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Effectiveness of a Multimodal Intervention using Movement, Mental Exercise and Dietary Approaches on Children with Specific Learning Difficulties

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Abstract

Since 2006, Care Corner Educational Therapy Service has been running the KidsBright multimodal intervention programme for children aged 5 – 13 with specific learning difficulties and developmental delays. The programme is a novel integration of mental, movement, and dietary approaches, and is aimed at enhancing the neurodevelopmental, learning and academic abilities of children. In this study, the purported effectiveness and feasibility of the programme is examined through test-retest analysis of 368 parent-rated forms of their child's ability level on ten outcomes over a six-month period in the programme – (i) Reading; (ii) Spelling; (iii) Handwriting; (iv) Verbal Skill; (v) Concentration; (vi) Ability to Sit Still; (vii) Memory; (viii) Motor Coordination; (ix) Social Interaction; (x) Mathematics. Findings indicated that there was indeed a significant improvement in the average ability level of children enrolled in the programme over time according to parental ratings. Subsequent analyses revealed that while parents' facilitation of home-based movement exercises were associated with improvements in many ability domains, there were no improvements associated with the child's consumption of fish oil supplements. The results also suggested that issues of service user attrition and their compliance to programme requirements may also need to be worked on in order for the programme to be more effective.

Keywords: KidsBright, Care Corner, National Council of Social Service, learning difficulties, SpLD, developmental delays, attention-deficit, ADHD, autism, ASD, dyslexia, intervention, movement, motor, mental, mathematics, numeracy, exercise, diet, nutrition, fish oil, parent, educational therapy, neurodevelopment

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INTRODUCTION

Specific Learning Difficulties and their Impact

Specific Learning Difficulties (SpLD) is an overarching term for a wide variety of learning difficulties, including Attention Deficit Hyperactivity Disorder (ADHD), dyslexia and Autism Spectrum Disorders (ASD) (British Dyslexia Association [BDA], 2018). These conditions are neurodevelopmental in nature and are classified under "Neurodevelopmental Disorders" in the latest edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-V) by the American Psychiatric Association (2013).

The DSM-V estimates that 5% to 15% of school-aged children have a learning difficulty across the academic domains of reading, writing and mathematics. The DSM-V also reports that 5% of children present with ADHD. Prevalence rates estimated locally in Singapore appear to be similar. According to a statement by Singapore's Minister for Social and Family Development, "5% of our student population have been diagnosed with special educational needs" (National Archives of Singapore, 2016), with this figure referring only to formally diagnosed cases.

Without effective support or intervention, researchers agree that children with SpLD will continue to fall behind their peers in their academic achievements. Loe and Feldman (2007) reported that "longitudinal studies show that the academic underachievement and poor educational outcomes associated with ADHD are persistent". A longitudinal study tracking children at-risk for reading disabilities from kindergarten to Grade 3 had showed that they remained behind their peers in reading abilities, and fell further behind as the years progressed (McNamara, Scissons, and Gutknecth, 2011).

Considering the substantial upper-bound prevalence rate of learning difficulties in Singapore i.e. 15%, and their potential impacts, it can be suggested that it is important for social and educational service providers to take serious effort to help these children reach their fullest potential in learning and academic achievement. The need for this challenge to be adequately met is further accentuated in view of the broader socio-economic context of the declining birth rate in Singapore, and given the small nation-state's emphasis on finding means to develop and capitalize on all of its existing human resource. Hence, there is a need for educational professionals, leaders and policy makers to continually explore and adopt more innovative and effective solutions, as may be informed by new findings and recent knowledge in related fields like neuroscience and dietary science, to maximise intervention outcomes for these children.

Existing Approaches in Addressing Specific Learning Difficulties

Currently, the most common and conventional intervention used among professionals to address the academic underachievement of children with SpLD is remedial teaching. This

usually involves using phonologically-based and multi-sensory teaching approaches to help children with difficulties in reading. Such well-evaluated traditional approaches do have some limitations. For example, teaching phonological skills alone or even in combination with single word reading may not be adequate enough to effectively help disabled readers, as improvement in these component skills trained does not always generalise or transfer to reading skill overall (Fawcett, 2015). Also, some dyslexic children fail to respond to phonologically-based remediation programmes (Torgesen, 2000).

For ADHD specifically, the main approaches used to address its core symptoms of inattention, hyperactivity and impulsivity, are medication and behavioural interventions. However, these approaches are limited in their effectiveness: only 65% to 75% of children with ADHD respond to any single stimulant medication (Barkley, 2018), with behavioural therapy shown to be less effective than medication (Brown et al., 2005). Furthermore, the beneficent effects of stimulant medications last only for a short term i.e. not more than a day (McCabe and Shaw, 2010; Meppelink, Bruin, and Bögels, 2016); the core symptoms of the condition will return once the medication has worn off (Young and Bramham, 2012). These medications may also cause side effects such as loss of appetite, growth delay, sleep disturbance and tics (Cortese et al., 2013).

Apart from these traditional interventions for SpLD, there are also alternative or complementary interventions available in the market to help these children. These include neurofeedback; cognitive abilities training (including computer-based training); coloured lenses prescription and dietary supplementation, offered largely by private centres and practitioners. Many of these alternative interventions purport to improve the cognitive abilities of these children. However, there is the concern that many of these interventions may not have been well-studied and evaluated on their effectiveness.

Additionally, there are also concerns over the potentially high cost of these interventions, as well as whether the gains in cognitive abilities from these interventions would be translatable into tangible improvements in the children's academic abilities (e.g. reading and numeracy), which is a crucial concern for many educators and parents. For instance, Cook (2014) and Pierson (2018) have urged caution over working memory and brain training programmes, as they had concluded that such techniques do not generalise to reading, spelling, comprehension or mathematics.

These concerns result in alternative or complementary interventions not being readily adopted by parents whom may be more cautious about enrolling their children into such programmes. For educational institutions and social service providers, being publicly funded and fiscally conscious, the further lack of an evidence base for these approaches may further reduce their willingness to adopt them to help children with SpLD.

KidsBright: A Novel Multimodal Intervention to Help Children with Specific Learning Difficulties

In recognition of the various intervention needs and gaps as outlined above, in 2006 the Educational Therapy Service (ETS) at Care Corner Singapore developed a novel and potentially cost-effective programme – the KidsBright programme, to seek to improve the learning abilities and basic academic abilities of children with SpLD.

Programme Principles

KidsBright is a unique neurodevelopment programme designed for children with SpLD from age 5 to 13. This programme was developed utilizing the principles of neuroplasticity, adopting the underlying premise that symptoms of SpLD and ADHD are due to delayed maturation of certain regions of the brain. The programme innovatively integrates the three modalities of movement exercise, mental exercise and dietary approach to enhance the neurodevelopment, and hence the learning and academic abilities of the children.

The programme comprises of weekly sessions for children, with a typical class size between 3 – 5 children; and three parent training sessions, where parents are trained on the theory and practical aspects of implementing various therapeutic exercises for their children at the home front. The parent training sessions are conducted at the start of the programme, and at every 10-to-12-week intervals thereafter.

