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Reconciling individual differences with collective needs: The juxtaposition of sociopolitical and neuroscience perspectives on remediation and compensation of student skill deficits

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ABSTRACT

The increasingly diverse student population within classrooms potentially stretches the competencies of every teacher. Differentiated instruction has been offered to help teachers accommodate diverse learners, but most instructional strategies are typically directed at compensating for – not remediating – cognitive and academic skill deficits. This differentiated instruction approach is contrasted with the extant learning science and educational neuroscience literature, which suggests early intervention and remediation of skill deficits is the preferred evidence-based practice. To overcome these competing and apparently contradictory positions, we argue children should be provided with systematic brain-based differentiated instruction in inclusive classrooms to prevent skill deficits, with compensatory accommodations provided only as necessary to help children access the general education curriculum. For those who continue to struggle, we argue remedial efforts should occur outside of, and in addition to, inclusive general education instruction, given the empirical evidence supporting both practices. Implications for training and system-level reform will be addressed.

1. Introduction

An important challenge for educators and policy makers is to determine whether disparate backgrounds and individual learner differences should be accommodated in the classroom or if differences should be attenuated once children begin formal instruction given all children are expected to acquire the same basic skills under a standard curriculum. Although most educators value and readily accommodate social, cultural, racial, gender, sexual orientation, and linguistic differences, can the same be said about cognitive, academic, and behavioural diversity in the classroom? Perhaps the larger and more difficult question to answer is what should be done if, as a result of this diversity, some children do not acquire the basic skills that others in the class master successfully?

Without fundamental building blocks for learning in place, acquisition of higher academic skills becomes unlikely. Thus, should cognitive diversity, which likely affects academic attainment, be accommodated or remediated? The premise that children come to school with diverse backgrounds that intersect with cognitive, academic, and psychosocial functioning, lays an important groundwork for the thesis that follows. Within this framework, we explore the notions of general and special education, instructional methods for serving diverse learners, the evidence-base for what constitutes effective instruction, and neuroscience perspectives on achievement and disability. Finally, we consider how best to address learner diversity so all children may benefit from their formal education, while recognizing and valuing their individual differences as an essential element of the human condition.

1.1. Traditional service delivery for children with and without special needs

Children are expected to come to school prepared to learn, having had appropriate opportunity to develop rudimentary linguistic, motor, social, and adaptive skills. In many educational

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systems, those who struggled with formal classroom learning were deemed to have poor academic "aptitudes", with low global intelligence thought to be the primary cause, a position still maintained by some today [1]. While low intelligence is a potential cause of learning problems, the renowned physician Samuel Orton [2] recognized that specific reading problems could occur in the presence of average intelligence, a condition which later became known as *specific learning disabilities* (SLD) [3]. Emerging in the 1960s and codified into law in many countries, the standard practice for struggling learners was to refer them for a special education evaluation. If test results found a difference between ability (often measured by a single IQ score) and achievement (also measured by standardized tests), these children were determined to have *minimal brain dysfunction* [4], and required special needs instruction as a result.

Many children were subsequently identified as having a disability, and placed in segregated special education settings, a presumably benevolent practice that led to divisiveness among educators. What ensued for the remainder of the century and continuing on to present times, is the enduring debate and controversy regarding how schools should identify children with special needs, and perhaps more importantly, how best to serve them within a public education system. With many students with special needs segregated, studies were undertaken to evaluate special education. Early studies attempting to show the relationship between cognitive "aptitudes" and intervention were not fruitful [5], as was the case with later efforts using multiple intelligences or learning styles as a framework for individualization [6]. In addition, children with disabilities could not be easily differentiated from those with low achievement based on traditional assessment practices [7], so categorical decisions regarding special education eligibility were questioned. In addition, substantial numbers of underprivileged and/or minority children were disproportionately placed in special education [8]. Evidence also emerged that showed the negative psychosocial consequences of disability labels and serving affected children in special education [9]. Not only did many students with special needs feel isolated and different from their peers, they also made little progress in overcoming their disabilities [10].

To those who advocated system reform, special education evaluations were costly, time consuming, ineffectual at determining disability, and unrelated to intervention [11]. Special education was seen as a de facto method of segregating children from diverse backgrounds, and when combined with low expectations and inadequate skill development among children in many special classrooms, many called for the end to special education [12]. The belief that these children had minimal brain dysfunction was dismissed as a fallacy [13], and there was a push to evaluate achievement and behavioural outcomes instead of wasting time and precious resources trying to determine the cause of disability [14]. With the onslaught of negative evidence, these indictments of special education beliefs and practices made it clear – something must be done for a field under siege [15].

1.2. Inclusive education for all children

Coinciding with legislative efforts to establish services for children with special needs was recognition that these children should be served in the *least restrictive environment*. For many special education opponents, this environment should be general education. What followed was a concerted effort to eliminate special education, or at least to restructure it, so that all children could be served in mainstream classrooms. Starting with mainstreaming [16], then the regular education initiative [11], and currently inclusive education [17], there has been a persistent effort to serve children with and without special needs in inclusive mainstream classrooms. The inclusion movement was strengthened by studies showing children with disabilities did as well or even better socially and academically in inclusive environments as compared to segregated settings [18]. Inclusion of children with special needs in mainstream classrooms not only improves outcomes, but also improves peer and teacher acceptance of these children [19]. Although the transition to inclusive placements was gradual, more children with special needs are currently being served in general education than ever before [20].

From a social justice perspective, serving children with special needs in inclusive settings was seen as an opportunity to provide equal access and opportunity to overcome their historic marginalization in special education [21]. Some critics of special education evaluation went so far as to suggest disability was merely a socially constructed phenomena [22], or worse, an effort designed to oppress the lives of those affected [23]. Advocates of this perspective argued that instead of being disabled, these children were just below their peers and needed more intensive instruction to improve their academic performance [24], not specialized or individualized instruction.

1.3. Inclusion in the age of high-stakes testing

With the benefits of inclusive education, it is difficult to argue a majority of children with special needs should be served in segregated classrooms, unless their disabilities are quite severe [25]. In the late 20th Century, the United States *No Child Left Behind* legislation demanded all children should achieve standardized benchmarks, and when government funding was tied to student achievement, educators were left scrambling to help their children achieve instructional benchmarks measured by high-stakes tests [26]. General education teachers often requested that their children with special needs be excluded from high-stakes testing requirements for fear of lowering overall class achievement scores [27], which would adversely affect the school. However, for students without waivers, teachers were told to provide testing *accommodations* (e.g., reader or scribe) as a viable solution [28]. Although generally supportive of inclusive education, most teachers reported their limitations in providing such accommodations [19,29], which seemed to be an ideal role for special education teachers.

Reform advocates also suggested co-teaching by general and special educators which could provide alternative instructional methods, so children with special needs could meet mandated standards [30]. Many students began receiving *instructional supports* and *accommodations* to help them *access* the general education curriculum [31]. In addition to co-teaching, the use of non-credentialed para-educators, instructional aides, and volunteers became more prevalent in inclusive classrooms [32]. The retooling of special education not only led to different roles and personnel changes, but it also brought about new perspectives on instruction. The long-held assumption, that children with disabilities had a lifelong problem that interfered with their achievement and occupational success e.g. [33], suggested to many educators that it was best to have *different* expectations and teaching methods for children with special needs [31]. These accommodations often took the form of *compensatory* strategies designed to enable children to *access* the curriculum and experience success.

1.4. Differentiated instruction emerges to fulfill inclusive education demands

To ensure all children could meet high standards, differentiated instruction [34] emerged as a predominant solution. An extension of traditional special education individualized instruction beliefs and practices to the inclusive classroom – with a modern twist –

differentiated instruction advocates suggested that differing backgrounds, experiences, and learning styles of children required varied instructional and assessment techniques, so children could learn using different modalities and demonstrate competence in different ways [35]. Fundamental to differentiation is the assumption that multiple intelligences or learning styles affect a child's response to curriculum and instruction, so teachers should understand child learning profiles and teach to each child's strengths to compensate for deficits [36]. By recognizing and valuing individual child strengths, while adjusting content, process, and product to accommodate for weaknesses, differentiation promised to help all children meet core standards [37]. Purportedly based on an understanding of brain functions [38], differentiation was seen as necessary to help children with special needs *compensate* for their interference with learning.

What followed was a plethora of alternative instructional and assessment techniques generated for teachers to provide instructional, curricular, or testing accommodations in inclusive classrooms [39,40]. The most common differentiation approaches include changes in teacher presentation, student response, timing/scheduling, and setting [36,41]. For instance, if a student had language difficulties, a note-taker or an audiotape recording during whole group instruction would be useful. If handwriting was a problem, then a scribe could write down the student's ideas or the student could learn keyboarding to type responses. Slow processing speed would necessitate extended time for the child to complete assignments or respond to all test items. If attention was a problem, moving the student to the front of the classroom or testing in a quiet room might be useful. Instead of spending hours on homework, students with special needs could be given less work or in some classrooms, no homework at all. If there was a word reading problem interfering with comprehension, then an aide would read the material and the student could respond orally to show comprehension. If math facts were a struggle, calculators could be used to do higher math problems. If oral expression was at issue, children could draw pictures or diagrams to show their understanding. Finally, if grading criteria seemed unfair for certain children, different evaluation criteria or methods could be used, such as student portfolios. Table 1 presents the common modifications and accommodations that are used for individuals with special needs e.g. [42–44].

Table 1
Compensatory instructional modifications and assessment accommodations for presumed weaknesses.

