

The Paradox of Reading Disabilities:
Assessing Creative Potential in Children at-risk for Reading Disabilities

by

Hilary Scruton, BA

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Abstract

This study explores the profiles of children who are at-risk for reading disabilities on both traditional reading-based tasks and measures of creativity. Twenty-six (26) children referred to the Learning Disabilities Association of Niagara Region were administered a series of reading-based measures, as well as measures of creativity and creative thinking. It was hypothesized that children at-risk for reading disabilities may be predisposed to characteristics aligned with creative thinking. Results of the study indicated that children at-risk for learning disabilities demonstrated phonological awareness abilities that were statistically significantly discrepant from their creative thinking skills. The sample of children in this study often demonstrated significantly below average phonological processing skills and creativity skills that were within average limits. In several cases, participants had creativity skills that were well above average. Such findings hold important implications for policy and practice around supporting children with reading disabilities.

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Overview

Research has consistently demonstrated that children with reading disabilities exhibit deficits in several core skill areas (Snow, Burns, & Griffin, 1998). Generally, children with reading disabilities have difficulties with phonological processing, letter sound understanding, phonics, and reading fluency – deficits that ultimately result in poor reading comprehension. Reading disabilities are primarily characterized by minor neurological dysfunction resulting in phonological processing problems despite individuals having average or above IQ (Fletcher et al., 1998). These characteristics most often result in academic challenges in the area of reading and other reading-based subjects. However, in addition to academic struggles, Stanovich (1986) suggests that children with reading disabilities also struggle from a phenomenon called the Matthew effect. This is a biblical term borrowed by Stanovich whereby *the rich get richer and the poor get poorer*. This effect posits that as children with reading disabilities progress through school, they fall increasingly behind their peers in reading. One interesting aspect of the Matthew effect is that children with reading disabilities are not falling further behind their peers because of their academic skill deficits *per se*. Rather, they are falling further behind because of an increasing lack of motivation to engage. In this sense, children comparing themselves to their peers may lead to the Matthew effect. Such comparisons can lead to low self-esteem, low self-worth, and mental health-related issues. It is important to note that there are other factors beyond the scope of this thesis (e.g., socioeconomic status, gender, or culture that can contribute to the Matthew effect. However, it becomes important to focus on not only how to effectively teach reading skills, but also how to think beyond traditional approaches in order to support children

with reading disabilities. This thesis is about exploring a nontraditional approach to supporting children with reading disabilities.

In response to the challenges associated with the Matthew effect, the field has begun to look for alternative perspectives that address issues of low self-esteem often experienced by children with reading disabilities. For instance, Eide and Eide (2011) suggest that there are distinct *advantages* to having a reading disability. The authors cite numerous examples of individuals with reading disabilities who have excelled in their careers. It is interesting to note that almost all of their cited examples have succeeded in careers that rely on innovation, creativity, and ‘outside-the-box’ thinking. The success of these individuals is thought to be associated with the idea that they are tapping into a type of neurological processing that is not otherwise used in reading-based tasks. More specifically, individuals with reading disabilities, a presumed left-sided neurological processing problem, tend to process reading-based information with the right side of their brain (Paulesu, Danelli, & Berlingeri, 2014). In overusing one side of their brain, it is hypothesized that individuals have well-developed right hemispheres, and, as such, have strengths associated with this type of processing, such as innovation and creativity.

This study explores the profiles of children who are at-risk for reading disabilities on both traditional reading-based tasks and measures of creativity. Twenty-six (26) children referred to the Learning Disabilities Association of the Niagara Region (LDANR) were administered a series of reading-based measures, as well as measures of creativity and creative thinking. It was hypothesized that children at-risk for reading disabilities may be predisposed to characteristics aligned with creative thinking. Such

findings hold important implications for policy and practice around supporting children with reading disabilities.

Reading Disabilities and the Matthew Effect

As suggested, the Matthew effect plays a significant role in the well-being of children with reading disabilities. As a result of their phonological processing problems, children with reading disabilities are slower in their word-level decoding leading to an underdeveloped vocabulary (Stanovich, 1986). This often creates a cycle whereby children experience a decrease in motivation to engage with reading-based material. In essence, the initial cognitive delays compound with motivational factors to produce conditions whereby children with poor phonological processing begin their trajectory throughout formal schooling at a significant disadvantage compared to their peers. As these children progress through their primary school years, the gap in reading achievement scores between them and their peers increases exponentially. Through this process, in addition to experiencing the academic disadvantage *per se*, children may also experience lower self-efficacy as they may compare themselves to grade-level achieving children in their class. This effect is what Stanovich has referred to as the Matthew effect. Three decades of research have sought to develop reading-based interventions aimed at reducing the Matthew effect. These interventions have produced moderate results at best. Reading interventions have not produced achievement gains for children with reading disabilities that place them at commensurate levels with their peers (O'Connor, Harty, & Fulmer, 2005). This finding has been attributed to a compounding of factors including cognitive processing problems and motivational factors. Therefore, it is important that

stakeholders concerned about supporting children with reading disabilities look for innovative approaches and understandings that move beyond reducing the Matthew effect. Support may include providing children with reading disabilities with an alternative perspective on their reading disabilities. In order to do this however, it is important to acknowledge the traditional understanding behind reading and reading disabilities.

Traditional Understandings of Reading Disabilities

Fundamentally, reading disabilities are characterized by neurologically based processing problems that manifest in poor phonological awareness (Galuschka, Ise, Krick, & Schulte-Körne, 2014). Phonological awareness is the ability to focus on and manipulate sounds in spoken language (Castles & Coltheart, 2004; National Reading Panel, 2000). Phonological awareness is comprised of many skills beginning with basic speech unit sounds—phonemes—as well as broader skills such as blending and segmenting (Castles & Coltheart, 2004). It has long been established that phonological awareness is not only correlational, but also causally related to individual differences in reading ability (Snow, Burns, & Griffin, 1998). Over the past three decades a plethora of research has provided longitudinal evidence that phonological awareness measured early in a child's development is a significant predictor for future reading and reading comprehension (e.g., Bradley & Bryant, 1978; Perfetti, Beck, Bell, & Hughes, 1981, Torgesen, Wagner, & Rashotte, 1994).