While KidsBright is conducted as a 6-month programme today, prior to 1 March 2013, the programme lasted over a 9-month period.

Movement Exercises

Eclectically designed by Care Corner ETS, the specific movement exercises in KidsBright are adapted from effective and easy-to-implement components from various movement therapy approaches (e.g. Blomberg (2015), Pheloung (2018) and Promislow (1999)). Parents attending the training classes in the programme are taught how to assist their children to carry out a set of specific movement exercises (which takes about 10 minutes) at home, and they are instructed to carry them out at least four times a week. An example of a parent-assisted movement exercise incorporated in KidsBright involves parents rocking children through repetitive pulling motions applied on their calves (see Figure 1). This is in augmentation to weekly sessions on ETS premises, where children perform a series of (partially different) movement exercises conducted by an ETS educational therapist. A new set of movement exercises are implemented every 10 – 12 weeks.

These exercises are targeted at enhancing the children's neurodevelopment, through (1) integrating retained primitive reflexes, (2) providing vestibular, proprioceptive and tactile stimulation, and (3) developing bilateral coordination, which benefits the learning and academic abilities of children with SpLD. The rationale for each of these achieving each of these goals are elaborated below:

Figure 1. An ETS educational therapist guides parents on how to perform the movement exercise with their children in a training session.

Rationale of Integrating Retained Primitive Reflexes. Primitive reflexes refer to automatic and stereotyped movements developed before birth, which are essential for a newborn's initial survival. However, over the first year of life in normal development, they would be expected to be gradually inhibited and transformed by the developing brain into more mature reactions (Goddard, 2002). This process is known as reflex integration.

Primitive reflexes and reflex integration have been regarded to be foundational to intelligence and cognitive development (Piaget, 1952; Masgutova, 2015). However, various factors such as illness, trauma, developmental or neurological impairment, and lack of movement of the baby are known to hinder reflex integration (Goddard, 2002). These primitive reflexes may then be retained (i.e. remain active) as the child grows older, and has been observed in some studies to be associated with learning difficulties in school-aged children. For instance, McPhillips and Jordan-Black (2007) had found a

statistically significant relationship between poor reading attainment and a high level of retained Asymmetrical Tonic Neck Reflex (ATNR) among children with reading difficulties (dyslexia). Retained primitive reflexes have also been shown to cause various developmental issues like poor reading ability, hyper-sensitivity, poor memory and attention (Goddard, 2002; Grigg, Fox-Turnbull, and Culpan, 2018).

At the same time, retained primitive reflexes are thought to be amenable to remediation. Specific stereotyped movements carried out regularly over a period of time could facilitate integration of these reflexes (Goddard, 2002). This was affirmed by a randomised, double-blind, controlled trial on 60 children aged 8 to 11 years, which had found that children with reading difficulties were able to successfully make significant gains in reading, after carrying out a specific movement sequence to integrate the retained primitive reflexes (McPhillips, Hepper and Mulhern, 2000).

Rationale of Providing Vestibular, Proprioceptive and Tactile Stimulation. According to Blomberg and Dempsey (2011), the brain of the child with ADHD or related difficulties may not have received adequate sensory stimulation for the neurons to branch off and create new synapses, and for sufficient myelination of the nerves to take place. This is thought to result in delays in the development and necessary linking up of different parts of the brain, affecting brain functioning as a whole.

The performance of frequent movement exercises is thought to provide a counteraction to these effects, through providing the child with vestibular, proprioceptive and tactile stimulation, which encourages the growth of the neural networks in the brainstem, cerebellum, basal ganglia and neocortex. For children with ADHD and related attentional difficulties whom are able to have their lack of sensory stimulation remediated in this way, this may result in improvements in their attention span, and a consequent reduction in hyperactivity and impulsivity.

Rationale of Developing Bilateral Coordination. Bilateral coordination or integration refers to the ability to use both sides of the body at the same time in a controlled and organized manner. Children who do not develop this ability adequately may have difficulties performing tasks such as writing, tying shoelaces and higher-level tasks like reading. Studies have also shown that the academic performance of children is correlated to their ability at bilateral coordination (da Silva Pacheco, Gabbard, Ries, and Bobbio, 2016).

Mental Exercises

The second modality in KidsBright – mental exercises, refer to an intervention approach of using quick mathematical calculations to enhance the development of the brain, especially the prefrontal cortex region. This approach is based upon work done by Kawashima (2005) who found that performing quick simple mathematical calculations is

an effective way to stimulate the prefrontal cortex, as observed through images taken by functional magnetic resonance imaging (fMRI) and near-infrared spectroscopy. Takeuchi et al. (2016) had similarly found that doing quick simple mathematical calculations effectively stimulates the prefrontal cortex, improving their processing speed, and performance at speeded executive function tasks. There was also an improvement in the plasticity of brain structures and perfusion.

In the KidsBright programme, mental exercises are implemented via tasking children to solve a series of mathematical calculation problems as quickly as possible within a short period. Examples of the calculation problems are "3 + 6 = ?" and "7 — 4 = ?". The difficulty of the problems assigned are pegged to each individual child's numeracy level, as assessed by Care Corner educational therapists. Children were instructed to attempt the mental exercises given to them at least four days a week, if not on a daily basis. Parents are also taught during the parent training classes on the theory of this intervention approach and how they could practically support their children in this where needed.

Dietary Approach

The final modality – the dietary approach in KidsBright involves enhancing children's cognitive functioning, through changing their diets to reduce their consumption of food additives and increasing their intake of essential nutrients to support optimal brain development. In the programme, parents are educated through training sessions on the importance of such a diet and given practical tips on how to implement it in their children's daily life. Concurrently, children are also given basic education on this diet. The topics in the parent training cover:

1. **Avoiding artificial food additives (e.g. colourings, preservatives)**

   Parents are instructed to avoid food items containing artificial food additives, but are taught to identify alternative food items which could be lower in such additives e.g. specific types of tidbits. The explanation to parents on the need to avoid food additives is based on work done by McCann et al. (2007), which found that food additives exacerbate hyperactive behaviours (inattention, impulsivity and overactivity) into middle childhood.

2. **Having a balanced diet**

   This includes emphasis on the importance of fruits and vegetables, consuming whole grains and unsaturated fats, and having a good source of protein. This is in line with the dietary recommendations for children with ADHD from Harvard Health (2009), as well as general dietary recommendations for children in Singapore from the KK Women's and Children's Hospital (n.d.).

3. Taking fish oil supplements as a source of omega-3 fatty acids

Rationale

Omega-3 fatty acids are a type of polyunsaturated fatty acids (PUFAs). Docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA) and alpha-linolenic acid (ALA) are among the three main forms of Omega-3 found, with Omega-3s in general having been found to be essential for normal brain development and function (Taylor and Connock, 2007). DHA in particular has also been found to play a vital role in neurite growth, membrane fluidity, neurotransmission and neuronal survival (Parletta, Milte, and Meyer, 2013).