Instructional	Compensation	Assessment/setting	Compensation
Large print	Visual	Scribe	Motor
Magnification device	Visual	Word processor	Motor
Sign language	Visual	Speech-to-text	Motor
Braille/enlarged print	Tactile	Brailler	Motor
Tactile graphics	Tactile	Note taker	Motor
Human reader	Auditory	Tape record response	Motor
Audiotape/disk	Auditory	Spelling/grammar device	Monitor
Books on tape	Auditory	Read aloud	Monitor
Amplification device	Auditory	Response monitor	Monitor
Videotape	Multisensory	Graphic/visual organizer	Organization
Screen reader	Multisensory	Calculator	Memory
Visual cues	Multisensory	Setting location-self	Attention
Notes, outlines, instructions	Multisensory	Reduce extraneous stimuli	Attention
Talking materials	Multisensory	Extended time	Speed
Highlighting/ underlining	Multisensory	Multiple/frequent breaks	Endurance
Alternate assessment	Multisensory	Scheduling	Endurance
Limiting content	Multisensory	Different workload	Endurance

The use of assessment accommodations and modified standards (e.g., different expectations) is now widespread [45]. Many jurisdictions have adopted multiple-choice assessment formats, and incorporate changes such as increasing white space, reducing distracters, reducing number of items, reducing length of passages, underlining or highlighting key words, segmented passages, simplifying graphics, simplifying language, or providing larger fonts and additional graphics [45]. Of those using computer-based tests, many adopted tutorials and/or sample test items for students to practice before high-stakes tests were administered, raising test scores as a result [43].

1.5. Is differentiated instruction evidence-based?

Although dozens of articles and books have been written extolling the virtue of differentiated instruction, surprisingly, there is limited and inconsistent scientific evidence for its efficacy [46–49]. Testing accommodations vary significantly among students, classes, schools, and districts, so it is unclear whether measurement integrity (i.e., reliability and validity) is maintained when alternative instructional or assessment approaches are used [50–52]. This led to a backlash by the United States Department of Education against schools who used modified achievement standards and assessments for high incidence disabilities, with the formal rule codified into law in 2015 [53]. Differentiated instruction has not demonstrated *substantial impact* in that it improves performance of children with disabilities relative to those who do not receive accommodations, and if they do help students with special needs, they similarly help peers without disabilities [48]. Just because an alternative instructional method or modified assessment is more enjoyable, interesting, or easier does not mean it is a better or a more authentic test of academic achievement [50].

Differentiation may be valuable conceptually, but its real world implementation remains a significant challenge, leading some to question whether it is actually feasible in practice [54] or that it is too difficult to provide accommodations that do not significantly alter assessment content or performance expectations [55]. Although these compensatory techniques are now widespread, there is little empirical guidance as to what is effective and what should be adopted in practice [56]. Research has shown that a large majority of teachers report that differentiation is just too difficult to implement effectively (84%) [57], perhaps because there is no set way to differentiate assessment or instruction [58] or there is considerable misinformation about what differentiation actually entails [59].

Advocates for differentiated instruction also purport that the approach is brain-based, but there is little evidence in the neuroscience, learning styles, or multiple intelligences literature that would support this contention [60,61]. The learning styles literature is more focused on rudimentary psychological processes (e.g., visual, auditory), not brain processes and systems most related to learning [62]. Perhaps individualization and differentiation are conceptually sound, but the problem lies in the learning styles and multiple intelligences [60] conceptual anchor. If the evidence-base regarding differentiated instruction is minimal, is there sufficient empirical evidence for instructional practices that *do* lead to improved academic outcomes for diverse learners?

1.6. Exploring the learning science evidence-base: what is good instruction?

It has been argued the negative effects of disability could be reduced or even eradicated by high quality teachers with strong instructional methods and high standards e.g. [63], a position that seeded the notions of high-stakes testing and more intensive instruction for children with learning challenges. From this

Table 2
Meta-analytic effect sizes for most effective teaching techniques.

General education [65]	ES	Reading [70]	ES	Math [71]	ES	Writing [72]	ES
Formative evaluation	.90						
Small group microteach	.88	Small group	1.00				
Behaviour management	.80						
Strategy instruction	.77	Strategy instruction	.75	Strategy instruction	1.22	Strategy instruct	1.02
Organize/guide Practice	.75			Mediated/guided	.52	Transcription	.55
Reciprocal teaching	.74						
Feedback	.73					Feedback	.80
Teacher-student relate	.72						
Spaced practice	.71						
Metacognitive	.69	Self-regulation	.92	Heuristics	1.56	Imagery	.70
Self-verbal/question	.64			Verbalization	1.04	Self-Question	.50
Problem-solving	.61						
Cooperative learn	.59						
Study skills	.59						
Direct instruction	.59	Explicit instruction	1.04	Sequence-hierarchy	.82	Text Structure	.59
Mastery learning	.58						
Worked examples	.57						
Conceptual map	.57					Prewriting	.54
Goals	.56					Goals	.76
Peer tutoring	.55	Peer mediation	.65	Peer tutoring	1.02	Peer assistance	.89
Hypermedia	.52	Text enhancement	.62				

perspective, there is no disability, just “dyspedagogia” – a term used to describe poor teaching as the cause of learning problems [64]. Evidence-based instruction is the key to successful learning, a view which espouses instructional methods shown to improve academic outcomes for all children.

For empirically-based instruction, Hattie [65] provided a monumental meta-analyses of 800 studies on teaching techniques (see Table 2). From these studies, the most effective instructional techniques – explicit instruction, regular progress monitoring, frequent feedback, and small group instruction – are effective for students in both general and special education [66]. Further, evidence-based teaching practices lead to improved academic and behavioural functioning for most children using a response-to-intervention (RTI) approach [67]. When specific academic content areas (reading, mathematics, written expression) are examined (Table 2), the most effective instructional techniques for these academic skills largely align with Hattie's findings. Most of these techniques are designed to *build* academic skills, not compensate for them. Thus, for struggling learners, it seems plausible that the most effective instructional methods appear to serve a *remedial* purpose, so children build skills they are lacking through successive tiers of intervention [68]. Individualization of instruction is more important as one ascends the tiers in these remedial models (e.g., more instructional effort needed), but the assumption is children learn in similar ways, and if children are struggling, the most effective strategy is teach the deficient skills through more intensive remedial efforts [69].

With little support for differentiated instruction, different learning styles, or multiple intelligences, and no substantive differences between low achievement and learning disabilities (defined using ability-achievement discrepancy) in the literature, evidence seems to suggest that all struggling learners should be considered for more intensive instruction [73]. Consistent evidence against the low achievement-discrepancy distinction suggests only achievement assessment is relevant [74] and if combined with nonresponse in an RTI model, it would seem logical to identify children for special needs services [75]. Traditional models often require children to struggle for years before getting a special needs evaluation, and even with that costly and time consuming evaluation process, the focus of these evaluations was on identifying disability, not on guiding classroom instruction [76]. By providing regular progress monitoring of children in the mainstream and more intensive instruction until struggling children develop basic skills to a level of proficiency, it would seem that *no child would be left behind*.

Thus, political ideology and the science of learning seem to converge under an apparently irrefutable evidence-base – building skills for all learners is the preferred approach, even for those who struggle or are called “disabled”. Perhaps children who struggle with learning should not be considered “disabled” given the label's negative connotations. It is important to recognize that there will always be some children who are the lower tail end of the normal distribution of learners (e.g., low achievement) [7], and so they will need more intensive help to achieve basic skills [69]. However, given the literature reviewed, little support can be found for that disability is different, with significant advantage for the low achievement perspective that struggling learners need more intensive instruction.

1.7. *Disability as difference: the cognitive processing evidence*

Is there evidence to support the notion that disability is different than low achievement? In other words, is there evidence that children with special needs have developmental deficits instead of developmental delays? There is *ample* scientific evidence children with disabilities do have substantive neuropsychological, cognitive, academic, and/or behavioural differences than children who do not struggle with these areas. A majority of this evidence comes from the neuroscience, cognitive psychology, and neuropsychology literature. Freed from ability-achievement discrepancy, researchers have systematically explored the merits of cognitive processing characteristics of children with learning and other disabilities. Children with disabilities have varying deficits in attention, phonological, orthographic, rapid naming, long-term memory, memory encoding/retrieval, processing speed, fluid reasoning, spatial processing, receptive/expressive language, psychomotor skills, response inhibition, working memory, processing speed, and executive function [77–96] relative to typical children, depending on the academic or behavioural concerns they display. Meta-analyses also support the deficit model, with phonological awareness, processing speed, working memory, and executive function deficits being the strongest indicators of learning disabilities, attesting to the value of cognitive assessment for understanding learner differences and tailoring instruction to individual

needs [97].

Capitalizing on these developments, research emerged supporting a neuropsychological approach for identifying a child's processing strengths and weaknesses (PSW) for disability identification and service delivery [98]. Although this research is relatively recent, results show PSW relevance for differential diagnosis of learning disability in reading e.g. [85,99–101], mathematics [84,85,102–104], written expression [105], and emotional/behavioural [106–109] areas. In one large-scale study comparing profiles of children with and without learning disabilities, PSW differences were large and characteristic of clinical populations, but if averaged across PSW domains (thus losing specificity), the heterogeneous learning disability group would not be different [82]. Not only do these studies show meaningful cognitive processes were relevant for identification of children with special needs, but these differences were also found to predict intervention response [79,83,111–120].

Although there are studies that question the utility of PSW approaches, these have used numeric data and cutoff scores to determine learning disability/no disability status [121,122], which is not consistent with the methods advocated in Hale and Fiorello's [123] concordance-discordance model [124]. This admonition against rigid, number-based, PSW approaches is especially worth consideration within the context of current legislative and legal requirements that children should be provided with a comprehensive evaluation in all areas of suspected disability, including neuropsychological functioning [125]. In addition, prominent governmental agencies are moving away from behavioural diagnostic criteria (e.g., DSM-5) to instead focus on genetic and neuroscience driven research domain criteria (RDoC) for defining clinical difficulties and guiding intervention [126]. This innovative RDoC approach, advocated for differential diagnosis of attention problems by the American Academy of Pediatric Neuropsychology Empirically-Derived Disorders of Attention [127], is based on empirical investigations designed to uncover the genetic and neuroscientific etiology of overt symptoms children display. Behavioural models for diagnosis lead to considerable neuropsychological heterogeneity, which confounds differential diagnosis and attenuates treatment effects [128]. Thus, PSW and RDoC have the potential to re-write long held misunderstandings and erroneous assumptions that have plagued diagnostic and treatment practices of behaviourally-defined disorders [129]. This is especially the case in education, where such ideas have not been considered.

