

Socio-emotional and cognitive resilience in children with reading disabilities

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In recent times, research on resilience in children facing adversities has proliferated. In this review, the authors characterize resilience in children with reading disorders (RD). To organize our discussion and categorize the specific outcomes such children demonstrate, we adopt the terms *cognitive resilience* and *socio-emotional resilience*. By paralleling other resilience research, we seek to uncover protective factors in the hopes that they can be targeted in education and interventions to improve cognitive functioning, socio-emotional wellbeing, and academic success of children with RD. We conclude by considering current limitations and addressing the need for future resilience research in this specific population of children.

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Introduction

Approximately 7% of children have specific difficulties in learning to read (developmental dyslexia, decoding-based reading disability or reading disorder; from here on RD; [1,2]). RD is a polygenic disorder characterized by deficits in rapid automatized naming (RAN; [3,4]) verbal short-term memory [5,6], and most notably phonological awareness (PA; [7–9]). These deficits not only lead to poor decoding [10], but most often result in downstream effects on spelling [11,12], vocabulary [13], and reading comprehension [14,15]. As a result, students may experience academic failure and are 2.5 times more likely to drop out of high school [16]. With increased risk for and experiences of

failure in school, as well as greater likelihood of peer rejection [17], students with RD are susceptible to negative socio-emotional consequences [18], which could in turn lead to further reduction in academic performance [19,20] (Figure 1).

Despite these academic risks and negative cognitive and socio-emotional consequences, many individuals with RD demonstrate positive trajectories and grow up to lead successful lives. This begs the question: which factors encourage *resilience* and ultimately success in some individuals with RD?

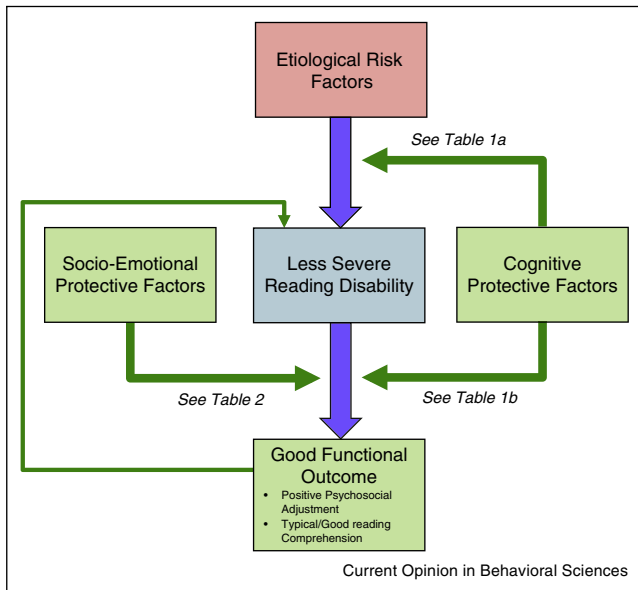
Present review

Traditionally, resilience has been defined as the trajectory from the presence of significant risk or adversity to achievement of positive adaptation or outcomes [21]. The present review applies the concept of resilience to children with or at-risk for developing RD, focusing primarily on protective factors that positively modify or alter the effects of risks and outcomes of children with RD. For details on etiological risk factors for RD and their mechanisms, readers are referred to Vandermosten Hoeft and Norton (2016) and Ozernov-Palchik *et al.* (2016) in the current issue. The focus on resilience and protective factors is timely as the field shifts toward a multifactorial theory of RD, that both risk and protective factors interacting at the genetic, neural, cognitive, and environmental levels contribute to the overall functional outcome of RD [22]. To provide a non-exhaustive qualitative review of the literature relevant to *cognitive resilience* and *socio-emotional resilience* of RD, operationalized in their respective sections, we used search terms relevant to resilience in RD and dyslexia (e.g. ‘protective,’ ‘compensation,’ ‘resilience,’ ‘unimpaired,’ ‘support,’ ‘adjustment,’ ‘environment,’ ‘strength’) with a focus on recent articles involving children and adolescents.

