

**Is Short Term Participation in a Multi-sensory Structured Language Reading Program  
Associated with Gains in Phonological Awareness and Nonword Decoding in Poor Readers  
in Residential Care?**

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## INTRODUCTION:

National reading statistics have demonstrated that approximately 65% of students in fourth grade in the US are not reading proficiently (NAEP, 2019). That number is higher in students living in poverty (NAEP, 2019) or adverse conditions (Laurens et al, 2020). Students with behavioral problems often fare worse (Arnold et al, 2005). Many do not receive diagnoses of learning disabilities due to poverty or behavior problems that may mask their academic difficulties. Indeed, the Individuals with Disabilities Education Act lists poverty and emotional disturbance as possible disqualifying factors for a diagnosis of specific learning disability (IDEA, 2018). For students who are not proficient readers, reading intervention often stops after 5<sup>th</sup> grade when the focus changes to accommodations. It's widely recognized that students who are poor readers or are identified with dyslexia or specific learning disability in reading, lack foundational skills related to phonological processing (Shaywitz & Shaywitz, 2005). Students with deficits in phonological awareness, phonological memory, and rapid naming, are often unable to use phonic knowledge and "crack the code of reading."

Poor phonological awareness (PA), and its subset, phonemic awareness, are highly correlated with reading difficulties. Phonological awareness deficits can cause difficulty with decoding, word recognition, fluency, and secondarily, reading comprehension. Until recently, most schools in the US did not offer instruction in phonemic awareness, although approximately 25% of students require direct and explicit instruction in this area (Adams et al, 2017).

Phonological awareness deficits can be remediated effectively using intervention programs. These programs often fall into the category of multi-sensory structured language (MSL) or Orton-Gillingham influenced (O-G) programs. These word-level reading programs use

instruction that is direct, explicit, and scaffolded, while employing a variety of instructional techniques including auditory, visual, kinesthetic, and tactile modalities. They are intended to help students begin accurately decoding words, with an end goal of adding them to their sight word lexicon via the process of orthographic mapping. Further, research tells us that struggling readers can improve their reading skills by participating in intervention programs that include three elements: instruction in phonemic awareness skills taught to advanced levels that result in the remediation of phonological awareness deficits, phonics and phonic decoding skills taught and reinforced to advanced levels, and rigorous practice of these skills using connected text (Kilpatrick, 2015, p. 304). The Barton Reading and Spelling System, a direct, explicit, Orton-Gillingham influenced, multi-sensory structured language program meets these three critical criteria. According to the publisher, the Barton System was developed for dyslexic readers but is appropriate for struggling readers who have a fluent understanding of the English language and an IQ above 70.

In addition to phonological awareness deficits, deficits can occur in phonological memory (PM). PM can be described as verbal short-term memory or verbal working memory. PM deficits are also associated with reading struggles. Often comorbid in boys with ADHD (Bolden et al, 2012), PM deficits are associated with decoding and fluency difficulties, as well as vocabulary and comprehension problems (Kibby et al, 2014). Students with PM deficits have difficulty with both the acquisition and comprehension of complex language (Gathercole & Baddeley, 1990).

Although not a direct reading system function, Rapid Naming (RN) deficits, or compromised retrieval from the long-term memory of known information, also affect fluent reading ability, as these deficits slow down decoding, word recognition, and negatively impact

spelling (Stainthorp et al, 2013). In struggling readers and those diagnosed with dyslexia, approximately 50% demonstrate RN deficits (Wolf & Bowers, 1999).

Harborcreek Youth Services (HYS) is a licensed Psychiatric Residential Treatment Facility (PRTF) in the state of Pennsylvania. HYS is certified as a Sanctuary Organization that embraces the Trauma-Informed Care principles and commitments as set forth by Sanctuary originator Sandra Bloom (Bloom, 1997) and is evaluated by the Sanctuary Institute. The facility employs a Developmental Trauma treatment approach that emphasizes exploration of each student's history of complex trauma and its impact on their development, thoughts, feelings, and behavior.