1.8. The neuroscience perspective: disability is indeed different, but amenable to intervention

If the reader is confused and left wondering whether there is a viable method for disability determination and service delivery, or why the special education, learning sciences, and cognitive processing literatures conflict, we are not surprised. Given the traditional approach to education and serving children with special needs, there are many questions, but few answers. It is possible, however, that the learning science literature supporting evidence-based instruction and the cognitive processing literature supporting individualization can be reconciled by a unifying body of evidence – one based on the fledgling fields of educational neuroscience [130,131] and school neuropsychology [123,132], which link psychological processes to brain function for those with and without learning difficulties or disabilities. We now have the ability to link observable behaviours, psychological processes, and neuroimaging findings [133], and results have revealed two facts from this large evidence-base often ignored in education. First, disability is indeed *different* from typical learning and behaviour, but symptoms of clinical interest are *dimensional* in nature. In other words, learning and behavioural difficulties occur, but they should be considered on a continuum of functioning from good to poor. Second, *remediation* of cognitive and academic weaknesses *normalizes* dysfunctional brain patterns in many children with learning and behavioural difficulties warranting clinical attention, so that disability is not necessarily permanent. This does not mean that all disabilities can be eradicated with evidence-based intervention, but suggests disability can be ameliorated in some cases and mitigated in others.

In support of the PSW literature, neuroscience and neuropsychological studies typically show children with reading, math, or writing disabilities have different neuropsychological profiles and use different brain structures and functions to process academic tasks [134–147]. Differences in structure and function have also been noted among children with neuropsychiatric disorders, such as ADHD, oppositional/conduct disorder, depression, bipolar, anxiety, autism, Asperger disorder, and Tourette Syndrome [149–159]. These neuroimaging and neuropsychological studies show that disorders are not just the lower end of the continuum in a particular deficit area, but that low functioning in one brain area is often accompanied by excessive functioning in another when performing academic tasks, and at times excessive functioning can also lead to disability (e.g., excessive vigilance leading to repeated checking behaviours). In addition, many different brain structures and functions are involved in reading, math, writing, or psychosocial functioning, and neuroscience evidence suggests that different processing deficits can lead to impaired achievement or behaviour, even within the same domain (e.g., reading, attention) [160–168], suggesting differential intervention response should be considered [169,170].

This evidence supports the contention that children with special needs often have *processing strengths and weaknesses*, with this pattern negatively impacting learning and behaviour. Thus, both PSW and neuroscience evidence suggest disability is different, with affected children experiencing developmental deficits, not developmental delays. Understanding how these circuits develop, and when development goes awry, provides a foundation for instructional strategies designed to prevent and/or ameliorate the problem [109,154,169–172]. Contrary to the compensatory strategies offered by differentiation advocates, neuroscience evidence supports the science of learning perspective that *remediating* these developmental deficits is in order to build skills and alleviate the deleterious effects of disability. Multiple intervention studies have shown that dysfunctional brain and neuropsychological patterns found for children with reading, mathematics, writing, and psychosocial problems can be attenuated or even eliminated following targeted interventions that build deficient skills [110,112,119,148,164,169–181]. This evidence is also supported by an extensive body of rehabilitation research, where suppressing intact functions (i.e., strengths) following brain damage can foster rehabilitation of damaged structures/functions (i.e., weaknesses) c. f., [182,183]. While differentiated instruction practices are often based on the assumption that disabilities are lifelong and those with special needs require instructional accommodations to compensate for the weakness, neuroscience and neuropsychology intervention evidence confirms what learning science/RTI proponents have been arguing – the best way to overcome a learning or behavioural problem is through remediation – not compensation – of skill deficits.

1.9. Transition from typical cognitive diversity to specific disability?

Can these apparently contradictory findings (disabilities are just low achievement needing more intensive instruction versus disabilities are specific processing deficits requiring differentiated instruction) be reconciled? If empirical evidence suggests most

children respond well to increasingly intensive evidence-based interventions that build or remediate skills, and there is little evidence for learning styles, multiple intelligences, aptitude-treatment interactions, or differentiated instruction, how does one reconcile the emergent cognitive processing and neuroscience evidence that confirms disability is indeed different, suggesting individualized instruction is necessary to remediate skill deficits? How do children begin as struggling learners, with some developing clear academic or behavioural deficits, and finally end up with brain-based disabilities who do not respond to intensive intervention?

Children come to the classroom from diverse backgrounds with different interests and needs. Factors such as language preference, socioeconomic status, family composition, sociocultural norms, and preferred activities surely affect how each child develops. This critical early developmental period prior to formal schooling lays downs important neurodevelopmental precursors for academic and psychosocial functioning [184]. This not only affects learning preference and overt behaviours, but brain development as well. Given these factors lead to considerable variability both in a child's brain function and interest preference, this could explain why large-scale epidemiological studies find that cognitive diversity is the *norm* for all children – not the exception – with at least 80% of typical children and most children with disability experiencing significant cognitive strengths and weaknesses on standardized cognitive tests across multiple studies and measures [185]. Children bring this cognitive diversity to the classroom, where teachers are charged with bringing uniformity among these diverse learners. But an important question remains, why does this omnipresent cognitive diversity lead to disability for some children, but not a majority of children?

We argue here that neurodevelopment provides the most plausible answer. The brain is a surprisingly malleable organ, and it develops remarkably throughout development [186]. When the human genome was first revealed, there were few genetic markers of disorders identified, but instead it was found that most disorders were polygenic, and most gene-environment interactions produced remarkable transformations and differing outcomes in individuals. This has led to the birth of epigenetics [187,188]. In recognizing these complex interrelationships, many different combinations of alleles could produce similar types of disorders, especially when it comes to disorders affecting learning and behaviour. Genetic differences among children surely play a role in this neurodevelopment, but epigenetics suggests these differences may be accentuated or diminished by environmental circumstances that turn genes on and off [189,190]. Thus, the child's brain is neither equipotential nor static, but an ever changing organ in response to environmental demands: a functional mosaic that interacts in different ways to subserve cognitive processes [191].

Donald Hebb [192], considered the founder of modern neuropsychology, first recognized an enduring neurodevelopmental principle when he opined *neurons that fire together wire together.* The goal of neurodevelopment is to make connections that make adaptive sense for an individual. Brain development essentially works like a sculptor who takes a solid block of stone that is chiseled into a fine masterpiece that is specific to each child. During this critical neurodevelopmental period the brain is never stagnant, but is building pathways that are adaptive for the individual, while destroying (pruning) ineffective or problematic pathways [193]. But it is important to note that plasticity does not always precipitate "positive" outcomes; what may be adaptive for the child in his early developmental environment (e.g., home) may actually undermine adaptive behaviour in a different environment (e.g., school), where it might go unnoticed, minimized, or even considered maladaptive.

How then does a child then progress from a typical child with cognitive diversity who will benefit from evidence-based instruction to one with a disability requiring special needs services? This answer is profound in its implication, and could dramatically change what we do in serving diverse leaners. Early in development, children likely prefer to do what they are inherently good at, and tend to minimize activities that they find difficult, as these are less enjoyable, leading to the typical cognitive diversity reported in the literature [185]. If the strengths and weaknesses are not examined sufficiently at home or in the school, the difference between the two would necessarily become greater with time.

Using strengths and avoiding weaknesses is a natural response to environmental demands. However, from a neurodevelopmental perspective, as the divide between used (strengths) and underused (weaknesses) brain circuits grows larger over time, the difference could lead to disability if the undeveloped circuits are needed in the home or school. For instance, a student who does not develop occipital-parietal (dorsal stream) phonics skills might do well with word reading, reading fluency, and reading comprehension early in school by using occipital-temporal (ventral steam) sight word reading [194]. However, as the lexicon expands dramatically in later elementary years, many words are learned during oral discourse for which there is no automatic visual representation of the known word [195]. As the student ages many more words are known by ear than by eye. When reading, the child must decode the uncommon word using the dorsal stream so it can be linked to lexical-semantic memory, and then it can be recognized and stored as a new sight word. If the child can decode, reading is not impaired, but for the child who used a sight word approach (ventral stream strength) only and has never learned phonics (dorsal stream weakness), the likelihood of significant reading comprehension impairment increases with each year the lexicon expands [196].

Strengths can be repeatedly used to compensate for weaknesses for some time before detection or remediation, as the strength-based strategy may help a child who is struggling get through tasks or social exchanges with little impairment. However, the long-term impact of strength-based learning might eventually fail the child and could ultimately lead to disability. Disparate strengths and weaknesses may become increasingly maladaptive as classroom expectations and demands change, and the child tries to use these "survival" strengths to get by. As they are repeated over and over, the patterns can become routinized and even automatized. Eventually, the brain's natural tendency to make these patterns – whether functional or dysfunctional – automatic and outside the realm of conscious control (i.e., transfer from cortical to subcortical circuitry) makes the patterns highly resistant to typical classroom instruction or behavioural intervention [154]. While the brain's plasticity, even at the subcortical level, can allow for recovery of function once a weakness is identified and remediated, the intensity (and associated cost) of the resultant tertiary care intervention for an automatic maladaptive behaviour would be substantially higher than if the problem were identified and corrected earlier.

In both the standard tertiary care model and even in an RTI model [197–199], children may struggle and/or fail year after year until they are provided with comprehensive evaluation. Each year a child waits, his/her strengths and weaknesses would necessarily become more disparate and automatized. With the delay in evaluation, it is no wonder that many children will have the brain–based disability, consistent with the neuroscience and neuropsychology literature. While neuroscience and learning science evidence supports remediation of deficit areas, well-intentioned teachers providing compensatory interventions may potentially be accentuating cognitive strengths and at the same time further diminish the brain's ability to overcome identifiable cognitive weaknesses. By accentuating and automatizing dysfunction, the

likelihood of lifelong disability becomes significant. Although we do not suggest that this is the cause of a disability, as there are many children with disabilities (e.g., genetic causes, severe injury) who cannot completely overcome their condition, it does suggest that we should be trying to remediate weaknesses instead of compensating for them.