Research has indicated that phonological processing problems are at the core of most children's reading difficulties (Philips, Clancy-Menchetti, & Lonigan, 2008).

Having strong phonemic processing prepares children for reading instruction, including phonics, spelling, and word identification (Adams, Foorman, Lundberg, & Beeler, 1998). As a result of phonological processing problems, children with reading disabilities demonstrate significant difficulties in word-level print processes such as phonics. Phonics is an important pre-requisite skill for higher order reading skills, such as fluency and comprehension. Although comprehension is often viewed as a primary difficulty experienced by children with reading disabilities, it is thought that the deficient, slow, and energy-demanding decoding uses up so much of the reader's mental resources that he or she has little capacity left to carry out interpretation (Perfetti, 1985). In general, phonological processing and subsequent phonics difficulties have a direct negative impact on the development of reading comprehension (Engen & Høien, 2002)

Neurophysiology of Reading Disabilities

In addition to understanding traditional definitions, for the purpose of this study it is also important to explore the neurophysiological underpinnings of reading disabilities. Research has elucidated the neurological patterns associated with the processing problems characteristic of learning disabilities and specifically reading disabilities. Eide and Eide (2011) summarize this research and posit that problems with phonological processing are typically attributed to functional variations in the left hemisphere of the central nervous system. Specifically, phonological processing is associated with dysfunction in the superior temporal lobe and the posterior parietal regions of the left hemisphere (Shaywitz, Lyon, & Shaywitz, 2006). Data from functional magnetic resonance imaging (fMRI) studies have pointed to consistent patterns of processing

whereby children with reading disabilities are compared to typical controls. In a review supported by the National Institute of Health, Shaywitz et al. (2006) indicate that during phonological processing tasks, children with reading disabilities displayed reduced activation in the left posterior temporoparietal cortex, but also abnormal overactivation in the right anterior and occipital system. An important finding was that in addition to the expected underactivation in the left hemisphere, there was an increase in activation in the right. In fact, Shaywitz et al. (2006) noted that the poorer the reader, the greater the activation in the right occipital-temporal region. The finding around overcompensation in the right hemisphere in children with reading disabilities is not often attended to in either research or practice. However, more recently, the field has begun to ask important questions about this over activation (Eide & Eide, 2011). Specifically, researchers have begun to recognize the link between right hemispheric processing and creativity.

Creativity

The current study adopts a definition of creativity situated within a psychological framework. Within this traditional perspective creativity has a long history in research and application. For several decades researchers have attempted to define creativity, but a standard definition has been elusive. That said, researchers agree upon several factors that are associated with creativity. First, creativity is thought to require two related ideas. Creativity demands both originality and effectiveness (Runcor & Jaeger, 2012) – to be creative, one must be able to generate an idea or product that is novel, unusual, or unique. However, it is easy to consider how an idea may be original yet have no utility.

Therefore, to be creative, in addition to originality, an idea or product must be effective or useful.

The primary component of the creative thinking process is considered to be divergent thinking. The divergent thinking process has been theorized to significantly predict creative achievement. Divergent thinking can be defined as the ability to generate multiple solutions to an open-ended problem (Baer, 2014). In order to better understand the divergent thinking process it is important to consider the foundations of the construct. The notion of divergent thinking dates back to Hudson's study of English schoolboys (1967), where he explored the relationship between creativity and intelligence. Specifically, he assessed creative problem solving in a sample of English schoolboys ranging in intelligence scores from average to very high. His first important finding is that measures of intelligence did not predict the ability to solve problems creatively. The second finding suggests two types of thinking. Specifically, the boys in the sample tended to fall into two distinct categories when solving problems. The first category was deemed *convergent thinking* and involved bringing together a variety of sources in such a way to produce a correct answer. This type of thinking proved to be useful in science and math-based tasks. The other type of thinking was deemed *divergent thinking* whereby when presented with a stimulus, one produces many different and diverse ideas resulting in a creative and elaborate thinking process. This type of thinking proved to be useful in the arts and humanities. Hudson's study led to the idea that individuals could be skilled in convergent thinking, divergent thinking, or both. However, it was divergent thinking that was thought to be the creative element of the problem solving process.

In addition to understanding theoretical underpinnings, research has begun to explore the neurophysiological underpinnings of creativity. Brain imaging studies have noted that the right regions of the central nervous system are consistently activated during tasks that require divergent thinking (Beaty, 2015; Gonen-Yaacovi et al., 2013). In tasks that engage divergent thinking, the regions of the brain that are activated include the right inferior frontal gyrus, right posterior medial cortex, the right superior parietal lobule, the right dorsolateral frontal cortex, and the right frontopolar cortex (Abraham, et al., 2008; Binder, Desai, Graves, & Conant, 2009; Cappa, 2008; Fiebach, Friederici, Smith, & Swinney, 2007).

Reading Disabilities and Creativity

Until recently, the field has paid little attention to the idea that individuals with reading disabilities, because of their neurological profile, might have access to creative problem-solving skills even more so than their typically achieving peers. This idea comes from bridging two important concepts: first, that individuals with reading disabilities show a distinct right brain processing pattern when working with information, and second, that creative problem solving, particularly divergent thinking, calls on right-hemispheric processing to be effective. The result of bringing together these two ideas is a notion that individuals with reading disabilities may be more effective in their divergent thinking *because* of their reading disability. That is, individuals with reading disabilities may have distinct advantages afforded to them around creativity by virtue of the overcompensation of their right-hemisphere while reading.

At its neurological core, the connection between reading disabilities and creativity may be founded on the concept of neural plasticity. Development of the brain throughout life occurs in concert with exposure to the environment (Cohen & Greenberg, 2008). In his work with macaque monkeys, Suomi (1999) demonstrates that environment and practice can significantly shape neural networks. The macaques in Suomi's research demonstrated significant neurological functioning shifts as a result of an enhanced environment that enabled them to practice particular behaviours. In the same way, it is reasonable to conclude that by overusing their right hemisphere during typically left-hemispheric processing tasks, children with reading disabilities are strengthening their right-hemispheric neural networks – a simple practice effect. More specifically, by overusing their right hemisphere, children with reading disabilities are strengthening their right hemispheric neural connections through the process of myelination – a neural process that strengthens the speed at which neural messages are transmitted. Children with reading disabilities may thus be more neurologically primed for creative thinking as a result of the neural sculpting process associated with the over-use of their right hemisphere. Understanding this core idea has provided researchers with a foundation to draw out specific causal explanations for the connection between reading disabilities and creativity.