According to Parletta, Niyonsenga and Duff (2016), and Hawkey and Nigg (2014), children with ADHD and ASD have lower internal levels of Omega-3. These claims are also consistent with a study on UK mainstream school children underperforming in reading, which had found correlations between lower DHA levels, and poorer reading ability and working memory performance (Montgomery, Burton, Sewell, Spreckelsen and Richardson, 2013).

As Omega-3 fatty acids cannot be synthesized in the human body, they must be obtained through dietary source (Simopoulos, 2008). In a regular diet, DHA and EPA would be found mostly in oily fish, and ALA mainly in some green vegetables, nuts and seeds (Harvard Health, 2016). With Kidd (2007) suggesting that the two most beneficial forms of Omega-3s for childhood brain development are DHA and EPA, there is hence reason for children with SpLD to ensure that they receive sufficient intake of fish oil, for which dietary supplements could be a good source of. While later studies had found mixed outcomes for children across different conditions receiving Omega-3 fatty acids supplementation (see Montgomery et al., 2018), in some earlier studies it had been found to be an effective intervention for children with ADHD (Hawkey and Nigg, 2014; Sonuga-Barke et al., 2013) [1].

Implementation

In the KidsBright programme, parents were educated on fish oil supplements available in the local market, and encouraged to purchase and administer them to their children, with dosage recommendations provided by ETS therapists. The dosage recommendations were consistent with average Omega-3 fatty acids dosages used in studies on Omega-3s supplementation and ADHD

1. *The KidsBright programme developers had made the professional judgment to implement fish oil / Omega-3s supplementation as part of the programme, as there was a positive risk-benefit ratio involved.*

symptoms (Hawkey and Nigg, 2014; Bos et al., 2015). Parents were also instructed to choose fish oil supplements that are highly purified, free of environmental pollutants such as methylmercury, a neurotoxin that could be found in less-purified forms of fish oil and impair neural development (Cleland, James, and Proudman, 2006).

As an alternative to fish oil supplementation, parents were also told to provide more fatty fish in the child's diet. This was especially for parents from lower-income households, who may have difficulty in affording fish oil supplements.

Evaluating the Effectiveness of the KidsBright Programme

While the KidsBright programme has been continuously run for the past decade, no formal evaluation of its effectiveness for its service users has yet been undertaken. It is not known if the integration of the mental, movement, and dietary therapy approaches has led to actual benefit for the children as theorized by the programme developers, and if there are aspects lacking in implementation.

In this study, the aims of the authors are thus to provide some understanding into these areas through addressing the following research questions:

1. Have children enrolled in the KidsBright programme improved over time in their previously weak abilities?

2. Were families enrolled in the programme able to comply fully with the therapeutic advice given by the programme educational therapists, and remain involved in the programme?

3. Can the children's improvements in abilities truly be attributed to each therapeutic component theorized to bring about change in the programme? In this research, this will be limited to assessing the effect of doing home movement exercises and taking fish oil supplements.

METHODS

Participants

Source: Data for this research came from a retrospective sample of 368 parent-participants enrolled in the KidsBright programme over a 10-year period between 21 August 2008 to 6 September 2018. These parents had been enrolled into KidsBright together with their child whom had either presented symptoms of, or had been diagnosed with SpLD.

More than 60% of parents were known to have been referred or had heard about the programme from formal sources i.e. social service agency (45.4%), school (8.7%), or healthcare provider (7.6%). The remainder were self-referrals (29.9%), referrals from a non-professional such as a friend or relative (5.2%), or from an unknown source (3.3%).

Children's Difficulties and Diagnoses: Half of the children enrolled in the programme (51.1%; n = 188) had received a specialist's diagnosis for their primary difficulty. The modal diagnosis was ADHD (inclusive of inattentive ADHD; 47.3%), followed by dyslexia (13.8%), ASD (13.3%), language difficulty (10.1%), global developmental delay (5.9%), and slow learning (3.7%). Other diagnoses (5.9%) included reading, motor, sensory, mathematics difficulties and difficulties not otherwise specified. About a-third of these children (n = 63) had multiple diagnosed difficulties.

Of the remainder without a formal diagnosis available for their primary difficulty, the presenting issue in most of these cases were attention-related difficulties (50.0%) [2]. 18.3% presented with reading-related difficulties, and the remaining included difficulties in language function, motor function, sensory function, and mathematics; slow learning and low intellectual quotient (IQ), and other difficulties not otherwise specified.

Children's Gender: The majority of the children were males (77.2%; n = 284). A statistically significant, higher proportion of males (63.4%) were known to have visited with a specialist to seek a diagnosis for their primary learning difficulty, as compared to females (36.9%).

Children's Age and School Level: The ages of children ranged from 4 years to 13 years, at the point of their start in the programme. The median child was 8 years old. Most children were attending primary school (90.5%), with 9.2% still in kindergarten and one child in secondary school.

Children's Ethnicity: Most children (89.7%) enrolled in the programme were ethnically Chinese. Malay and Indian children comprised 3.3% and 3.5% of the sample respectively, and the remaining 3.5% were of other ethnic groups.

Household Income Per Capita: Information on the household income per capita (PCI) had been sought from parents at the point of enrolment, but not in a consistent manner, with overlapping income-bands being used across respondents. Hence, there was some

2. *The needs of these children were identified by Care Corner educational therapists, who had taken developmental and medical histories of all children, as well as teacher-reports, upon their enrolment into the programme.*

uncertainty in the PCI breakdown of families. Taking a PCI of $700 as a breakpoint [3], it was determined that between 44.8 – 46.5% of families in the sample could be classified as low-income (below the breakpoint).

Parent Rating Assessment form: The main measure that was used for the research, the parent rating form, had been conceptualized during the initial years of the KidsBright programme by staff at Care Corner ETS, out of need to allow the attending educational therapist a basic gauge of tracking the child's progress through the programme. It is an original measure by Care Corner ETS and has not been tested elsewhere for validity and reliability. The language of the form is in English, but co-presented with Mandarin translations. Items on the form are relatively straightforward, and seek parents' self-perception regarding the current level of their child on ten learning and academic abilities outcomes, according to a 5-point Likert-type scale (1 – Very Weak; 2 – Moderately Weak; 3 – Marginally Weak; 4 – Acceptable/Average; 5 – Good):

a. Reading;
b. Spelling;
c. Handwriting;
d. Verbal Skill;
e. Concentration;
f. Ability to Sit Still;
g. Memory;
h. Motor Coordination;
i. Social Interaction;
j. Mathematics

In addition, the form also sought information on the child's compliance to two programmatic components, through asking (1) the average number of times weekly movement exercises the child did at home, and (2) the average number of times weekly consumption of fish oil supplements by the child, since the previous rating. Parents responded to this section according to a frequency scale (0 – 6 times each week on average, rounded to the nearest whole number); this section is not queried in the pre-test.

