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Targeted Cognitive-Based Tier II Interventions to Increase Student Achievement

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TARGETED COGNITIVE-BASED TIER II INTERVENTIONS TO INCREASE STUDENT ACHIEVEMENT

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by

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Acknowledgments

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ABSTRACT

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Rachel K. Wakefield

The purpose of this study was to examine whether targeted cognitive-based reading interventions are more effective than traditional evidence-based Tier II reading interventions. Ninety students who performed in the lowest third on a state reading test from a rural school district in Virginia were placed into three groups: 1) students who received traditional evidence-based reading interventions, 2) students whose teachers were trained in Cattell-Horn-Carroll theory and whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs, 3) students who were tested using the Woodcock Johnson III Tests of Cognitive Abilities (WJ-III) and were given interventions tailored to their cognitive profile. The mean reading scores on a posttest were compared. Contrary to the research hypotheses, results indicated that there were no significant differences between groups.

Chapter I

Review of Literature

Determining how best to help students who struggle with reading has been a focus of educational research for decades. Not only is reading a critical component of all other academic areas, but reading proficiently by the end of third grade is directly linked to completing high school with a diploma (Annie E. Casey Foundation, 2010). In an aim to help students reach proficient reading levels, different models have been implemented in schools to provide struggling readers with additional interventions, resources, and accommodations.

Historically, children could only receive specialized services for reading difficulties if they qualified for special education using a discrepancy model of comparing cognitive ability and academic achievement. In utilizing this model, a culture of "wait-to-fail" was established as a discrepancy between IQ and reading achievement appears only after years of academic failure (Bradley, Danielson, & Doolittle, 2007). Furthermore, the key time to address reading difficulties was missed as the best time to intervene is in the younger years and the average age at which children qualify for special education services is nine-years-old (Feifer & Della Toffalo, 2007). Additionally, there has been a failure to show meaningful differences between students with low reading scores with and without IQ-achievement discrepancies (Mather, 2012). In using this model, low achieving students with lower cognitive abilities are ineligible to receive any specialized reading services despite showing a need for interventions, services, and accommodations. The IQ-discrepancy model of evaluation rarely leads to the

implementation of appropriate interventions and also presents with validity and reliability concerns (Vaughn & Linan-Thompson, 2003; Stuebing et al., 2002).

Given these concerns, the usefulness of using the discrepancy approach as the sole criterion in providing children specialized services came into question and a Response-to-Intervention model was endorsed by many organizations (Kavale, Holdnack, & Mostert, 2005). With the reauthorization of IDEA in 2004, new language was placed in the legislation that stated, "In determining whether a child has a specific learning disability, a local educational agency may use a process that determines if the child responds to scientific, research-based intervention as part of the evaluation procedures…" (Public Law 108-446, §614(b)(6)(B)). Essentially, RTI is a multi-tier approach, where all students get high-quality instruction and struggling learners are provided with increasingly intense levels of service (Hoover, 2009). Although there is no universally accepted RTI model at this point, most use a three-tiered approach in which students can move through the tiers of services (Kavale & Spaulding, 2008). In Tier I, all students are provided with empirically validated instruction and progress is monitored. Students who do not respond to instruction progress to Tier II and get either more intensive instruction or different instruction. Progress is continued to be monitored, and students who still fail to respond are placed in Tier III. At this point, there is either the implementation of even more intensive interventions, the student is referred for an evaluation, or the student may qualify for special education (Fuchs, Moch, Morgan, & Young, 2003.)

There is ample research that demonstrates the effectiveness of RTI as a prevention and instructional model (Little, 2012). In a recent review of 13 studies that examined the effectiveness of RTI, there was some level of improvement on academic achievement

with the implementation of an RTI program in every study (Hughes & Dexter, 2011). Additionally, RTI has been shown to reduce the number of placements in special education in the early elementary years and reduce the disproportionality of minority students placed in special education (Hoover, 2010). However, there is also much criticism surrounding this research given the small-scale of these studies (Reynolds & Shaywitz, 2009), the differences in how RTI is implemented, how students are identified as not responding, and how the interventions selected and monitored for students in Tiers II and III (Kavale & Spaulding, 2008). In fact, in an examination of the RTI model, Reynolds and Shaywitz (2009) argued that "the research base is not yet sufficient to provide adequate or reliable guidance to practitioners in how to implement RTI as an effective service delivery process" (p.131).

