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IQ and targeted based cognitive tier II interventions

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IQ AND TARGETED BASED
COGNITIVE TIER II INTERVENTIONS

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By

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ABSTRACT

The purpose of this study was to examine the relationship between IQ and response to intervention. Thirty six students were administered the Woodcock Johnson III Tests of Cognitive Abilities (WJ-III) and assigned interventions based on the results. The IQ scores from the "tested' group were grouped by highest and lowest and then compared to the students' outcomes on the standardized reading assessment after all students had received the intervention. Results indicated that students in the high IQ group performed significantly better on the standardized reading assessment. The results also indicated a moderate positive correlation between the students' IQ and performance on the reading assessment. Further, results indicated that IQ significantly predicted the students' outcome on the reading assessment.

IQ and Targeted Based Cognitive Tier II Interventions

Chapter I: Literature Review

Intelligence and how it is used is a controversial topic within school systems. The question of, "What is intelligence?" has been discussed for over a century and the definition of intelligence is still being debated today. Regardless of its ambiguous nature, intelligence is still used in a variety of ways within the school system. When used correctly by educators, intelligence can be a valuable factor in making decisions that are in the best interest of the child. Specifically, school systems use a child's intelligence quotient (IQ) as part of a comprehensive evaluation in determining placement into special education. IQ is also sometimes used as a vital piece of information in assessing a child's behavior. However, IQ is most often used when it pertains to a child's academics. A child's IQ score is used in conjunction with a child's achievement prior to making any decisions about the educational needs of a child. A child who is experiencing learning problems will often be given an academic intervention in order to remediate the specific problem. A student who does not respond to academic interventions will most likely be evaluated before any decisions are made pertaining to the educational needs of the child. Prior to the intervention no evidence is collected to determine whether the child will successfully respond to the intervention. Determining a child's IQ score prior to academic intervention may predict how a child responds to the intervention (Vellutino, Scanlon, & Lyon, 2000).

A child's IQ score is most effective when it is assessed using a valid IQ assessment and is considered as part of a comprehensive screening along with a variety of other factors (Fuchs & Young, 2006). A team of educators should review all of the available data, including the results of an IQ test, in order to make informed decisions that will meet the child's learning need

Following the assessment, the progress of the student should be monitored and academic interventions should be used to target the specific learning weaknesses of the child (Fuchs, Mock, Morgan, & Young, 2003). Although it may come in many different forms and have a variety of titles; this comprehensive process will likely be used well into the future of the educational system. Currently, many states employ an instructional delivery model known as Response to Intervention (RTI).

Response to Intervention

Although it may take many different forms, RTI is used by hundreds of different school systems across the United States. The most common form of RTI involves three tiers: Tier I, Tier II, and Tier III. Tier I is general instruction provided to all students at grade level. Students, who do not respond to instruction at the Tier I level are then given additional, more specialized instruction at the Tier II level. Failure to respond at the Tier II level will likely result in the student being moved to the Tier III level and possibly receiving special education services (Brozo, 2009). The specialized types of instruction that students receive at Tier II and Tier III are known as academic interventions. One of the main goals of interventions is to increase achievement by providing specialized high intensity instruction. Interventions are designed to bridge the gap between intelligence and achievement (Fuchs et al., 2003). The types of interventions used vary by tier and are designed to target the specific discrepancies of each student. Interventions for students with reading difficulties are the most common and the most researched. Reading interventions in the early grades at the Tier II level have proven to be extremely effective at increasing reading achievement of students who are at risk for reading difficulties. Research has shown that reading interventions coupled with high-quality classroom reading instruction have proven so effective that less than 2-5% of first graders would remain at

risk for reading difficulties when such a program is implemented (McMaster, Fuchs, Fuchs, & Compton, 2005).

