

RESEARCH REPORT

Luke Waites Center for Dyslexia and Learning Disorders

Jet: A Fast-Paced Reading Intervention

Preliminary Findings from Routine Practice

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Dyslexia is a highly prevalent learning disability (5-17% of the general population) that negatively affects an individual's ability to learn to read and spell. It is a neurological disorder that disrupts a number of cognitive processes involved in reading, leading to characteristic deficits in word reading and spelling accuracy, as well as poor reading fluency (Fletcher et al., 2018). These deficits are often evident as early as first grade and persist well into adolescence and even adulthood (Ferrer et al., 2015). In 2022, there were over 270,000 Texas high school students with dyslexia in the public education system, representing approximately 5% of all high schoolers statewide. Although dyslexia is most often identified in elementary school, many students continue to require intervention and other support services throughout their academic careers.

A vast and growing literature over the last several decades has documented efficacy of systematic, phonologically based reading instruction in successfully remediating reading deficits in children with dyslexia (National Institute on Child Health and Development, 2000). Due to the nature of dyslexia, children need intensive interventions of extended durations to elicit significant improvements in reading skills (e.g., Denton et al., 2006). These children benefit from direct, systematic instruction in the structure of the language and need extended opportunities for targeted practice to consolidate knowledge (Fletcher et al., 2018). The same practices which are effective at remediating dyslexia in younger students are generally successful with students in older grades (Lovett et al., 2012, 2021). However, less is known about student outcomes in the understudied population of high school students with dyslexia.

The Intervention

The Luke Waites Center for Dyslexia and Learning Disorders (LWCDLD) has previously developed and disseminated a successful dyslexia intervention called *Take Flight: A Comprehensive Intervention for Students with Dyslexia* which has been widely adopted in schools across the country since its release in 2006 (Avrit et al., 2006). Although older students benefit from the same intervention content as elementary students, they have less time in their academic schedules to complete the work. Fortunately, older students also have a greater capacity for incorporating the large volume of new learning at a faster pace than younger students. In light of these factors, LWCDLD has developed an accelerated intervention program that covers the same information in one school year instead of two, with materials more suitable for older students. This accelerated program is called *Jet: A Fast-Paced Reading Intervention*.

The Current Study

The purpose of the current study is to examine changes in literacy skills over time for high-school students with dyslexia who are receiving *Jet* instruction as routine dyslexia instruction in their schools. The pilot data presented below provide a preliminary examination of student performance over the course of treatment for two distinct samples.

Pilot Study 1

Participants

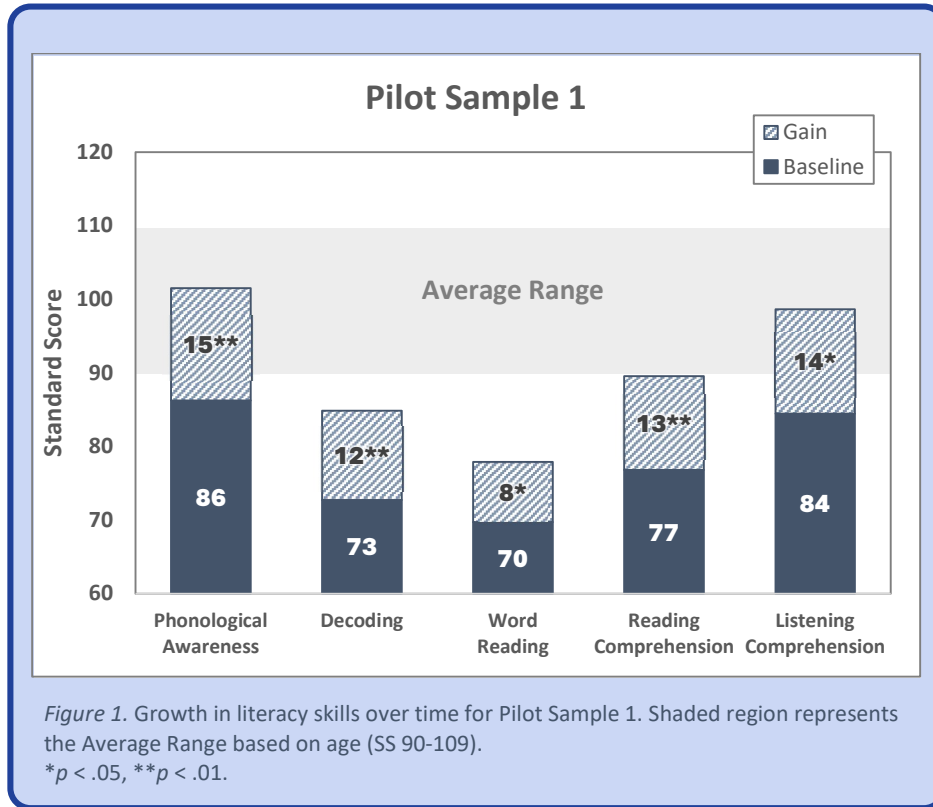
The *Jet* intervention was piloted in a sample of eighteen secondary students receiving dyslexia intervention across several districts in the Southwestern United States. All instruction was delivered by a pilot group of district dyslexia therapists who completed training in the use of the *Jet* curriculum. All assessments and intervention activities were completed as standard procedure for the district. Demographic and outcome data were collected by district personnel, de-identified, and shared retrospectively through a secure online data management system hosted at Scottish Rite for Children (Harris et al., 2009; Harris et al., 2019).