For each rating, respondents were presented the same form in which they had filled in their pre-test, and respondents were instructed to mark the rating at each time-point using a different shape. The questionnaire may be referred to in Annex A.

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3. *As a point of comparison, children from households with a monthly PCI of $690 and lower would be eligible for the Ministry of Education Financial Assistance Scheme (FAS). The $700 cutoff set here will be a close approximation to that.*

PROCEDURES

Data Collection

Upon enrolment in the programme, parents had provided demographic information about their family to Care Corner ETS. As part of the enrolment package, the parent rating assessment form was subsequently given to parents by ETS educational therapists to complete. The parents were re-administered this form at two further time-points in the programme: (1) approximately 3 months after the start of programme; and (2) approximately 6 months after the start of programme [4].

Data Coding

All data had been originally provided in the form of hardcopies. Care Corner ETS subsequently coded all available data and made available the full, de-identified digital dataset to the National Council of Social Service (NCSS) in 2019, which conducted the data analysis. Some administrative data which was not collected through the parent rating form earlier, such as the start and exit dates of the child in the programme, and other demographics were also included in the dataset. Prior to commencing planned analyses, the data was cleaned by NCSS, which involved rectifying typographic errors, and excluding responses which were returned too early or late (more than a month before or after they were supposed to have been administered in the programme).

Data Analysis

With the cleaned dataset, basic descriptive analyses and a series of univariate repeated -measures analysis of variance (RM-ANOVA) were undertaken in IBM SPSS software (IBM Corporation, 2016) to ascertain if there had been significant changes in each ability score over time, per the parent rating forms. The attrition rate of families in the programme over time was also analysed through examining each child's record of their start and exit date in the programme, and missing values were analysed then.

The lavaan R package for structural equation modelling (Rosseel, 2012), running atop the open-source R statistical computing engine and RStudio frontend (R Foundation for Statistical Computing, 2019; RStudio Team, 2018) was used for linear growth curve modelling (Duncan, Duncan and Strycker, 2013; Muniz-Terrera et al., 2017) of the change

4. *Parents enrolled in the programme prior to 1 March 2013 had the parent rating form administered to them a fourth time, at approximately 9 months into the programme; this was when the KidsBright programme was run as a longer-duration programme of between 9 – 12 months. These forms were excluded from the analysis. There were no forms administered at the 9-month mark after 1 March 2013.*

in ability scores across each rating (time), and across different frequencies of movement exercises done and fish oil supplements consumed at each rating.

All variables collected through the parent rating form were inspected and assessed to be approximately normally distributed. 11.3% of observations were missing (of an expected total of 11,040 observations – for 368 parents rating 10 abilities at 3 time-points), before accounting for participant attrition in the programme. After adjusting for attrition, the proportion of accidental omissions fell to 7.5%. Missing values analysis suggested the data to be at least missing at random (MAR), as there was no trend (per Fisher's exact tests) that the omissions were correlated with their past ability ratings. Hence, planned analyses were unlikely to be biased by missing data, and for the RM-ANOVA analyses, cases with missing values were excluded on an analysis-by-analysis level.

RESULTS

Improvements Observed for Children over Time

Across all the ten abilities measured in the parents rating form: RM-ANOVAs for each of the ten ability scores (Reading; Spelling; Handwriting; Verbal Skill; Concentration; Ability to Sit Still; Memory; Motor Coordination; Social Interaction; Mathematics) by time of rating (at pre-test; at 3 months; at 6 months), were conducted for the entire sample (N = 368), with lower-bound (conservative) corrections performed as Mauchly's W tests had suggested that assumptions of sphericity had not been met. These analyses demonstrated that children enrolled in the KidsBright programme, since its inception, had improved in their mean abilities scores for all abilities, over time (see Table 1).

In Initially Weak Areas: As the KidsBright programme had a specific interest in trying to improve the abilities of children in their weak areas, rather than just in improving abilities in general, subsequent analyses were further scoped to ascertain if improvements over time had been observed for participants in areas which were rated to be weak at pre-test i.e. rated between 1 to 3. The proportion of children reported to be weak in each of the ten ability areas may be referred to in Table 2. Based on the median, most parents (60.1%) had rated their children to be weak on at least seven out of ten abilities, and all children were weak in at least one ability.

RM-ANOVAs for each of the ten ability scores by time of rating were hence conducted, this time limiting to each sample only the children whom had reported weak scores on the ability at pretest, since the programme's inception. Lower-bound (conservative) corrections on the degrees-of-freedom were again performed as Mauchly's W tests had suggested that assumptions of sphericity had not been met. These analyses supported the view that even for children who were weak in an ability initially, their mean score for that ability had improved over time in the programme (see Table 3).

Table 1: Repeated-Measures ANOVA of Ability Score by Rating for Entire Sample (N = 368) Regardless of Pre-Test Scores, with Bonferroni-Corrected Pairwise Comparisons between Ratings

Ability	Time of Rating	RM-ANOVA[a]							Bonferonni Comparisons		
		M	*SD*	*F*	*df*	*MS*	*p*	η_p^2	At Pre-Test	At 3 Months	At 6 Months
Reading (*n* = 259)	At Pre-Test	2.92	1.26							**	**
	At 3 Months	3.30	1.14	160.66	1.00	73.42	< .001	.38	**		**
	At 6 Months	3.67	1.08						**	**	
Spelling (*n* = 247)	At Pre-Test	3.00	1.24							**	**
	At 3 Months	3.42	1.13	170.77	1.00	73.21	< .001	.41	**		**
	At 6 Months	3.77	1.10						**	**	
Handwriting (*n* = 260)	At Pre-Test	2.78	1.06							**	**
	At 3 Months	3.22	0.98	153.85	1.00	71.55	< .001	.37	**		**
	At 6 Months	3.52	0.90						**	**	
Verbal Skill (*n* = 260)	At Pre-Test	3.12	1.14							**	**
	At 3 Months	3.50	1.02	132.82	1.00	64.63	< .001	.34	**		**
	At 6 Months	3.82	0.87						**	**	
Concentration (*n* = 259)	At Pre-Test	3.12	1.14							**	**
	At 3 Months	3.50	1.02	244.46	1.00	123.25	< .001	.49	**		**
	At 6 Months	3.82	0.87						**	**	
Motor Coordination (*n* = 247)	At Pre-Test	3.48	1.05							**	**
	At 3 Months	3.77	0.93	79.05	1.00	29.99	< .001	.24	**		**
	At 6 Months	3.97	0.82						**	**	
Sitting Still (*n* = 258)	At Pre-Test	2.64	1.08							**	**
	At 3 Months	3.09	1.02	162.17	1.00	88.21	< .001	.39	**		**
	At 6 Months	3.47	0.97						**	**	
Memory (*n* = 258)	At Pre-Test	2.88	1.13							**	**
	At 3 Months	3.26	1.06	146.05	1.00	64.26	< .001	.36	**		**
	At 6 Months	3.59	0.96						**	**	
Social Interaction (*n* = 258)	At Pre-Test	3.47	1.05							**	**
	At 3 Months	3.76	0.96	115.86	1.00	35.20	< .001	.31	**		**
	At 6 Months	3.99	0.89						**	**	
Mathematics (*n* = 262)	At Pre-Test	2.47	1.15							**	**
	At 3 Months	2.93	1.15	182.06	1.00	95.88	< .001	.41	**		**
	At 6 Months	3.33	1.06						**	**	