RTI has proven to be successful at bridging the gap between IQ and achievement through the use of targeted interventions (Rinaldi, Averill, & Stuart, 2011). Prior to RTI, intelligence was thought to play an important role in academic performance. Specifically, it was thought that a child with a low IQ was unable to learn. It was also thought that a child with a high IQ and low achievement has a learning disability. Research has shown that neither of these statements is completely true (Fuchs & Young, 2006). Although research shows IQ has less predictive properties than previously thought; IQ testing remains extremely important in identifying specific cognitive discrepancies and determining which interventions are needed by breaking down the overall IQ score into its individual components (Foley-Nicpon, Assouline, & Stinson, 2012). The literature does show that high IQ and low IQ students have different learning styles, process information differently from each other, and have structural neurological differences (Kelsay, Swerdlik & Reeder, 1985; Mills, 2003; Seung-Hyun, Soo Yong, Kyung Hee, & Kil-Jae, 2007). Therefore, understanding the differences between high IQ and average to low average IQ learners plays a crucial role in predicting how a student will respond to intervention.

Average and High IQ

The research in the area of IQ is clear in identifying a link between IQ and achievement. The research indicates that as IQ increases achievement increases and ultimately success in life also increases (Firkowska-mankiewicz, 2002). However, what is not clear is where to draw the line. Different studies use different IQ assessments with different cutoff scores to determine students with "high" IQ's. Therefore, assumptions have to be made when attributing learning

characteristics to students based on their IQ. Studies examining the relationships between learning characteristics and IQ should be interpreted with this understanding in mind.

Students with average to high IQ's often have different learning needs within the classroom when compared to students with lower IQ's. Assuming no discrepancies in the cognitive processes of a student with a higher IQ; it is likely the student will understand the information being taught more quickly and with better comprehension than his or her peers. Average to high IQ students are more likely than their peers to understand complex ideas and how several ideas connect to one another (Oakland, Joyce, Horton, & Glutting, 2000). Students with above average intelligence tend to favor more abstract concepts and themes within the curriculum than their peers. Research has also shown high IQ students are more flexible and open in regards to classroom instruction. High IQ learners also tend to appreciate logical interpretation and objectivity more than their non-high IQ peers (Mills, 2003). It should be mentioned that students from either group of high IQ or non-high IQ are just as diverse in many different areas such learning styles, interests, and personality traits; however, there are some patterns that appeared among high IQ students. Students who are intelligent tend to be more dedicated to obtaining knowledge and have a higher desire to learn. Although obtaining information visually through reading or hearing material is usually a stress-free way of procuring information for these students, many of them prefer hands on activities while learning such as labs, solving everyday problems, and learning from their environment. Many prefer working alone rather than in a group and do not need as much structure within the classroom. Thus, the general curriculum being taught to average learners in the classroom is not well suited for high IQ learners. High IQ students will often become passive in their learning habits and may even display undesirable behaviors (Thomson, 2010).

In addition to learning styles, there are also neurological differences between high IQ and low IQ students. There are results showing that there are differences in neuropsychological functioning when using EEG results to observe various patterns of brain function between high IQ individuals and people with average intelligence. During the examination of these patterns, it was discovered that high IQ individuals scored much higher on memorizing activities that those who had average intelligence. It was discovered that these two groups had very different brain patterns when being mapped with an EEG during memorizing tasks. Most of the brain patterns, in the high IQ individual took place in the right hemisphere of the brain (Seung-Hyun et al., 2007). Studies have also shown differences between high IQ and average IQ children in the anatomical features of the brain. One study showed a positive correlation with IQ and brain cell density (Haier, Jung, Yeo, Head, & Alkire, 2004). Another study illustrates that the speed of change in the thickness of the cerebral cortex over time was closely related to IQ. Specifically, the thickness of the cerebral cortex grew more rapidly in high-IQ children than low-IQ children; the prefrontal cortex was especially thicker in these children (Shaw et al., 2006).

