military Medical University. All subjects gave written informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

Y-YX and ML contributed to the design and conception of this study. Y-YX, Z-QF, and Y-JX elaborated the study protocol and gained ethical approval. JZ, Y-JY, and S-HP developed the intervention program. Y-JX wrote the manuscript, and Z-QF, Y-JX, JZ, and S-HP complemented the description of the design, randomization, and the statistical analysis. Z-QF, Y-JY, and ML participated in a critical review of the manuscript. All authors have contributed to the revision of the initial manuscript and have read and approved of the final version of the article submitted.

FUNDING

This study was financially supported by National Natural Science Foundation of China (No. 31700958) and National Social Science Foundation of China (No.15CSH056).

ACKNOWLEDGMENTS

The authors sincerely thank all the participants for their cooperation.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2018.00432/full#supplementary-material

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