Translating Education Neuroscience for Teachers

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Abstract

BACKGROUND Translating neuroscience to education involves providing accurate and simplified information about neuroscience to teachers.

AIM AND PROCEDURES The aim of this research was to understand if providing translated abstracts from neuroscientific articles helped teachers understand content more thoroughly. Surveys, experimental manipulation, and focus group discussions were conducted with thirty teachers from two primary schools in Singapore. Teachers shared their familiarity with neuroscience, self-rated their understanding of neuroscientific abstracts, and provided feedback on the abstracts' translations.

FINDINGS Results indicate that translated abstracts did not improve attitudes significantly; however, focus group discussions revealed that teachers were more interested in the applications of neuroscience research in classroom pedagogy.

CONCLUSIONS These findings highlight the importance of improving communication between neuroscientists and educators.

Keywords: educational neuroscience, research translation, science communication, teachers, teaching implications

Translating Education Neuroscience for Teachers [1]

The purpose of this study was to explore how neuroscientific findings can be translated into more understandable text for teachers in order to promote the application of brain-based classroom strategies. We first define neuroscience and education, and explain their relationship. We then explain the rationale for addressing the gap between neuroscience and education and introduce the present study.

Neuroscience refers to the scientific study of the nervous system and the brain, combining knowledge from several disciplines such as psychology, biology, and chemistry. Research on neuroscience allows us to better understand how the brain is related to behavior and it can have important implications for neurological disorder treatments, educational reforms, and child development. This understanding is especially important for educators as it may have direct implications on their work, such as understanding the role of working memory and long-term memory in learning (Guy & Byrne, 2013), and how working memory can influence students' performance in math (Ashcraft & Krause, 2007) and spelling (Ormrod & Cochran, 1988).

Education is a broad process that shapes an individual's identity. In this manuscript, we focus on education as the provision of teaching instruction, and the acquisition of knowledge (Kumar & Ahmad, 2008). This focus includes the role of the brain in our educational experience.

The Relationship between Neuroscience and Education

Educational neuroscience refers to how neuroscientific knowledge can be integrated with teaching and learning practices to enable effective brain-based teaching and learning strategies. Educational neuroscience is a new and developing field, with huge potential to be applied in formal academic settings (Carew & Magsamen, 2010). Just as science enhanced

[1] Abbreviations: Translational Education Neuroscience Clearinghouse (TENC), Allied Educators (AEDs)

medicinal practices, the Royal Society has suggested that education and neuroscience can work synergistically to improve educational practices (The Royal Society, 2011, p. 5).

However, educational neuroscience also faces certain challenges. An early influential critique by Bruer in 1997 argued that the implications of neuroscientific research were not highly applicable to educational practices at the time, resulting in a wide gap between neuroscience and education (Bruer, 1997). Although the field expanded greatly in a decade, Bruer (2006) also suggested that cognitive psychology holds more promises in its relevance to education.

With advancements in non-invasive brain research techniques such as functional magnetic resonance imaging and electroencephalogram, it became easier to integrate our understanding of the brain and its role in cognitive psychology, and a field known as cognitive neuroscience began to develop. Cognitive neuroscience is concerned with how cognitive functions such as reading, writing, and speaking are explained by brain activities (Düvel, Wolf & Kopiez, 2017). Ansari, Coch and De Smedt (2011) noted that with the advent of non-invasive neuroimaging techniques to study the brain in the 1990s, cognitive neuroscience research has advanced so remarkably that the 1990s-2000s have been regarded as the “Decade of the Brain” (p. 37). Knowledge about brain development using imaging techniques allowed for the early identification of cognitive deficits, so that early intervention could take place, especially in the context of learning disabilities and special needs education (Dawson, 2008; Hoeft et al., 2007). As knowledge of cognitive neuroscience continues to grow, it provides much promise for education. In contrast to Bruer, other researchers such as Szücs and Goswami (2007) have embraced the integration of cognitive psychology, neuroscience and education and view educational neuroscience as the understanding of how the circuitry of the brain changes with learning, and how we can use this knowledge to impact education and pedagogy.

Besides criticism on the applicability of neuroscientific findings to education (Bruer, 1997), another reason for skepticism in bridging the gap between education and neuroscience is that there have been many instances where research has been misinterpreted by people outside of the scientific community, resulting in misinformation and misconceptions that led to the development of "neuromyths". The Organisation for Economic Co-operation and Development (OECD) defines a neuromyth as "a misunderstanding, a misreading and in some cases a deliberate warping of the scientifically established facts to make a relevant case for education or for other purposes" (OECD, 2002, p. 71). These neuromyths often stem from truths, but they have become so oversimplified, exaggerated, or overgeneralized that they are no longer accurate representations of the original neuroscience findings (Howard-Jones, 2010). A study by Howard-Jones in 2014 revealed that it was very common for teachers to erroneously accept neuromyths to be neuroscientific findings. For example, while multiple controlled laboratory studies have established that there is a lack of evidence on whether individuals learn best when taught in their preferred learning style (Coffield et al., 2004; Geake, 2008; Kratzig & Arbuthnott, 2006), more than 90% of teachers in the UK, Netherlands, Turkey, Greece, and China believed that "individuals learn better when they receive information in their preferred learning style" (Howard-Jones, 2014, p. 817).

Many educational packages that are targeted at educators and which claim to be brain-based, often stem from some neuromyths and contribute to the continued propagation of those neuromyths (Goswami, 2006). In addition, these neuromyths tend to be accepted without being further questioned (Dündar & Gündüz, 2016). This lack of critical evaluation puts educators at risk of adopting so-called brain-based teaching strategies when they do not have any scientific basis (Carew & Magsamen, 2010; Geake, 2008; Hook & Farah, 2013). Neuromyths often end up doing more harm than good to students (Düvel, Wolf & Kopiez, 2017). Therefore, it is critical that educators be informed of accurate teaching implications of neuroscience, so that what they adopt in their teaching practices will be true to research findings on neuroscience.

Addressing the Gap between Neuroscience and Education

Efforts have been put in place to address the gap between neuroscience and education. For example, neuroscientists conduct lectures and workshops targeted at teachers to inform them about current findings in neuroscience and classroom implications of neuroscience research (Zadina, 2015). The Society for Neuroscience (SfN) was established in 1969 with one primary goal of increasing the public's general knowledge of neuroscience and informing the public about current research findings on neuroscience and their meanings ("Chapter II: Establishing the society for neuroscience," n.d.) The SfN has an initiative providing the non-scientific community with a resource called *The Neuroscience Core Concepts*, in which neuroscience ideas are taught to the non-scientific community in a user-friendly manner without compromising on scientific accuracy ("Core Concepts," n.d.). In addition, renowned institutions such as the Harvard Graduate School of Education offers graduate programmes in mind, brain, and education to educate potential researchers and practitioners about findings on cognitive neuroscience and education ("Mind, Brain and Education," n.d.) Such initiatives aim to train people in neuroscience and education, potentially integrating both disciplines and giving rise to a new framework that transforms the view of learning (Fischer et al., 2007; Szücs & Goswami, 2007). Another initiative that provides a platform for neuroscientists and educators to communicate is The Learning Zone, where knowledge about neuroscience and classroom experiences are discussed online for the benefit of the community ("The Learning Zone," n.d.). The Learning Zone is a project by Gallomanor, who specializes in facilitating communication between the community and organisations, with a strong focus on education ("Gallomanor," n.d.). These kinds of initiatives help to connect educators to neuroscientists, raising awareness on issues in education and neuroscience, and how inter-related these disciplines are.