At the end of RTI, all that is known is that a student has significant reading difficulties and that he or she did not responded positively to the interventions that were utilized. In using RTI as a diagnostic model, there is not only a question of validity, but one is no closer in determining what do with instruction after a child fails to respond to the interventions (Reynolds & Shaywitz, 2009). In order to obtain information as to *why* a student is not responding to the core curriculum or interventions, a comprehensive evaluation that examines a student's cognitive strengths and weakness can be utilized to give insight into cognitive predictors of reading achievement that allows for the determination of more effective instructional approaches (Reynolds & Shaywitz, 2009).

A handful of studies have been conducted that examine the effectiveness of utilizing cognitive assessments to guide academic interventions. Naglieri and Johnson (2000) looked at the effectiveness of a cognitive-based academic intervention in

improving arithmetic computation. Specifically, 19 students were individually administered the *Cognitive Assessment System* (CAS), a test of cognitive ability based on the Planning, Attention, Simultaneous, and Successive (PASS) theory. All students were then provided interventions in which discussions were facilitated to encourage planning, self-reflection, and verbalization of strategies. Results showed that children with a cognitive weakness in Planning showed much greater improvement compared with students who had no cognitive weakness or a cognitive weakness in the areas of Attention, Simultaneous, or Successive (Naglieri & Johnson, 2000). However, the results of this study were not replicated by Kroesbergen, Van Luit, and Naglieri (2003). In this study, 267 Dutch students with learning disabilities were administered the CAS to measure the PASS processes. Students then received specialized instruction aimed at encouraging planning strategies to use with multiplication problems. Discussions were facilitated to encourage self-reflection, understanding of the solutions, and picking an efficient strategy. Unlike the study conducted by Naglieri and Johnson (2000), there were no significant differences found between children with a specific cognitive weakness and those with no specific cognitive weakness in terms of math achievement (Kroesbergen et al., 2003). The two studies above focused on math achievement, whereas Fiorello, Hale, and Snyder (2006) discussed a case study that examined cognitive hypothesis testing and response to intervention for a child with reading problems. In this study, a student who had failed to respond to traditional evidence-based reading interventions was referred for a Cognitive Hypothesis Testing Evaluation. Through this evaluation, the team found that the student had sequencing problems, deficits in language formulation, word structure and syntactic problems, as well as working memory and executive function deficits.

Targeted academic interventions were created to help the student combine phonemes and morphemes quickly and efficiently by using passages from his reader, recording errors, breaking the error words down, using flash cards of the common letter clusters, and showing flashcards in rapid succession. In a pretest/posttest measurement, the student's reading accuracy increased from 67% to 98% (Fiorello et al., 2006).

Although RTI is successful at remediating many students reading difficulties, especially in the early grades, there is an argument that students who do not initially respond to interventions would benefit from a comprehensive cognitive processing evaluation that could be used as a platform for remediation (Little, 2012; Fiorello et al., 2006). One approach that has substantial empirical support is that of the Cattell-Horn-Carroll (CHC) theory of cognitive abilities linked to reading achievement (Hale, Kaufman, Naglieri, & Kavale, 2006; Fiorello et al., 2006). CHC theory is a hierarchal framework consisting of three strata: overall cognitive functioning or *g* (stratum III), broad abilities (stratum II), and narrow cognitive abilities (stratum I) (Evans, Floyd, McGrew, & Leforgee, 2001). The Woodcock Johnson III Tests of Cognitive Abilities (WJ-III; Woodcock, McGrew, & Mather, 2001) measure seven CHC broad cognitive abilities include: Fluid Reasoning (*Gf),* Comprehension-Knowledge (*Gc*), Short-term Memory (*Gsm*), Visual Processing (*Gv*), Auditory Processing (*Ga*), Long-term Storage and Retrieval (*Glr*), and Processing Speed (Gs) (Schrank & Flanagan, 2003). Many of these critical CHC cognitive factors have been shown to be strongly related to reading achievement. (McGrew & Wendling, 2010; Flanagan, Fiorello, & Ortiz, 2010). Specifically, auditory processing (*Ga*), long-term storage and retrieval (*Glr*), crystallized abilities (*Gc*), short-term memory (*Gsm*), and processing speed (Gs) have been shown to