*Note. ** p < .01, Bonferroni-corrected. [a] Lower-bound corrections were applied to the df for statistical testing.*

Table 2: Proportion of Children Reported to be Weak in Ability at Pre-Test

Ability	% Of Entire Sample	% Of Sample Enrolled before 1 March 2013	% Of Sample Enrolled after 1 March 2013
Reading	65%	73%	42%
Spelling	64%	70%	47%
Handwriting	73%	75%	67%
Verbal Skill	59%	64%	46%
Concentration	93%	94%	91%
Motor Coordination	77%	77%	78%
Sitting Still	71%	75%	62%
Memory	46%	47%	44%
Social Interaction	49%	49%	50%
Mathematics	78%	85%	59%

Note. nOf Entire Sample = 368; nOf Sample Enrolled before 1 March 2013 = 266; nOf Sample Enrolled after 1 March 2013 = 102.

Families' Involvement and Compliance with the Programme

Programme Involvement: The attrition rate of families from the programme was assessed. Based on the programme start and exit date records available, the KidsBright programme since its inception (N = 368) had managed to keep about 90% (n = 330) of all children enrolled engaged in the programme for at least a period of five-and-a-half months.

Table 3: Repeated-Measures ANOVA of Ability Score by Rating for Entire Sample in Initially Weak Areas, with Bonferroni-Corrected Pairwise Comparisons between Ratings

Ability	Time of Rating	RM-ANOVA[a]							Bonferonni Comparisons		
		M	*SD*	*F*	*df*	*MS*	*p*	η_p^2	At Pre-Test	At 3 Months	At 6 Months
Reading (*n* = 165)	At Pre-Test	2.12	0.79							**	**
	At 3 Months	2.69	0.93	195.14	1.00	90.92	< .001	.54	**		**
	At 6 Months	3.17	0.97						**	**	
Spelling (*n* = 152)	At Pre-Test	2.18	0.78							**	**
	At 3 Months	2.81	0.97	192.12	1.00	89.21	< .001	.56	**		**
	At 6 Months	3.26	1.06						**	**	
Handwriting (*n* = 188)	At Pre-Test	2.26	0.72							**	**
	At 3 Months	2.82	0.82	189.39	1.00	88.89	< .001	.50	**		**
	At 6 Months	3.23	0.83						**	**	
Verbal Skill (*n* = 155)	At Pre-Test	2.32	0.68							**	**
	At 3 Months	2.90	0.81	176.62	1.00	93.33	< .001	.53	**		**
	At 6 Months	3.41	0.82						**	**	
Concentration (*n* = 239)	At Pre-Test	1.97	0.75							**	**
	At 3 Months	2.56	0.86	253.25	1.00	127.51	< .001	.52	**		**
	At 6 Months	3.00	0.93						**	**	
Motor Coordination (*n* = 104)	At Pre-Test	2.42	0.68							**	**
	At 3 Months	3.03	0.88	109.95	1.00	50.94	< .001	.52	**		**
	At 6 Months	3.40	0.78						**	**	
Sitting Still (*n* = 198)	At Pre-Test	2.17	0.72							**	**
	At 3 Months	2.75	0.86	191.85	1.00	106.57	< .001	.49	**		**
	At 6 Months	3.21	0.91						**	**	
Memory (*n* = 181)	At Pre-Test	2.28	0.72							**	**
	At 3 Months	2.77	0.84	185.85	1.00	83.65	< .001	.51	**		**
	At 6 Months	3.24	0.87						**	**	
Social Interaction (*n* = 111)	At Pre-Test	2.44	0.64							**	**
	At 3 Months	2.95	0.78	110.47	1.00	41.09	< .001	.50	**		**
	At 6 Months	3.30	0.80						**	**	
Mathematics (*n* = 205)	At Pre-Test	2.01	0.82							**	**
	At 3 Months	2.56	0.99	198.00	1.00	105.73	< .001	.49	**		**
	At 6 Months	3.02	0.95						**	**	

*Note. ** p < .01, Bonferroni-corrected. [a] Lower-bound corrections were applied to the df for statistical testing*

Programme Compliance: At each time-point (at 3 months; at 6 months) on average, about 2 in 3 parents were able to ensure that their children had completed at least 4 times of movement exercises weekly (the minimum per ETS therapists' recommendation) – 67% out of 349 were able to do so at 3 months, and 66% out of 293 were able to do so at 6 months. About 1 in 2 ensured that their children had at least 4 times weekly intake of fish oil supplements (the minimum per ETS therapists' recommendation) – 56% out of 348 were able to do so at 3 months, and 59% out of 293 were able to do so at 6 months. Excluding missing responses, only about two-fifths of parents were able to ensure that both requirements were met at each time-point.