A key point of consideration is that the information provided by neuroscientists to educators does not necessarily address what educators want to know. Teachers tend to want answers to “how to” questions. Goswami (2006) highlighted how teachers want relevant information with potential applications for the classroom while neuroscientists tend to focus more on the experimental aspects of their research and be more conservative in their reporting to avoid any definitive claims. While neuroscientists and educators have some common interests in improving learning, there is still room for improvement in how cognitive neuroscientific research informs education and vice versa (Immordino-Yang & Gotlieb, 2017). Ansari and his colleagues (2011) called for more communication between neuroscientists and educators in order “to arrive at common questions and a common language” (p. 39). While some efforts are in place, there is still room for more relevant, practical communication between neuroscientists and educators, for neuroscientists to better understand the needs of educators, and for educators to be inspired to maximize the classroom applications of neuroscientific research findings and benefit students.

Present Study and Hypotheses

This study was conducted in support of the Translational Education Neuroscience Clearinghouse (TENC) project at the National Institute of Education (NIE) in Singapore by Walker and colleagues (2017). The TENC project is currently ongoing and aims to create an online database of translated neuroscience abstracts for teachers to access. As part of the larger TENC project, abstracts of neuroscientific papers are translated, and the authors gathered feedback from teachers about how to improve these translations and these findings are presented in this paper.

We set out to examine whether translating neuroscience abstracts is useful for teachers. We define translation as simplifying neuroscientific abstracts in a way that is accurate, avoids jargon, and is comprehensible to readers without a neuroscientific background. The goal is for teachers to be well-informed about neuroscientific findings and their implications for the classroom, so that they can use important teaching strategies in the classroom to enhance student learning (Berninger & Richards, 2007; Coch & Ansari, 2009). This is one way to help teachers gain insight from research findings about cognitive neuroscience. Teachers may find value in these research findings and consider how they could incorporate it into their teaching strategies.

There were three main components to this study. The first component examined whether all the teachers had the same level of familiarity on neuroscience. This was investigated through a pre-survey on existing general knowledge and familiarity with neuroscience. If the teachers received similar scores, it allowed for the comparison of teachers in different groups without their initial knowledge levels acting as confounds. We hypothesized that the teachers would be similar on their familiarity of neuroscience so that there would be no statistically significant difference in pre-survey scores between the Translated and Untranslated groups.

The second component of this study aimed to understand if translating neuroscience abstracts would be useful to teachers, by looking at the teachers' self-reported attitudes towards the untranslated and translated neuroscience abstracts. To translate neuroscience abstracts, we replaced technical terms used in the original abstracts with layman descriptions so they were easily understood by readers without background in neuroscience. Current neuroscientific articles in scientific journals are targeted at an audience in the scientific community that is familiar with specialized research terminology. While they may be useful and informative to other neuroscientists and researchers, they are less helpful and informative to educators (MacLellan, 2016). Thus, it is important to understand whether educators find it useful to read the translated abstracts from neuroscientific journal articles, and how these translations can help them learn about the brain and apply it in their teaching practice. To do so, we explored the differences in self-reported attitudes between teachers who read two untranslated abstracts and teachers who read an untranslated abstract followed by a translated abstract. We hypothesized that the group who read untranslated abstract A followed by translated abstract A would experience a greater improvement in self-reported attitudes for usefulness of the neuroscience abstracts compared to the group who read untranslated abstract A followed by untranslated abstract B.

Finally, the third component of this study examined the effectiveness of the translated abstracts, the applicability and relevance of the translated abstracts for teachers, and whether the abstracts answered the needs of teachers through a focus group discussion. It was expected that teachers would indicate they found the translated neuroscience abstract to be more useful than the untranslated abstract, and would prefer the translated abstract.

Methods

Participants

Thirty teachers (three males and 27 females) from two neighborhood primary schools in Singapore participated in this study. A priori power analysis was conducted using G*Power software version 3.1 to estimate the required sample size, given a large effect size $f = 0.5$ (Cohen, 1988), $\alpha = 0.05$ and power ($1-\beta$) = 0.8, finding that the minimum sample size required was $N = 28$. Schools were contacted via email correspondence. Approval was obtained from school principals before teachers were invited to participate in the study. All teachers were informed about the study and consented to participate before the study commenced. This study’s methods and procedures have been approved by the Institutional Review Board (IRB) of Nanyang Technological University (IRB No: 2017-08-056).

The teachers were aged between 26 and 55 years old (*M* = 36.8, *SD* = 8.8), with varying lengths of teaching experience (*M* = 10.9, *SD* = 7.7). Refer to Table 1 for the breakdown of teaching experience by years.

Table 1

Teaching Experience of Participants

Teaching Experience (Years)	Number of Teachers	Percentage (%) of Teachers
Less than or equal to 5	8	26.7
More than 5, less than or equal to 10	10	33.3
More than 10, less than or equal to 15	5	16.7
More than 15, less than or equal to 20	4	13.3
More than 20	3	10.0

The teachers taught a variety of different subjects in their primary schools, including English, Mother Tongue, Mathematics, Science, Social Studies, Arts, Physical Education, as well as Civics and Moral Education. Many of the teachers taught more than one subject. Refer to Table 2 for a breakdown of the subjects taught by the teachers.

Table 2

Subjects Taught in School by Participants

Subjects Taught	Number of Teachers	Percentage (%) of Teachers	*M*	*SD*
English	19	63.3	1.37	.490
Mathematics	17	56.7	1.43	.504
Mother Tongue	5	16.7	1.83	.379
Science	7	23.3	1.77	.430
Social Studies	9	30.0	1.70	.466

Arts	3	10.0	1.90	.305
Physical Education	1	3.3	1.97	.183
Civics and Moral Education	2	6.7	1.93	.254

The sample consisted of teachers who were ethnically Chinese (*N* = 19), Malay (*N* = 8), Indian (*N* = 2), or Javanese (*N* = 1). As for highest education level achieved, 20% of the teachers had a pre-bachelor's diploma (*N* = 6), 50% had a bachelor's degree (*N* = 15), 20% had a postgraduate diploma (*N* = 6), and 10% had a master's degree (*N* = 3).

The majority of the teachers did not have formal training in special education. Only a handful of teachers attended or completed a locally offered teachers training in special needs professional development program (*N* = 5, 16.7%) while only 1 teacher was a certified special needs teacher. Despite not having received formal training in special education, many of the teachers had worked with students with special needs during their teaching career (*N* = 24; 84%). Demographic questions on experience with special needs were asked because the abstracts presented were on the topic of special needs, specifically attention deficit and hyperactivity disorder (ADHD).

Design

The study used a mixed-methods approach that included both quantitative and qualitative components. The quantitative aspect consisted of a pre-survey and two reading tasks, investigating the first two components of the study (i.e., familiarity with neuroscience and self-reported attitudes on the abstracts, respectively). The qualitative aspect consisted of focus group discussions which examined the third component of the study (i.e., teachers' feedback about the translations).

Teachers were randomly assigned to either the Translated group (*N* = 15) or the Untranslated group (*N* = 15) for the pre-survey and the reading tasks. They completed the pre-survey before proceeding to the reading tasks. The reading tasks required teachers to read two abstracts and answer several questions to ascertain their self-reported attitudes towards the abstracts. Both groups read an untranslated abstract for Reading Task 1. However, depending on the group they were assigned to, the teachers read either a translated abstract (the Translated group) or an untranslated abstract (the Untranslated group) for Reading Task 2 (see Figure 1). The teachers were not informed about the translated and untranslated abstracts and simply asked to rate the abstracts that were presented to them.