Cognitive resilience

While there are numerous studies that define *resilience*, there are currently few studies that operationalize *cognitive resilience*. A PubMed search of cognitive resilience, for example, shows that most of the dozen peer-reviewed studies utilizing the term do so in reference to aging and related disorders, defining it as preserved cognitive function despite evident neuropathology (such as lesions and neurofibrillary tangles) [23] or significant genetic risk (from presence of apolipoprotein E ε4 allele) [24]. Within this framework, individuals who display cognitive resil-

Figure 1



Good functional outcome for those with RD when strong protective factors (thicker, solid green lines) interplay with etiological risk factors to mediate outcome. The thinner green line indicates how good functional outcome may improve RD severity by enhanced reading experience, for example, though more empirical research is needed in this area. Blue solid lines indicate trajectories of RD.

ience may be considered as those with neurobiological risk factors for RD (such as presence of risk genes for RD, a family history of RD, or phonological processing deficits; see also Vandermosten Hoeft Norton (2016) and Ozernov-Palchik *et al.* (2016) in current issue) who never develop, or only develop mild deficits of the core phenotype, such as difficulties in decoding words. We may also refer to those with RD who display core characteristic deficits of RD but who show milder downstream effects such as reading comprehension deficits as displaying cognitive resilience. In this section, we will discuss the protective factors that may enable cognitive resilience.

Studies examining characteristics of at-risk pre-readers who never develop later reading problems provide important clues for mechanisms of cognitive resilience in children with RD (Table 1a). A study by Gallagher *et al.* [25] showed that at-risk pre-readers who were unimpaired on reading measures at school-age performed higher than their at-risk impaired counterparts on early measures of oral language tests — later studies showed similar results [26,27]. Strengths in expressive language in children at familial risk for dyslexia who never develop the disorder is observed as young as 2 years old [28]. Some authors have suggested that the mechanism of resilience for these children is the use of language skills and semantic context to circumvent phonological decoding deficits — known as *semantic bootstrapping* [29]. Executive function (EF)

may also be another mechanism through which children display cognitive resilience. For example, a recent study showed that poor EF in preschool is a predictor of later RD, and that strengths in EF had more significant positive effects ‘when a child showed poor performance on the core predictors of dyslexia, suggesting good [EF] provides some compensation for the impact of low ‘readiness’ for learning to read [30•].’ Another study found that high levels of task-focused behavior — often referred to as internal goal-driven, top-down or endogenous attention — is what distinguished children with familial risk of RD who never developed it from those at-risk who were later diagnosed [31•] — empirical research should further explore the process in which these types of attention impact reading outcome. Finally, strengths in some types of early fine motor skills may also be important for later reading outcome [32]. While the mechanism is unknown, it is intriguing that fine motor skill tasks such as hand-writing have been shown to rely on brain regions also relevant to reading in beginning readers [33]. This relationship may be epiphenomenal, and thus the primary factor contributing to reading outcome should be investigated.

Mechanisms of cognitive resilience may also be inferred from studies of children who develop RD but who do not show the typical downstream effects such as weakness in reading comprehension arising from phonological and decoding deficits, otherwise known as *resilient readers* [34] (Table 1b). Resilient readers may rely more on contextual information to be able to read successfully [35] — this is in line with Stanovich’s [36] ‘*Interactive compensatory model of dyslexia*’. One study of ‘compensated’ dyslexic university students — where ‘compensated’ is defined as those achieving higher than expected literacy in light of phonological deficits — showed that students’ strengths in morphological awareness were associated with improved reading outcome [37•]. Other studies have similarly found that children with RD can rely on morphological structure to decode words faster, despite decoding difficulties [38,39]. Vocabulary skills have also been implicated as a compensatory mechanism for college students with RD [40], and have been shown to mediate between impaired verbal working memory and oral reading fluency in adolescents with RD [41]. More superior verbal reasoning skills in general have been shown to explain higher reading, spelling, morphological, and syntactic skills in students with RD [42]. As is the case in at-risk pre-readers, this implies that resilient readers may use contextual cues or *semantic bootstrapping* in order to process written text. EF may also play an important role for compensated or resilient readers — strong working memory in particular may circumvent reading problems in dyslexic children [43•]. Cognitive flexibility, another EF component, has been found to be crucial for reading comprehension in low-risk readers, and may also be important for those with RD [44]. A

Table 1a

Recent longitudinal studies (2009–2016) on potential protective factors contributing to cognitive resilience in pre-readers at-risk for RD.