be fundamental to basic reading in numerous studies (Fiorello et al., 2006). Therefore, in using CHC research to guide interpretations of a comprehensive assessment, insights are provided into "(a) why certain methods of instruction or intervention were not effective; (b) what interventions, compensatory strategies, and accommodations might be more effective; and (c) the most promising means of delivering instruction and implementing intervention" (Flanagan et al., 2010, p.739).

Although there have been some studies that examine the effectiveness of cognitive-based targeted academic interventions, they have been limited by subject matter and sample size. Therefore, in looking at a larger sample and using a variety of reading interventions, are individually tailored cognitive-based academic interventions more effective in Tier II than a one-size-fits-all approach to Tier II interventions? Given the time and expense of a comprehensive evaluation, is it possible to train teachers on the CHC theory which will help guide them to make hypotheses about a child's cognitive strengths and weaknesses which in turn will influence what interventions are given to each student in Tier II? The purpose of this present study is to determine whether cognitive-based academic interventions tailored to individual students are more effective for struggling readers in the third grade than evidence based interventions not tailored to individual cognitive profiles. The purpose of this study is also to examine whether it is necessary to test a student to determine their cognitive strengths and weaknesses; or whether teachers can be trained on the CHC theory with tailored interventions based on a cognitive deficit approach and decide which students get which targeted intervention without the necessity of cognitive testing.

Hypotheses

This study is organized around four primary hypotheses.

1. There will be a difference in posttest reading scores between three groups of students: 1) students who were given traditional evidence-based Tier II interventions, 2) students whose teachers were trained in CHC theory and whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs, and 3) students who were tested using the Woodcock Johnson III Tests of Cognitive Abilities and were given interventions tailored to their cognitive profile.
2. Students who were tested using the Woodcock Johnson III Tests of Cognitive Abilities and were given interventions tailored to their cognitive profile will have higher posttest reading scores than students whose teachers were trained in CHC theory and whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs.
3. Students who were tested using the Woodcock Johnson III Tests of Cognitive Abilities and were given interventions tailored to their cognitive profile will have higher posttest reading scores than students who were given traditional evidence-based Tier II interventions.
4. Students whose teachers were trained in CHC theory and whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs will have higher posttest reading scores than students who were given traditional evidence-based Tier II interventions.

Chapter II

Method

Participants

Ninety third graders from fifteen different classrooms in six elementary schools in Wythe County Public Schools, Virginia were selected to participate in the current study.

Procedure

At the beginning of the 2011-2012 school year, all third-grade students in the Wythe County Public Schools school district took a pretest reading benchmark. Students who scored in the bottom third on this test and were not receiving Tier III special education pull-out instruction were selected to participate in the current study (N=90). There were 30 children in the control group (interventions-as-usual group), 30 children in the teacher decision group (teachers were trained in CHC theory and chose the cognitive interventions that they thought would be best for each child), and 30 children in the tested group (teachers were training in CHC theory, students were tested with the WJ-III COG and assigned a cognitive intervention based on their cognitive deficits). Six schools were part of the current study and students were assigned to one of the three groups based on their school. The schools were selected randomly without replacement. The teachers in both treatment groups received twelve hours of training on the CHC theory. The training covered detailed information about learning disabilities, the neuropsychology of learning, psychology assessments, cognitive neuropsychological perspectives, and interventions based on CHC theory. The students in the tested group were administered Tests 1-9 and 11-17 of the Woodcock Johnson III Tests of Cognitive Abilities (WJ-III COG; Woodcock et al., 2001) by trained school psychology graduate students. Seven

"Strategies" were developed based on the CHC clusters (i.e., Comprehension-Knowledge, Long-Term Retrieval, Visual-Spatial Thinking, Auditory Processing, Fluid Reasoning, Processing Speed, and Short-Term Memory). Two evidence-based interventions were selected for each strategy. In the trained teacher group, the teachers picked what CHC area they felt a study struggled with the most. The student then was given the first intervention in that Strategy area. In the group in which students were tested, the strategy was chosen for each student based on the lowest cluster score on the WJ-III COG. Students in all groups were progress monitored using benchmark tests at two points in the year. At these points, the mean score of progress was determined for the treatment groups. If a student had a progress score that was greater than one standard deviation below the mean progress score, that student was switched to the second intervention within the Strategy. Students who made sufficient progress continued with the same intervention. In order to maintain fidelity, teachers in the treatment groups charted the date and duration of the interventions given. Additionally, an intervention specialist observed the implementation of interventions, the level of engagement, the protocols being used, and the dates that the observations occurred.