Low IQ

Students with average to low average IQ have some differing traits than that of students with higher IQ's. Many of these students prefer learning in small groups with more direction and assistance from authority figures in more controlled surroundings when learning new information. Students in this IQ range use more concrete thought processes with very little open ended theories and abstract concepts. These students need more encouragement in order to continue learning. The literature indicates that self-concept does positively affect the learning process with students who have lower IQs, in various educational activities, than that of students with higher IQs (Thomson, 2010). Elementary grade level students, at a lower intelligence level,

are also more affected by how they feel about what is being learned, and how they relate to the information, referred to as "affective learning". Their self-concept directly relates to how they feel about the material being learned. It was found that the students, who "felt good" about the words being taught, learned the information more quickly than that of their high IQ peers. This has far reaching implications for teachers who need to present material to be learned in an affirmative manner to students who have lower IQs (Kelsay et al., 1985). Students with borderline intelligence seem to have significant difficulties with working memory and executive functioning. Working memory has been shown to be directly related to students who have reading difficulties. Students who had working memory impairments achieved below grade level in reading when compared to their peers unless appropriate interventions are implemented. Working memory affects classroom performance in remembering directions for assignments and finishing educational activities and assignments (Alloway, Gathercole, Kirkwood, & Elliott, 2009).

Low IQ scores can also be related to social skills and self-determination. Social skills and self-determination are needed for persons to have a better quality of life and which allows them to be included socially with others (Nota & Soresi, 2004). Lower intelligence has been directly linked to lower than average social skills. A person's social skill capabilities play an important role in a student's learning. Social skills have been shown to affect students' success in post-secondary achievement in education and careers (Elliott, 1988). Research indicates that self-determination, in regards to daily living tasks and commitments, is directly related to IQ. The more severe the intellectual delay the lesser the score of self-determination. Self-determination can be higher in individuals with low IQ if persons with lower intelligence are given decisions about their surroundings and their options that directly affect them (Stancliffe & Abery, 2000).

Neuroscience and IQ

Research of intelligence scores has shown that a person's IQ stays fairly consistent throughout a person's life. However, with the introduction of neuroscience, the study of brain maturation over the length of a person's life indicates that there are periods during a person's life where IQ may vary, especially during the ages of thirteen to nineteen years of age. Images of the brain illustrate that change in an adolescent's verbal IQ is directly linked to grey matter thickness in an area of the left motor cortex. This area of the brain is triggered by hearing speech. Non-verbal IQ was related to the thickness of the grey matter in the anterior cerebellum. This area is activated by the movement of the hand. This research shows that verbal and nonverbal abilities are directly connected to sensorimotor skills. Previous research demonstrates that general intelligence is directly linked to the anterior frontal and parietal regions. Therefore, it has been postulated that general intelligence may very well remain steady over time but fluctuations in the ability to execute specific tasks related to verbal and non-verbal intelligence are directly linked to fluctuations in sensorimotor skills (Ramsden et al., 2011).

High Stakes Tests and IQ

The research indicates that intelligence and self-control are the primary ways to surmise what content a student has mastered in school and the competence of the student. Over the last one hundred years it has been proven consistently that IQ predicts how successful a student will be in school. Self-control denotes the independent handling of one's own concentration to task, feelings, and actions or attitude. Self-control far outweighs the ability to predict achievement when compared to a child's learning capability (Duckworth & Seligman, 2005; Duckworth, Tsukayama, & Quinn, 2012). Self-control has a tendency to affect grades on a student's report card and not on high stakes testing. However, intelligence does play a role in achievement when

accessing information informally in an environment outside of school. Students with high intelligence attain more information and skills outside of school (Gottfredson, 2002). Intelligence can impact high stakes testing when the student is able to use higher functioning problem solving skills to unravel problems in relation to "figuring out" an answer that was not taught in the content of the classroom. This is one reason why the material being taught in the classroom must connect as closely as possible to the high stakes test being given. Educational systems are in the process of renovating academic goals and objectives by streamlining them to what is being taught in the classroom (Duckworth, et al., 2012).

IQ and Interventions

There have been varied findings when researching "the extent to which intelligence scores predict intervention response in treatment studies of children with reading difficulties" (Stuebing, Barth, Molfese, Weiss, & Fletcher, 2009). A secondary analysis of the research pertaining to interventions and intelligence revealed various results; while some studies indicated IQ is directly related to achievement others indicate IQ has no impact on achievement. Much of the research shows that discrepancy is not a significant forecaster of intellectual variance between low achieving children and children with a reading disability. This could due to varying definitions of a learning disability (Hoskyn & Swanson, 2000). Many states are still looking at the discrepancy model to determine students eligible for special education services. Many younger students do not have a big enough discrepancy between IQ and achievement until they have failed in the school system for one to three years (Stage, Abbott, Jenkins, & Berninger, 2003). Research has shown IQ did not affect outcomes of reading interventions in high IQ students (Share, McGee, & Silva, 1989). However, another study showed that superior IQs were related to better reading results (Rutter, & Yule, 1975).