Table 1. *Sample Demographics for Pilot Study 1*

	Mean (SD)	Range
Age (years; months)	16y;8m (10m)	15;3-18;2
Gender (Female %)	44	
Ethnicity (Hispanic %)	11	
Race:		
Black / African Am.	83	
White	0	
Other	11	
Free/Reduced Lunch (% yes)	55	
Comorbidities		
ADHD	22.2	
SLI	5.6	
Other	11.1	

Measures & Analysis

District assessment batteries measured a range of language and literacy skills to confirm a characteristic profile of dyslexia and measure growth in literacy skills over time. For most students in the current sample, the baseline battery included the Phonological Awareness composite score from the Comprehensive Test of Phonological Processing, 2nd Edition (CTOPP 2; Wagner et al., 2013) and the Word Attack, Word Identification, Passage Comprehension, and Listening Comprehension subtests of the Woodcock Reading Mastery Tests, 3rd Edition (WRMT-3; Woodcock, 2011). These subtests were re-administered to each student at the completion of the intervention to measure growth in targeted literacy skills. A doubly multivariate analysis was run on written language skills (decoding, word reading, passage comprehension) over time (pre, post-intervention). Six students were missing Phonological Awareness scores at both timepoints; one additional student was missing Listening Comprehension scores at both timepoints. To maximize the analytic sample used to evaluate each of these skills, repeated-measures ANOVAS were run on each of these outcomes independently.



Treatment Effects

A battery of oral and written language assessments were administered pre- and post-intervention to assess changes in standard score performance for students receiving the intervention. Group means on these measures at baseline and post-intervention timepoints are shown in Figure 1. For all measured literacy outcomes, mean performance for the sample was below the average range prior to the intervention, with strengths in oral language skills relative to written language skills. Profile analyses revealed significant improvements in written language skills over the course of treatment, Wilk's $\Lambda = .42$, $F(3,15) = 6.80$, $p = .004$, $\eta_p^2 = .58$. Reliable and robust effects of time were found for decoding, $F(1,11) = 12.98$, $p = .004$, $\eta_p^2 = .54$, word reading, $F(1,11) = 12.98$, $p = .004$, $\eta_p^2 = .54$, and reading comprehension, $F(1,11) = 12.98$, $p = .004$, $\eta_p^2 = .54$. Oral language skills were relative strengths prior to treatment, and further improved well into the Average Range at the end of the year. Phonological awareness improved significantly over time, $F(1,11) = 12.98$, $p = .004$, $\eta_p^2 = .54$, as did listening comprehension, $F(1,16) = 6.23$, $p = .02$, $\eta_p^2 = .28$. Because standard scores represent performance relative to developmental norms, this change in performance indicates that during the intervention period students' literacy skills accelerated at a rate faster than their age-equivalent peers, bringing them closer to the average range by the end of treatment. Follow-up analyses of each individual outcome measure revealed both statistically and clinically significant gains in individual skills.

Pilot Study 2

Participants

The *Jet* intervention was piloted in a sample of secondary students receiving dyslexia intervention across several districts in the Southwestern United States. All instruction was delivered by a pilot group of district dyslexia therapists who completed training in the use of the *Jet* curriculum. All intervention activities were completed as standard procedure for the district. Students assigned to classes using the *Jet* curriculum were invited to participate in the study. Parental consent and student assent were obtained for 13 students receiving dyslexia instruction under the instruction of three therapists. For this sample, certified diagnosticians employed by SRC completed pre- and post-intervention batteries with participating students on their home campus.