For instance, Eide and Eide (2011) explain that because individuals with reading disabilities, or left hemispheric processing problems, may have poor automaticity and are less efficient on routine tasks, they are almost 'forced' to experiment with innovate problem-solving techniques in order to find new and better ways of doing things. This 'out-of-the-box' thinking often results in creative and innovative ideas. In other words,

the broader network connections provided by the right hemisphere favour new and creative connections, as well as recognition of unusual relationships (Eide & Eide, 2011).

Another example of this type of relationship centres on the decoding problems children with reading disabilities typically experience. Decoding problems often make it difficult for children to blend and segment printed words. However, this problem may actually cause children with reading disabilities to use contextual cues to compensate for parts of the word or sentence that they have missed (Eide & Eide, 2011). Contextual cue processing is associated with right hemispheric processing. Individuals with reading disabilities have also demonstrated increased strengths in interconnected reasoning – a task that has been associated with right brain processing. Interconnected reasoning may be seen as the ability to spot important connections within information and between ideas in order to produce a big-picture view.

In general, children with reading disabilities demonstrate consistent patterns of right hemispheric processing when engaging with reading, typically a left-hemispheric processing task. This over-use of their right hemisphere may afford children with reading disabilities advantages associated with right-brain thinking. Creative thinking has long been established as a skill that calls on right-brain processing (Beaty, 2015; Gonen-Yaacovi et al., 2013). The distinct neurological profiles of children with reading disabilities may be particularly primed to engage effectively in creative problem-solving tasks. In other words, children with reading disabilities may be neurologically endowed to succeed with creative problem solving tasks *because* of their reading disability. This is not simply a play-on-words. Rather, this way of thinking represents an important shift. If children with reading disabilities are primed for creativity, it is important that all

concerned stakeholders consider the *strengths* associated with having a reading disability. My thesis explored these ideas and the possibility that children with reading disabilities may have specific strengths associated with creativity and creative thinking.

Research Questions

My research questions are centered on the notion that children with reading disabilities may demonstrate particularly strong creative thinking skills in relation to their phonological processing skills. There is a wealth of research and understanding about reading disabilities, as well as creativity. However, very little research has explored the relationship between these two constructs. From a neurological and theoretical perspective, it is reasonable to hypothesize that children with reading disabilities, because of their right-hemispheric neurological over-use, may be more adept at right-brain skills areas, such as creative thinking. Following this, my thesis asks the following research questions.

1. Do children at-risk for reading disabilities demonstrate phonological awareness skills that are significantly below average benchmarks?

Research has demonstrated consistently that children with reading disabilities show distinct patterns of phonological awareness impairments compared to their grade-level peers. As such, I hypothesized that in this study, participants who have been identified as at-risk for reading disabilities will demonstrate phonological awareness skills that fall within the bottom 20th percentile as measured by a standard test of phonological awareness.

2. Do children at-risk for reading disabilities demonstrate creativity profiles as measured by a traditional measure of creative thinking that are equivalent to or above average benchmarks?

Based on the notion that children with reading disabilities tend to over-use their right hemisphere during reading based tasks, it was hypothesized that children may be particularly strong in creative thinking skills. It was expected that participants would demonstrate creative thinking skills that fell within the average or above range compared to national benchmarks as measured by a standard measure of creativity.

3. What is the relationship between children's profiles on phonological awareness and creative thinking abilities?

It was hypothesized that children with reading disabilities would demonstrate profiles of phonological awareness that are significantly below their creative thinking skills. Further it was hypothesized that lower phonological awareness would be inversely related to creative thinking. That is, lower phonological awareness would be associated with higher creative thinking.

My research questions hold important practical implications for how understanding the link between creativity and reading disabilities may shift the experience of children at-risk for reading disabilities within traditional school experiences.

Methods

This study adopted a cross-sectional design measuring phonological awareness and creativity in a sample of children with reading difficulties. Participating children were part of a literacy program called Reading Rocks offered by the Learning Disabilities Association of Niagara Region (LDANR). Reading Rocks is a one-on-one tutoring program that is individualized to the needs and interests of the child. The program is designed in one-hour instructional sessions, two nights a week. Participating children are assessed in their phonological awareness and creative thinking before beginning the Reading Rocks program.

In addition to the group design, I also examined the profiles of 3 individual participants to illustrate specific examples of phonological awareness and creative-problem solving abilities. It was important to examine children on an individual level as it points to the notion that children with learning disabilities may have creative strengths that are in advance of typically achieving children.

Participants

Study participants included 26 children enrolled in the Reading Rocks program held at Brock University. Children (16 boys and 10 girls) were between the ages of 5 and 14 with a mean age of 9.5, $SD = 2.1$. Age was entered as a covariate in several of the analyses (as indicated in the results section). The participating children are deemed eligible for Reading Rocks by the LDAN Program Coordinator if they have been experiencing reading difficulties or have been diagnosed with a reading or reading disability. These could include difficulties blending sounds, poor phonological

awareness, or significant reading difficulties at school. A formal diagnosis of a reading or learning disability is not required for entry into the program, however all children are screened for other exceptionalities. Children with global intellectual impairments or significant behavioural issues were not eligible for the study.

Three individual children were chosen specifically on the basis of their phonological awareness and creative thinking profiles. These children demonstrated profiles that exemplify important discrepancies in phonological awareness and creative thinking.

Measures

Reading-Based Measures

The Comprehensive Test of Phonological Processing (CTOPP) was developed by Wagner, Torgesen and Rashotte (1999) and provides assessment in phonological processing abilities in individuals 5 to 24 years of age. The CTOPP is an individually administered norm-referenced test designed to identify people who would benefit from instructional support in phonological processing. This study focuses on the two phonological subtests that comprise the CTOPP Phonological Awareness composite: Elision and Blending Words.