1.10. Conclusion: disability exists, but it can be prevented, mitigated, and even ameliorated in many cases

From both an educational neuroscience and learning science evidence-base, the literature is clear. Early identification of learning needs and providing evidence-based instruction can prevent many individuals from building problematic neural strengths and weaknesses if teachers become literate in understanding and serving these diverse learners in their classrooms. Thus, we believe that knowledge of brain-behaviour relationships is not only critical for disability identification and service delivery, it is also essential practice for those who might prevent the pattern from becoming routinized – teachers and parents. Through our *Teaching Brain Literacy Initiative,* we are developing multimethod teacher education and psychologist curricula and consultation methods, as well as multimedia instruction and assessment tools, to help educators differentiate instruction based on current knowledge of brain structure and function. We not only provide media-based and direct instruction, but also discuss individual children who struggle with learning in the participants' classrooms, and foster teacher use of brain-based differentiated instruction through collaborative consultation in the schools. With brain literacy differentiated instruction, teachers can be sensitive to the diverse learners in their classrooms by adjusting their methods to meet individual needs. Thus, brain-based differentiated instruction is designed to help students succeed in acquiring the necessary foundational skills for higher-level learning. It also allows teachers to judge how well children respond to differentiation, which would be important for considering whether a child needs more individualized special needs instruction.

When combined with multi-tier intervention models [98,114,115], we have an opportunity to prevent individual strengths and weaknesses from becoming significant enough to warrant disability identification and service delivery, but for those who do not respond, a comprehensive evaluation may be necessary to develop individualized and targeted intervention strategies [98,200]. Although these preventative efforts have been met with success, much work is needed to advance understanding of brain-behaviour relationships in education and to bring brain literacy to educators [201].

Given these challenges, it is unlikely that disability can be eradicated from the education system vernacular. For those who do not respond to our best attempts at early intervention (e.g., non-responders) or children with more significant neurodevelopmental disorders, the evidence base is quite clear that these children may require individualized remediation and special education service delivery. When genetic loadings for disability are high, and combined with inadvertent reinforcement of compensatory strengths at the expense of furthering weaknesses, a child may have a disability that requires individualized assessment of PSW, and targeted intervention tailored to individual needs [98,201]. However, both the learning science and neuroscience literature agree these specialized interventions should be designed to remediate – not compensate for – the disabling condition.

Providing individuals with disabilities interventions designed to help them work around or compensate for their problems instead of facing them head on may be counterproductive. Although we argue for differentiation to provide services to these children, the predominant model currently in place of using child strengths (e.g., reading text to a child instead of teaching them to read) or providing ways for children to avoid their disabling weaknesses (e.g., using underlining to highlight key concepts for students instead of having them find key concepts), the principles of neurodevelopment suggest we may indeed be reinforcing the disability instead of helping children overcome it. In cases where disability is severe, there is a need to provide compensatory approaches so children with special needs can access the curriculum (e.g., reading support in science class), but given our knowledge of neuroplasticity, *strategies designed to reduce this compensatory dependence should also be undertaken.*

From a neurodevelopmental and neurorehabilitation brain plasticity perspective, the goal of intervention should be to build new or reconstruct aberrant pathways, not compensate or accommodate for them, so the natural process of building functional pathways and breaking down dysfunctional ones can free the child from the confines of their disability in many cases. Hebb's notion is again essential to consider here – we want to create instructional approaches and interventions that lead to neurons firing and wiring together so that academic and behavioural success is possible for all children, including those with and without disability. Based on the extant evidence, it would appear that remediation efforts, not compensatory ones, will accomplish this end.

It is important to note that we are not advocating for a return to segregated general and special education, at least for high incidence disabilities. Given the enormous benefits of inclusive education, for children with special needs, their peers, and the teachers who serve them, we argue that remediation should be rigorous and individualized, and this should occur outside the general education classroom. But this remediation should occur in addition to inclusive education. Individualized remediation should not replace inclusive education, but instead supplement it.

We believe the team teaching approach discussed earlier [30] should provide two important functions in this model. The special needs teacher should be best able to provide remedial evidence-based instruction that is individualized based on knowledge of brain-behaviour relationships and specialized instructional techniques to help children overcome weaknesses. This remediation should occur outside of normal class time. During normal inclusive class activities, the team teaching arrangement can work in consultative fashion, where each teacher facilitates brain literacy practices for all students, including those with special needs. In this way, we expect outcomes for all children will be enhanced, many children with learning challenges will be served without individualized services, and for those who do not respond to these intervention efforts, individualized remedial special education services can be provided outside the context of inclusive classroom instruction.

Thus, our position brings together disparate camps, ideologies, and methods under a single evidence-based umbrella. Not only does this position reconcile the long-standing debate regarding the nature of individual differences and disabilities, but it also provides recommendations that will potentially foster learning and behavioural outcomes for all children with and without special needs in inclusive settings.