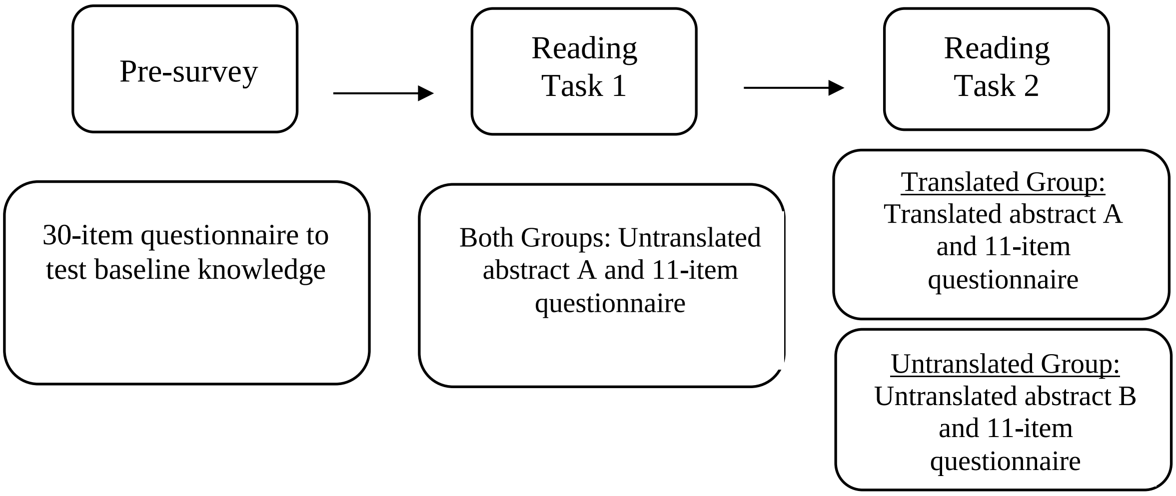

Figure 1. Procedure for the Translated and Untranslated groups.

For each reading task, teachers had to complete a post-reading questionnaire to report their attitudes towards the abstract. The difference in mean reading scores was obtained by subtracting the mean score of Reading Task 1 from that of Reading Task 2. The two groups' mean difference scores were compared to obtain insight on whether the Translated group had improved more in their self-reported attitudes about the usefulness of the abstracts than the Untranslated group – our second hypothesis.

Lastly, for the focus group discussions, eight teachers (four from each school) were randomly selected from the thirty participants. The focus group discussions were conducted after the pre-survey and reading tasks.

Materials and Procedures

All teachers first answered demographic questions on their age, gender, and teaching experience. Next, they completed the pre-survey followed by the reading tasks. Finally, eight teachers joined the focus group discussions. Statistical analyses of the pre-survey and reading tasks were conducted using the Statistical Package for the Social Sciences software.

Pre-survey. The purpose of the pre-survey was to obtain a better understanding of teachers' familiarity with neuroscience. The pre-survey questions were adapted from a professional development course on Applied Educational Neuroscience for teachers (Hale, 2015). The 30-item pre-survey contained accurate and inaccurate statements about neuroscience which teachers had to indicate their levels of agreement or disagreement with, via a 5-point Likert type scale that ranged from "Strongly Disagree" to "Strongly Agree" (refer to Appendix A for the full list of items for the pre-survey). Mean scores were obtained from the pre-survey data and a t-test was conducted to evaluate for possible familiarity differences between teachers assigned to the Translated and Untranslated groups. This data illustrated whether teachers from both groups started off on similar baseline levels on familiarity with neuroscientific knowledge.

Reading tasks. The untranslated abstract A was administered to both groups in Reading Task 1. For the Translated group, teachers read the translated abstract A for Reading Task 2. Meanwhile, teachers in the Untranslated group read Untranslated abstract B (a completely different abstract from abstract A) in Reading Task 2. The use of two different untranslated abstracts is to minimize the exposure effect to the same abstract. See Appendix B for the abstracts used in the reading tasks and how they were chosen.

After reading each abstract, teachers completed an 11-item questionnaire to rate their self-reported attitudes towards the abstracts (see Appendices C and D). The questionnaire was developed and reviewed jointly with the TENC project (Walker, Tan & Chen, 2017), and had been piloted on four subjects to review its validity. The items measured teachers' opinions about the usefulness of each abstract based on how relevant they found the abstract to be to their teaching profession, how comfortable they felt reading the abstract, and how much they thought they understood about the abstract. Participants responded to the items on a 5-point Likert-type scale that ranged from “Strongly Disagree” to “Strongly Agree”. Such scales have been found to decrease the feelings of annoyance in survey respondents and enhance the quality of the feedback collected (Sachdev & Verma, 2004).

Focus group discussion. We conducted a focus group with the teachers to gather feedback on the reading tasks, how they felt about the translations, and their attitudes towards neuroscience in general. Focus groups have the advantage of providing participants with a platform for communicating with one another and building on each other’s feedback and thoughts (Leung & Savithiri, 2009).

The focus group discussions were conducted as part of a larger study for the TENC project at NIE. Four teachers from each of the two schools (N = 8) were randomly selected, taking into account their availability to participate. Focus group sessions were held for the teachers at their respective schools, with both sessions lasting approximately 45 minutes. All participants were female and had varying teaching experiences. Teachers were given a new translated abstract and a new untranslated abstract, and were asked to review them during the focus group session.

As the reading tasks were an experimental manipulation, bullet points had not been used in the reading task translations to prevent introducing a confounding variable (i.e., style of abstract presentation). However, since the focus group was not an experimental manipulation and its goal was to obtain feedback, the translations presented during the focus group discussion were in bullet point format (refer to Appendix E for the focus group discussion abstracts). In addition, after the first focus group discussion (with School 1), we continued to work on the translated abstract based on the feedback from School 1 teachers to create a different translation for use in the second focus group discussion (with School 2). Specifically, we added an additional section, Classroom Implications (see Appendix E for the abstracts used in the focus group sessions). The teachers were asked questions to guide the flow of the focus group discussions (see Appendix F).

The audio recordings of the focus group discussions were transcribed, and codes were assigned to keywords and phrases that represented the themes of the questions. The focus group data was analyzed using constant comparison analysis in which a list of codes was generated, and similar codes were merged to form first categories, then themes (Strauss & Corbin, 1998).

Results and Discussion

Pre-survey

For the pre-survey, the Translated group (N = 15) had a mean score of M = 3.24, SD = 0.14, while the Untranslated group (N = 15) had a mean score of M = 3.26, SD = 0.19 with normal distributions with no violation of assumptions for parametric statistics. An independent samples t-test showed no significant difference between the Translated group and the Untranslated group ($t(28) = 0.32$, $p = .75$), suggesting that both groups had similar baseline levels of familiarity with neuroscience, confirming the first hypothesis.

Reading Task

Each group's overall difference in Reading Task scores was computed by subtracting the group's mean score for Reading Task 1 from its mean score for Reading Task 2 to calculate the group's improvement in Reading Task score (i.e. Reading Task 2 – Reading Task 1). The score difference was found to be numerically higher for the Translated group: M = 0.76, SD = 0.46 for the Translated group while M = 0.59, SD = 0.82 for the Untranslated group. Since both mean score differences were positive, there was a trend that both groups experienced improvements in reading score from Reading Task 1 to Reading Task 2.

Group results for the post-reading surveys are shown in Table 3.

Table 3

Group Statistics for Reading Tasks (Post-survey Scores)

Group	Difference Score *M*	Difference Score *SD*	Reading Task	*M*	*SD*
Translated Group	.758	.457	1	2.56	.409
			2	3.32	.299
Untranslated Group	.594	.816	1	2.47	.767
			2	3.06	.626

A one-way ANOVA was conducted to compare the difference in reading scores of the Translated group to that of the Untranslated group. While the differences in reading scores were normally distributed for both the Translated group and the Untranslated group, the assumption of homogeneity of variance was not met. Levene's test of Homogeneity of Variance (Levene, 1960) showed that the variances for difference in scores for Reading Tasks 1 and 2 were not equal, $F(1, 28) = 5.53$, $p = 0.026$. The *Welch's F* test was thus used as a correction for violation of homogeneity of variance (Kohr & Games, 1974, Ruxton, 2006; Welch, 1947; Zimmerman, 2004). The difference in test scores between the translated and untranslated group did not significantly differ, ($F(1, 21.99) = 0.46$, $p > .05$), with an effect size of $\eta^2 = 0.0162$. According to Cohen (1998), this would suggest a small effect.