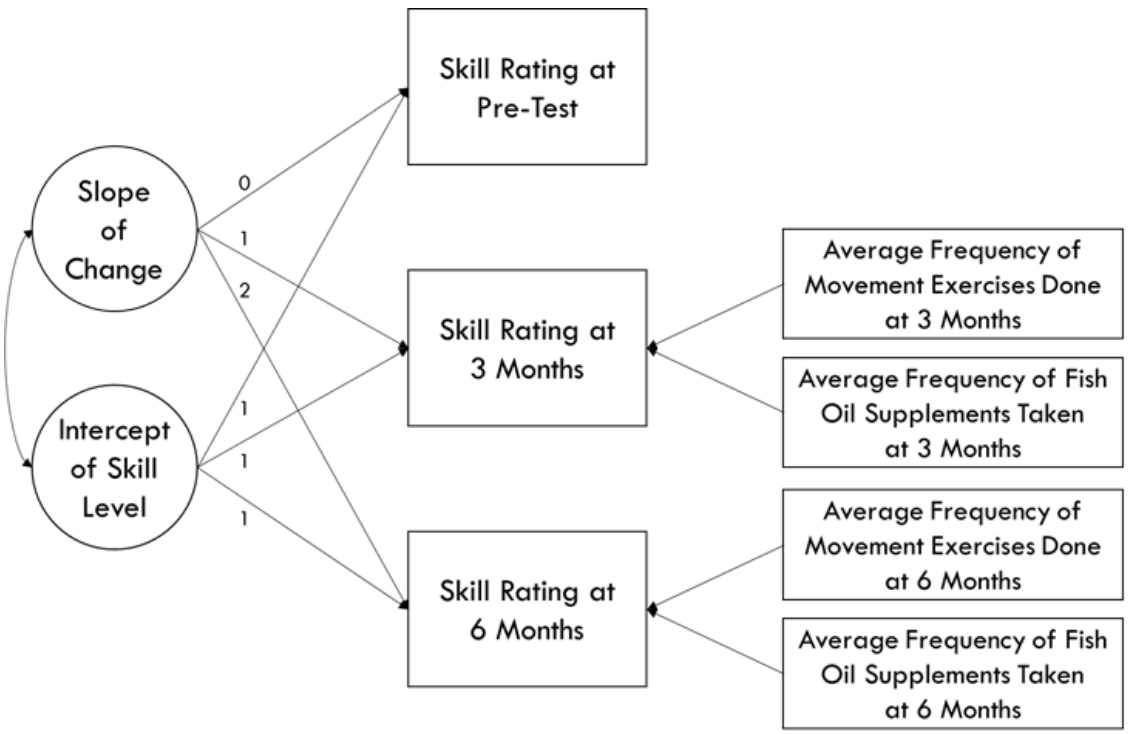

Figure 2. Simplified path diagram of bivariate linear growth model used for fitting. All exogenous variables are allowed to freely correlate with each other; paths are not shown to maintain a clearer presentation. Intercepts and error variances are also not shown to maintain a clearer presentation.

Table 4: Model Fit Statistics for Linear Growth Curve Model, with Fish Oil Supplement Intake and Movement Exercise Conduct as Time-Varying Covariates, for Sample in Initially Weak Areas

Ability	*n*	χ^2 statistics			CFI	TLI	RMSEA statistics		SRMR
		χ^2 estimate	*df*	*p*			RMSEA	90% CI	
Reading	235	3.776	9	.926	1.000	1.000	.000	[.000, .028]	.035
Spelling	217	6.558	9	.683	1.000	1.000	.000	[.000, .069]	.045
Handwriting	267	8.659	9	.478	1.000	1.000	.000	[.000, .082]	.040
Verbal Skill	213	13.685	9	.134	.971	.952	.058	[.000, .117]	.044
Concentration	341	13.217	9	.153	.989	.981	.042	[.000, .087]	.044
Sitting Still	279	13.594	9	.138	.981	.969	.051	[.000, .103]	.052
Memory	257	10.255	9	.330	.995	.992	.029	[.000, .096]	.057
Motor Coordination	160	13.992	9	.123	.967	.946	.067	[.000, .131]	.048
Social Interaction	176	19.283	9	.023	.941	.901	.102	[.036, .165]	.081
Mathematics	284	14.339	9	.111	.980	.967	.058	[.000, .112]	.063

Note. A robust maximum-likelihood (MLR) estimator was used for modelling, with full-information maximum-likelihood performed on missing values.

Attribution to Programmatic Components

Model Fitting: Bivariate linear growth curve models (LCGM; see Figure 2) were fit to each ability, for each subsample of respondents with weak scores in the ability at pre-test. Each growth curve was fit for 3 time-points: at pre-test (0 months), 3 months, and 6 months. The frequency of fish oil supplements taken, and frequency of movement exercises done on average for each participant, were introduced as linear-continuous time-varying exogenous variables. All models produced evidenced a generally good fit to the data, suggesting their validity for interpretation (see Table 4).

Subsequently, the estimated intercept and slope values of the growth in ability score over time for participants, as well as the effect taking fish oil supplements and doing movement exercises had on the ability level at 3 months and 6 months from the models fit are reported in Table 5. These parameters were interpreted. [5]

Table 5: Intercepts, Slopes and Effects of Time-Varying Covariates for Linear Growth Curve Model, with Fish Oil Supplement Intake and Movement Exercise Conduct as Time-Varying Covariates, for Sample in Initially Weak Areas

	M		*B*			
	Intercept	Slope	f(Fish Oil Supplements at 3 months)	f(Fish Oil Supplements at 6 Months)	f(Movement Exercise at 3 Months)	f(Movement Exercise at 6 Months)
Reading	2.153**	0.431**	-0.006	-0.020	0.039*	0.060*
Spelling	2.198**	0.464**	-0.015	-0.026	0.053**	0.062*
Handwriting	2.268**	0.356**	0.006	0.032	0.041*	0.039
Verbal Skill	2.299**	0.478**	0.002	0.001	0.028	0.039
Concentration	1.989**	0.441**	-0.027	-0.028	0.051**	0.059*
Sitting Still	2.198**	0.432**	-0.015	-0.041	0.042*	0.080*
Memory	2.305**	0.399**	-0.031	-0.012	0.045*	0.051
Motor Coordination	2.386**	0.477**	0.030	0.003	-0.007	0.004
Social Interaction	2.429 **	0.380**	0.014	0.024	0.018	0.010
Mathematics	1.995**	0.453**	-0.007	0.001	0.038*	0.033

Note. $^{*}p < .05$. $^{**}p < .01$. *A robust maximum-likelihood (MLR) estimator was used for modelling, with full-information maximum-likelihood performed on missing values.*

5. *With reference to Table 5, the interpretation of the coefficients would be as such: for an average child starting out in the programme with a Reading score of about 2.15 (intercept term), an increase of 0.43 points (slope term) had been observed for every 3 months' passing in the programme. Between two children, holding all other factors constant, the child who had performed one more movement exercise per week during their first 3 months in the programme, over the other, would have improved in their Spelling score by 0.039 points more than the other (beta-coefficient estimated of* $f_{Movement\ Exercise\ (3\ Months))}$. *If the first child had performed two more movement exercises per week in the 3rd to 6th month of the programme than the second child, then an improvement of 0.120 points (2 units x beta-coefficient estimated of* $f_{Movement\ Exercise\ (6\ Months))}$ *over the second child was observed.*

Effect of Time in Programme: It can be demonstrated from the LCGM that in general across all abilities, children's ability level had increased with time passed in the programme.

Effect of Taking Fish Oil Supplements: For the measured programmatic component of taking fish oil supplements, the LCGM did not offer statistical support for the view that it had helped with improving participant ability levels over time, for any ability.

Effect of Performing Home Movement Exercises: For the measured programmatic component of performing home movement exercises, consistent positive effects were found from the LCGM for it to result in improvements in Reading; Spelling; Concentration, and Sitting Still, for participants who were initially weak in those areas.

For those initially weak in Handwriting, Memory and Mathematics, only partial evidence was found for movement exercise to have a positive effect. The hypothesized beneficial effect of movement exercise appeared to be present at 3 months, but was not sustained at 6 months.

DISCUSSION

Summary of Results

The study had set out to evaluate: whether the KidsBright programme in Singapore had been effective to help children enrolled in the programme, to improve in their previous weak learning and academic outcomes, and whether families in the programme had been able to comply with the requirements of the KidsBright programme. It also aimed to test the validity of a specific part of the KidsBright programme logic model, on whether home movement exercises, and fish oil supplementation, contributed to better child outcomes in the programme.

Overall, the findings of this study indicated that children enrolled in the KidsBright programme had experienced a significant improvement in their average ability level over time, across all areas. More importantly, improvements had been observed among those whom had started with poor initial scores in the programme – those potentially belonging to the children being most at-risk of, or already experiencing the worst effects of SpLDs. Another finding to note is the relatively large effect sizes of these improvements found provided by the KidsBright intervention, against more modest gains reported for more-conventional interventions e.g. stimulant medications (Brown et al., 2005).