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References

[1] L.S. Gottfredson, Resolute ignorance on race and Rushton, Personal. Individ. Differ. 55 (3) (2013) 218–223.
[2] S.T. Orton, "Word-blindness" in school children, Arch. Neurol. Psychiatry 14 (5) (1925) 581.
[3] S.A. Kirk, B. Bateman, Diagnosis and remediation of learning disabilities, Except. Child. (1962).
[4] B.D. Bateman, Educational implications of minimal brain dysfunction, Read. Teach. 27 (7) (1974) 662–668.
[5] K.A. Kavale, S.R. Forness, Substance over style: assessing the efficacy of modality testing and teaching, Except. Child. 54 (3) (1987) 228–239.
[6] S.A. Stahl, Different strokes for different folks? A critique of learning styles, Am. Educ. 23 (3) (1999) 27–31.
[7] D. Fuchs, L.S. Fuchs, P.G. Mathes, M.W. Lipsey, P.H. Roberts, Is learning disabilities just a fancy term for low achievement? a meta-analysis of reading differences between low achievers with and without the label, Executive Summary, 2001.
[8] J.L. Hosp, D.J. Reschly, Disproportionate representation of minority students in special education: academic, demographic, and economic predictors, Except. Child. 70 (2) (2004) 185–199.
[9] J. Wiener, C.Y. Tardif, Social and emotional functioning of children with learning disabilities: does special education placement make a difference? Learn. Disabil. Res. Pract. 19 (1) (2004) 20–32.
[10] C. Carlberg, K. Kavale, The efficacy of special versus regular class placement for exceptional children: a meta-analysis, J. Spec. Educ. 14 (3) (1980) 295–309.
[11] M.C. Reynolds, M.C. Wang, H.J. Walberg, The necessary restructuring of special and regular education, Excepti. Child. 53 (5) (1987) 391–398.
[12] H.J. Walberg, Learning 'disabilities' revisited, Eur. J. Spec. Needs Educ. 8 (3) (1993) 289–302.
[13] D.J. Reschly, F.M. Gresham, Current neuropsychological diagnosis of learning problems: a leap of faith, in: Handbook of clinical child neuropsychology, Springer, US, 1989, pp. 503–519.
[14] J. Ysseldyke, D. Marston, Origins of categorical special education services in schools and a rationale for changing them, Spec. Educ. Transit.: Funct. Assess. Noncategorical Program. (1999) 1–18.
[15] D. Fuchs, L.S. Fuchs, Inclusive schools movement and the radicalization of special education reform, Except. Child. 60 (4) (1994) 294–309.
[16] D.P. Biklen, Mainstreaming compliance to quality, J. Learn. Disabil. 18 (1985) 58–61.
[17] J. McLeskey, D. Henry, M.I. Axelrod, Inclusion of students with learning disabilities: an examination of data from reports to congress, Except. Child. 66 (1) (1999) 55–66.
[18] N.M. Ruijs, T.T. Peetsma, Effects of inclusion on students with and without special educational needs reviewed, Educ. Res. Rev. 4 (2) (2009) 67–79.
[19] E. Avramidis, B. Norwich, Teachers' attitudes towards integration/inclusion: a review of the literature, Eur. J. Spec. Needs Educ. 17 (2) (2002) 129–147.
[20] J. McLeskey, E. Landers, D. Hoppey, P. Williamson, Learning disabilities and the LRE mandate: an examination of national trends, Learn. Disabil. Res. Pract. 26 (2) (2011) 60–66.
[21] L. Terzi, Beyond the dilemma of difference: the capability approach to disability and special educational needs, J. Philos. Educ. 39 (3) (2005) 443–459.
[22] J. Ysseldyke, When politics trumps science: generalizations from a career of research on assessment, decision making, and public policy, Communique 38 (4) (2009) 6–8.
[23] D.J. Goodman, Promoting Diversity and Social Justice: Educating People from Privileged Groups, Routledge., New York, NY, 2011.
[24] F.M. Gresham, Responsiveness to intervention: an alternative approach to the identification of learning disabilities, Identif. Learn. Disabil.: Res. Pract. (2002) 467–519.
[25] K.K. Poon, Challenging behaviors among children with autism spectrum disorders and multiple disabilities attending special schools in Singapore, Res. Dev. Disabil. 33 (2) (2012) 578–582.
[26] D. Meier, Many children left behind: How the No Child Left Behind Act is damaging our children and our schools, Beacon Press, Boston, MA, 2004.
[27] L. Darling-Hammond, Race, inequality and educational accountability: the irony of 'no child left behind', Race Ethn. Educ. 10 (3) (2007) 245–260.
[28] L.S. Fuchs, D. Fuchs, A.M. Capizzi, Identifying appropriate test accommodations for students with learning disabilities, Focus Except. Child. 37 (6) (2005) 1.
[29] B.J. Scott, M.R. Vitale, W.G. Masten, Implementing instructional adaptations for students with disabilities in inclusive classrooms a literature review, Remedial Spec. Educ. 19 (2) (1998) 106–119.
[30] M.L. Thurlow, D.C. Cormier, M. Vang, Alternative routes to earning a standard high school diploma, Exceptionality 17 (3) (2009) 135–149.
[31] J.H. Soukup, M.L. Wehmeyer, S.M. Bashinski, J.A. Bovaird, Classroom variables and access to the general curriculum for students with disabilities, Except. Child. 74 (1) (2007) 101–120.
[32] M.F. Giangreco, M.B. Doyle, Students with disabilities and paraprofessional supports: benefits, balance, and band-aids, Focus Except. Child. 34 (7) (2002) 1.
[33] S.C Cramer, W. Ellis, Learning Disabilities: Lifelong Issues, Brookes Publishing, Baltimore, MD, 1996.
[34] C.A. Tomlinson, S.N. Kaplan, J.S. Renzulli, J. Purcell, J. Leppien, D. Burns, The Parallel Curriculum: A Design to Develop High Potential and Challenge High-Ability Learners, Corwin Press, Inc., Thousand Oaks, CA, 2002.
[35] J. Tuttle, Differentiated Classrooms (Report), Cedar Mountain Academy, Woodbury, 2000.
[36] C.A. Tomlinson, The möbius effect addressing learner variance in schools, J. Learn. Disabil. 37 (6) (2004) 516–524.
[37] H.M. Levy, Meeting the needs of all students through differentiated instruction: helping every child reach and exceed standards, Clear. House: J. Educ. Strateg. Issues Ideas 81 (4) (2008) 161–164.
[38] D.A. Sousa, C.A. Tomlinson, Differentiation and the Brain: How Neuroscience Supports the Learner-friendly Classroom, Solution Tree Press, United States, 2011.
[39] N. Gregg, J. Lindstrom, Accommodation of instructional and testing situations, Evid. -based Interv. Stud. Learn. Behav. Chall. (2008) 302–318.
[40] L.R. Ketterlin-Geller, E.M. Jamgochian, Instructional adaptations: accommodations and modifications that support accessible instruction, in: Handbook of Accessible Achievement Tests for All Students, Springer, New York, 2011, pp. 131–146.
[41] M.L. Thurlow, S.J. Thompson, S.S. Lazarus, Considerations for test administration to special needs students: accommodations and modifications, in: Handbook of Test Development, 2006, pp. 653–673.
[42] G.H. Gregory, C. Chapman, Differentiated Instructional Strategies: One Size Doesn't Fit All, Corwin Press, Thousand Oaks, CA, 2012.
[43] C.A. Tomlinson, Differentiated classroom: Responding to the Needs of All Learners, ASCD, Alexandria, VA, 2014.
[44] National Center for Educational Progress, NAEP accommodations increase inclusiveness ⟨http://nces.ed.gov/nationsreportcard/about/accom_table.aspx⟩, 2015 (accessed 19.03.16).
[45] S.S. Lazarus, D.C. Cormier, M.L. Thurlow, States' accommodations policies and development of alternate assessments based on modified achievement standards a discriminant analysis, Remedial Spec. Educ. 32 (4) (2011) 301–308.
[46] T. Hall, N. Strangman, A. Meyer, Differentiated instruction and implications for UDL implementation, Effective Classroom Practices Report, Office of Special Education Programs, Washington, DC, 2013.
[47] J.R. Harrison, N. Bunford, S.W. Evans, J.S. Owens, Educational accommodations for students with behavioral challenges: a systematic review of the literature, Rev. Educ. Res. 83 (4) (2013) 551–597.
[48] R.J. Kettler, Testing accommodations: theory and research to inform practice, Int. J. Disabil. Dev. Educ. 59 (1) (2012) 53–66.
[49] B.J. Lovett, Testing accommodations under the amended americans with disabilities act the voice of empirical research, J. Disabil. Policy Studies 25 (2) (2014) 81–90.
[50] S.N. Elliott, R.J. Kettler, P.A. Beddow, A. Kurz, E. Compton, D. McGrath, D. Bolt, Effects of using modified items to test students with persistent academic difficulties, Except. Child. 76 (4) (2010) 475–495.
[51] E. Stone, T. Davey, Computer-adaptive testing for students with disabilities: a review of the literature, ETS Res. Report. Ser. 2 (2011) 24.
[52] A.E. Wyse, A.D. Albano, Considering the use of general and modified assessment items in computerized adaptive testing, Appl. Meas. Educ. 28 (2) (2011) 156–167.
[53] United States Department of Education, Improving the academic achievement of the disadvantaged; assistance to states for education of children with disabilities. ⟨https://www.federalregister.gov/articles/2015/08/21/2015–20736/improving-the-academic-achievement-of-the-disadvantaged-assistance-to-states-for-the-education-of⟩, 2016 (accessed 19.03.16).
[54] J. Carolan, A. Guinn, Differentiation: lessons from master teachers, Educ. Leadersh. 64 (5) (2007) 44.
[55] S.J. Salend, Determining appropriate testing accommodations; complying with NCLB and IDEA, teaching, Except. Child. 40 (4) (2008) 14–22.
[56] D. Scanlon, D. Baker, An accommodations model for the secondary inclusive classroom, Learn. Disabil. Q. 35 (4) (2012) 212–224.
[57] S. Farkas, A. Duffett, Results from a national teacher survey, High achieving students in the era of NCLB, 2008, pp. 49–82.
[58] R. Wormeli, Busting myths about differentiated instruction, Princ. Leadersh. 5 (7) (2005) 28–33.
[59] B. Logan, Examining differentiated instruction: teachers respond, Res. High. Educ. J. 13 (2011) 1.
[60] T.J. Landrum, K.A. McDuffie, Learning styles in the age of differentiated instruction, Exceptionality 18 (1) (2010) 6–17.
[61] H. Pashler, M. McDaniel, D. Rohrer, R. Bjork, Learning styles concepts and evidence, Psychol. Sci. Public Interest 9 (3) (2008) 105–119.
[62] A.N. Schneider, D.J. Parker, E. Crevier-Quintin, H.A. Kubas, J.B. Hale, Luria and learning: How neuropsychological theory translates into educational practice, in: B.J. Irby, G. Brown, R. Lara-Alecio (Eds.), Handbook of Educational Theories, Information Age, Charlotte, NC, 2013.
[63] S.L. Christenson, D.M. Decker, H.L. Triezenberg, J.E. Ysseldyke, A. Reschly, Consequences of high-stakes assessment for students with disabilities, Educ. Policy 21 (4) (2007) 662–690.
[64] P. Westwood, Specific learning disabilities. Learning and Learning Difficulties: A Handbook for Teachers, 2004, p. 71.
[65] J.A.C. Hattie, Visible Learning: A Synthesis of 800+ Meta-analyses on Achievement, Routledge, Abingdon, 2009.
[66] S. Vaughn, S. Linan-Thompson, What is special about special education for students with learning disabilities? J. Spec. Educ. 37 (3) (2003) 140–147.
[67] W.D. Tilly, The evolution of school psychology to science-based practice:

Problem solving and the three-tiered model, Best Pract. Sch. Psychol. V1 (2008) 17–36.
[68] M.J. McLaughlin, Closing the achievement gap and students with disabilities: the new meaning of a "free and appropriate public education", in: Proceedings of the Second Annual Symposium on Educational Equity. NCLB and Its Alternatives: Examining America's Commitment to Closing Achievement Gaps, Teachers College, Columbia University, New York, NY, 2006.
[69] S.R. Jimerson, M.K. Burns, A.M. VanDerHeyden, Response to intervention: the science and practice of assessment and intervention, in: Handbook of Response to Intervention, Springer, 2007, pp. 3–9.
[70] S. Berkeley, T.E. Scruggs, M.A. Mastropieri, Reading comprehension instruction for students with learning disabilities, 1995–2006: a meta-analysis, Remedial Spec. Educ. (2009).
[71] R. Gersten, D.J. Chard, M. Jayanthi, S.K. Baker, P. Morphy, J. Flojo, Mathematics instruction for students with learning disabilities: a meta-analysis of instructional components, Rev. Educ. Res. 79 (3) (2009) 1202–1242.
[72] S. Graham, D. McKeown, S. Kiuhara, K.R. Harris, A meta-analysis of writing instruction for students in the elementary grades, J. Educ. Psychol. 104 (2012) 879–886.
[73] J.M. Fletcher, S. Vaughn, Response to intervention: preventing and remediating academic difficulties, Child. Dev. Perspect. 3 (1) (2009) 30–37.
[74] T.D. Tolar, L. Fuchs, J.M. Fletcher, D. Fuchs, C.L. Hamlett, Cognitive profiles of mathematical problem solving learning disability for different definitions of disability, J. Learn. Disabil. (2014).
[75] D.J. Francis, J.M. Fletcher, K.K. Stuebing, G.R. Lyon, B.A. Shaywitz, S. E. Shaywitz, Psychometric approaches to the identification of LD IQ and achievement scores are not sufficient, J. Learn. Disabil. 38 (2) (2005) 98–108.
[76] A.M. VanDerHeyden, M.K. Burns, Essentials of Response to Intervention, John Wiley & Sons, Unites States, 2010.
[77] T.P. Alloway, R.G. Alloway, Investigating the predictive roles of working memory and IQ in academic attainment, J. Exp. Child. Psychol. 106 (1) (2010) 20–29.
[78] J.A. Carmichael, R.L. Fraccaro, D. Miller, D. Maricle, Academic achievement and memory differences among specific learning disabilities subtypes, Learn. Disabil.: A Multidiscip. J. 20 (1) (2014) 8–17.
[79] E. Cho, G.J. Roberts, P. Capin, G. Roberts, J. Miciak, S. Vaughn, Cognitive attributes, attention, and self-efficacy of adequate and inadequate responders in a fourth grade reading intervention, Learn. Disabil. Res. Pract. 30 (4) (2015) 159–170.
[80] P.T. Cirino, L.S. Fuchs, J.T. Elias, S.R. Powell, R.F. Schumacher, Cognitive and mathematical profiles for different forms of learning difficulties, J. Learn. Disabil. 48 (2) (2015) 156–175.
[81] K.K.H. Chung, C.S.H. Ho, Second language learning difficulties in chinese children with dyslexia: what are the reading-related cognitive skills that contribute to english and chinese word reading? J. Learn. Disabil. 43 (3) (2010) 195.
[82] D.L. Compton, L.S. Fuchs, D. Fuchs, W. Lambert, C. Hamlett, The cognitive and academic profiles of reading and mathematics learning disabilities, J. Learn. Disabil. (2011).
[83] D.C. Geary, M.K. Hoard, L. Nugent, D.H. Bailey, Mathematical cognition deficits in children with learning disabilities and persistent low achievement: a five-year prospective study, J. Educ. Psychol. 104 (1) (2012) 206.
[84] J.B. Hale, C.A. Fiorello, R. Dumont, J.O. Willis, C. Rackley, C. Elliott, Differential ability scales – second edition (neuro)psychological predictors of math performance for typical children and children with math disabilities, Psychol. Sch. 45 (2008) 838–858.
[85] J.B. Hale, C.A. Fiorello, J.A. Miller, K. Wenrich, A.M. Teodori, J. Henzel, WISC-IV assessment and intervention strategies for children with specific learning disabilities, in: A. Prifitera, D.H. Saklofske, Lg Weiss (Eds.), WISC-IV Clinical Assessment and Intervention, 2nd ed.,Elsevier Science, New York, NY, 2008, pp. 109–171.
[86] D. Fuchs, D.L. Compton, L. Fuchs, V.J. Bryant, C.L. Hamlett, W. Lambert, First-grade cognitive abilities as long-term predictors of reading comprehension and disability status, J. Learn. Disabil. 45 (3) (2012) 217–231.
[87] R. Heikkilä, M. Torppa, M. Aro, V. Närhi, T. Ahonen, Double-deficit hypothesis in a clinical sample extension beyond reading, J. Learn. Disabil. (2015).
[88] S.R. Hooper, W.G. Willis, Learning Disability Subtyping: Neuropsychological Foundations, Conceptual Models, and Issues in Clinical Differentiation, Springer Science & Business Media, Berlin, Germany, 2013.
[89] V. Menon, Large-scale brain networks in cognition: emerging principles, Anal. Funct. Large-scale Brain Netw. (2010) 43–54.
[90] C.R. Niileksela, M.R. Reynolds, Global, broad, or specific cognitive differences? Using a MIMIC model to examine differences in CHC abilities in children with learning disabilities, J. Learn. Disabil. 47 (3) (2014) 224–236.
[91] V. Tobia, A. Fasola, A. Lupieri, G.M. Marzocchi, Numerical magnitude in children with mathematical difficulties with or without reading difficulties, J. Learn. Disabil. (2014).
[92] M.C. Passolunghi, I.C. Mammarella, Selective spatial working memory impairment in a group of children with mathematics learning disabilities and poor problem-solving skills, J. Learn. Disabil. 45 (4) (2012) 341–350.
[93] M. Semrud-Clikeman, J. Walkowiak, A. Wilkinson, G. Christopher, Neuropsychological differences among children with Asperger syndrome, nonverbal learning disabilities, attention deficit disorder, and controls, Dev. Neuropsychol. 35 (5) (2010) 582–600.
[94] S.W. Toll, S.H. Van der Ven, E.H. Kroesbergen, J.E. Van Luit, Executive functions as predictors of math learning disabilities, J. Learn. Disabil. 44 (6) (2011) 521–532.
[95] R.K. Vukovic, L.S. Siegel, Academic and cognitive characteristics of persistent mathematics difficulty from first through fourth grade, Learn. Disabil. Res. Pract. 25 (1) (2010) 25–38.
[96] M. Westendorp, E. Hartman, S. Houwen, J. Smith, C. Visscher, The relationship between gross motor skills and academic achievement in children with learning disabilities, Res. Dev. Disabil. 32 (6) (2011) 2773–2779.
[97] E.S. Johnson, M. Humphrey, D.F. Mellard, K. Woods, H.L. Swanson, Cognitive processing deficits and students with specific learning disabilities: a selective meta-analysis of the literature, Learn. Disabil. Q. 33 (1) (2010) 3–18.
[98] J.B. Hale, V. Alfonso, V. Berninger, B. Bracken, C. Christo, J. Yalof, Critical Issues in response-to-intervention, comprehensive evaluation, and specific learning disabilities identification and intervention: an expert white paper consensus, Learn. Disabil. Q. 33 (2010) 223–236.
[99] C.D. Elliott, J.B. Hale, C.A. Fiorello, C. Dorvil, J. Moldovan, Differential ability scales–II prediction of reading: global scores are not enough, Psychol. Sch. 47 (7) (2010) 698–720.
[100] S.G. Feifer, R. Gerhardstein Nader, D.P. Flanagan, K.R. Fitzer, K. Hicks, Identifying specific reading subtypes for effective educational remediation, Learn. Disabil.: A Multidiscip. J. 20 (2014) 18–30.
[101] C.A. Fiorello, J.B. Hale, L.E. Snyder, Cognitive hypothesis testing and response to intervention for children with reading problems, Psychol. Sch. 43 (8) (2006) 835–853.
[102] J.B. Hale, Cognitive hypothesis testing for a child with math disability, in: C. A. Riccio, J.R. Sullivan, M.J. Cohen (Eds.), Neuropsychological Assessment and Intervention for Childhood and Adolescent Disorder, John Wiley & Sons, New York, NY, 2010.
[103] J.B. Hale, C.A. Fiorello, M. Bertin, R. Sherman, Predicting math competency through neuropsychological interpretation of WISC-III variance components, J. Psychoeduc. Assess. 21 (2003) 358–380.
[104] H.A. Kubas, M.A. Drefs, J. Poole, A.D. Schmid, S.C. Holland, C.A. Fiorello, Cognitive and academic profiles associated with math disability subtypes, Learn. Disabil.: A Multidiscip. J. 20 (2014) 31–44.
[105] M.E. Fenwick, H.A. Kubas, J.W. Witzke, K.R. Fitzer, D.C. Miller, D.E. Maricle, J. B. Hale, Neuropsychological profiles of written expression learning disabilities determined by concordance-discordance model criteria, Appl. Neuropsychol.: Child. (2015) 1–14.
[106] E.M. Backenson, S.C. Holland, H.A. Kubas, K.R. Fitzer, G. Wilcox, J. A. Carmichael, J.B. Hale, Psychosocial and adaptive deficits associated with learning disability subtypes, J. Learn. Disabil. 48 (5) (2015) 511–522.
[107] L.A. Hain, J.B. Hale, "Nonverbal" learning disabilities or Asperger Syndrome? Clarification through cognitive hypothesis testing, in: N. Mather, L.E. Jaffe (Eds.), Comprehensive Evaluations: Case Reports for Psychologists, Diagnosticians, and Special Educators, John Wiley & Sons, New York, NY, 2010, pp. 372–387.
[108] L.A. Hain, J.B. Hale, J. Glass-Kendorski, Comorbidity of psychopathology in cognitive and academic SLD subtypes, in: S.G. Pfeifer, G. Rattan (Eds.), Emotional Disorders: A Neuropsychological, Psychopharmacological, and Educational Perspective, School Neuropsychology Press, Middletown, MD, 2009, pp. 199–226.
[109] J.B. Hale, L.A. Hain, R. Murphy, G. Cancelliere, D.L. Bindus, H. Kubas, The enigma of specific learning disabilities: a neuropsychological framework for examining learning, behavior, and environment, in: C.A. Noggle, R.S. Dean (Eds.), The Neuropsychology of Psychopathology, Springer Publishing Company, New York, 2013.
[110] V.W. Berninger, M.O.M. May, Evidence-based diagnosis and treatment for specific learning disabilities involving impairments in written and/or oral language, J. Learn. Disabil. 44 (2) (2011) 167–183.
[111] J.M. Fletcher, K.K. Stuebing, A. Barth, C.A. Denton, P.T. Cirino, D.J. Francis, S. Vaughn, Cognitive correlates of inadequate response to intervention, Sch. Psychol. Rev. 40 (1) (2011) 3.
[112] J.C. Frijters, M.W. Lovett, K.A. Steinbach, M. Wolf, R.A. Sevcik, R.D. Morris, Neurocognitive predictors of reading outcomes for children with reading disabilities, J. Learn. Disabil. 44 (2) (2011) 150–166.
[113] S. Gustafson, L. Fälth, I. Svensson, T. Tjus, M. Heimann, Effects of three interventions on the reading skills of children with reading disabilities in grade 2, J. Learn. Disabil. 44 (2) (2011) 123–135.
[114] J.B. Hale, Implementing IDEA with a three-tier model that includes RTI and cognitive assessment methods, Sch. Psychol. Forum: Res. Pract. 1 (2006) 16–27.
[115] J.B. Hale, A. Kaufman, J.A. Naglieri, K.A. Kavale, Implementation of IDEA: integrating response to intervention and cognitive assessment, Psychol. Sch. 43 (2006) 753–770.
[116] T. Helland, T. Tjus, M. Hovden, S. Ofte, M. Heimann, Effects of bottom-up and top-down intervention principles in emergent literacy in children at risk of developmental dyslexia: a longitudinal study, J. Learn. Disabil. 44 (2) (2011) 105–122.
[117] J.S. Iseman, J.A. Naglieri, A cognitive strategy to improve math calculation for children with ADHD and LD: a randomized controlled study, J. Learn. Disabil. 44 (2) (2011) 184–195.
[118] H.A. Kubas, E.M. Backenson, G. Wilcox, J.C. Piercy, J.B. Hale, The effects of methylphenidate on cognitive function in children with attention-deficit/hyperactivity disorder, Postgrad. Med. 124 (5) (2012) 33–48.
[119] M.L. Lorusso, A. Facoetti, D.J. Bakker, Neuropsychological treatment of dyslexia: does type of treatment matter? J. Learn. Disabil. 44 (2) (2011) 136–149.
[120] J.T. Mascolo, N.L. Kaufman, J.B. Hale, Illustrative case reports using the WISC-