The process for admission to the program is largely determined by state requirements as well as a few conditions from the program itself. Students must be males between the ages of 10 and 19 and can be a resident of any county in Pennsylvania. Students are referred by their community treatment team after less restrictive community alternatives have been tried unsuccessfully. Some students may also face intervention from the juvenile justice or juvenile dependency systems, which can result in the court referring the student for residential placement. Fewer than 40% of the students placed at HYS have court involvement, and only a small percentage of those have an actual court order for placement. In general, placement at HYS is a voluntary decision made by the caregiver or other agent responsible for the student.

Students must have a diagnosed mental health disorder and sufficient past treatment history to qualify for services. Students have typically posed a risk to their own safety or the safety of others and often have issues with school refusal, peer conflicts, and poor focus on schoolwork. Approximately two thirds of students admitted to the facility have a diagnosed mood disorder that includes depressive symptoms. Approximately one third are diagnosed with

Attention-Deficit Hyperactivity Disorder, and one third may also be diagnosed with Autism Spectrum Disorder. The facility may occasionally admit a student with an intellectual disability, but most students have cognitive abilities in the average range. Students who are actively psychotic, or those who require psychotropic medications on an as-needed basis to achieve calm or safety are not considered appropriate for admission. Historically, 70% of students treated at the facility have already had one or more previous placements in similar facilities.

The average length of stay at HYS is eight months and is determined by the student's progress on treatment plan goals and objectives. A variety of therapeutic and educational activities are offered, and students can participate in one, all, or none of these options. Through every facet of the program, students are encouraged to participate rather than compelled. If faced with a student's refusal to participate in any area of the treatment program, the team works with the student on improved goals to deepen his engagement rather than use adverse consequences or control techniques.

While at HYS, students are enrolled in the on-site, approved private school. They are under the instruction of certified special education and regular education teachers. Classrooms are self-contained for the core subjects of language arts, mathematics, social studies, and science. Students also attend physical education, employability, and health classes. No reading program is utilized except Barton tutoring for those students with specific reading needs. Within each class, there are no more than 12 students with a low ratio of staff to students—at least one childcare counselor and one teacher for every 12 students.

Upon admission, the student's records are obtained from their home school district, and their assigned subjects are based upon their needs for learning as well as graduation requirements. Along with the typical class load for a student, there is also opportunity for the

student to complete classes for credit recovery. This can be completed during the school year and throughout summer school. All earned credits are transferrable to their home school district or to another district to which they may move. Additionally, if a student has earned the necessary credits and are considered eligible to graduate, they may receive their diploma from HYS which is approved by the Pennsylvania Department of Education.

Students requiring special education are also serviced. Individual Education Programs (IEPs) are developed based upon their needs, using existing IEPs and evaluation reports from their previous school district. Progress monitoring is completed and revisions to IEPs are closely monitored by the multi-disciplinary team (MDT). Meetings are held with the guardians of the students as well as MDT members from their home school district. Complex and thorough planning is completed to ensure their continuity of services while at HYS, as well as a smooth transition back to the home school district.

In 2018, in recognition that many students in the program demonstrated poor reading skills, a pilot reading program aimed at improving word-level reading was initiated. The purpose of the pilot was to determine whether boys residing at HYS would benefit from short term participation in the Barton Reading and Spelling System and show gains in phonological awareness and decoding ability, despite their brief stays at the facility.

#### METHODS:

Initially, HYS hired a certified Barton tutor to train faculty and staff to administer the Barton System and develop a method for selecting students. After six months of attempted implementation, it was determined that the nature of the student population required dedicated tutors who could implement tutoring sessions at regular intervals without interruption. At this time, two professional tutors were engaged. During the first year of the pilot, an additional

volunteer tutor was added. One of the tutors was certified in the Barton System and administered screening assessments to all HYS students upon admission.