Two paired sample t-tests was conducted to compare average reading scores across groups and reading tasks. Reading scores improved significantly from Reading Task 1 to 2 independent of group, $t(29) = -5.65$, $p < 0.01$, with Reading Scores for Reading Task 2 being higher than Reading Task 1 by 0.68 on average. However, both groups performed similarly on average independent of reading task, $t(14) = .173$, $p > 0.05$ (See Figure 2).

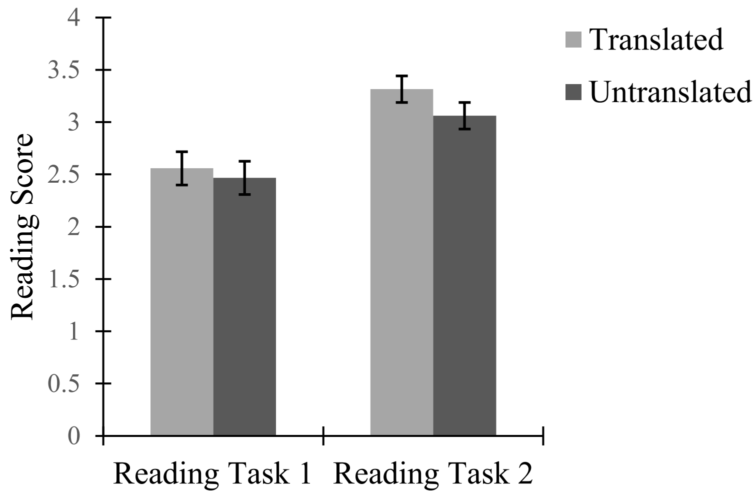

Figure 2. Reading scores of Translated and Untranslated groups for Reading Task 1 and 2. Error bars denote one standard error around the mean.

As a result, the second hypothesis that teachers who read the untranslated followed by translated abstracts would experience greater improvement in attitudes towards the abstracts compared to teachers who read two untranslated abstracts was not met. This finding is further discussed in the Limitations section.

Focus Group Discussion

Overall, all teachers expressed their preference for reading the translated abstracts to the untranslated abstracts. Analysis of the focus group discussions data showed the following three main ideas.

First, teachers were more interested in learning about classroom implications rather than the brain itself. During the focus group discussions, teachers expressed that they were interested in finding out the definitions of the learning disorders discussed in the readings and discovering classroom applications of the abstracts such as teaching strategies, and that they wanted readings that were straightforward enough for them to quickly focus on the important information (refer to Figure 3).

"I think that the terms are important. I feel like as long as you have a list of definitions, it's like a dictionary towards neuroscience. Then, teachers might ease themselves into reading other articles."

– Teacher 4, School 1

"You need to tell [the teachers] explicitly, so how about more specific ways to engage [the students]?"

– Teacher 5, School 2

"If you want it eventually to be brought down to the teacher level I think you have to break down. I mean you can have this paper, but when you go down to the classroom, it has to be simplified."

– Teacher 1, School 1

When the teachers were asked what would pique their interest in the articles, Teacher 8 from School 2 commented, "How to engage them in learning? How long is the attention span? And what are the modes of teaching that these children prefer?" This corresponded with the consensus that the teachers wanted to learn about teaching strategies that they could apply in their classrooms.

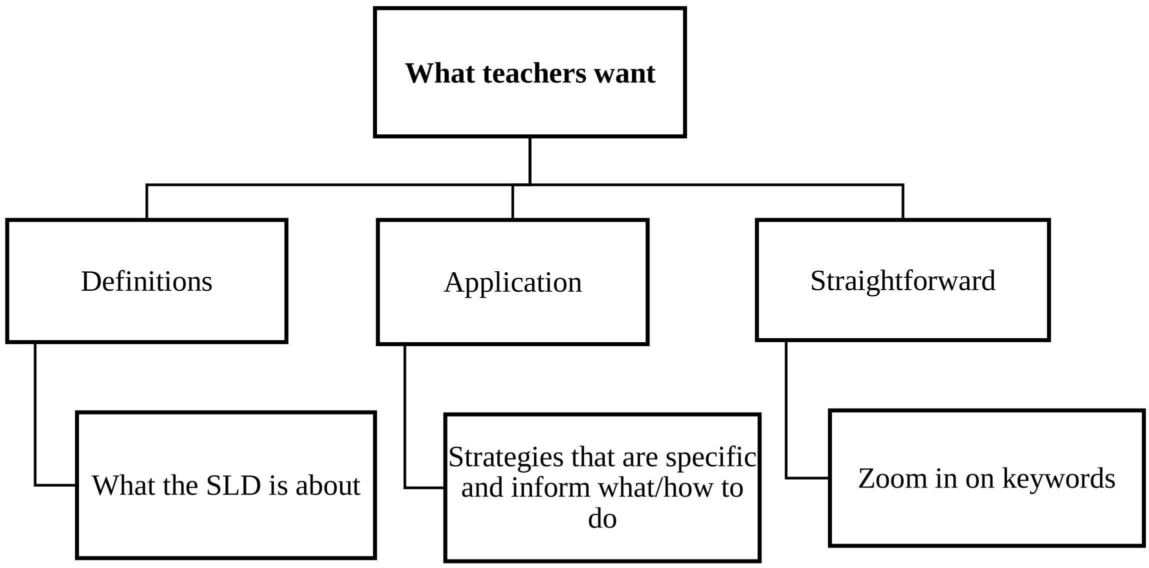

Figure 3. Overview of what teachers want: Definitions, applications and straightforward tips.

In fact, teachers alluded to their low level of interest in the abstracts (see Figure 4):

"As a teacher, I don't find this article particularly helpful, beacuase it deals with a lot of the technical aspects of ADHD… it doesn't equip me with any skill or et cetera to handle such children."

– Teacher 7, School 2

"Not much (information) in terms of how it can help us to manage their behavior."

– Teacher 4, School 1

"Since it is so biological, what can I do then? I can't change the brain. So, I'm not sure how relevant is this information to a teacher."

– Teacher 2, School 1

"[The article] mentioned using longitudinal approach. What is that to us? [It is] very statistical."

– Teacher 8, School 2

These comments reflect the teacher's dislike for readings that were overly abstract and biological; instead, they wanted to learn about strategies that they could apply during their teaching practice. Specifically, teachers wanted to learn strategies to manage and teach children with learning disabilities. Teacher 1 from School 1 mentioned that "it would be good at that time, if we had known more ways to manage these children". Therefore, teachers were more interested in learning about classroom applications rather than the biological and brain basis of learning disorders.

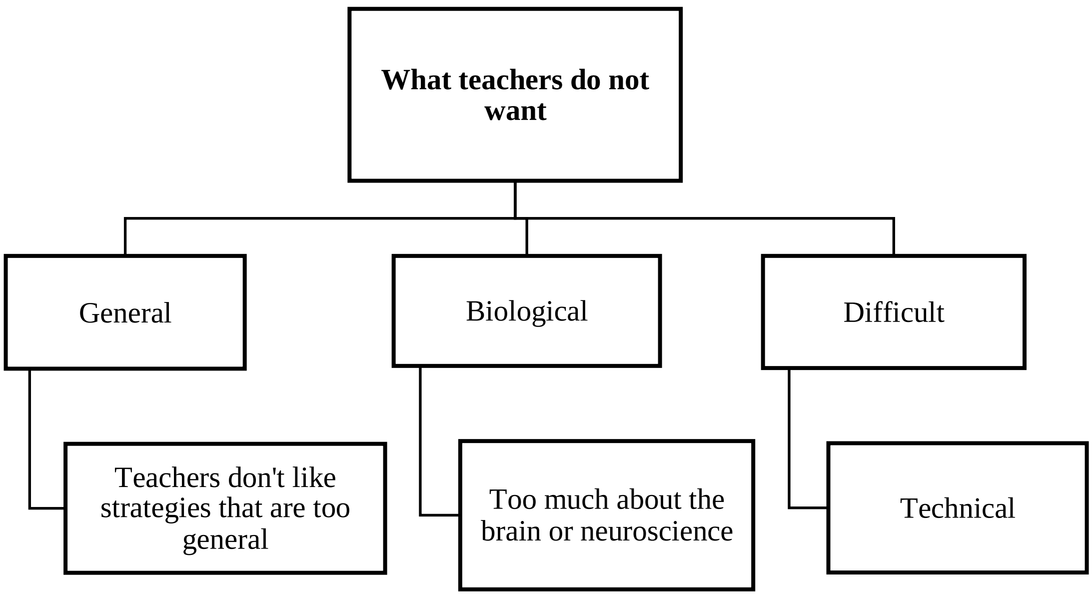

Figure 4. Overview of what teachers do not want: General applications, too much biological information, and difficult readings.