IV, in: D.P. Flanagan, A.S. Kaufman (Eds.), Essentials of WISC-IV Assessment, 2nd ed.,John Wiley & Sons, Hoboken, NJ, 2009, pp. 468–515.
[121] J. Miciak, J.M. Fletcher, K.K. Stuebing, S. Vaughn, T.D. Tolar, Patterns of cognitive strengths and weaknesses: identification rates, agreement, and validity for learning disabilities identification, Sch. Psychol. Q. 29 (1) (2014) 21.
[122] K.K. Stuebing, J.M. Fletcher, L. Branum-Martin, D.J. Francis, Evaluation of the technical adequacy of three methods for identifying specific learning disabilities based on cognitive discrepancies, Sch. Psychol. Rev. 41 (1) (2012) 3.
[123] J.B. Hale, C.A. Fiorello, School Neuropsychology: A Practitioner's Handbook, Guilford Press, New York, NY, 2004.
[124] T.G. Burns, Wechsler individual achievement test-III: What is the 'gold standard'for measuring academic achievement? Appl. Neuropsychol. 17 (3) (2010) 234–236.
[125] P.W. Wright, J.B. Hale, E.M. Backenson, E.C. Eusebio, S.G. Dixon, Forest Grove v. TA Rejoinder to Zirkel an attempt to profit from malfeasance? J. Psychoeduc. Assess. 31 (3) (2013) 318–325.
[126] T. Insel, B. Cuthbert, M. Garvey, R. Heinssen, D.S. Pine, Research domain criteria (rdoc): toward a new classification framework for Re..., Am. J. Psychiatry 167 (2010) 7.
[127] J.B. Hale, Empirically-defined disorders of attention (EDDA) work group: Developing a model for future research and practice. Invited Workshop at the 4th Annual American College of Professional Neuropsychology Conference, Las Vegas, NV, 2012 March.
[128] J.B. Hale, L.A. Reddy, S.L. Decker, R. Thompson, J. Henzel, A. Teodori, M. B. Denckla, Development and validation of an executive function and behavior rating screening battery sensitive to ADHD, J. Clin. Exp. Neuropsychol. 31 (2009) 897–912.
[129] S.E. Morris, B.N. Cuthbert, Research domain criteria: cognitive systems, neural circuits, and dimensions of behavior, Dialog. Clin. Neurosci. 14 (1) (2012) 29–37.
[130] U. Goswami, Neuroscience and education, J. Educ. Psychol. 74 (1) (2004) 1–14.
[131] K.W. Fischer, Mind, brain, and education: building a scientific groundwork for learning and teaching1, Mind Brain Educ. 3 (1) (2009) 3–16.
[132] D.C. Miller, Essentials of School Neuropsychological Assessment, John Wiley & Sons, United States, 2011.
[133] J.F. DeSouza, S. Ovaysikia, L.K. Pynn, Correlating behavioral responses to fMRI signals from human prefrontal cortex: examining cognitive processes using task analysis, J. Vis. Exp.: JoVE 64 (2012).
[134] S. Ashkenazi, J.M. Black, D.A. Abrams, F. Hoeft, V. Menon, Neurobiological underpinnings of math and reading learning disabilities, J. Learn. Disabil. 46 (6) (2013) 549–569.
[135] V. Berninger, T. Richards, Inter-relationships among behavioral markers, genes, brain and treatment in dyslexia and dysgraphia, Future Neurol. 5 (4) (2010) 597–617.
[136] I. Berteletti, J. Prado, J.R. Booth, Children with mathematical learning disability fail to recruit verbal and numerical brain regions during multiplication, Cortex 57 (2014) 143–155.
[137] V. Blau, J. Reithler, N. van Atteveldt, J. Seitz, P. Gerretsen, R. Goebel, L. Blomert, Deviant processing of letters and speech sounds as proximate cause of reading failure: a functional magnetic resonance imaging study of dyslexic children, Brain 133 (3) (2010) 868–879.
[138] I. Dumontheil, T. Klingberg, Brain activity during a visuospatial working memory task predicts arithmetical performance 2 years later, Cereb. Cortex 22 (5) (2012) 1078–1085.
[139] M.E. Fenwick, H.A. Kubas, J.W. Witzke, K.R. Fitzer, D.C. Miller, D.E. Maricle, J. B. Hale, Neuropsychological profiles of written expression learning disabilities determined by concordance-discordance model criteria, Appl. Neuropsychol.: Child. (2015) 1–14.
[140] D.C. Geary, Mathematical disabilities: Reflections on cognitive, neuropsychological, and genetic components, Learn. Individ. Differ. 20 (2) (2010) 130–133.
[141] M.M. Mazzocco, K.J. Grimm, Growth in rapid automatized naming from grades K to 8 in children with math or reading disabilities, J. Learn. Disabil. 46 (6) (2013) 517.
[142] K.R. Pugh, P. McCardle, Conclusion: integration of methodologies in cognitive neuroscience—research, planning, and policy, how children learn to read: current issues and new directions in the integration of cognition, Neurobiol. Genet. Read. Dyslexia Res. Pract. (2011) 301.
[143] K. Kucian, T. Loenneker, E. Martin, M. von Aster, Non-symbolic numerical distance effect in children with and without developmental dyscalculia: a parametric fMRI study, Dev. Neuropsychol. 36 (6) (2011) 741–762.
[144] R.L. Peterson, B.F. Pennington, Developmental dyslexia, Lancet 379 (9830) (2012) 1997–2007.
[145] T.L. Richards, T.J. Grabowski, P. Boord, K. Yagle, M. Askren, Z. Mestre, V. Berninger, Contrasting brain patterns of writing-related DTI, fMRI, and DTI–fMRI connectivity correlations in children with and without dysgraphia or dyslexia, NeuroImage: Clin. 8 (2015) 408–421.
[146] B.A. Shaywitz, S.E. Shaywitz, B.A. Blachman, K.R. Pugh, R.K. Fulbright, P. Skudlarski, J.M. Fletcher, Development of left occipitotemporal systems for skilled reading in children after a phonologically-based intervention, Biol. Psychiatry 55 (9) (2004) 926–933.
[147] P.G. Simos, J.M. Fletcher, S. Sarkari, R.L. Billingsley, C. Denton, A. C. Papanicolaou, Altering the brain circuits for reading through intervention: a magnetic source imaging study, Neuropsychology 21 (4) (2007) 485.
[148] P.G. Simos, J.M. Fletcher, S. Sarkari, R. Billingsley-Marshall, C.A. Denton, A. C. Papanicolaou, Intensive instruction affects brain magnetic activity associated with oral word reading in children with persistent reading disabilities, J. Learn. Disabil. 40 (1) (2007) 37–48.
[149] J.C. Bledsoe, M. Semrud-Clikeman, S.R. Pliszka, Neuroanatomical and neuropsychological correlates of the cerebellum in children with attention-deficit/hyperactivity disorder–combined type, J. Am. Acad. Child. Adolesc. Psychiatry 50 (6) (2011) 593–601.
[150] F. Cauda, T. Costa D.M., K. Sacco, F. D'Agata, S. Duca, A. Vercelli, Meta-analytic clustering of the insular cortex: characterizing the meta-analytic connectivity of the insula when involved in active tasks, Neuroimage 62 (1) (2012) 343–355.
[151] S. Cortese, C. Kelly, C. Chabernaud, E. Proal, A. Di Martino, M.P. Milham, F. X. Castellanos, Toward systems neuroscience of ADHD: a meta-analysis of 55 fMRI studies, Am. J. Psychiatry 169 (10) (2012) 1038.
[152] E. Hollander, S. Poskar, A. Gerard, Subtypes and spectrum issues, Obsessive-Compuls. Disord.: Curr. Sci. Clin. Pract. (2012) 133–159.
[153] N.M. Kleinhans, T. Richards, L.C. Johnson, K.E. Weaver, J. Greenson, G. Dawson, E. Aylward, fMRI evidence of neural abnormalities in the subcortical face processing system in ASD, Neuroimage 54 (1) (2011) 697–704.
[154] L.F. Koziol, D.A. Budding, J.B. Hale, Understanding neuropsychopathology in the 21st century: current status, clinical applications, and future directions, Neuropsychol. Assess. youth: Evid.-based Approach Emot. Behav. Disord. (2013) 327–345.
[155] K. Rubia, R. Halari, A. Cubillo, A.M. Mohammad, S. Scott, M. Brammer, Disorder-specific inferior prefrontal hypofunction in pure attention-deficit/hyperactivity disorder compared to boys with pure conduct disorder during cognitive flexibility, Hum. Brain Mapp. 31 (12) (2010) 1823–1833.
[156] S. Selvaraj, D. Arnone, D. Job, A. Stanfield, T.F. Farrow, A.C. Nugent, D. P. Dickstein, Grey matter differences in bipolar disorder: a meta-analysis of voxel-based morphometry studies, Bipolar Disord. 14 (2) (2012) 135–145.
[157] B. Sundermann, M.O. Lütke Beverborg, B. Pfleiderer, Toward literature-based feature selection for diagnostic classification: a meta-analysis of resting-state fMRI in depression, Front. Hum. Neurosci. (2014) 8.
[158] H. van Ewijk, D.J. Heslenfeld, M.P. Zwiers, J.K. Buitelaar, J. Oosterlaan, Diffusion tensor imaging in attention deficit/hyperactivity disorder: a systematic review and meta-analysis, Neurosci. Biobehav. Rev. 36 (4) (2012) 1093–1106.
[159] P.D. Walshaw, L.B. Alloy, F.W. Sabb, Executive function in pediatric bipolar disorder and attention-deficit hyperactivity disorder: in search of distinct phenotypic profiles, Neuropsychol. Rev. 20 (1) (2010) 103–120.
[160] S.H.A. Chen, J.B. Hale, H.A. Kubas, J.W. Witzke, K. Murphy, J. McKee, Research Domain Criteria for Deciphering ADHD Neuropsychological Heterogeneity, Poster Presented at The International Neuropsychological Society, Boston, MA, 2016.
[161] L.E. Cutting, H.S. Scarborough, Multiple bases for comprehension difficulties: the potential of cognitive and neurobiological profiling for validation of subtypes and development of assessments, Reaching an understanding: Innovations in how we view reading assessment, in: J.P. Sabatini, T. O'Reilly, E. R. Albro (Eds.), Reaching an Understanding, Rowman & Littlefield Publishers Inc., Plymouth, UK, 2012, pp. 101–116.
[162] R. DeKeyser, Interactions between individual differences, treatments, and structures in SLA, Lang. Learn. 62 (s2) (2012) 189–200.
[163] D.A. Fair, D. Bathula, M.A. Nikolas, J.T. Nigg, Distinct neuropsychological subgroups in typically developing youth inform heterogeneity in children with ADHD, in: Proceedings of the National Academy of Sciences 109(17), 2012, pp. 6769–6774.
[164] J.B. Hale, L.A. Reddy, M. Semrud-Clikeman, L. Hain, J. Whitaker, J. Morley, K. Lawrence, A. Smith, N. Jones, Executive impairment determines ADHD medication response: Implications for academic achievement, J. Learn. Disabil. 44 (2011) 196–212.
[165] L. Kaufmann, M.M. Mazzocco, A. Dowker, M. von Aster, S.M. Göbel, R. H. Grabner, O. Rubinsten, Dyscalculia from a differential perspective, Front. Psychol. 4 (516) (2013) 2.
[166] M. Liotti, S.R. Pliszka, K. Higgins, R. Perez, M. Semrud-Clikeman, Evidence for specificity of ERP abnormalities during response inhibition in ADHD children: a comparison with reading disorder children without ADHD, Brain Cogn. 72 (2) (2010) 228–237.
[167] A. Overvelde, W. Hulstijn, Implicit motor sequence learning in children with learning disabilities: deficits limited to a subgroup with low perceptual organization, Dev. Neuropsychol. 37 (7) (2012) 579–589.
[168] C. Peyrin, M. Lallier, J.F. Demonet, C. Pernet, M. Baciu, J.F. Le Bas, S. Valdois, Neural dissociation of phonological and visual attention span disorders in developmental dyslexia: FMRI evidence from two case report, Brain Lang. 120 (3) (2012) 381–394.
[169] V. Berninger, M. Dunn, Brain and behavioral response to intervention for specific reading, writing, and math disabilities: what works for whom? Learn. LD (2012) 59–89.
[170] N. Davis, L. Barquero, D.L. Compton, L.S. Fuchs, D. Fuchs, J.C. Gore, A. W. Anderson, Functional correlates of children's responsiveness to intervention, Dev. Neuropsychol. 36 (3) (2011) 288–301.
[171] B. Butterworth, Y. Kovas, Understanding neurocognitive developmental disorders can improve education for all, Science 340 (6130) (2013) 300–305.
[172] B.A. Wandell, J.D. Yeatman, Biological development of reading circuits, Curr. Opin. Neurobiol. 23 (2) (2013) 261–268.
[173] L.A. Barquero, N. Davis, L.E. Cutting, Neuroimaging of reading intervention: a systematic review and activation likelihood estimate meta-analysis, PLoS One 9 (1) (2014) e83668.