The significant improvement in reading and spelling scores in particular appears noteworthy in two ways. Firstly, improving literacy score of children with dyslexia is a very challenging task, even when using the conventional phonologically-based teaching

approaches as not all children respond to these approaches. It is also difficult to ensure the improvements in phonological skills would translate to more accurate or more fluent reading (Fawcett, 2013).

Secondly, the findings indicate that KidsBright is effective in improving the reading and spelling abilities of children specifically, apart from improving their cognitive abilities like attention or memory. This suggests that the KidsBright programme has an advantage over typical brain training programmes that focus on training the child's working memory; those programmes have been criticized to be limited in generalizability to bring about actual improvements to reading and spelling for the children (Pierson, 2018).

Subsequent analyses done in a test of the programme logic revealed however not all theorized aspects of the programme appeared to contribute to these improvements observed. There was no statistically significant association found between fish oil consumption with gains in scores for children with SpLDs enrolled in the KidsBright programme. However, the performance of home-based movement exercises, as facilitated by the parent, was found to have a positive role in improving many of the outcomes measured by the study. This relationship was found after having controlled for other nuisance and unmeasured factors in the programme (e.g. within-person maturation effects, through the LCGM), which would demonstrate the necessity of including home-based movement exercises as part of the service model of the programme.

At the same time, it was noted from the analysis that there had also been a significant main effect of the children having improved in all their scores, simply as they spent time in the programme. This suggested that the KidsBright programme had been effective for the most part (including ability areas where movement exercises had not shown a robust contribution), not solely because of the home movement exercises, but other factors may also have had a potential role in improving outcomes for children with SpLD as well. However, as these factors were not evaluated or controlled for in this study, their role in contributing to better outcomes for children with SpLDs remain speculative at this point without empirical evidence. These factors may include other deliberate components of the KidsBright programme e.g. mental exercises, movement exercises done in weekly sessions on ETS premises, the other two aspects of dietary approach apart from fish oil supplements, and other extra-programmatic factors e.g. ETS educational therapist effects; child maturation.

Lastly, in analysing if families had been able to comply with the demands of the KidsBright programme, it had been found that one third of parents had not abided by the home-based movement exercise dosage re
commendations by the ETS therapists – which, as suggested by other analyses in this report, has been demonstrated to be an important factor in improving outcomes. Notwithstanding that there were no significant effects found for fish oil supplementation, there also appeared to be more difficulties for families to comply with the recommended

guidelines for fish oil supplementation in the programme. This could potentially be explained by way of the relatively large proportion of low-income families in the sample, whom may not have had the economic resources to access fish oil supplements as regularly.

One out of every ten children enrolled in the programme at the start had also not managed to last the six months in the programme. Hence, it could be inferred that was clear room for improvement on managing issues of service user attrition and therapeutic compliance in the programme. Doing better in these regards to ensure that children with SpLDs could receive the recommended amount of support by the families and ETS therapists would be an easy way to bring about significant, added gains for the target audience of the programme.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

It is recognized that there are certain weaknesses and limitations noticeable in this research. The consequences, and potential points presented in mitigation, about these critiques would be discussed in the following paragraphs.

Firstly, as a retrospective study without rigorous a priori designs or case controls, the rigour and quality of evidence in this report falls short of what is produced with the randomized controlled trial (RCTs) typically used to evaluate the efficacy of other therapies e.g. medication, with this client group. It may not be excluded as a logical possibility that in the absence of KidsBright, the children included in this evaluation could still have experienced the same growth in their ability areas; the gains by the children in this programme could potentially not have been to KidsBright's credit. However, it is noted that the consensus of wider literature appears to be that children with SpLD who do not receive interventions will only continue to fall further behind their peers over time in their academic abilities/abilities and achievements. Hence, it is more probable that these opposite (positive) results achieved by the children here, could be rightly attributable to the intervention that they have gone through.

However, a second critique may follow in that there were no strict controls made in this research for the possibility that children in the programme could have also been undergoing other interventions concurrent with KidsBright e.g. also undergoing neurofeedback therapy. This poses a validity threat to the research, as the intervention that they have gone through may not be KidsBright bona fide. The improvements observed may also be as a result of these other interventions and activities done in conjunction with KidsBright, rather than due to KidsBright itself. However, it is noted through anecdotal feedback from ETS therapists that this could be unlikely, as there is a practice at Care Corner ETS to discourage parents from having their children receive multiple interventions at the same time, as they could possibly be conflicting with each

other in approach. [6] Moreover, no measures were taken of whether or not the children were also receiving stimulant medication, because its positive effect of controlling the core symptoms is only short-term (few hours and less than a day) and core symptoms will return once the medication has worn off as indicated under the "Existing Approaches" segment.

A third critique may deal with the reliance on parent-report format to track improvements for the children in the research. However, it is noted to be common practice to collect information from parents via parent rating form for screening or assessment of children's behaviours such as ADHD (Papageorgiou, Kalyva, Dafoulis, and Vostanis, 2008). Parent rating scales are frequently used to assist in ADHD diagnosis, alongside with school teachers rating form (e.g. Conners Comprehensive Behaviour Rating Scale (CBRS)), hence this objection could be somewhat mitigated. A more pertinent threat to validity has been that the questionnaire had been administered using the same sheet of paper throughout the evaluation, with previous markings being in sight; the ratings are vulnerable to be affected by expectancy bias on the part of parents. This happens when the parents may rate the child more positively than is actually the case, due to subconsciously wanting to – (i) avoid the reality that the child has not improved despite all the money and effort invested, or (ii) avoid looking bad as they as the parent may also feel responsible or blamed if the child does not show improvement.

A fourth critique may lie in the lack of rigorous process evaluation or checks on whether the home and parental components of the programme were indeed done as they should. This has important ramifications for the study, as fish oil consumption had not been found to have a positive effect on any of the outcomes for children. As mentioned earlier, while one conclusion from this may be simply that fish oil supplements do not actually have the hypothesized effects as otherwise believed, this could be a hasty inference. A counter could be actually that there was a lack of sufficient standardization and quality control in the collection and tracking of fish oil consumption in the programme. [7] Having not addressed this issue, it may remain as yet inconclusive as to whether or not fish oil supplements truly do not have a therapeutic role to play in improving outcomes for the child.

As such, future evaluators of KidsBright may wish to take heed of the above pointers to improve upon the state of the evaluation. While it may be difficult to expect a RCT to be done with the limited resources available, many parts of the research can be improved

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6. *Furthermore, for pre-2013 cohorts, a majority of children had been from lower-income families. They may not have had the necessary financial resources to access other interventions concurrently.*
7. *This includes whether even as parents may have complied with the frequency of fish oil administration as advised by Care Corner ETS, it is unclear whether they have also administered the correct dosage.*

in rigour through cheaper, simpler tweaks. For instance, to re-design the forms such that the pre-tests and each re-test can be filled in on fresh sheets of paper; to collect information on more factors to aid in process evaluation; and to understand and control for the extent to which the child is pursuing other interventions at the same time as KidsBright. The programme should also be more fully evaluated, including components such as mental exercises, and other attributes and activities that are done through the span of the programme. It may be useful for a full logic model of the programme to be drafted up, which can aid in a design of such a complete evaluation.