This first focus group finding is consistent with literature stating that what teachers want to know is how to apply brain research to the classroom, which essentially means that they are more interested in learning teaching strategies (Dubinsky, 2010). However, many scientific articles that inform teachers about neuroscience do not translate the findings into teaching strategies or applications for the classroom. This may explain why the participants did not find the abstracts to be relevant to their profession.

Secondly, while teachers expressed a preference for the translated abstracts over the untranslated abstracts, they preferred more simplified language in both types of abstracts. Apart from the comment by Teacher 1 of School 1 in support of Figure 3, another comment about the untranslated abstracts is included here:

"Sometimes you can't understand these kinds of jargon."

– Teacher 8, School 2

When asked about what they thought about the translated abstracts, some of the teachers commented that these too could have been further simplified:

> "And also, while it's easier to understand [compared to the untranslated abstract] but it's not exactly very reader friendly because the sentences are still very long. So, I think the layout would help. It's an improvement from this [the untranslated abstract], but still not ideal."

– Teacher 6, School 2

> "I wish that it can be further simplified, because I think in our day to day job, we are really rushing in and out, and if there is something that is more simplified, and something that we can really grab and go, and process immediately at our level, I think that it will be very helpful."

– Teacher 3, School 1

These comments highlight how teachers wanted the translations to be further simplified and better organized (i.e., shorter and more straightforward sentences). Although all teachers agreed that they preferred the translated abstract to the untranslated abstract, there clearly remains much improvement to be made for the translations. Refer to Figure 5 for a summary of the teachers' opinions and constructive criticism of the Translated abstracts.

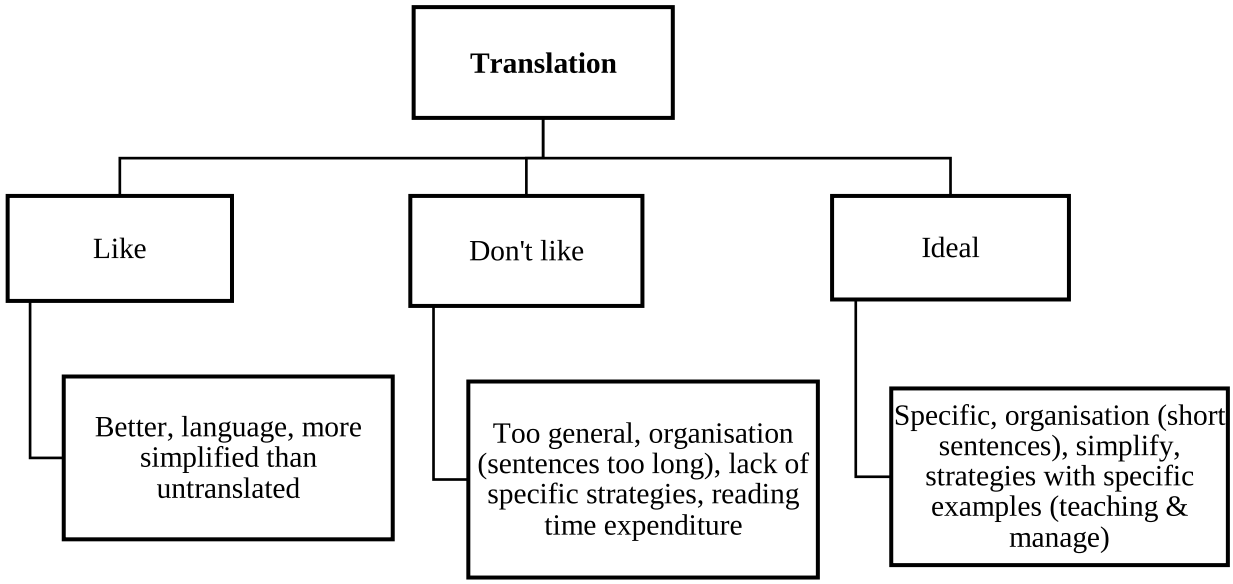

Figure 5. Teachers’ attitudes towards the translated abstracts. This illustrated what teachers liked, did not like, and what they thought would be ideal for the translation.

This second focus group finding revealed that teachers wanted readings that are straightforward about the text’s key points and classroom implications. The teachers expressed that as they were constantly busy with teaching, they preferred readings that had been simplified enough for the teachers to understand them without having to spend too much time researching to understand the reading. This finding echoes the results of another study in which teachers were concerned that they did not have the luxury of time to spend understanding scientific papers that are often written in a way that requires significant time to explore, yet may not prove to be useful to them (MacLellan, 2006).

Lastly, teachers did not actively take the initiative to read up on their own about the learning disabilities that they were concerned about, instead preferring to obtain external assistance. When asked how they could improve their teaching strategies to benefit a student with a learning disability in their class, most teachers responded that they would rely on their personal connections and seek people whom they could get help from as their first step (refer to Figure 6). These colleagues included special educators, school counsellors, previous form teachers or subject teachers, as well as parents of the student:

> "I think our first cut would be going to our Allied Educators (AEDs), and we will speak to the previous form teachers to get a gist of how the child is, or if there is anything that we need to pre-empt ourselves with."
>
> – Teacher 1, School 1

> "I guess for me, I get the most support from the school counsellors and the school AEDs."
>
> – Teacher 2, School 1

Even when they did read up on their own, teachers preferred to rely on popular media websites and books that are easier to understand than scientific journals for information on neuroscience or the relevant learning disability (see Figure 6):

> "If there's urgent need, just Google what is the condition about, but [it] will not be like from those popular scientific journal website, just a normal simple Google search."
>
> – Teacher 5, School 2

> "Sometimes when it's so specific, instead of going online [maybe it will be] more time efficient to actually look for a book."
>
> – Teacher 6, School 2

Another teacher also made an interesting statement about the singularity of learning disabilities, opining that some strategies that worked for a particular student might not be found online because of the nature of learning disabilities:

“These kind of strategies, you won’t find it online. So for myself, I will always go back to the teachers first, the people around first, to see who around me can help for this particular child, but only if this case is so new that no one around us knows about it, then I will go and Google it.”.