Study	Population	Relevant findings	Protective factor(s)
Studies with pre-readers at-risk for RD			
[26]	Family history of RD	At-risk RD children in kindergarten with good reading outcome 3 years later showed lower performance on spelling and reading accuracy than typical readers, but had better oral language skills (expressive vocabulary) than at-risk RD children with poor reading outcome.	Oral language skills
[27]	Family history of RD Language difficulties	Oral language measures (articulation, word repetition, and expressive vocabulary) in preschool predicted phoneme awareness and grapheme-phoneme knowledge at school entry, which predicted word-level literacy skills after school entry.	Oral language skills
[28]	Family history of RD	At-risk RD children with no later RD outperformed at-risk RD children with later RD in grade 2 on tasks of vocabulary production and maximum sentence length at 1–2 yrs old.	Oral language skills
[32]	Family history of RD	Preschool fine motor skills predicted unique variance in early reading skills at age 5 regardless of risk status.	Motor skills
[31*]	Family history of RD	Irrespective of early cognitive risk factors, high levels of task-focused behavior were associated with the absence of RD in grade 2 in kindergarteners at familial risk of RD at 5 years old.	High levels of task-focused behavior
[30**]	Family history of RD Language difficulties	Executive function skills (inhibitory control, selective attention, working memory), fine motor skills, and oral language skills (expressive/receptive vocabulary, sentence repetition, sentence/word structure) in preschool all increase the prediction probability for later RD at 8 years old.	Executive Functions Motor skills Oral language skills
[29]	Family history of RD	In a longitudinal study, those at-risk pre-readers at 3 years who had the best reading outcome at 13 years had strong oral language skills (non-word repetition, vocabulary, grammatical sensitivity).	Oral language skills
[47]	Low PA and poor letter knowledge	Environmental protective factors (peer acceptance, positive teacher affect) predicted students' improved reading fluency in grade 4 with cumulative effects for those identified as at-risk for RD in kindergarten.	Interpersonal relationships

Table 1b

Recent studies (2009–2016) on potential protective factors contributing to cognitive resilience in those diagnosed with RD.

Study	Population	Relevant findings	Protective factor(s)
Studies in readers diagnosed with RD			
[37*]	RD young adults	Compensated readers (those with high literacy despite phonological deficits) performed higher than their RD counterparts and similarly to controls on measures of morphological awareness.	Morphological awareness
[38]	RD children	RD readers were assisted by semantic properties of morphemes, whereas typically developing readers relied more on form properties of morphemes during a visual word recognition task.	Morphological awareness
[39]	RD children	Both RD and typical children used morphemic constituents to improve their performance on a pseudoword reading task.	Morphological awareness
[40]	RD young adults	The RD group outperformed controls in a vocabulary depth task, suggesting high vocabulary may be important for successful compensation.	Vocabulary
[41]	RD adolescents	In adolescents with RD, the impact of low verbal working memory on oral reading fluency depended on vocabulary skills.	Vocabulary
[42]	RD children	RD children with superior verbal reasoning significantly outperformed RD children with lower verbal reasoning on reading, spelling, morphological, and syntactic skills	Verbal reasoning
[43*]	RD children	Although gifted RD students still showed weaknesses in PA and rapid naming compared to control groups, they showed strengths in working memory and language skills compared to their non-gifted RD counterparts.	Executive functions Vocabulary Grammar

neuroimaging study showed that greater right prefrontal activation during a reading task — an area associated with EF [45] — is correlated with future gains in reading comprehension in children with RD [46] (see

Hancock, Richland, and Hoefft, under review, for more on frontostriatal hyperactivation in RD and proposed compensatory roles). This was the case despite lack of

systematic interventions in these children, which may infer its relevance to cognitive resilience.