The initial screening battery consisted of two basic assessments. The first was a context free, graded word list assessment (CFGWL). The assessment consisted of 12 graded lists of 20 words each, ranging from kindergarten level through 11<sup>th</sup> grade. Students were asked to read lists of words until six words on any one list were missed. At this time, the assessment was ended. The clinician observed and recorded the number of words that were read automatically or decoded correctly. Decoding practices were also observed for errors common to dyslexic and struggling readers. These included errors such as B/D reversals, transpositions of letters or sounds within syllables, omitting or adding sounds, and shape reading (guessing at a word based on the first few and last few letters). Students who reached the ceiling (70%) on a graded word list that was below their grade level were then administered the Barton Nonword Reading Assessment (BNWRA). This assessment is closely aligned with the scope and sequence of the Barton System and is comprised of 27 nonwords demonstrating simple to complex patterns of phonic knowledge. Students begin reading simple single syllable, short vowel sound words and progress to multisyllabic, complex words. Students' decoding skills were analyzed for method and accuracy. The BNWRA is scored by counting the number of words read correctly, whether read automatically or accurately decoded. The total score is the percentage of correct words. Students who performed poorly on one or both initial screening assessments were administered the Comprehensive Test of Phonological Processing (CTOPP2).

The CTOPP2 is a norm referenced assessment that measures three elements of language processing necessary for fluent reading, Phonological Awareness, Phonological Memory, and Rapid Naming. The CTOPP2 has four categories of subtests: Phonological Awareness, Alternate

Phonological Awareness, Phonological Memory, and Rapid Naming. Each group of subtests allows for the computation of a composite score. Composite scores were used to calculate the rate of gains/losses on the CTOPP2 in this study.

The first area of processing measured is Phonological Awareness (PA). Poor phonemic awareness, which is a subset of phonological awareness is considered to be the most common reason students struggle to learn to read (Hulme et al, 1990). The CTOPP2 measures PA with three subtests (Elision, Blending Words, and Phoneme Isolation) that examine PA skills with real words. In addition to PA skills measured using real words, the CTOPP2 also measures PA skills using nonwords in the Alternate Phonological Awareness composite (APA) The composite score in this group is comprised of two measures of phonological awareness using nonwords: Blending Nonwords and Segmenting Nonwords. These subtests are important to administer when assessing older students, as some are able to use rudimentary spelling skills to “game” the Elision subtest in the PA composite. Administering the APA subtests can often find phonological awareness deficits that would otherwise be obscured. (Kilpatrick, 2015, p. 165). With proper intervention, PA and APA deficits can be remediated.

Phonological memory deficits are a second area of processing measured by the CTOPP2. The subtests included in this composite include Memory for Digits and Nonword Repetition. Both subtests measure student ability with verbal short-term memory, and evaluate the efficacy of the phonological loop, which is controlled by the central executive system of the brain. Students with this deficit can have a variety of difficulties with reading including remembering sounds when decoding, particularly in multi-syllabic words, difficulty with pronouncing and remembering the order of phonemes in new and complex vocabulary, and thus have difficulty learning and using both new and complex vocabulary (Gathercole & Baddeley, 1990).

Phonological memory can also affect reading speed and comprehension. Phonological memory deficits are often seen in students who have ADHD, and like ADHD, represent an executive function deficit (Rapport et al, 2008). Unlike phonological awareness deficits, phonological memory deficits are not expected to be corrected by reading intervention, but phonological memory can be practiced, and students can become adept at improving the number of sounds they can hold while blending words. In general, this deficit can be supported, but not remediated through MSL intervention.

Although not related directly to reading, Rapid Naming (RN) deficits can also affect students' ability to read fluently and are the third measure of language processing measured by the CTOPP2. Rapid naming represents the ability to elicit known information from the long-term memory. Rapid Naming subtests include Rapid Digit Naming and Rapid Letter Naming. Rapid naming is compromised in approximately 50% of struggling readers. Some readers who have extensive instruction in phonological awareness will be able to improve their rapid naming skills (Kilpatrick, 2015, p. 175). Others will become accurate readers but will continue to read more slowly than average students even after remediation (Torgesen et al, 2001).

It should be noted that while phonological awareness deficits are recognized as the most common reason students struggle with reading, not all struggling readers have significant deficits in this area of language processing. Some students display only deficits in phonological memory or deficits in phonological memory and rapid naming, or only rapid naming. Although most US schools are now measuring student PA skills with tools such as DIBELS, it is uncommon for schools to screen students for difficulty with phonological memory. Students with PM deficits who lacked PA deficits were eligible for enrollment in the program.