Using a synthesized approach to reviewing the literature can assist in determining why some of the research has shown diverse outcomes when regarding the subject of the effects of intelligence on achievement. One synthesized study illustrated that IQ has a limited correlation with academic performance. In contrast, it demonstrates that low reading achievement can actually decrease IQ over a person's lifetime. Likewise, a theory of IQ determining the level of achievement cannot be supported (Hoskyn & Swanson, 2000).

Evaluating specific cognitive processes for recognizing learning characteristics of students with learning disabilities has been disputed amongst educators (Gresham, 2009). Even though there has been clear evidence that there are specific intellectual mechanisms "processes" in the brain that are directly related to learning various kinds of tasks. It is unclear of how useful the assessed information on these intellectual capabilities are to successful reading interventions (Vellutino, et al., 2004). When evaluating the results to intervention between those students who responded faster to intervention compared to students who responded more slowly, it was discovered that the "fast responders" initially had higher intellectual capabilities that relate to reading skills including "phonological awareness", "rapid naming" and "verbal working memory" than those of the "slow responders." When looking at verbal IQ and nonverbal IQ in relation to change in reading rate between these two groups, no correlations could be found in response to intervention based on these indicators (Vellutino, Scanlon, and Jaccard, 2003). Consequently, research seems to indicate that individual sub test scores that make up the verbal IQ and relate to reading make an impact on success in reading interventions compared to an overall verbal IQ score. When researchers analyzed verbal IQ along with another language skill, such as vocabulary knowledge, students' word identification increased. However, verbal IQ alone is not a good indicator of reading growth for real word or pseudoword reading in reading

intervention success. In addition, when studying reading progression in grades 1 through 9, studies indicate that students who have one or more deficits in language skills related to reading, such as "phonological awareness" and "rapid automatized naming" is the best indicator of students not advancing in their reading development. Overall, research shows that it is not necessary to include IQ when identifying children who may have early reading difficulties or may not respond as well to reading interventions (Stage, et al., 2003). However, it is found that "analyzing patterns of strengths and weaknesses" and using a "multifactorial view of intelligence" to see how children will learn reading concepts when given intensive intervention, has the most promising outlook when predicting student's success to intervention. This concept especially holds true for older students who need intense instruction in reading comprehension. It is less true for younger students who are trying to learn phonological awareness. When intelligence is broken down into its individual parts, it is extremely useful in assessing a student's rate of learning and how to teach a student by targeting their specific skill deficits. It assists in how to instruct the student in "bridging the gap" in achievement. The lack of literature illustrates more research needs to be done in order to better understand the impact of IQ on academic interventions (Fuschs, & Young, 2006).

It is extremely important to understand all of the differences between students with high IQ and average to low IQ prior to predicting how students will respond to intervention. These differences may include learning styles, social ability, emotional stability, and neurological structure. Although the research indicates there are correlations between IQ and these differences it is important to remember students can display a wide array of these factors regardless of their IQ.

Understanding the link between IQ and response to intervention could prove to be extremely important to educators. A better understanding of this link could lead to changes in the process of providing reading intervention, as well as, the specific types of interventions used in an educational environment. Further, this could also aid in determining the duration and intensity of intervention each student receives. An understanding of this link could also help aid in the selection of interventions. The connection between interventions and IQ needs to first be understood at its most basic level before more research can investigate the specific factors at work in the way a student responds to reading intervention. Do students with high IQs or low IQs respond better to reading intervention? The following study attempts to answer this question. It is hypothesized students with higher IQs will perform better than students with low IQs on the end of the year test after receiving a targeted reading intervention. Answering this question will help provide the groundwork for more specific research relating to IQ and interventions.