Data Analysis

A two factor mixed model analysis of variance was used to determine whether there were differences between the control group, the teacher decision group, and the tested children group on the pretest. It was anticipated that there would be no significant differences between the pretest scores. As such, a two factor mixed model analysis of variance was then used to determine whether there were differences between the control group, the teacher decision group, and the tested children group on the posttest scores,

with one factor being the within-subjects factor and the other factor being the between-subjects factor. The analysis examined how the between-subjects factor affected the within-subjects factor.

Chapter III

Results

With random assignment of the schools, we anticipated there would be no significant differences between the pretest scores in each group; ANOVA tests confirmed there were no significant mean differences in pretest scores.

Table 1

Analysis of Variance Summary Table, Pretest Scores

Source	SS	DF	MS	F-Statistic	P-Value
Group	36.067	2	18.033	1.450	.240

Computed using alpha = .05

Given that there were no significant differences between the groups on the pretest scores, the posttest scores were examined to determine if there were significant differences between the groups. The descriptive statistics of the posttest scores in each group are depicted in Table 2. For group one (control group), scores ranged from 8 to 33, the mean was 26.33, the median was 26.50, the variance was 34.506, and the standard deviation was 5.874. For group two (teacher trained group), scores ranged from 9 to 31, the mean was 23.73, the median was 25.00, the variance was 39.513, and the standard deviation was 6.286. For group three (students given tests of cognitive abilities), scores ranged from 7 to 33, the mean was 25.17, the median was 26.00, the variance was 30.351, and the standard deviation was 5.509.

Table 2

Posttest Scores on the Reading Section

	N	Range	Minimum	Maximum	Mean	Std. Dev.	Variance
Group 1 (Control)	30	25	8	33	26.33	5.874	34.506
Group 2 (Teacher)	30	22	9	31	23.73	6.286	39.513
Group 3 (Tested)	30	26	7	33	25.17	5.509	30.351

To determine if there were mean differences in posttest scores, a two factor mixed model ANOVA was utilized. The results, as depicted in Table 3, show that with the decision level set at .05, there were no significant differences in mean posttest scores between the groups ($F = 1.426$, $df = 2$, $p = .237$).

Table 3

Analysis of Variance Summary Table, Posttest Scores

Source	SS	DF	MS	F-Statistic	P-Value
Group	101.756	2	50.878	1.462	.237

Computed using alpha = .05

Chapter IV

Discussion

The findings suggest that there were no significant differences in mean reading scores between students who were given traditional evidence-based interventions, students whose teachers were trained in CHC theory and whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs, and students who were tested using the WJ-III COG and were given interventions tailored to their cognitive profile.

It was hypothesized that the students in the treatment groups would have significantly greater reading gains than those students in the control group. However, this was not the case. In this specific study, students who were given targeted Tier-II cognitive-based interventions did not have significantly greater reading gains than students who received traditional evidence-based Tier-II reading interventions.

Given that there are different criteria in measuring success, an exploratory analysis was completed that examined the difference in pass rates between the three groups. Two teacher outliers were eliminated in this analysis. In the control group, seven students failed the state assessment and eight students passed. Of these students, four were in special education and two of the students in special education passed. In the teacher trained group, eight students failed the state assessment and 22 passed. Of these students, six were in special education and none of the students in special education passed. In the tested group, 11 students failed the state assessment and 23 passed. Of these students, seven were in special education and four of the students in special education passed. Below is a table describing the pass rate percentage in each group:

Table 4

Pass Rates of the Posttest State Assessment

Group	Pass rate	Special Education Pass Rage
Control Group	53%	50%
Teacher Trained Group	73%	0%
Tested Students Group	68%	57%