– Teacher 2, School 1

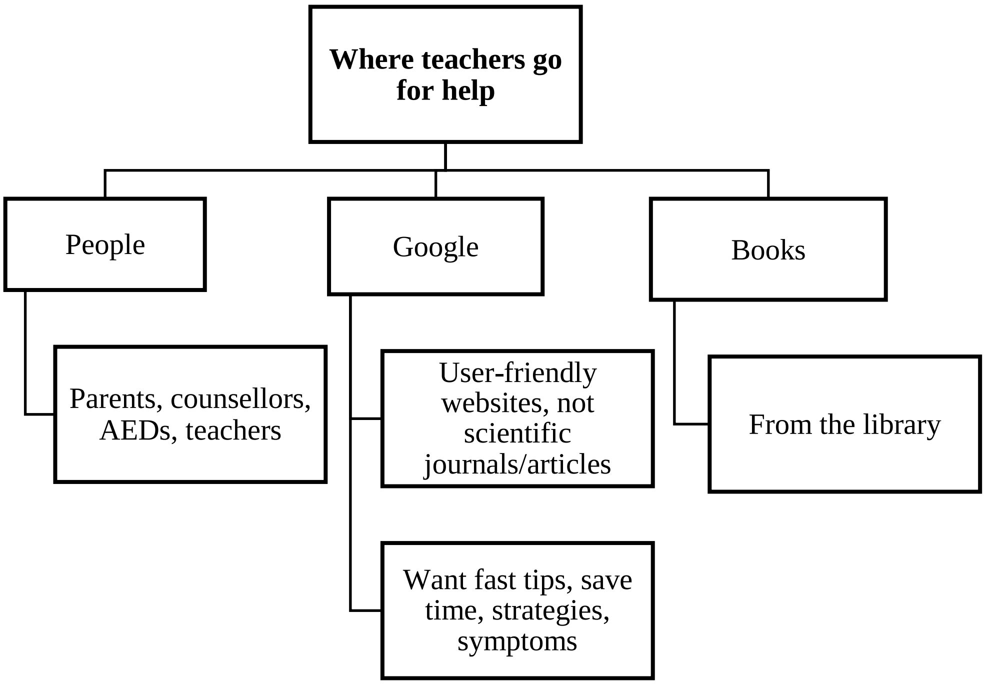

Figure 6. Teachers’ options for help include consulting people, searching on Google, and reading books.

The teachers prefer to access websites as they find them easier to understand than scientific journals and articles. Zadina (2015) noted that teachers “are usually not reading the scientific body of literature, but are getting information second or third hand” (p. 72), usually from sources that target the general audience. Given these findings, teachers are very susceptible to neuromyths. Thus, there is a need to connect teachers to sources of neuroscientific information at a level that is clear and easily understood yet does not compromise scientific accuracy, especially if the sources provide practical teaching strategies that they can use with their students.

Limitations

The present study was conducted within certain constraints and does have limitations to be addressed in future studies. As only one abstract was presented for each reading task (meaning that each teacher only read two abstracts in total during the experimental component), it might not be possible to generalize from our study the usefulness of translating neuroscience abstracts for teachers. Given that the scope of cognitive neuroscience is very broad, two abstracts cannot represent the entire field. We also acknowledge that the abstracts presented were all from research about ADHD and that the teachers' understanding about ADHD may differ across groups. To obtain a more representative gauge of teachers' attitudes towards neuroscience readings, future studies could provide teachers with a larger number of translated and untranslated abstracts on different topics.

Another point to note is that both groups had better scores in Reading Task 2 than Reading Task 1. It is possible that presenting the abstracts consecutively led to an unintended practice effect (Duff et al., 2007). Another potential source of error to this study is the anchoring effect. The anchoring effect is a cognitive bias where the presentation of one item biases the individual to rely on that item as a basis for his or her decision (Tversky & Kahneman, 1974). In this way, the teachers in the Translated group could have felt so overwhelmed from reading the untranslated abstract in Reading Task 1 that their attitudes towards the usefulness of the neuroscience abstracts did not change from the baseline set by the first reading task. In other words, the initial, untranslated abstract anchored the teachers' perceptions of neuroscience to the idea that neuroscience was too challenging to comprehend. Thus, the second, translated abstract was not able to significantly move the teachers' impressions away from that starting level. Consequently, the Translated group teachers did not experience significantly more improvements in their attitudes about the usefulness of the translated abstracts, compared to the Untranslated group teachers who read only untranslated abstracts. The counterbalancing of the order of presentation of the translated and untranslated abstracts in future studies could minimize both the practice effect and anchoring effect.

Implications and Future Directions

This study provides important insight into how teachers perceive neuroscience findings and what neuroscientists can learn from educators, highlighting the importance of two-way communication in educational neuroscience.

While neuroscientists are more interested in the experimental aspects of their research and in reporting their findings in a scientific manner, teachers prefer learning what needs to be done in the classroom to improve their teaching practice (Goswami, 2006). Perhaps neuroscientists could communicate better with educators if they understood the needs of teachers, and teachers could understand neuroscientific findings better if neuroscientists reported their findings in a manner that targeted the non-scientific community. More still needs to be done in order to translate neuroscientific research findings and utilize them to learning (Ansari, Coch & De Smedt, 2011). A shift towards seeing neuroscientists and educators as equal stakeholders in contributing towards the advancement of educational neuroscience would be very promising in order to create knowledge that was translated from research to improve learning. Perhaps having more researchers who are trained in both education and cognitive neuroscience would help to bridge the gap between the two disciplines and come up with a new framework that integrates education and cognitive neuroscience to transform our understanding about learning (Fischer et al., 2007; Szücs & Goswami, 2007). Educators can then determine how to use such knowledge in a manner that best supports the classroom (Immordino-Yang & Gotlieb, 2017).

Conclusion

This study examined the effectiveness of translating neuroscience abstracts for teachers as a way to bridge the gap between neuroscience and education. While the reading tasks showed that translating neuroscience abstracts for teachers did not appear to result in better teacher attitudes towards neuroscience abstracts, this could have been due to the limited number of abstracts presented, and the order in which they were presented. Future counterbalanced studies may prove to be more illuminating. Focus group discussions revealed that teachers wanted education-relevant neuroscience readings that use simplified language so that they can better understand the readings and provide specific classroom strategies they can apply. Teachers also preferred readings with straightforward layouts that would allow them to quickly extract important points. Better communication between neuroscientists and educators will greatly facilitate the translation of neuroscience to education, so that our understanding of learning is improved, paving the way for enhanced teaching strategies.

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Appendix A

Translating Education Neuroscience for Teachers: Pre-Survey

Please read each item and then indicate your agreement with the statement using the Likert scale below (1 = strongly disagree to 5 = strongly agree). Thank you.

General Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Once a child learns a new skill with 90% accurately, there is no need to practice it over and over.	1	2	3	4	5
2. I feel adequately trained to meet the needs of diverse learners in my mainstream classroom.	1	2	3	4	5
3. Although brain connections improve through development, there is a pruning process that decreases the amount of neurons over time.	1	2	3	4	5
4. Using knowledge of brain-behavior relationships help me interpret classroom assessment results to both understand children and guide my instruction.	1	2	3	4	5
5. I have received sufficient training to understand the causes of child learning and behavior.	1	2	3	4	5
6. The brain adapts to its environment, so the right intervention can lead to positive brain changes, but the wrong intervention could lead to automatic brain problems.	1	2	3	4	5
7. Since there is no relationship between fine motor and oral expression skills, developing a child's handwriting and talking skills are separate development tasks children need to learn independently.	1	2	3	4	5
8. Homework and worksheets are important to practice previously learned skills to a level of automaticity because this frees higher level brain functions for new learning.	1	2	3	4	5
9. It is best to focus classroom interventions in the achievement area that is the problem for a child, the cause of the problem is not relevant for my instruction.	1	2	3	4	5
10. Although music was thought to be a right brain function, string instruments are processed by the right brain but percussion instruments are processed by the left.	1	2	3	4	5
11. Our knowledge of brain-behavior relationships changed dramatically in the last 20 years, leading to important insights into the causes of learning and behavior problems.	1	2	3	4	5