During the earliest days of the pilot study, multiple students became upset during the parts of the CTOPP2 that are administered by a robotic voice recording. They became agitated and stated that they couldn't hear or understand the recording despite appropriate sound and volume checks. Several students refused to continue with the assessment. After consultation with the HYS Director of Education and the study team, it was decided that students would be administered the CTOPP2 orally with an experienced clinician who had given the first edition of the CTOPP orally for over a decade. All participants whose scores are reported in this study were administered the CTOPP2 orally in both pre- and post-testing.

Although the Barton System is recommended for students whose IQ is above 70, research demonstrates that students with intellectual disabilities who have IQs below 70 are capable of learning to read at grade level (Kilpatrick, 2015, p. 51). Intellectually disabled students at HYS who performed poorly on the initial screening assessments and showed deficits in one or more areas of the CTOPP2 were offered enrollment in the program on a trial basis.

HYS students who had performed poorly in one or both screening assessments and showed difficulty in one or more areas of language processing as measured by the CTOPP2 were offered spots in the Barton Tutoring Program.

Some students with identified learning disabilities in reading comprehension were referred to the program for screening. If students did not demonstrate any difficulty with word level reading and did not demonstrate any deficits in phonological processing on the CTOPP2, they were not enrolled in the program as the Barton System and MSL programs in general, are word level reading programs designed to teach students decoding skills, and do not address reading comprehension deficits in-depth.

All students who were offered enrollment in the program and agreed to participate were administered the Barton Student Screening. This assessment measures a student's ability to discriminate and hold a minimum of three sounds in auditory memory. This is a necessary skill for program participation. Students who failed the screening were referred to speech therapy for an evaluation. Students who passed the screening were enrolled in the program and received two hours of one-on-one tutoring per week with a professional tutor.

Students whose data is included in this program were pre-tested with the CFGWL, the BNWRA, the CTOPP2, and were post-tested with the same battery at discharge from the program and/or facility. They represent 38% of students who participated in the program. Some students were not given all the pre-tests prior to the hire of the professional tutors, several students were discharged suddenly, and were unable to participate in post-testing, and three students quit the program and refused to be post-tested. In total, 31 students received at least some tutoring during the span of the pilot.

Because HYS employs the Sanctuary Model, students are allowed to refuse to participate or attend tutoring sessions. Some students repeatedly refused. When not meeting tutoring fidelity standards, students spend more time reviewing material than progressing through the program. Students were offered earned incentives such as snacks, treats, and a twice annual student party in an attempt to keep attendance consistent.

Students progressed through the Barton levels at their own pace. Students were taught to mastery and as intellectual abilities and severity of student difficulties varied, the speed of progress through the program was highly variable. Because students at HYS reside for varying numbers of months, many students had limited exposure to the program. Students whose scores are reported in this study received tutoring from 2.7 months to 9.9 months. For calculation

purposes, eight session hours is treated as one month of tutoring. Disruptions did occur during brief summer and holiday breaks. Also, as students near discharge, they begin to have frequent home visits to ease the transition back to family life and these visits sometimes interfered with scheduled tutoring sessions. Due to the COVID-19 pandemic, there were several disruptions in tutoring beginning in March of 2020. Within three weeks of lockdown, tutors began working with students virtually via Whizzimo, a digital Barton System platform. Two tutors continued to meet with students virtually until October of 2020 when the pilot was ended.

All MSL programs unfold in a specific order of phonic instruction for copyright purposes. MSL program instruction does not align with grade level reading standards. For example, students in the Barton System's Level 3 have been instructed in phonemic awareness concepts with the use of sounds and without letters, have learned very basic phonics including the most common letter sound correspondences, and word decoding practice in the form of single syllable words with short vowel sounds (the closed syllable type). However, a student who has completed Level 4 will have had instruction in four syllable types, closed, open, unit, and vowel team, and will have been exposed to short and long vowel sounds, schwa, and the syllable division rules in English allowing for the decoding of three and four syllable words. Students who have completed Level 3 will be reading words such as "lunch" and "desk", but students who have completed Level 4 will be reading and spelling words like "frequency" and "calculus." For this reason, large jumps in grade level reading can occur once a student has completed instruction in Level 4. However, due to the nature of placement at HYS, many students only received instruction up to or including Level 3. In addition, simple words that contain silent E endings such as "gate" or "broke" are not instructed in the Barton System until Level 6 of the program. Most students would spend well over a year in the Barton System before reaching

Level 6. Likewise, very simple concepts such as AR, OR, ER, IR, and UR are not introduced in the Barton System until Level 7, so while a very compromised student could be fluently reading “frequency” in level 4, that same student may be unable to read “gate” or “dart.” This is the nature of MSL programs, and why measuring grade level equivalency is not always useful in demonstrating progress unless a student completes or nears completion of a program.