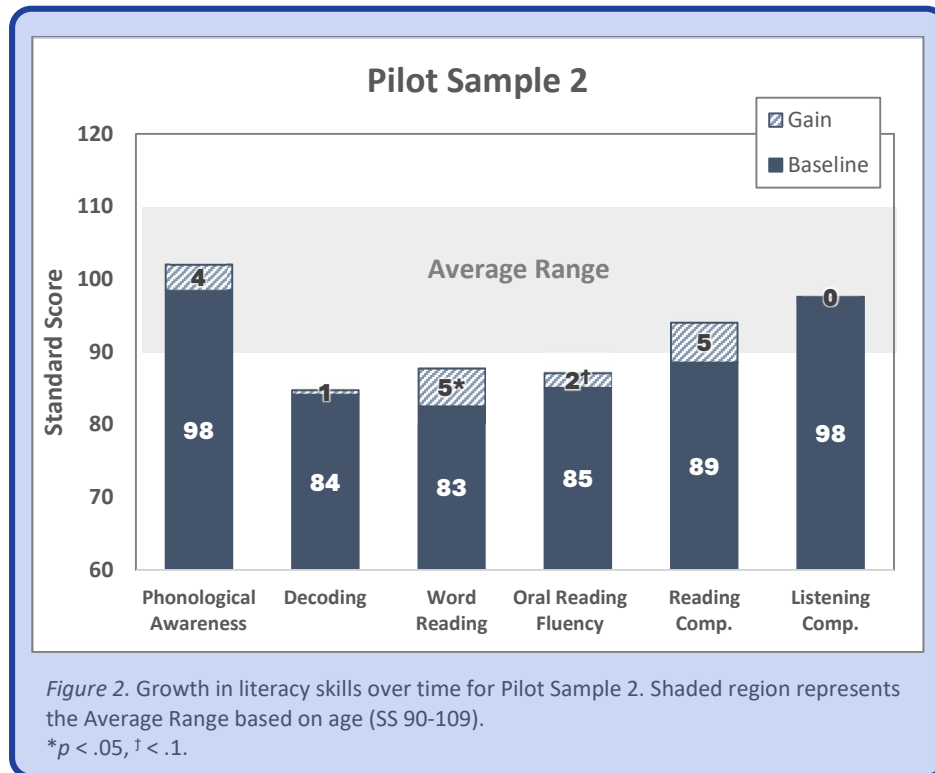
Select demographic and intervention data (i.e., progress measures, attendance data) for participating students were provided by the district.

Table 2. *Sample Demographics for Pilot Study 2.*

	Mean (SD)	Range
Age (years; months)	14y;8m (11m)	13;11-17;5
Gender (Female %)	61	
Ethnicity (Hispanic %)	30	
Race:		
Black / African Am.	61	
White	23	
Other	15	
Free/Reduced Lunch (% yes)	53	
Comorbidities		
ADHD	7	
SLI	0	
Other	7	
None	86	

Measures & Analysis

District assessment batteries measured a range of language and literacy skills to confirm a characteristic profile of dyslexia and measure growth in literacy skills over time. Once enrolled in the study, students were scheduled to complete a baseline assessment battery. The baseline battery included the phonological awareness composite score from the Comprehensive Test of Phonological Processing, 2nd Edition (CTOPP 2; Wagner et al., 2013) and the Word Attack, Word Identification, Oral Reading Fluency, Passage Comprehension, and Listening Comprehension subtests of the Woodcock Reading Mastery Tests, 3rd Edition (WRMT-3; Woodcock, 2011). It is worth noting that most students began intervention classes in late August, but consent was not obtained until October. On average, the baseline study assessments were completed within 6 weeks of the beginning of the intervention for these students. The full battery of subtests was re-administered to each student at the completion of the intervention to measure growth in targeted literacy skills. At each of the two timepoints, one student was unavailable for testing. Regression-based imputation was used to estimate scores using student age and the autoregressor for each outcome. Two doubly multivariate analyses were then run on performance over time (pre-, post-intervention): for written language skills (decoding, word reading, oral reading fluency, passage comprehension) and oral language skills (phonological awareness, listening comprehension). Univariate analyses were then performed to examine change at the level of the individual outcome.



Treatment Effects

A similar battery of oral and written language assessments was administered pre- and post-intervention to assess changes in standard score performance for students receiving *Jet* instruction. Group means on these measures at baseline and post-intervention timepoints are shown in Figure 2. For all measured written language outcomes, mean performance for the sample was below the average range prior to the intervention. Significant strengths were observed for oral language skills (phonological awareness and listening comprehension) which were both well within the Average Range prior to treatment. Profile analysis revealed significant improvement in written language skill over time, Wilks' $\Lambda = .33$, $F(4,9) = 4.54$, $p = .03$, $\eta_p^2 = .67$. Because standard scores represent performance relative to developmental norms, this change in performance indicates that during the intervention period students' literacy skills accelerated at a rate faster than their age-equivalent peers, bringing them closer to the average range by the end of treatment. Follow-up analyses of each individual outcome measure revealed both statistically and clinically significant gains in individual skills. Univariate repeated measures analyses revealed significant improvements in word reading, $F(1,12) = 7.10$, $p = .02$, $\eta_p^2 = .37$, and marginal significance for oral reading fluency, $F(1,12) = 3.84$, $p = .07$, $\eta_p^2 = .24$. The effect of time on passage comprehension was robust, although growth did not reach a level of significance, $F(1,12) = 2.69$, $p = .13$, $\eta_p^2 = .18$. Decoding skills did not reliably change over the course of treatment, and the effect was small, $F(1,12) = .06$, $p = .82$, $\eta_p^2 = .01$. Oral language skills were relative strengths prior to treatment and did not reliably change over time. On average, phonological awareness scores increased over time, although a moderate effect size was observed ($\eta_p^2 = .08$). Reliable changes in listening comprehension were not observed, and the effect of time was small ($\eta_p^2 = .01$). Together, findings revealed reliable improvements in written language skills, with more variable and modest results in oral language skills.