Elision is a 20-item subtest where the examinee listens to an orally presented word, says the word, listens to an orally presented sound in that word, removes that sound from the word, and says the resulting word. For instance, The CTOPP Elision subtest involves deleting a sound from a word (e.g., “Say drive without the /r/” = dive). The testing begins with the first item and continues until the examinee misses three items in a

row or completes the last item in the subtest. As testing proceeds, the items get more difficult as the size of the segment to be removed becomes smaller. The beginning items require the removal of a whole word from a compound word. Later items require removal of smaller parts, such as syllables and onset rime units. The remaining items require the removal of individual phonemes in rime units and consonant clusters. The raw score is the total number of correct responses. Reliability for the Elision is .77 (Wagner et al., 1999)

Blending Words is a 20-item subtest assessing the ability to combine sounds to form words. The examinee listens to orally presented individual sounds in a word, combines those sounds, and says the resulting word. For example, Blending Words involves identifying a word from its parts (e.g., “What word do these sounds make: /t/ /a/ /n/?” = tan). Testing begins with the first item and continues with progressively more difficult items until the examinee misses three items in a row or completes the last item in the subtest. Easier items require examinees to blend two syllables to form a word while the hardest items require examinees to blend 8–10 individual phonemes into a single word. The raw score is the total number of correct responses (Kilpatrick, 2012). Reliability for the Blending Words is .71 (Wagner et al., 1999)

Torrence Test of Creative Thinking

Measuring *creative thinking* has proved to be elusive for research within psychological frameworks. In other words, research has asked whether it is possible to assess one’s ability to think in ways that result in products or ideas that are novel and effective. One of the most widely used assessments for creative problem-solving is the

Torrance Test of Creative Thinking (TTCT) (Torrence 1974 as described in Fink, Benedek, Staudt & Neubauer, 2007). Specifically, the TTCT measures a set of narrowly defined creative thinking capacities. The TTCT creative thinking assessment calls for participants to solve ill-structured problems for which a variety of possible solutions can be found. In this study, the Figural subtest of the TTCT was administered to all participants. The TTCT-Figural consists of three activities: Picture construction, picture completion, and repeated figures of lines or circles. The tests were administered using the standard directions described by Torrance. Ten minutes of working time was provided for each subtest.

The Figural TTCT has five subscales. Fluency (the ability to produce ideas or a number of relevant responses), Originality (ability to produce unique, unusual ideas, or novel responses), Abstractness of Titles (abstract thinking ability and ability for synthesis and organization thinking processes and for capturing the essence of the information involved), Elaboration (ability to think in a detailed and reflective manner as well as motivation to be creative), and Resistance to Premature Closure (ability to be intellectually curious and open-minded). Reliability coefficients for the TTCT figural tests ranged from .50 to .96 (Torrance, 1974).

Procedure

Participating children were part of the Reading Rocks program held at Brock University. Reading Rocks is an 8 week, 16 session, literacy program offered in partnership with the Learning Disabilities Association of Niagara Region (LDANR). Each child in the program works one-on-one with a trained literacy tutor. The program sessions are aimed

at supporting literacy and motivation skills. For the purpose of this study children were administered the CTOPP and TTCT measures on the first night of the program prior to commencing Reading Rocks. The assessments were administered by the individual tutors working with each child who were trained in administration of the assessments under the guidance of the research team. The entire battery of assessments was completed within approximately 45 minutes.

Data Analysis

Data from the TTCT assessments was scored at the Scholastic Testing Service (STS). This is a standard scoring process associated with the TTCT. For each of the five figural subtests of the TTCT the STS provides information on raw scores, standard scores, grade-related norms, age-related norms, national and local percentile rank scores (US), and a checklist of creative strengths. Data from the CTOPP measures were scored by me. Correlational analyses were computed for all measures to explore initial relationships between variables. Paired-sample t-tests were computed to explore the relationships between phonological awareness and creative thinking measures. For the individual analyses, scores and pictorial examples were examined.

Results

As a first step to answering the study's research questions, means and standard deviations are presented in Table 1.

Table 1. Means and Standard Deviations for the CTOPP and TTCT

Measures	Mean	Standard Deviation
CTOPP PA Index	75.92	12.58
<i>Elision</i>	5.27	2.22
<i>Blending</i>	6.81	2.53
TTCT Average	91.19	13.75
<i>Fluency</i>	81.77	19.18
<i>Originality</i>	78.38	16.37
<i>Titles</i>	102.50	21.40
<i>Elaboration</i>	106.69	18.47
<i>Resistance</i>	86.27	15.66

In order to compare participants across age and grade, raw scores were computed as standard scores using the technical data from both the CTOPP and TTCT. The Elision and Blending raw scores were computed into a Phonological Awareness (PA) Index standard composite score. Comparisons were drawn using the PA Index composite score and the TTCT Average standard score along with all TTCT subtest standard scores.

Correlations were computed to examine the relationships between variables.

Table 2. Pearson *r* Correlations for the CTOPP and TTCT

		Gender	Fluency	Originality	Titles	Elaboration	Resistance	TTCT Avg	Elision	Blending	PA Index
Gender	Pearson <i>r</i>	1	-.279	-.291	-.102	.039	-.187	-.212	-.483*	-.444*	-.537**
	Sig.		.168	.149	.621	.850	.361	.300	.012	.023	.005
	N	26	26	26	26	26	26	26	26	26	26
Fluency	Pearson <i>r</i>	-.279	1	.737**	.148	.282	.797**	.762**	-.155	.043	-.066
	Sig.	.168		.000	.472	.163	.000	.000	.448	.836	.750
	N	26	26	26	26	26	26	26	26	26	26
Originality	Pearson <i>r</i>	-.291	.737**	1	.257	.356	.539**	.747**	.025	.039	.031
	Sig.	.149	.000		.204	.074	.004	.000	.905	.852	.882
	N	26	26	26	26	26	26	26	26	26	26
Titles	Pearson <i>r</i>	-.102	.148	.257	1	.695**	.342	.688**	.182	.305	.289
	Sig.	.621	.472	.204		.000	.088	.000	.373	.130	.153
	N	26	26	26	26	26	26	26	26	26	26
Elaboration	Pearson <i>r</i>	.039	.282	.356	.695**	1	.421*	.753**	.177	.223	.241
	Sig.	.850	.163	.074	.000		.032	.000	.388	.274	.236
	N	26	26	26	26	26	26	26	26	26	26
Resistance	Pearson <i>r</i>	-.187	.797**	.539**	.342	.421*	1	.804**	-.151	.060	-.038
	Sig.	.361	.000	.004	.088	.032		.000	.463	.771	.854
	N	26	26	26	26	26	26	26	26	26	26
TTCT Avg	Pearson <i>r</i>	-.212	.762**	.747**	.688**	.753**	.804**	1	.038	.197	.142
	Sig.	.300	.000	.000	.000	.000	.000		.855	.336	.490
	N	26	26	26	26	26	26	26	26	26	26
Elision	Pearson <i>r</i>	-.483*	-.155	.025	.182	.177	-.151	.038	1	.544**	.852**
	Sig.	.012	.448	.905	.373	.388	.463	.855		.004	.000
	N	26	26	26	26	26	26	26	26	26	26
Blending	Pearson <i>r</i>	-.444*	.043	.039	.305	.223	.060	.197	.544**	1	.900**
	Sig.	.023	.836	.852	.130	.274	.771	.336	.004		.000
	N	26	26	26	26	26	26	26	26	26	26
PA Index	Pearson <i>r</i>	-.537**	-.066	.031	.289	.241	-.038	.142	.852**	.900**	1
	Sig.	.005	.750	.882	.153	.236	.854	.490	.000	.000	
	N	26	26	26	26	26	26	26	26	26	26