RESULTS:

The mean time spent in the program was 5.7 months per student. The range of participation was 2.7 months at the low end, 9.9 months at the upper end, with a median value of 5.8 months of instruction (Table 1). Unless otherwise noted, due to the small sample size, results in the tables will be reported using the median score to avoid the influence of outliers.

Table 1

Student	Time Tutored (months)	Intellectual Disability?
A	4.6	no
B	7.3	no
C	6.1	no
D	7.5	yes
E	5.4	yes
F	2.9	no
G	9.9	no
H	3.9	no
I	2.7	no
J	6.4	no
Median	5.8	

Table 1: Number of months spent in tutoring program by student

Despite the short duration of the program, gains were made by all students in word decoding as measured by the Barton Nonword Reading Assessment (Table 2). Students made a mean gain of 5% per month. The mean percentage gain on the BNWRA was 29.5%. Scores ranged from 4% gain to 51% gain, with a median gain of 30%. Because the Barton System is a

word-level reading program, designed to improve students’ ability to decode and map unknown words, this assessment is a strong measure of student progress toward remediation.

Table 2

Student	Initial BNWRA	Exit BNWRA	Change in BNWRA
A	59%	89%	30%
B	19%	70%	51%
C	19%	33%	14%
D	15%	44%	29%
E	63%	81%	18%
F	63%	93%	30%
G	44%	93%	49%
H	26%	56%	30%
I	37%	59%	22%
J	63%	67%	4%
Median	40.5%	68.5%	29.5%

Table 2: Percentage of words correctly read on the Barton Nonword Reading Assessment and percentage of improvement.

Similarly, all students showed gains on the CFGWL. The mean improvement was 4.37% per month of instruction. The gains ranged from 1.2% to 53.1% with a median of 22.9% improvement in number of words read (Table 3). Values were largely clustered between 19 and 29% with six of 10 students falling within this range.

Table 3

Student	Initial CFGWL	Exit CFGWL	Change in CFGWL
A	104	124	19.2%
B	95	123	29.5%
C	28	31	10.7%
D	49	75	53.1%
E	149	181	21.5%
F	131	164	25.2%
G	102	127	24.5%
H	66	73	10.6%
I	70	87	24.3%
J	163	165	1.2%
Median	99	124	22.9%

Table 3: Number of words read correctly with percentage of improvement on the context free graded word lists

Very large gains were made by most students in Phonological Awareness Composite Score (PACS). Gains on the PACS subtests were a mean of 39 percentile points. All students made progress in PACS. Range of gains was between 5 and 81 percentile points, with a median of 30 percentile points improvement (Table 4).

Table 4

Student	Initial PACS	Exit PACS	Change in PACS
A	35%	91%	56%
B	9%	75%	66%
C	9%	14%	5%
D	0%	18%	18%
E	18%	50%	32%
F	21%	89%	68%
G	5%	86%	81%
H	35%	63%	28%
I	75%	93%	18%
J	63%	79%	16%
Median	20%	77%	30%

Table 4: Percentile score and percentile point improvement on the Phonological Awareness Composite of the CTOPP2

Although all students made progress in PA, not all students demonstrated a weakness in phonological awareness during pre-testing. Four students initially scored above the 35<sup>th</sup> percentile, yet they also improved. Six students scored below the 25<sup>th</sup> percentile, with the four lowest scores ranging from below the 1<sup>st</sup> percentile to the 9<sup>th</sup> percentile (Table 4).

The Alternate Phonological Awareness Composite Scores (APACS) also showed a large mean gain of 39 percentile points (Table 5). 90% of students made gains in this composite. The only student who did not make gains scored at the 61<sup>st</sup> percentile in both pre- and post-testing. The range of gains on the APACS was between 0 and 78 percentile points, with a median gain of 45 percentile points.