12. Children with good achievement use fewer brain areas to do academic tasks, but a child with special education needs (SEN) uses more brain areas to do the same task.	1	2	3	4	5
13. The only way to help children who struggle in a particular academic area learn new skills is to provide them with individual instruction or small group instruction, they always fail in large classes.	1	2	3	4	5
14. The left brain is specialized for facts and details and the right brain is specialized for the “big picture” or global-holistic thinking.	1	2	3	4	5
15. The left brain is like boxes, closets and rooms, whereas the right brain is more like hallways, pathways and highways.	1	2	3	4	5
16. For children to care or have empathy for one another it is only important they perceive another person’s facial expressions and the tone of their voice accurately.	1	2	3	4	5
17. Although most people think that they are in control of their behavior, the reality is about 70% of human behavior is automatic, without much thought or conscious effort.	1	2	3	4	5
18. Reading skills are governed by the left “verbal” brain, but math skills are governed by the right “nonverbal” brain.	1	2	3	4	5
19. Although an oversimplification, the back of the brain is most important for learning; whereas the front of the brain is most important for emotional and behavior functioning.	1	2	3	4	5
20. A child does not have to learn sound-letter associations, s/he can just learn to read whole words by sight and still read quite well.	1	2	3	4	5
21. All significant emotional and behavioural problems lead to poor attention, but for different biological causes, some of which are opposite of each other.	1	2	3	4	5
22. “Brain boss” or executive functions are more likely to be related to written expression more than any other reading or math.	1	2	3	4	5
23. We are born with a genetic predisposition for certain learning and behavior characteristics but the environment can either turn on or off certain genes, leading to very different outcomes as a result.	1	2	3	4	5
24. A child with a poor home environment marked by yelling and physical punishment has memory problems because s/he represses the bad memories, it has little to do with their brain function.	1	2	3	4	5

25. A child can read words accurately and quickly, but still have problems understanding a sentence or reading passage because of a working memory (keeping track of the words and their relationship) problem.	1	2	3	4	5
26. I can listen to a child's oral sentences, observe his/her actions, or look at his/her class work on assignments and develop hypotheses about their brain function.	1	2	3	4	5
27. I can link brain structures/functions to everyday real world activities in the classroom.	1	2	3	4	5
28. Memory encoding and retrieval are governed by different areas of the brain than memory storage, with the former more often related to emotional/behavioural functioning.	1	2	3	4	5
29. Once I understand a child's brain-based cognitive strengths and weaknesses I am able to differentiate instruction for them during whole group instruction.	1	2	3	4	5
30. Many children have learning problems only because they are disinterested or unmotivated to achieve, there are no brain areas responsible for providing motivation for learning.	1	2	3	4	5

Note: Taken from Hale, J.B. (2015). *Educational Neuroscience Workshop Survey*.

Appendix B

Reading Tasks

The Choice of Abstracts

The abstracts used in the reading tasks were from the Translational Education Neuroscience Clearinghouse study at the National Institute of Education in Singapore, which translated more than 300 neuroscience abstracts to provide teachers with more easily understood information about teaching children with special needs. As neuroscience is a very broad topic, the literature was narrowed down to five learning disabilities in special education research: autism spectrum disorder, attention deficit hyperactivity disorder (ADHD), dyscalculia, dysgraphia, and dyslexia. Papers were selected from the top twenty journals in neuroscience, following a strict list of search terms and selection criteria. The two articles that were the most similar in word count and type of learning disability (specifically, ADHD) were chosen for the reading tasks.

Untranslated Abstract A

There is controversy over the nature of the disturbance in brain development that underpins attention-deficit/hyperactivity disorder (ADHD). In particular, it is unclear whether the disorder results from a delay in brain maturation or whether it represents a complete deviation from the template of typical development. Using computational neuroanatomic techniques, we estimated cortical thickness at >40,000 cerebral points from 824 magnetic resonance scans acquired prospectively on 223 children with ADHD and 223 typically developing controls. With this sample size, we could define the growth trajectory of each cortical point, delineating a phase of childhood increase followed by adolescent decrease in cortical thickness (a quadratic growth model). From these trajectories, the age of attaining peak cortical thickness was derived and used as an index of cortical maturation. We found maturation to progress in a similar manner regionally in both children with and without ADHD, with primary sensory areas attaining peak cortical thickness before polymodal, high-order association areas. However, there was a marked delay in ADHD in attaining peak thickness throughout most of the cerebrum: the median age by which 50% of the cortical points attained peak thickness for this group was 10.5 years (SE 0.01), which was significantly later than the median age of 7.5 years (SE 0.02) for typically developing controls (log rank test _(1)2 _ 5,609, P < 1.0 _ 10_20). The delay was most prominent in prefrontal regions important for control of cognitive processes including attention and motor planning. Neuroanatomic documentation of a delay in regional cortical maturation in ADHD has not been previously reported.

Source: Shaw et al. (2007).

Translated Abstract A

It is debatable whether attention-deficit/hyperactivity disorder (ADHD) is due to delayed brain development (brain development that follows the typical trajectory, but slower) or atypical brain development (brain development that does not follow the typical trajectory). This study examined the developmental trajectory of the ADHD brain by estimating the cortical thickness (the thickness of the outermost layer of the brain) of 224 children with ADHD and 223 children without ADHD from their brain scanning images. The age at which cortical thickness reaches its peak could be an indicator of brain maturation. Results showed similar overall trajectory of brain development for children with and without ADHD – the brain areas involved in processing lower-level sensory or motor information achieved peak cortical thickness before the brain areas involved in integrating higher-level sensory and/or motor information, showing similar overall patterns of maturation. However, peak cortical thickness in 50% of the points measured throughout the brain of children with ADHD was achieved at a much later age (delayed by 2 to 5 years) compared to children without ADHD. This suggests that there is a great delay in the maturation of the ADHD brain, especially in the prefrontal brain regions involved in higher-level cognitive processes, such as controlling and shifting of attention according to task demands, holding relevant information in memory for processing, inhibiting automatic inappropriate motor responses, and planning and making decisions about motor movements. The results provide evidence showing that ADHD is characterised by a delay in brain maturation, rather than an atypical trajectory in brain development.

Untranslated Abstract B

Attention Deficit Hyperactivity Disorder (ADHD) has long been associated with abnormalities in frontal brain regions. In this paper we review the current structural and functional imaging evidence for abnormalities in children and adults with ADHD in frontostriatal, fronto-parieto-temporal, fronto- cerebellar and fronto-limbic regions and networks. While the imaging studies in children with ADHD are more numerous and consistent, an increasing number of studies suggests that these structural and functional abnormalities in fronto-cortical and fronto-subcortical networks persist into adulthood, despite a relative symptomatic improvement in the adult form of the disorder. We furthermore present new data that support the notion of a persistence of neurofunctional deficits in adults with ADHD during attention and motivation functions. We show that a group of medication-naıve young adults with ADHD behaviours who were followed up 20 years from a childhood ADHD diagnosis show dysfunctions in lateral fronto-striatoparietal regions relative to controls during sustained attention, as well as in ventromedial orbitofrontal regions during reward, suggesting dysfunctions in cognitive- attentional as well as motivational neural networks. The lateral fronto-striatal deficit findings, furthermore, were strikingly similar to those we have previously observed in children with ADHD during the same task, reinforcing the notion of persistence of fronto-striatal dysfunctions in adult ADHD. The ventromedial orbitofrontal deficits, however, were associated with comorbid conduct disorder (CD), highlighting the potential confound of comorbid antisocial conditions on paralimbic brain deficits in ADHD. Our review supported by the new data therefore suggest that both adult and childhood ADHD are associated with brain abnormalities in fronto-cortical and fronto-subcortical systems that mediate the control of cognition and motivation. The brain deficits in ADHD therefore appear to be multi- systemic and to persist throughout the lifespan.

Source: Cubillo et al. (2012)

Appendix C

Survey on Reading Task 1 and 2

Please read each item and then indicate your agreement with the statement, using the Likert scale below (1 = strongly disagree to 5 = strongly agree). Thank you.

General Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I understood the aim of the study.	1	2	3	4	5
2. The reading task was difficult to comprehend.	1	2	3	4	5
3. The language and tone used in the reading task was appropriate for teachers.	1	2	3	4	5
4. There was one or more technical term(s) used in the reading task, that I am not familiar with.	1	2	3	4	5
5. I feel better equipped to identify signs and symptoms of the specific learning disorder after reading the reading task.	1	2	3	4	5
6. The reading task was useful in helping me to understand the brain basis of the specific learning disorder.	1	2	3	4	5
7. I can verbally explain what I have read to someone else whom has no knowledge in Neuroscience.	1	2	3	4	5
8. I can identify the key message(s) and takeaway(s) of the reading task.	1	2	3	4	5
9. The content of the reading task is relevant to me as a teacher.	1	2	3	4	5
10. The reading task has helped me to feel better equipped as a teacher in my subject area.	1	2	3	4	5
11. I could potentially apply what I have learnt from the reading task to my overall teaching practice.	1	2	3	4	5

Additional three questions included for Reading Task 2 only

Please read each question, and then indicate your response to the questions by checking the boxes. You may only tick one box per question.

Questions	**Response**		
1. Which reading task do you prefer?	Reading Task 1 ☐	Reading Task 2 ☐	No preference ☐
2. Which reading task did you felt was easier to understand?	Reading Task 1 ☐	Reading Task 2 ☐	No difference ☐
3. Which reading task did you felt was more relevant to your teaching practice?	Reading Task 1 ☐	Reading Task 2 ☐	No difference ☐

Appendix D

Focus Group Discussion Abstracts

School 1 and 2's Untranslated Abstract

In recent years, a change in perspective in etiological models of attention deficit hyperactivity disorder (ADHD) has occurred in concordance with emerging concepts in other neuropsychiatric disorders such as schizophrenia and autism. These models shift the focus of the assumed pathology from regional brain abnormalities to dysfunction in distributed network organization. In the current contribution, we report findings from functional connectivity studies during resting and task states, as well as from studies on structural connectivity using diffusion tensor imaging, in subjects with ADHD. Although major methodological limitations in analysing connectivity measures derived from noninvasive in vivo neuroimaging still exist, there is convergent evidence for white matter pathology and disrupted anatomical connectivity in ADHD. In addition, dysfunctional connectivity during rest and during cognitive tasks has been demonstrated. However, the causality between disturbed white matter architecture and cortical dysfunction remains to be evaluated. Both genetic and environmental factors might contribute to disruptions in interactions between different brain regions. Stimulant medication not only modulates regionally specific activation strength but also normalizes dysfunctional connectivity, pointing to a predominant network dysfunction in ADHD. By combining a longitudinal approach with a systems perspective in ADHD in the future, it might be possible to identify at which stage during development disruptions in neural networks emerge and to delineate possible new endophenotypes of ADHD.

Source: Konrad & Eickhoff (2010).

School 1's Translated Abstract

- Neuroimaging studies suggest that there are brain abnormalities in ADHD, although the underlying atypical brain development is not clearly understood.
- Recent studies suggest that ADHD individuals show weak structural connectivity (how different brain regions are connected anatomically to one another) and functional connectivity (how different brain regions relate functionally to one another) in a complex brain network.
- This paper aims to review studies on the underlying structural and functional connectivity deficits in ADHD during resting and task states.
- ADHD individuals show greater activity in the brain regions involved in processing sensory information, but reduced connections in the brain regions involved in maintaining the cognitive processes at rest compared to typically developing individuals.
- ADHD individuals might be processing excessive sensory information at rest and have difficulty with regulating attention, so they are easily distracted and unable to stay attentive.
- ADHD individuals show less efficient communications between the brain regions involved in cognitive functions, but more efficient communications between the brain regions involved in response inhibition compared to typically developing individuals.
- ADHD individuals have deficits in higher-level cognitive processes and might have to put in great effort to inhibit automatic inappropriate motor responses.
- ADHD individuals might suffer from a developmental delay that starts to normalise during adolescence, which is reflected as the reduction in inattention and/or hyperactivity symptoms during adolescence.

School 2's Translated Abstract

- The aim of this paper was to review studies that examined brain connectivity in individuals with ADHD.
- Individuals with ADHD showed greater activation in the brain regions involved in processing sensory information, but reduced connectivity in the brain regions involved in maintaining ongoing cognitive processes at rest, suggesting that they might have difficulty with regulating attention and become easily distracted.
- Individuals with ADHD showed abnormal communications between the brain regions involved in executive function and inhibiting motor responses, suggesting that they might have deficits in attention and have to put in great effort to inhibit automatic motor responses.
- As children with ADHD entered adolescence, their hyperactivity symptoms reduced, which might suggest a developmental delay.

Classroom Implications

- Since individuals with ADHD may have difficulty with regulating attention, teachers may want to grab their attention.
- Teachers can set clear learning objectives and explicitly ask students to pay attention when going through important concepts. (BCP1)
- Teachers can include activities that are focused on students, require active participation of students, allow students to express their opinions, or involve social interaction with others. (BCP16)
- Teachers can engage students by using shared interests or what students already know and like. (BCP41)

Appendix E

Focus Group Discussion Procedure

Prompts	• Can you elaborate? • That's interesting. Tell me more about it. • I don't understand… • Do you mean… • Can you provide specific examples?
Procedure	**Arrival** Hello everyone. I'm Rachel, and I will be the moderator for this FGD. Zachary will also be helping with the moderating, and Li will be assisting us. Today our focus group discussion will be to gather feedback about the article translations that we show you, and to find out what kind of search terms teachers use to look up SLD/neuroscience information. We would like to invite all of you to share your honest opinions and thoughts with us, and your feedback will be very valuable in helping us to understand how neuroscience and education can be better integrated in teaching. Before we start, I will just like to go over some ground rules. This is a discussion, so there are no right or wrong answers, just different points of view. We welcome and respect all opinions and feedback. I will also like to check with all of you whether it's alright if we voice record this discussion? – we will not be identifying anyone through the voice recording, but it is just so that we can refer back to the conversation in case we miss out something interesting or critical.

	(wait for participants to agree) We ask that you silent your mobile phones. If you must respond to a call, please do so as quietly as possible and re-join us as quickly as you can. Perhaps we could start off by getting you to introduce yourselves? Get them to talk about: ● Allocated number ● Teaching experience ● Experience with SLDs ● Their perspective on SLDs and neuroscience/educational neuroscience
	Introduction by Participants ● How long have you been involved in teaching? ● Any experiences with SLDs? ● Think back over all the time that you have spent training to become a teacher – how much have you learnt about neuroscience in education? What are your thoughts about this? Was it adequate/inadequate?

	Abstracts I will now like to invite all of you to read the paper that we will be distributing. Perhaps we could take about 2 minutes or so to do this. **[give published abstract first]** 1. What do you think about the reading task you just read? 2. What do you like/dislike about it? 3. What do you think can be improved? I'll like to invite you to read the next paper. We can take another 2 minutes to do so. **[give translated abstract next]** 1. What do you think about the reading task you just read? 2. What do you like/dislike about it? 3. What do you think can be improved? **[get them to compare both abstracts]** 1. Any comments about the reading tasks? 2. What do you think is the difference between the two? 3. Which abstract do you prefer to read/feel more comfortable reading? **4.** Does reading the published/translated abstract make you want to find out more information about the topic?

	Specific Learning Disorders 1. If you have a student with a specific learning disorder in your class, what do you do to learn/understand more about the SLD? And/or Neuroscience? **2.** What are some challenges that you face dealing with students with SLDs?
	Search Terms ● What kind of search terms do you normally use in your google search for SLDs? (e.g. ADHD, dyslexia, dyscalculia, ASD) ● Where do you normally go to look up information about learning disorders/neuroscience?
	Wrapping Up ● Suppose if you were in charge and could make the project better, what would you change about the translated abstracts? ● Any last thoughts or comments?
	Conclusion ● Summarise with confirmation ● Review purpose, and ask if anything has been missed ● Thank participants and dismissal