[174] V. Berninger, H.L. Swanson, Diagnosing and treating specific learning disabilities in reference to the brain's working memory system, in: H. L. Swanson, K.R. Harris, S. Graham (Eds.), Handbook of Learning Disabilities, Guilford Press, New York, NY, 2013, pp. 169–185.
[175] M.H. Breteler, M. Arns, S. Peters, I. Giepmans, L. Verhoeven, Improvements in spelling after QEEG-based neurofeedback in dyslexia: a randomized controlled treatment study, Appl. Psychophysiol. Biofeedback 35 (1) (2010) 5–11.
[176] S.R. Kesler, K. Sheau, D. Koovakkattu, A.L. Reiss, Changes in frontal-parietal activation and math skills performance following adaptive number sense training: Preliminary results from a pilot study, Neuropsychol. Rehabil. 21 (4) (2011) 433–454.
[177] A.J. Krafnick, D.L. Flowers, E.M. Napoliello, G.F. Eden, Gray matter volume changes following reading intervention in dyslexic children, Neuroimage 57 (3) (2011) 733–741.
[178] T. Luculano, M. Rosenberg-Lee, J. Richardson, C. Tenison, L. Fuchs, K. Supekar, V. Menon, Cognitive tutoring induces widespread neuroplasticity and remediates brain function in children with mathematical learning disabilities, Nat. Commun. 6 (2015) 8453.
[179] B. Penolazzi, C. Spironelli, C. Vio, A. Angrilli, Brain plasticity in developmental dyslexia after phonological treatment: a beta EEG band study, Behav. Brain Res. 209 (1) (2010) 179–182.
[180] S. Tanimoto, R. Thompson, V.W. Berninger, W. Nagy, R.D. Abbott, Computerized writing and reading instruction for students in grades 4–9 with specific learning disabilities affecting written language, J. Comput. Assist. Learn. 31 (6) (2015) 671–689.
[181] J. Tijms, Effectiveness of computer-based treatment for dyslexia in a clinical care setting: outcomes and moderators, Educ. Psychol. 31 (7) (2011) 873–896.
[182] S.K. Meehan, J.R. Zabukovec, E. Dao, M.A. Linsdell, L.A. Boyd, cTBS over contralesional sensory cortex enhances hemiparetic arm function after stroke, Neurosci. Lett. 500 (2011) 26–30.
[183] B.A. Wilson, N. Kapur, D.A. Stuss, G. Winocur, I.H. Robertson, Cogn. Neurorehabil.: Evid. Appl. (2008) 522–533.
[184] M. Semrud-Clikeman, P.A.T. Ellison, Child Neuropsychology: Assessment and Interventions for Neurodevelopmental Disorders, Springer Science & Business Media, New York, NY, 2009.
[185] J.B. Hale, C.A. Fiorello, J.A. Kavanagh, J.A. Holdnack, A.M. Aloe, Is the demise of IQ interpretation justified? A response to special issue authors, Appl. Neuropsychol. 14 (2007) 37–51.
[186] R.L. Bryck, P.A. Fisher, Training the brain: practical applications of neural plasticity from the intersection of cognitive neuroscience, developmental psychology, and prevention science, Am. Psychol. 67 (2) (2012) 87.
[187] F.A. Champagne, R. Mashoodh, Gene–environment interplay and the origins of individual differences in behavior, Curr. Dir. Psychol. Sci. 18 (3) (2009) 127–131.
[188] M.J. Meaney, Epigenetics and the biological definition of gene × environment interactions, Child. Dev. 81 (1) (2010) 41–79.
[189] T. Kubota, K. Miyake, T. Hirasawa, K. Nagai, T. Koide, Novel etiological and therapeutic strategies for neurodiseases: epigenetic understanding of gene-environment interactions, J. Pharmacol. Sci. 113 (1) (2010) 3–8.
[190] M.J. Millan, An epigenetic framework for neurodevelopmental disorders: from pathogenesis to potential therapy, Neuropharmacology 68 (2013) 2–82.
[191] A.R. Luria, The Working Brain: An Introduction to Neuropsychology, Basic Books, New York, 1976.
[192] D.O. Hebb, The Organization of Behavior: A Neuropsychological Approach, John Wiley & Sons, New York, NY, 1949.
[193] V. Menon, Developmental pathways to functional brain networks: emerging principles, Trends Cognit. Sci. 17 (12) (2013) 627–640.
[194] R. Borowsky, J. Cummine, W.J. Owen, C.K. Friesen, F. Shih, G.E. Sarty, FMRI of ventral and dorsal processing streams in basic reading processes: insular sensitivity to phonology, Brain Topogr. 18 (4) (2006) 233–239.
[195] J.E. Turner, T. Valentine, A.W. Ellis, Contrasting effects of age of acquisition and word frequency on auditory and visual lexical decision, Mem. Cogn. 26 (6) (1998) 1282–1291.
[196] K.R. Fitzer, J.B. Hale, C. Lebel, M. Walton, Cognitive hypothesis testing for targeted reading disability subtype interventions: impact on reading competency and white matter connectivity, in: Proceedings of the 43Rd International Neuropsychological Society. Denver, CO, February 2015.
[197] S. Al Otaiba, R.K. Wagner, B. Miller, "Waiting to fail" redux understanding inadequate response to intervention, Learn. Disabil. Q. 37 (3) (2014) 129–133.
[198] D.J. Reschly, Learning disabilities identification primary intervention, secondary intervention, and then what? J. Learn. Disabil. 38 (6) (2005) 510–515.
[199] C.R. Reynolds, S.E. Shaywitz, Response to intervention: prevention and remediation, perhaps. Diagnosis no, Child Dev. Perspect. 3 (1) (2009) 44–47.
[200] J.B. Hale, C.A. Fiorello, R. Thompson, Integrating neuropsychological principles with response-to-intervention for comprehensive school-based practice, in: E. Arzubi, E. Mambrino (Eds.), A Guide to Neuropsychological Testing for Health Care Professionals, Springer Publishing Company, New York, N, 2010, pp. 229–262.
[201] J.B. Hale, K.L. Wycoff, C.A. Fiorello, RTI and cognitive hypothesis testing for specific learning disabilities identification and inptervention: the best of both worlds, in: D.P. Flanagan, V.C. Alfonso (Eds.), Essentials of Specific Learning Disability Identification, John Wiley & Sons, Hoboken, NJ, 2010, pp. 173–202.