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

As expected, several significant positive correlations were found within phonological awareness subtest scores (ranging from 0.54 to 0.90) and also within the creative thinking subtest scores (ranging from 0.15 to 0.80). However, supporting the third research question of this study, non-significant and often negative correlations were found between phonological awareness scores and creative thinking scores. Specifically, the correlation between TTCT average and PA average was $r = .014$. Several negative correlations were found between TTCT subtest scores and CTOPP subtest scores (ranging from -0.18 to 0.30). These low and negative correlations point to the non- and potentially inverse relationship between phonological awareness and creative thinking.

To further explore the differences between phonological awareness and creative thinking, paired sample t-tests were computed for the TTCT Creativity Index score and the corresponding subtests against the CTOPP PA Index scores. A statistically significant difference was found for the TTCT Index score and the CTOPP PA Index score, $t(25) = 4.51$, $p < .001$. No statistically significant difference was found for the TTCT Fluency Subtest score and the CTOPP PA Index score, $t(25) = 1.26$, $p = .219$. No statistically significant difference was found for the TTCT Originality subtest score and the CTOPP PA Index score, $t(25) = 0.617$, $p = .543$. A statistically significant difference was found for the TTCT Titles subtest score and the CTOPP PA Index score, $t(25) = 6.31$, $p < .001$. A statistically significant difference was found for the TTCT Elaboration subtest score and the CTOPP PA Index score, $t(25) = 7.98$, $p < .001$. A statistically significant difference was found for the TTCT Resistance subtest score and the CTOPP PA Index score, $t(25) = 2.58$, $p < .05$.

Comparisons of the CTOPP against the TTCT Index and Subtest scores are illustrated in Figure 1.

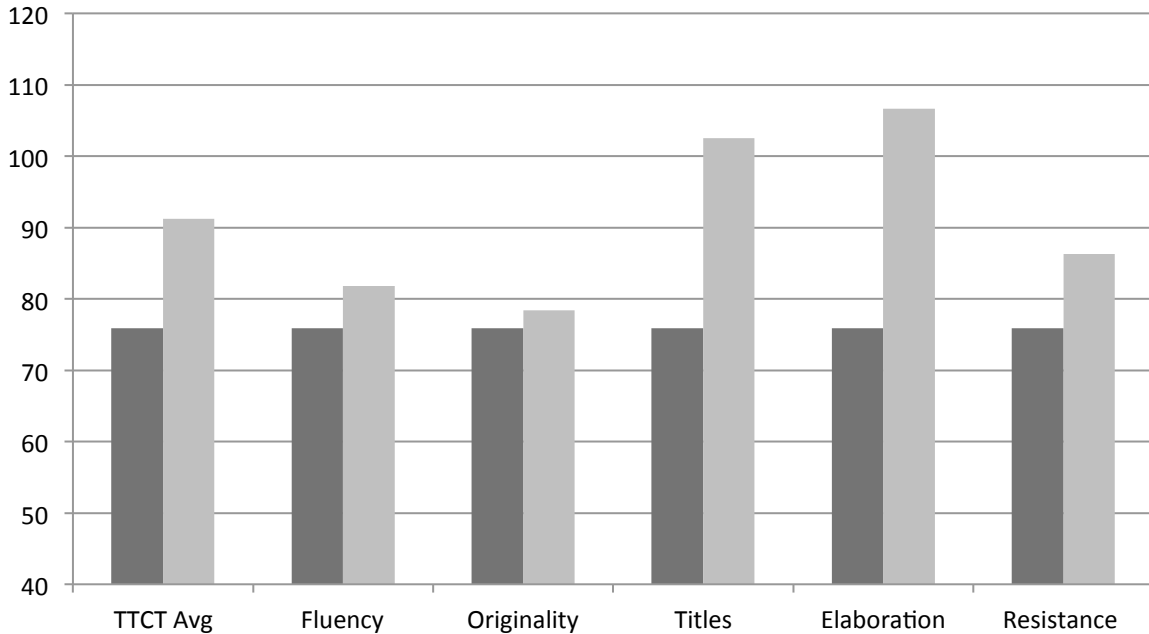


Figure 1: CTOPP average compared to all TTCT scores.

Individual Analyses

In addition to the general analyses, it was important to consider examples of individual children in their phonological awareness and creativity. Exploring individual examples of particularly creative children with learning disabilities speaks to the idea that children with learning disabilities may have creative strengths that are in advance of typically achieving children. This idea holds important implications for all stakeholders.

Participant A

Within the study's sample, there were several children who had below average phonological awareness scores and creativity scores that were in average limits. For

example, Participant A's phonological awareness and creativity profiles are illustrated in Figure 2. Participant A is an example of a child who demonstrated lower phonological awareness scores and average creativity scores.