In addition to cognitive factors, environmental factors may contribute to cognitive resilience. For example, a study of children with RD showed that the effect of RD on reading fluency was mediated by support from teachers and peers with a cumulative effect [47] — the contribution of interpersonal protective factors will be discussed more in the section on socio-emotional resilience.

In summary, oral language skills (e.g. vocabulary) appear to be critical for cognitive resilience in children at-risk for and with a diagnosis of RD. Executive functions and other language skills such as morphological awareness also appear to be important factors that promote cognitive resilience. Neurologically, prefrontal and related networks that underlie these processes may be involved. However, more research is warranted on the mechanisms underlying brain–behavior relationship regarding protective factors, compensatory mechanisms in RD, and in particular, prevention of RD in children at-risk for developing RD.

Socio-emotional resilience

In addition to cognitive resilience, students with RD can exhibit *socio-emotional resilience*, or positive psychosocial adjustment despite risk presented by RD. In the transactional nature of the resilience framework, RD can be seen as influencing a child at the individual, family, and community level — these factors can in turn be protective and counterbalance the risk presented by RD, thereby promoting resilience. In this section we will discuss the risks to socio-emotional well-being children with RD face, and how despite these challenges children with RD can exhibit resilience and maintain positive internal concepts and relationships.

Studies have shown that the presence of RD acts as a risk factor for socio-emotional maladjustment. One proposed mechanism underlying this relationship is that socio-emotional functioning issues co-occur with RD, potentially because of deficits in information-processing and impulsivity ('primary-cause hypothesis'; [48,49]). Another viewpoint is that socio-emotional problems arise as a secondary emotional reaction from the stress of repeated reading failure ('secondary-cause hypothesis'; [48,50]). Regardless, the literature is clear that students with RD are more likely than their typically developing peers to have low self-esteem, face peer rejection, and become anxious or depressed [18,51] — additional comorbidities [52,53], low socio-economic status or social support [18,54], as well as being a female [49,51], typically exacerbate these negative outcomes. This can result in a vicious cycle whereby negative emotions and social experiences reciprocally interact with a child's RD, limiting cognitive capacity and sustaining reading failure [19,20].

Several individual attributes may contribute to socio-emotional resilience and academic achievement of those with RD. Early longitudinal studies implicated self-awareness, proactivity, perseverance, realistic educational plans, and appropriate goal setting in promoting resilience for well-adapted adults with RD and other Learning Disabilities (LDs) [55–57]. More recently, a prospective study of a program for middle school students with RD showed that increases in *locus of control* were associated with more adaptive coping strategies, increased school engagement, and overall well-being [58]. Other studies have linked *sense of coherence* (an index of sense of control and resources; [59]) and *self-determination* (viewing oneself as a causal agent; [60]) to positive socio-emotional and academic adjustment in students with RD and other LDs. In other words, it appears that a greater sense of control is important for students to cope effectively with the difficulties that their RD presents — this concurs with an early retrospective study of highly successful adults with RD/LD, where the dominant factor implicated in success was the individual's ability to take control of his or her life [61,62]. In addition, *hope* was found to mediate between risk and protective factors for students with RD/LD in one study, resulting in greater academic self-efficacy and effort investment [63**] — this may be because hopeful thinking involves goal-oriented thoughts, which may help in coping with academic and social barriers [63**,64,65].

Growth mindset, an individual's belief that his or her intelligence is malleable (e.g. an incremental theory of intelligence), as opposed to a fixed mindset where one believes one's intelligence cannot be further developed (e.g. entity theory of intelligence), is associated with increased resilience in children [66], and has been shown to buffer against demotivation that results from academic difficulties [67]. Baird *et al.* [68] found that maladaptive goal orientation and effort attributions in youth with RD/LD are linked directly to their entity theories of intelligence. These findings suggest that if youth with RD would adopt a growth mindset, they would be less likely to perceive the exertion of effort as indicative of low ability, and may instead persevere through reading challenges and subsequently perform higher. In line with this, one neuroimaging study has shown that growth compared to fixed mindset leads to stronger coupling between attention allocation and post-error performance during an attention and inhibitory control task, presumably in the anterior cingulate cortex, part of the medial prefrontal region (flanker task; [69]). In other words, those who adopt a growth mindset show a more adaptive brain–behavior connection in adjusting to errors — this is important for students with RD, as they may be better able to adjust their performance on academic tasks when given feedback on their weaknesses and errors.