Table 5

Student	Initial APACS	Exit APACS	Change in APACS
A	53%	97%	44%
B	30%	75%	45%
C	12%	16%	4%
D	0%	37%	37%
E	30%	37%	7%
F	21%	86%	65%
G	8%	86%	78%
H	21%	90%	69%
I	61%	61%	0%
J	8%	53%	45%
Median	21%	68%	45%

Table 5: Percentile score and percentile point improvement on the Alternate Phonological Awareness Composite of the CTOPP2

60% of students made gains in PMCS as measured on the CTOPP2 (Table 6). Most gains were small and overall averaged 11 percentile points. Three students displayed losses of 2, 4, and 15 percentile points. One student’s score remained the same. Changes ranged from a loss of 15 percentile points to an improvement of 56 percentile points with a median gain of 3 percentile points.

Table 6

Student	Initial PMCS	Exit PMCS	Change in PMCS
A	12%	12%	0%
B	5%	61%	56%
C	1%	2%	1%
D	1%	5%	4%
E	5%	3%	-2%
F	1%	12%	11%
G	53%	81%	28%
H	16%	45%	29%
I	12%	8%	-4%
J	45%	30%	-15%
Median	9%	12%	3%

Table 6: Percentile point score and percentile point change on the Phonological Memory Composite of the CTOPP2

80% of students displayed gains in RNCS (Table 7), although on average gains were small, amounting to an 11 percentile point improvement. Changes ranged from a loss of 8 percentile points to a gain of 43 percentile points, with a median gain of 8 percentile points.

Table 7

Student	Initial RNCS	Exit RNCS	Change in RNCS
A	53%	68%	15%
B	98%	90%	-8%
C	1%	1%	0%
D	2%	45%	43%
E	45%	53%	8%
F	2%	21%	19%
G	81%	90%	9%
H	0%	4%	4%
I	5%	12%	7%
J	1%	1%	0%
Median	4%	33%	8%

Table 7: Percentile point score and percentile point change on the Rapid Naming Composite of the CTOPP2.

When examining the overall results of the pilot study, students demonstrated gains in both word level reading skills on the CFGWKL and in nonword decoding ability on the BNWRA. Student gains in both phonological awareness with real words and alternate phonological awareness skills with nonwords were very large. Most students experienced remediation of all PA and APA deficits. Gains in rapid naming were more modest and were not experienced by all students. Phonological memory deficits were only improved in a few students, although 2 students made large gains. Statistical analysis (Table 8) demonstrates that the improvements in the CFGWL, BNWRA, PACS, APACS, and RNCS are all unlikely to be the result of chance.

Table 8

<b>Wilcoxon Signed-Rank Test</b>		
	<b>V</b>	<b>p</b>
Change in CFGWL	55.000	0.002
Change in BNWRA	55.000	0.006
Change in PACS	55.000	0.006
Change in APACS	45.000	0.009
Change in PMCS	33.500	0.213
Change in RNCS	32.500	0.050

*Table X*: Wilcoxon signed-rank test values comparing student gains to a hypothetical population with median gains of 0.

## DISCUSSION:

As shown in Table 1, the median time spent in the program was 5.8 months. The greatest length of enrollment of any student was 9.9 months, and the shortest duration was 2.7 months. Some students moved very rapidly, others very slowly. This was due to a variety of reasons, which included differences in IQ, emotional lability, behavioral issues, conflicts with scheduling, and varied focusing ability.

Spending little time in the program was not necessarily associated with small gains, however. The student with the second shortest duration in the program spent only 2.9 months in tutoring but moved very rapidly through the program. He demonstrated a 30% gain in decoding ability on the BNWRA, earning a 93% on the post-test assessment. He chose to leave the program after less than three months as he no longer believed he needed help.

While all students showed gains on the CFGWL, the gains were smaller than on the BNWRA. Progress on this assessment was not expected to be large. Four of 10 students only progressed through the program enough to be exposed to instruction in the reading of single

syllable, short vowel sound words. Even so, 90% demonstrated an improvement of over 10% in ability to read multi-syllabic grade levelled words (Table 3).

As MSL programs do not follow grade level reading equivalency standards in scope and sequence, measuring grade level reading equivalent is not the best indicator of improvement in word level reading.