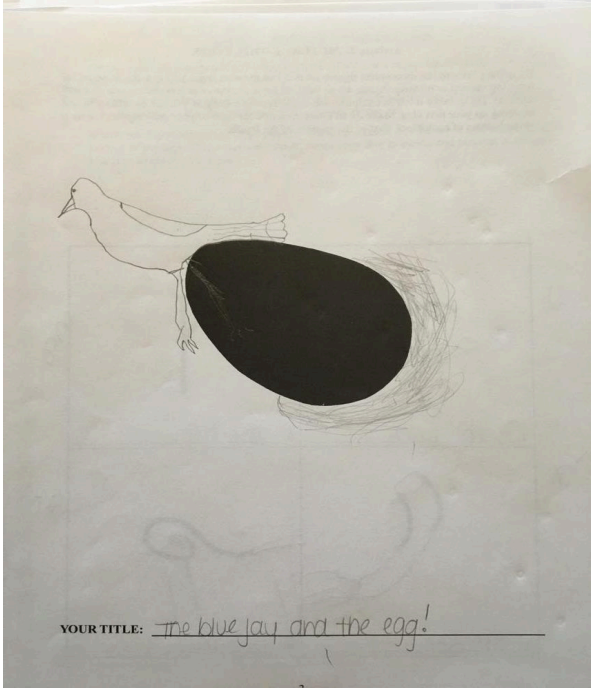
Achievement Profile	TTCT Drawing
CTOPP PA Index 76	
<i>Elision (raw)</i> 8	
<i>Blending (raw)</i> 6	
TTCT Average 96	
<i>Fluency</i> 67	
<i>Originality</i> 82	
<i>Titles</i> 113	
<i>Elaboration</i> 128	
<i>Resistance</i> 88	

Figure 2. Participant A profile

Participant A's CTOPP standard scores equated to percentile rank scores of 12 (PA Index), 16 (Elision) and 9 (Blending). Participant A's creativity percentile rank scores were significantly different from the CTOPP scores and often well above average, 37 (Average), 5 (Fluency), 18 (Originality), 74 (Titles), 92 (Elaboration), and 27 (Resistance). Of particular note are Participant A's exceptionally high scores in Titles and Elaboration.

However, in addition to participants with average creativity profiles, there were also children who had lower phonological profiles with creativity profiles that were above average. Two examples of such profiles are illustrated below.

Participant B

Participant B is an example of a child with low phonological awareness and exceptionally high creativity. Participant B's phonological awareness and creativity profiles are illustrated in Figure 3. Along with the profile is one of Participant B's creativity drawings.

Achievement Profile	TTCT Drawing
CTOPP PA Index 76	
<i>Elision (raw)</i> 5	
<i>Blending (raw)</i> 13	
TTCT Average 108	
<i>Fluency</i> 95	
<i>Originality</i> 91	
<i>Titles</i> 126	
<i>Elaboration</i> 133	
<i>Resistance</i> 93	

Figure 3. Participant B profile

Participant B's CTOPP standard scores equated to percentile rank scores of 5 (PA Index), 1 (Elision), and 25 (Blending). Participant B's creativity percentile rank scores

were significantly discrepant from the CTOPP scores and often well above average, 70 (Average), 41 (Fluency), 32 (Originality), 90 (Titles), 95 (Elaboration), and 37 (Resistance). Of particular note are Participant B's exceptionally high scores in Titles and Elaboration.

Participant C

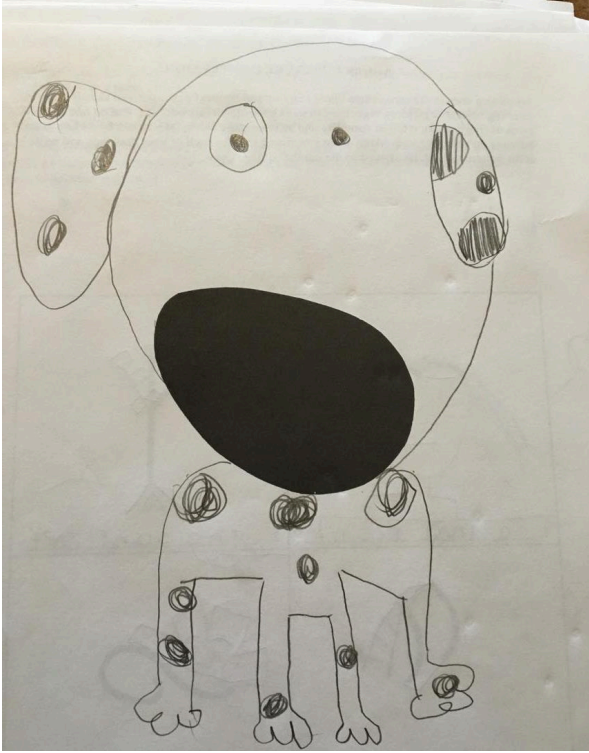
Achievement Profile:	TTCT Drawing
CTOPP PA Index 68	
<i>Elision (raw)</i> 3	
<i>Blending (raw)</i> 8	
TTCT Average 108	
<i>Fluency</i> 103	
<i>Originality</i> 110	
<i>Titles</i> 115	
<i>Elaboration</i> 111	
<i>Resistance</i> 100	

Figure 4. Participant C profile

Participant C's CTOPP standard scores equated to percentile rank scores of 8 (PA Index), 9 (Elision), and 16 (Blending). Participant C's creativity percentile rank scores were significantly discrepant from the CTOPP scores and often well above average, 70 (Average), 46 (Fluency), 70 (Originality), 85 (Titles), 77 (Elaboration), and 49

(Resistance). Like Participant B, it is important to note the particularly high scores in Titles and Elaboration.

Discussion

The purpose of this study was to explore the creative thinking skills of children with learning disabilities. In general, the results support the hypothesis that many children with learning disabilities have creativity profiles that are discrepant from their phonological awareness profiles. The sample of children in this study often demonstrated significantly below average phonological awareness skills and creativity skills that were within average limits. In several cases, participants had creativity skills that were well above average.