The aforementioned individual attributes can be bolstered by family-level factors. Family cohesion partially

explained hopeful thinking in a group of students with RD/LD [63**]. Children [70,71] and adults [72] with RD who have strong relationships with their parents, and whose parents had a good understanding of their RD [71], are found to have higher self-esteem than those with weaker parental relationships. Al-Yagon has suggested unique roles for mothers and fathers in this socio-emotional resilience. Strong attachment to fathers is associated with more sense of coherence, hope, and effort in children with RD, while attachment to mothers has been found to protect against loneliness and internalizing symptoms such as anxiety [73*,74**].

Peers may also play a protective support role outside the home. A recent study showed that a high quality relationship with a best friend contributed significantly to lower internalizing and externalizing issues in adolescents with learning disabilities (LD) including RD [74**]. Similarly, having stable and close friendships was found to be a protective factor for university stu-

dents with RD/LD, predicting greater global self-worth and social self-concept [75]. A large body of literature confirms the relationship between peer support and acceptance, and positive socio-emotional outcomes in children — unfortunately, work in the RD population specifically focuses mainly on peers as threats [70].

Teachers are in a role to foster a classroom environment that promotes socio-emotional resilience — analysis of a nationally representative sample showed that mentorship by teachers was associated with self-esteem differences in youth with RD/LD compared to nonmentored youth [76]. Additionally, supportive teachers can effectively protect children against negative impacts of peer rejection due to their RD, controlling for other risk variables [17]. Perceptions of teachers as caring and available are also important in promoting positive affect for RD students [74**]. Though a thorough discussion comparing special education versus mainstream educational settings for children with RD is beyond the scope of this review,

Table 2

A summary of protective factors (2009–2016) contributing to socio-emotional resilience for children with RD.

Study	Relevant findings	Protective factor(s)
Individual		
[68] ^a	The maladaptive effort attributions and self-regulatory profiles of youth with LD were due to their fixed mindset — this suggests that adopting a growth mindset could lead to more positive cognitions when exerting effort in their academics.	Growth mindset
[63**] ^a	Hope mediated between risk and protective factors for high school students with LD, contributing to greater academic self-efficacy.	Hopeful thinking
[59] ^a	Children's sense of coherence mediated the association between their maternal attachment and their hope and effort.	Sense of coherence
[58]	A coping program for students with RD resulted in a more internal locus of control, which was associated with a reduction in nonproductive coping strategies.	Internal locus of control
[60] ^a	In a sample of adolescents with LD, self-determination significantly correlated with self-concept and emerged as a potential predictor of academic achievement.	Self determination
Family		
[63] ^a	Family cohesion partially explained hopeful thinking among high school youth both with and without LD.	Family cohesion
[59] ^a	A greater number of significant paths emerged between maternal affect and adjustment of children with LD than those children without LD, suggesting that maternal emotion may play a unique role in children with LD.	Maternal affect
[73*] ^a	Maternal attachment contributed to internalizing adjustment and paternal attachment to coping resources for children with LD — these paths were more significant than in children without LD.	Strong parental attachment
[71]	Children with RD who had strong relationships with their parents and parents with a greater understanding of RD had higher global self-worth.	Parental support and understanding of RD
Community		
[75] ^a	University students with LD who had stable friendships were more likely to have higher global self-worth than students with LD who did not have these relationships.	Peer relationships
[74**] ^a	For adolescents with LD (but not comorbid ADHD or typically developing students), ratings of their homeroom teacher as caring and available contributed to high positive affect, and high quality of perceived friendship contributed to lower internalizing and externalizing problems.	Teacher support Peer relationships
[76] ^a	Adolescents with LD who were mentored by teachers had higher self-esteem and graduation rates compared to their non-mentored counterparts.	Mentorship by teachers
[17]	Teacher support protected children with RD from the negative impacts of peer rejection. Additionally, smaller class size functioned as a protective factor against social withdrawal due to peer rejection.	Teacher support Small class size

^a The sample for these studies involved children with broad learning disabilities, which includes children with RD as well as disorders in mathematics and/or writing.

studies suggest that children with RD have higher self-esteem when they are in smaller classrooms [17].