Conclusions

The current studies investigated growth in oral and written language skills for two samples of high school students receiving instruction in the *Jet* program within a routine public-school intervention setting. Dyslexia is a specific learning disorder characterized by deficits in word-level reading and spelling abilities. These word-level difficulties often give way to secondary consequences including weaknesses in reading fluency, comprehension, and written expression. Prior to the intervention, students in both samples demonstrated literacy profiles characteristic of dyslexia, with weaknesses in both word- and passage-level reading skills relative to oral language skills. Although relative strengths in oral language were seen in both samples, it is important to note that baseline ability differed across samples. Whereas students in the first study had below average oral language skills, students in the second study performed well within the average range prior to the intervention on both oral language measures. Additionally, the written language skills of the first sample were reflective of a more severely impaired group, with mean written language standard scores ranging from 70-77, whereas the second sample ranged from 83-89. It is possible these differences in baseline ability contributed to differences in patterns of growth and overall findings across the two studies.

In the first study, significant and large effects of time were found for all written and oral language skills over the course of the intervention. For this sample, mean performance was below average across all measured skills prior to treatment. Analysis of post-intervention performance suggests positive effects of intervention which are both statistically and clinically meaningful. On measures of oral language, which were below average at baseline, students closed the gap with their age-equivalent peers by the end of the intervention, with mean performance near population average ($M_{PA} = 101$, $M_{LC} = 98$). Significant gains were also observed in written language skills, although these skills were relatively weaker at baseline and remained below the average range at post-test.

Literacy skills of the students in the second study also improved over treatment, but this growth was modest in relation to that of the first study. Of the measured outcomes, only word reading and reading fluency revealed reliable effects of time. However, an examination of effect sizes reveals that time accounted for a large amount of variability within the sample for most measured written language skills ($\eta_p^2 = .18-.37$), with the exception of decoding. A moderate effect of time was found for phonological awareness ($\eta_p^2 = .08$). The relatively smaller effect in phonological awareness compared to written language skills is not surprising given the average performance of the group at baseline. Interestingly, the sample's average performance on tests of phonological awareness assessed in their district evaluation was significantly lower ($M = 86.27$, $SD = 17.28$) than at study pre-test ($M = 97.25$, $SD = 17.97$; $t(10) = 4.80$, $p = .001$). This is particularly of note in consideration of the testing timeline for this pilot group. For most students in the sample, the district evaluation was conducted in the previous school year. It is possible that these students received remedial support between initial identification of dyslexia and the start of intervention classes the next fall. Furthermore, these students had completed several weeks of intervention completed prior to study enrollment and pre-test, which may also inflated their baseline scores. Greater growth in this area would be expected for a sample with more notable baseline deficits measured prior to any intervention services, as seen in the first sample.

A few considerations are warranted in the interpretation of these data. First, both studies consist of small samples ($n < 20$). Trends can be difficult to detect in small samples due to insufficient

statistical power. Given the sample sizes, variability around group means, and strength of measured effects, it is likely that the effects measured in the second study would reach statistical significance in a larger sample. Second, the age-based standard scores utilized in these analyses represent relative performance in comparison to other individuals of the same age. Therefore, an increase in standard score reflects an accelerated pace of development compared to age-equivalent peers. A standard score which does not change over time does not indicate a lack of growth, but growth which is not accelerated relative to the norming sample. A lack of growth over time would be reflected in a decrease in standard score, as the level of expected ability necessarily increases with age. Across both samples, student performance reflected accelerated growth (i.e., standard score gains) in all cases except listening comprehension in the second study, which did not change. No instances were observed in either sample which would indicate a lack of raw score growth or skill regression.

Together, these findings provide preliminary support for the use of the *Jet* intervention program in developing a range of oral and written skills in secondary students with dyslexia. Students receiving *Jet* instruction demonstrated both statistically and clinically meaningful improvements in word reading, with variable but strong effects in phonological awareness, fluency, reading comprehension, and language comprehension.

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