The first research question asked about phonological awareness profiles in children at risk for learning disabilities. In the study's sample, participants had a mean phonological awareness index scores of 75.92 with a standard deviation of 12.58. These results are consistent with general definitions of learning disabilities suggesting that one of the primary deficits in children with learning disabilities is impaired phonological awareness. From a neurocognitive perspective, it is hypothesized that phonological awareness deficits are caused by processing problems associated with functional deficits in the left hemisphere of the central nervous system (Health, Shaywitz, Lyon, & Shaywitz, 2006). The cause of such deficits is elusive, but a leading causal theory posits that a mutation in a particular gene (DCDC2) causes a premature interruption in prenatal cell migration within the left hemisphere of the central nervous system (Health, Shaywitz, Lyon, & Shaywitz, 2006). However regardless of cause, the result of the phonological

awareness deficits is impaired reading-related tasks. This often results in significant challenges in academic tasks as well as potential secondary problems including lower motivation to engage at school and potentially more significant issues related to well-being and mental health. As such, one purpose of the current study was to explore a non-traditional perspective focusing on strengths.

The second research question asked about creativity profiles of children at-risk for learning disabilities. In this study, creativity was measured by the Torrence Test of Creative Thinking. The TTCT measures an individual's ability to solve ill-structured problems for which a variety of possible solutions can be found. The sample of children in this study had a mean creative thinking index of 91.19 with a standard deviation of 13.75. A paired-samples t-test illustrated that this creative thinking index score was statistically significantly different from the CTOPP PA index score, $t(25) = 4.51$, $p < .001$. This result suggests that generally children at-risk for reading disabilities demonstrated creative thinking skills that were discrepant from their phonological awareness skills. It is important also to note that there were specific creative thinking skills that were particularly strong. As illustrated in Table 1 and Figure 1, children at-risk for reading disabilities demonstrated strong creative thinking skills in the Titles ($M = 102.50$, $SD = 21.40$) and Elaboration ($M = 106.69$, $SD = 18.47$) subtests of the TTCT. The higher scores in these particular subtests may suggest that children at-risk for reading disabilities have particular skills associated with abstract thinking abilities, the ability for synthesis and organization thinking processes, and for capturing the essence of the information involved (Titles subtest); as well as the ability to think in a detailed and reflective manner, including motivation to be creative (Elaboration subtest).

The individual analyses conducted in this study were meant to explore specific examples of children at-risk for reading disabilities in their creative thinking skills related to their phonological awareness skills. The examples were chosen based on the distinct processing profiles of the participants. The examples provide important implications for all stakeholders concerned with supporting children at-risk for reading disabilities. Participant A demonstrated lower phonological awareness skills and commensurately was a struggling reader (noted anecdotally). However, Participant A demonstrated creative thinking skills that were within average limits. Participants B and C also demonstrated below average phonological awareness skills in the low range, but creative thinking skills that were in the high-average range. It is important to note that within the sample there were children whose creative thinking and phonological awareness profiles that were not as discrepant as Participants A, B or C, however in general this pattern was evident for most of the children in the sample. The individual case studies are important as they capture some specific characteristics of children at-risk for reading disabilities in respect to their creative thinking skills. It is important to note that all three examples here illustrated particular strengths in Titles and Elaboration.

The results of this study hold important implications for research, practice, and policy. From a research perspective, the past several decades have focused on understanding the neuro-cognitive processing deficits associated with learning disabilities and we now have a firm understanding of these constructs. However, there is a paucity of research conducted on creativity and learning disabilities, and the research that has been done has been ambiguous at best. The current study attempts to add to this body of research. Children in this sample demonstrated creative thinking skills that were

discrepant from their phonological awareness skills. Creative problem solving has been hypothesized to be associated with right hemispheric cognitive processing.

Acknowledging that all cognitive processing involves a host of neural functions and connections, it is important to note that children at-risk for reading disabilities tend to overuse their right hemispheric processing during reading tasks, holding to the theory of neural-sculpting, it follows that their right hemispheres should be well developed. As such, children at-risk for reading disabilities, with their distinct neurological profiles, may be particularly primed to engage effectively in creative problem-solving tasks. The results of this study lend support to the idea that children with learning disabilities may indeed be indicating academic profiles that align with their neurological tendencies of right hemispheric strength.

Theoretically, the results lend support to the idea that children with learning disabilities may have intellectual strengths that fall outside traditional pathways. Gardner (1987) has long proliferated the importance of recognizing individual differences in intelligence and notes that children with learning disabilities may have specific strengths in nonverbal processing skills. More recently Edie and Edie (2013) suggest that there may be distinct advantages to having learning disabilities. They cite numerous examples of individuals with dyslexia who have reached tremendous levels of success. It is interesting to note that almost all of their cited examples have succeeded in fields that rely on innovation, creativity, and ‘outside-the-box’ thinking. The success of these individuals is thought to be associated with the notion that they are using a type of neurological processing that is not otherwise used in academic tasks.

Individuals with learning disabilities, a presumed left-side neurological processing problem, process information with the right side of the brain – even with tasks that should be processed with the left side (e.g. language). In over-using their right hemisphere it is hypothesized that individuals with learning disabilities have well-developed right hemispheres, and, as such, have strengths associated with this type of processing, such as innovation and creativity. In this way, Eide and Eide (2011) posit that individuals with learning disabilities are succeeding in specific ventures because of their learning disabilities. Richard Branson for instance, considers his learning disability “his greatest strength.” At an early age Branson learned about the mechanics of his learning disability and adapted. He attributes his success with management to the skills he was forced to develop because of his left-hemispheric processing problem. David Bois, another example, is considered to be one of the prominent criminal lawyers in the United States. Bois was diagnosed with learning disabilities at a very early age and attributes his success as a legal negotiator to his early experience of having to rely on his listening and talking skills instead of his poor reading abilities. Individuals such as these are examples of individuals with learning disabilities who attribute their success to having learning disabilities. It is important that stakeholders consider the idea of fostering the development of strengths in children who have learning disabilities.

Another important implication of this study centers on the idea that children today should be prepared to consider jobs and careers that extend beyond traditional learning pathways. “Sixty-five percent of today’s preschoolers will grow up to work in jobs or pursue careers that don’t yet exist” (Davison, 2013). To meet the demands of jobs that do not yet exist, educational systems need to think forward. Traditionally, educational

reform around learning disabilities has focused on intensive and explicit reading instruction. This type of instruction has proved successful in moderately increasing reading achievement gains for children at-risk for reading failure. However, research has also demonstrated consistently that regardless of efficacy of the program, children with learning disabilities engaged in a reading intervention rarely increase their reading achievements to levels that are commensurate with their non-learning disabled peers (Jenkins & O'Connor, 2002). As such, children with learning disabilities are constantly facing a climate of deficit and recovery. It is not surprising then that prevalence rates of mental health problems, lower socioeconomic status, and overall life satisfaction (Putting a Canadian Face on Learning Disabilities, 2004) are positively correlated with learning disabilities.