Attachments to others may increase socio-emotional resilience for children with RD by providing a ‘secure base [77]’ where children can then direct energy and attention toward exploring their environment and acquiring skills needed for reading. Related to this is ‘stress and coping theory,’ the belief that when social support is perceived as available, individuals are able to reframe negative experiences and engage in productive coping skills [78]. Although such social support theories are valuable in explaining potential mechanisms underlying socio-emotional resilience, more work should be done to understand how they function specifically for children with RD.

In summary, attributes such as sense of control, growth mindset, and hopeful thinking, as well as strong interpersonal relationships and supportive classroom contexts can foster socio-emotional resilience in children with RD (see Table 2). Neurobiological correlates and well-controlled studies with more quantitative measures lag in comparison to cognitive studies in RD, and is a suggested area of growth in the field.

Conclusion

Our findings suggest that while some children have etiological risk factors that confer risk for RD, cognitive and socio-emotional protective factors may reduce the severity of RD symptoms and individual outcome through several strategies and mechanisms identified in this review. These protective factors that lead to cognitive and socio-emotional resilience likely influence reading outcome in a reciprocal manner (though empirical evidence is lacking), and together contribute to an individual’s capacity to adapt to adversity. With regards to (preventative) interventions in at-risk pre- and beginning readers, in addition to fostering skills directly related to reading (e.g. PA) honing oral language skills and EFs early may also be beneficial. In examining literature related to resilient or compensated readers, utilizing cognitive strengths (e.g. semantic contextual clues) to offset potential core deficits can improve reading outcome [34–36], as well as building on the confidence and optimism of those with RD. Children with RD should be made to feel like they are in control of their lives and academic outcomes. Fostering a growth mindset is also particularly important given the academic difficulties children with RD face — this can be done by praising perseverance and effort [79].

Several limitations of this review and the field we reviewed should be acknowledged. First, we operationalize the term *cognitive resilience* based off of its use in aging and dementia literature. To our knowledge, the literature discussing RD does not use this specific terminology. Second, we discuss some protective factors that are not typically considered etiological risk factors for RD (e.g. motor skills, executive

functions), but if further research indicates that they are, then their role as protective (and not merely absence of risk) should be reconsidered. One way to investigate this is to examine the extent of impairment in those at-risk for RD in these areas, or whether those which above-expected reading outcome show enhancement of these skills. Third, we discuss preserved self-esteem and self-efficacy as positive features for children with RD, but it should be noted that an overly positive estimation of one’s abilities, or *positive illusory bias*, has been documented in children with LD and can be detrimental [80]. Future research should focus more on this potential issue, as well as on the importance of realistic competency assessment and its relation to self-esteem and performance in children with RD. Fourth, much of the literature involving children with RD focuses disproportionately on risk factors and negative outcomes. More work with a focus on factors that promote positive outcomes in children with RD is needed, specifically on mechanisms of resilience rather than merely identifying protective antecedent variables. Finally, due to space constraints, we recommend other reviews such as the following for neurobiological mechanisms underlying resilience [81,82], as they are not discussed here.

To our knowledge, this paper represents one of the only recent reviews investigating resilience within the population of children with or at-risk for RD. Our hope is that emphasizing contributors to resilience for students with or at-risk for RD will bolster our understanding of best practices for these children that may not be achieved with deficit-focused models. Such knowledge will contribute to higher reading and academic performance in these children, allowing them to grow into competent and successful adults.

Conflict of interest

Nothing declared.

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