Gains on the PACS were very large. Post-test scores placed students between the 14<sup>th</sup> percentile and the 93<sup>rd</sup> percentile, with a median score of the 77<sup>th</sup> percentile. 80% of scores on the post-test were above the 50<sup>th</sup> percentile. 60% of post-test scores were above the 75<sup>th</sup> percentile (Table 4). This indicates that the Barton System was extremely effective in phonological awareness instruction and deficit remediation. This is important, as phonological awareness deficits are considered the most common reason students struggle with reading. Without intact phonological awareness, students do not have the ability to use phonic knowledge to decode words and store them for efficient retrieval via the process of orthographic mapping (Kilpatrick, 2015, p. 101).

As with PACS, gains on the APACS were also very large. 60% of students initially scored below the 25<sup>th</sup> percentile on the APACS battery, scoring <1<sup>st</sup> percentile to the 21<sup>st</sup> percentile. At post-test, only one student scored below the 25<sup>th</sup> percentile. 70% scored above the 50<sup>th</sup> percentile and 50% of students scored above the 75<sup>th</sup> percentile (Table 5), indicating once again that the Barton System was very effective at improving and remediating deficits in phonological awareness.

Gains in PM were small on average, which was the expected result, as MSL programs are not designed to remediate phonological memory but do support it. Supportive multisensory instruction methods include auditory, visual, kinesthetic, and tactile techniques to help students

hold increasingly longer strings of sounds in phonological memory. In addition, students are taught to divide large words into logically identifiable syllable types. Despite this, two students did display large gains in PM (Table 6).

Some students showed very low scores in phonological memory on the CTOPP2; 80% scored below the 20<sup>th</sup> percentile. 50% of students scored at or below the 5<sup>th</sup> percentile, representing extremely low scores. As deficits in phonological memory are often comorbid with ADHD, these deficits were not surprising, as all the students whose data is reported in this study have ADHD, but the number of students with very severe deficits was unexpected. Of these students, Students A and I scored below the 20<sup>th</sup> percentile in PM in the absence of PA deficits. Although it could be theorized that since MSL programs are designed to remediate PA deficits, and only support PM deficits, these students would not have made progress similar to their peers who have PA deficits. However, both students made significant gains on the BNWRA, improving by 30% and 22% respectively (Table 6).

Student gains in RN were modest and sporadic (Table 7). As previously mentioned, although students can sometimes make gains in RN when they are taught phonemic awareness skills to an advanced level, this is not always the case. Correction of phonemic awareness deficits along with instruction in phonic knowledge can contribute to improved orthographic mapping and growth in a student's sight word lexicon- defined as words mapped to the brain and recognized automatically- which will sometimes spur growth in RN, but deficits cannot always be attributed to poor mapping. Cognitive difficulties such as slow processing speed and memory problems can also contribute to or cause deficits in RN. Many remediated students become highly accurate readers with below average reading speed (Torgesen et al, 2001).

As previously mentioned, the Barton Reading and Spelling System is designed to remediate struggling readers who show signs of dyslexia and have an IQ of 70 or above. Students D and E each had IQs below 70 and were designated as Intellectually Disabled. As research suggests, low IQ was not a barrier to improving reading skills with proper instruction. Both students showed gains in decoding ability, making gains of 29% and 18% on the BNWRA. On the CFGWL, student D demonstrated a very large gain of 53.1% and student E showed a gain of 21.5% (Table 2). However, it should be noted student E had a more robust initial score on the graded word lists, while student D had a very low initial score and was in fact, an emergent reader when he began the program.

At the onset of the program, behavioral health and educational staff at HYS had two major concerns regarding implementing the Barton System. First, would the students have enough time in instruction to remediate phonological awareness deficits, make progress in their decoding ability, and improve their self-esteem regarding their academic ability, and second, would giving them this instruction for such a short period of time be fair, as due to their ages and the highly specialized nature of the program, it would be unlikely they could continue receiving intervention when they returned to their home schools.