One of the purposes of this study was to offer an alternative approach to supporting children with learning disabilities – an approach that focuses on strengths as opposed to deficits. Current education curriculum models have traditionally been designed to teach basic skills focused around literacy, mathematics, science, and traditional arts and music and have not focused enough on promoting skills around creativity and creative problem solving. However, it may be hypothesized that our current educational models are becoming unaligned with current social and economic outlooks. Following Davison's (2013) suggestion, in order to succeed in future job markets, children will require skills and techniques that extend beyond traditional learning pathways. This extension may include providing children with creative thinking skills. Children with learning disabilities, because of their distinct neurological profiles, may be primed to succeed in such environments. By allowing children, particularly those with

learning disabilities, to develop and build their creative problem solving skills, we will be setting them up to succeed in a creative society. There are several specific and concrete tactics and strategies that can be incorporated into a classroom environment that promote creativity and creative problem solving. Although a thorough implementation strategy for these tactics is beyond the scope of this thesis, it is important that educators continue to provide children with learning disabilities with creative thinking tactics, such as differentiated instruction, creative leadership, and outside-the-box thinking. Growing up creative is an important idea and the results of this thesis lend support to the notion that children with learning disabilities may be particularly adept at creative thinking.

“Today educators consider it the highest expressions of learning. Psychologists consider it the highest form of self-actualization. Business executives consider it the most critical characteristics of leadership in the 21st Century. While creativity may once have been considered a pleasant novelty, today creative problem solving is a 21st century survival skill. As technology takes over routine jobs, our professional and personal success depends on it” (Mandate from the Buffalo State International Centre for Studies in Creativity).

As we move further into the twenty-first century, our society is becoming increasingly aware of the importance of creative thinking. Several new and innovative postsecondary programs such as Buffalo State’s program in creativity are acknowledging the critical importance of preparing students to succeed in a creative world. Policy around supporting and promoting creativity and creative thinking is beginning to emerge. Internationally, several countries have begun to develop provincial and national policy around supporting creativity and creative thinking in schools and the workplace. For

instance, in the United Kingdom, the Department of Education partnered with the National Advisory Committee on Creative and Cultural Education to develop and publish a report called *All Our Futures: Creativity Culture and Education* (2006). The report emphasizes that all children and young people can benefit from developing their creative abilities and that curriculum around creativity should be seen as a general function of education. The report also recommends that creativity could be developed in all areas of the school curriculum. The results of the current study support these types of policy initiatives. Growing up creative in today's society can be an important and useful skill. This study aimed to promote the idea that children with learning disabilities may be inherently advantaged in creativity and creative thinking. It is important that all stakeholders concerned about supporting children with learning disabilities work to recognize their inherent strengths and provide opportunities for these children to thrive.

Limitations

There are several limitations to the current study. The first and perhaps most prominent surrounds the definition of creativity. Creativity and creative thinking are elusive constructs. Throughout the study of creativity and creative thinking, researchers and theorists have disagreed on what it means to be creative and who should be considered creative. Coupled with the complexity of the neural system that is activated during creative problem solving tasks, the general concept of creativity is difficult to define. In the current study, I have operationalized creative thinking as those skills that are measured by the Torrance Test of Creative Thinking. However, I acknowledge that this is a limited view of creativity and that the field will continue to struggle to define the

term. A second limitation surrounds the idea that children were assessed in a clinical setting. It is acknowledged that creativity happens in natural environments that cannot be studied with a clinical tool. Children can demonstrate creativity and creative thinking in a variety of settings and curriculum areas that extend beyond school settings. For instance, individuals are creative chefs, landscapers, socialites, etc. The current study assumes a narrow definition of creativity. Beyond the scope of this study, there are several other factors that contribute to creativity beyond phonological awareness. These include factors such as family, culture, 'race,' gender, media influence, class-based identity, peers, etc. These factors are acknowledged as important ideas that cannot easily be teased apart within the current study. A third limitation is the sample of children in the current study. The sample used was one of convenience. Participating children were those that were participating in the Reading Rocks program. The sample was not formally identified as children with learning disabilities but rather those who were demonstrating lower phonological awareness. The sampling technique here will temper the reliability of the results.

Conclusion

Growing up creative is an important idea in today's classrooms. As education seeks to prepare children for their futures, it is important that the system considers traditional as well as nontraditional pathways. Children in this study demonstrated phonological awareness profiles that deemed them at-risk for reading disabilities. In general, children with learning disabilities struggle within traditional learning models. The Matthew effect is a consistent effect where struggling readers tend to fall further

behind their nonlearning disabled peers as they progress through their school years. For several decades researchers have attempted to develop and study reading-based interventions aimed at reducing the Matthew effect. Although such interventions have produced moderate gains in reading, they have failed to eliminate the effect. The current study attempted to explore a non-traditional learning pathway that focuses on strengths. In business, the arts, and several non-traditional career endeavors there are numerous examples of individuals with learning disabilities who have reached significant levels of success. It is interesting to note that many of these examples have succeeded in fields that rely on innovation, creativity, and “outside the box” thinking. The success of these individuals is thought to be associated with the notion that they are using a type of neurological processing that is not otherwise used in academic tasks. Individuals with learning disabilities, a presumed left-side neurological processing problem, process information with the right side of the brain – even with tasks that should be processed with the left side (i.e., language). In over-using their right hemisphere it is hypothesized that individuals with learning disabilities have well-developed right hemispheres and as such, have strengths associated with this type of processing, such as innovation and creativity. In this way, it can be hypothesized that individuals with learning disabilities may be succeeding in specific ventures because of their dyslexic advantage. Their key message is that brain processing associated with learning disabilities is not simply a barrier to learning; rather it is a reflection of an entirely, different pattern of brain organization and information processing—one that predisposes a person to important abilities. The current study lends support to the notion that children at-risk for reading

disabilities may be particularly primed to succeed in areas that call on creativity and creative thinking.

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