Finally, it may also be useful to consider the use of validated outcome measurement tools, and incorporate multiple perspectives e.g. the child themselves; the therapist; teachers at school, if possible, to provide a more valid and reliable assessment of the child's changes through the programme.

PRACTICAL IMPLICATIONS

In this research, some indicative evidence was suggested for the KidsBright multimodal intervention programme to be an effective complementary intervention to conventional approaches available in the sector for children with SpLDs. In doing so, KidsBright can be said to have successfully responded to the quest of parents for effective medication-free alternatives for their children with ADHD to help them learn better in schools and in remedial teaching classes. It also answered ETS educational therapists' search for complementary interventions to help children with SpLD learn faster in remedial teaching classes.

In addition, a niche may be found for KidsBright among the landscape of services in Singapore for children with SpLD as a relatively low-cost programme, appealing to fiscally minded parents, education stakeholders and social service practitioners alike. KidsBright is typically conducted in a small group setting of 3 to 5 children, reducing the labour cost of service provision as compared to a one-to-one intervention such as neurofeedback and counselling. Further reliance on high professional labour and material costs are also reduced as the KidsBright experience has shown that it is possible to train parents to conduct regular therapy exercises at home, augmenting the therapist's efforts, to achieve the desired high frequency of activity for therapeutic effect. KidsBright also can be conducted without any special equipment (e.g. neurofeedback and sound therapy) or room (e.g. sensory integration room) requiring to be setup. Parents' costs are also reduced with lesser hours of therapist's direct intervention needed, and avoiding their need to commute to the service center with the child as often.

At the same time, this evaluation has surfaced that certain practices in the programme may need to be looked at further or strengthened, in order to deliver a more cohesive,

impactful intervention to children with SpLD and their families. In the light of findings from this study, Care Corner ETS plans to improve the implementation of KidsBright programme by:

1. Reviewing the component of fish oil supplements in KidsBright – one possibility is to make it as an optional recommendation to parents to give fish oil supplements to the children, tailoring it to the needs of each child instead of having it as a general practice; this would then need to be taken into account in the evaluation.
2. Revising the content of parent rating form to collect more factors to aid in process evaluation, such as how frequently mental exercises are done by the child at home, and whether the child is concurrently receiving medication or other therapies;

3. Establishing practical measures to work with parents and children to reduce attrition, and improve compliance on implementing home exercises. This could include the use of parent diaries to log the exercises carried out, which could be reviewed on a regular basis by ETS therapists who could help address any obstacles in their performance.

4. Adding objective measures of performance on standardised tests for the children at pre and post-test on at least some measures to validate the parental ratings. This would strengthen the findings considerably.

CONCLUSION

Through this research, KidsBright, a novel multi-modal intervention programme in Singapore which involves parents in implementing home-based components has been evaluated on its effectiveness on children with a range of SpLDs including ADHD, dyslexia and ASD. Findings indicated that children enrolled in this programme had experienced a significant improvement in their average ability level over time, across all 10 areas evaluated, based on parental ratings: (i) Reading; (ii) Spelling; (iii) Handwriting; (iv) Verbal Skill; (v) Concentration; (vi) Ability to Sit Still; (vii) Memory; (viii) Motor Coordination; (ix) Social Interaction; (x) Mathematics.

The home-based movement exercise modality of the programme was found to be effective in improving many ability domains, while no evidence was found for fish oil supplementation modality to contribute to any improvements for children. The results also suggested that issues of service user attrition and their compliance to programme requirements may also need to be worked on in order for the programme to be more effective.

In terms of practical implications, the evidence suggests that this programme could be an effective complementary intervention to conventional approaches for helping children with SpLDs. For children with ADHD, this programme may be considered as an effective, medication-free alternative to help them learn better. For children with other SpLDs, it could serve as an effective complementary intervention to help them to learn faster in remedial teaching classes.

Care Corner ETS plans to continue improving the KidsBright programme, and extending it to more parents and educators to help more children with SpLDs reach their fullest potential in learning and academic achievement. This will in turn help level up the educational outcome for these children, who constitute a significant portion of each cohort of students in Singapore.

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ANNEX A: PARENT RATING FORM FOR REFERENCE

KidsBright Programme
Parent Rating Scale 家长评估 指表

Please rate each item below according to your child's current ability and behaviour.
请 根 据孩子现有的能力 和表现，在项目 1 至 10 的栏目上进行评估。

1	2	3	4	5	U
Very Weak 非常弱	Moderately Weak 弱	Marginally Weak 稍微弱	Acceptable/Average 没问题	Good 好	Unsure 不清楚

1. Reading 认字/阅读能力 1 2 3 4 5 U
   (Ability to recognise/understand words for child's age group)
2. Spelling 听写能力 1 2 3 4 5 U
   (Ability to learn spelling)
3. Handwriting 写字能力 1 2 3 4 5 U
   (Ability to write neatly)
4. Verbal skill (talking) 口语(说话)能力 1 2 3 4 5 U
   (Includes pronunciation and expression of ideas)
5. Concentration 注意力 1 2 3 4 5 U
   (Ability to focus on task)
6. Ability to sit still 能安静的坐 1 2 3 4 5 U
7. Memory 记忆力 1 2 3 4 5 U
   (Ability to remember things well)
8. Motor coordination 动作协调能力 1 2 3 4 5 U
   (Poor motor coordination includes clumsiness in hand and leg movements e.g. easily falling/tripping over when walking
   困难如：容易摔倒，难学骑脚车， 握笔姿势不佳)
9. Social Interaction 社交能力有交朋友的能力 1 2 3 4 5 U
   (Ability to relate to people e.g. having no friends indicates poor Social interaction ability)
10. Math 数学能力(能明白数学的概念) 1 2 3 4 5 U
    (Ability to understand math concepts for child's age group)

Following 2 items are to be filled up only at subsequent parent training sessions:-

*Movement Exercises (Home) 脑部激发运动
No. of times done weekly (on average) 0 1 2 3 4 5 6

*Fish Oil Supplement 鱼油补充剂
No. of times taken weekly (on average) 0 1 2 3 4 5 6

Child's Name 孩子姓名: _____ **Parent's Name 父母姓名:** _____

(1) 1st Rating Date (第一次评估日期)_____ use a **circle** 进行评估时以**园圈**为符号 ○

(2) 2nd Rating Date (第二次评估日期)_____use a **square** 进行评估时以**正方形**为符号 □

(3) 3rd Rating Date (第三次评估日期)_____use a **triangle** 进行评估时以**三角形**为符号 △