In looking at the overall pass rates, both treatment groups had higher pass rates than the control group. In examining special education pass rates, students who were tested using the Woodcock Johnson III Tests of Cognitive Abilities and were given interventions tailored to their cognitive profile had higher pass rates than students whose teacher chose an intervention that he/she thought would be most tailored to the student's cognitive needs. This suggests that targeting interventions based on a student's strengths and weaknesses may be more beneficial to students in special education than giving interventions not tailored to their cognitive profiles. However, future research is needed to determine the extent to which cognitive-based interventions are helpful. It is also important that future studies examine the different criteria of success (e.g., gains in reading scores, end reading scores, fluency benchmarks, state assessment passage rates, etc.).

Two studies that examined targeted cognitive-based math interventions found mixed results. Naglieri and Johnson (2000) found that students who had a cognitive weakness in Planning showed much greater improvement when compared with students who had no cognitive weakness or a cognitive weakness in the areas of Attention, Simultaneous, or Successive. However, these results were not replicated by Kroesbergen

et al. (2003) in a study with a much larger sample size. Given the limited amount of studies examining targeted cognitive-based interventions and the different results from the studies, it is important to take the results obtained from our data with caution. Additionally, Fiorello et al. (2006) found that in a pretest/posttest measurement, targeted academic interventions helped increase a student's reading accuracy increased from 67% to 98%. However, our study was different in that we had ninety participants and the comprehensive assessment was not nearly as detailed. Furthermore, Fiorello et al. solely looked at accuracy rate and reading comprehension questions rather than reading questions from a State assessment.

This study has limitations that need to be considered when interpreting the results. First, the sample group consisted of a group of students in a rural area of Virginia that is not reflective of the general U.S. population. Therefore, it is difficult to generalize these results, and there may have been variables within this sample that influenced the results. Second, even though the schools were selected randomly, there could have been variables within the schools that impacted the students' scores (e.g. teaching style, time spent on the interventions, cultural factors within the schools, etc.). Ideally, the students, not the schools, would have been randomly selected and matched by student characteristic and background.

It is important that future studies continue to examine whether targeted cognitive-based interventions impact academic achievement. With such limited studies and mixed results from the studies, it is important to look at the factors that may be at play in helping students succeed. More research is also needed to further examine the best way to develop targeted cognitive-based interventions. For example, Fiorello et al. (2006) argue

that although CHC theory provides a strong foundation of identifying a student's cognitive strengths and weaknesses, it is important to also consider underlying neuropsychological processes. It may be that a single test of cognitive abilities is not enough information to determine the best targeted intervention and that other assessments, teacher input, and parent input be used to help target interventions.

Overall, the results of this study show that evidence-based Tier II interventions are effective at increasing reading scores, but given the limitations of this study, it remains unclear as to whether targeted cognitive-based interventions are more effective than traditional evidence-based interventions.

Appendix

IRB Approval Letter

MARSHALL UNIVERSITY
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Office of Research Integrity
Institutional Review Board
401 11th St., Suite 1300
Huntington, WV 25701

FWA 00002704

IRB1 #00002205
IRB2 #00003206

October 19, 2011

Fred Krieg, Ph.D.
Psychology Department

RE: IRBNet ID# 274494-1
At: Marshall University Institutional Review Board #2 (Social/Behavioral)

Dear Dr. Krieg:

Protocol Title:	[274494-1] Targeted Based Cognitive TIER II Interventions to Increase Student Achievement	
Expiration Date:	October 19, 2012	
Site Location:	MU	
Submission Type:	New Project	APPROVED
Review Type:	Exempt Review	

In accordance with 45CFR46.101(b)(2), the above study and informed consent were granted Exempted approval today by the Marshall University Institutional Review Board #2 (Social/Behavioral) Chair for the period of 12 months. The approval will expire October 19, 2012. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date.

If you have any questions, please contact the Marshall University Institutional Review Board #2 (Social/ Behavioral) Coordinator Michelle Woomer, B.A., M.S at (304) 696-4308 or woomer3@marshall.edu. Please include your study title and reference number in all correspondence with this office.

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