In addition to the remediation of phonological awareness deficits in either PACS, APACS, or both, in all but one student and improvement in both nonword and real word reading on the BNWRA and CFGWL assessments, it should be noted that at post-testing, most students demonstrated an ability to read new, context free grade level words whose decoding hadn't been instructed in tutoring. This appeared to be evidence that as students' phonological awareness deficits were remediated, their prior phonic knowledge was able to be used. These students were beginning to "crack the code" of reading on their own, a phenomenon referred to as the "self-

teaching hypothesis.” These students should be able to continue to do improve their reading with practice, even in the absence of further instruction (Kilpatrick, 2015, p.95).

Upon interviewing students at discharge, those that stayed with the program indicated pride in their reading improvement, as well as in their ability to learn. Student quotes included the following: “I realized for the first time that I catch on pretty quick.” Another expressed hope for the future saying, “When I get home, I’m going to go up to the Circle K and apply for a job. I can fill out a job application now.” Another student described surprise at his reading improvement stating, “I couldn’t really read when I got here. I came because I was in trouble. I never expected to learn to read while I was here, but I did!” When surveyed about incentives that could be offered to make tutoring attendance more consistent, one student stated, “I don’t need any incentives to come to tutoring. I’m coming because I’m finally getting the help I’ve always needed.”

Other students expressed an interest and pride in learning for the first time. One student stated, “When I leave here, I’m going to get straight A’s for the rest of my time in school. I know what I’m capable of now.” Another said, “Reading turns out to be a great way to get information! Anything I want to know; I just look it up! I am xxxxxx, word-looker-upper!” When asked what he had previously thought the purpose of reading was, the same student replied, “I don’t know. I guess I always just thought it was something they made you do to make you feel bad about yourself.”

Several students enrolled in the program self-reported an improvement in ADHD symptoms. These reports were unprompted and unexpected. Future research studies will include a comparison of behavioral health assessment measures, administered pre- and post- enrollment along with questions regarding ADHD symptoms.

In addition to student enthusiasm for the Barton program, classroom teachers also reported positive improvement in students' work and attitude. Teachers reported an increase in independence with classroom work as well as higher rates of assignment completion. One teacher commented that students enrolled in the program who were in her class, "started acting like scholars" and began taking their schoolwork more seriously. At times she noted that this caused conflict with other students who demonstrated distracting behaviors. Three teachers noted that students who had previously refused to read aloud in class, were now volunteering to do so. One noted that the student was not reading that well initially, but was still willing to volunteer repeatedly, although he had been embarrassed to do so before he began the program. Teachers remarked on improvements in writing and spelling ability as well. One teacher stated, "I have been employed at HYS for the past 36 years and the Barton Reading Program is by far the most beneficial educational program we have ever offered to our residents. Please keep coming back!"

Because of the improvement in student academic attitudes, reading, and spelling, the HYS faculty and staff were all supportive and enthusiastic about the program. When tutors could no longer work one-on-one with students due to the pandemic, staff and teachers willingly assisted students with logging on for virtual instruction. Teachers were willing to allow students to be pulled from class to attend tutoring and would provide support and individual instruction for missed class time. Of the six teachers on staff, three took training in the Barton System and were very familiar with implementation and were able to easily recognize improvements in decoding, reading, and spelling ability and attribute it to the Barton program.

Concerns regarding students' lack of access to continued remediation once they returned to their home schools were mitigated in several ways. First, exit assessments were written for

each student at discharge. For students with IEPs, documentation was provided in the exit assessments demonstrating that the program was improving the students' reading abilities. These reports were sent to the students' home schools and made available to parents. Second, recommendations for specific accommodations were made, tailored to individual student needs, in order to provide students with support and better access to curriculum when they returned to their home schools.

In conclusion, the outcomes of the pilot study demonstrate that students in residential care, who participated in short-term reading instruction with the Barton Reading and Spelling System, an Orton-Gillingham influenced, multi-sensory, structured language reading program, had associated gains and remediation of phonological awareness deficits and improvements in word level reading on both a nonword decoding assessment and a context free, grade level word list assessment (Table 8). Students also experienced modest gains in rapid naming but did not experience significant improvements in phonological memory deficits. Students who participated in the program also experienced improvements in attitudes about reading, learning ability, and demonstrated new and positive classroom behaviors. HYS was awarded a grant for expanding the Barton program and is currently conducting a larger study which is examining further measures of reading progress and behavioral health.

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