Chapter II: Method

Participants

As part of a larger study examining the effectiveness of interventions based in cognitive processing strategies, participants were selected from fifteen third grade classes in rural-urban area of Virginia. The primary selection criterion was based on the participants' performance on a pretest reading benchmark in which students scoring in the bottom third and not receiving special education services (Tier III) were included in the current study.

Measures

Participants were categorized using two characteristic variables: (a) students who had IQ scores on the Woodcock Johnson Test of Cognitive Abilities which fell in the top thirty percent of the tested group, (b) students who had IQ scores on the Woodcock Johnson Test of Cognitive Abilities which fell within the bottom thirty percent of the tested group. The General Intellectual Ability score on the Woodcock Johnson Test of Cognitive Abilities was used as the measure of overall intellectual ability. Achievement outcomes were derived from participant reading scores on the state of Virginia's curriculum-based standardized assessment (SOL).

Procedure

Students were administered the Woodcock Johnson III Test of Cognitive Abilities to determine deficit areas in each student's cognitive processing ability. Students were then assigned interventions (in which teachers were trained) matched to their deficit areas. Subsequent testing (SOL scores) determined differences between each group. Several statistical analyses were used to examine the relationship between IQ and SOL scores. IRB approval was obtained for this study. The IRB approval letter is located in the appendix.

Chapter III: Results

An independent-samples t test comparing the mean SOL reading scores of the low IQ and high IQ groups found a significant difference between the means of the two groups (t (20) = -2.511, p < .05). The results of this analysis are depicted in Table 1. The mean of the low IQ group was significantly lower (m = 395.18, sd = 71.632) than the mean of the high IQ group (m = 459.36, sd = 45.317).

Table 1
Results of t-test and Descriptive Statistics for High IQ and Low IQ groups SOL Reading Test Scores

	High IQ Group			Low IQ Group			95% CI for Mean Difference	t	df
	M	SD	n	M	SD	n			
Sol Reading Test Scores	459.36	45.31	11	395.1	71.6	11	117.493, 10.871	2.51	16.8

* p < .05.

A simple linear regression was calculated predicting students SOL scores based on their IQ. The results of this analysis are depicted in Tables 2.a and 2.b A significant regression equation was found (F (1, 20) = 8.902, < .01) with an R^2 of .308. Participants' predicted achievement is equal to 225.15 + 2.18 (IQ). The results of this analysis indicate that IQ was found to be a significant predictor of test scores. The results also indicated that IQ was found to account for 30.8% of the test scores. The Pearson correlation coefficient indicated a moderate positive correlation (r (20) = .555, p < .01), indicating a significant linear relationship between IQ and SOL reading scores. Student's with higher IQ's tended to perform better than students with lower IQ's. Therefore, the results illustrate that as IQ increased test scores increased. The regression analysis of the IQ and SOL scores can be seen in Figure 1.

Table 2.a
Coefficients with IQ as Predictor

Model		B	Std. Error	Beta	t	Sig.	95.0% CI for B	
							Lower Bound	Upper Bound
1	Constant	225.156	68.829		3.271	.004	81.581	368.732
	Retention	2.181	.731	.555	2.984	.007	.656	3.705

*a. Dependent Variable: Post-Test Scores

Table 2.b
ANOVA Summary of IQ as a Predictor

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29108.527	1	29108.527	8.902	.007[b]
	Residual	65395.837	20	3269.792		
	Total	94504.364	21			

a. Dependent Variable: SOL

b. Predictors: (Constant), IQ

Chapter IV: Discussion

The findings of this study suggest that IQ plays a significant role in whether or not intervention will be effective at increasing reading achievement, as measured by the Standards of Learning assessment scores. Specifically, students with higher IQ's who have received cognitive interventions at the Tier II level will likely have higher scores than students with lower IQ's who have received the same interventions. These results are somewhat surprising considering that previous research has indicated that an overall IQ score does not predict achievement in reading even after the students have received intervention (Share, McGee, & Silva, 1989; Hoskyn & Swanson, 2000). The previous research instead points to analyzing patterns of students' strengths and weaknesses within the framework of cognitive processing model as the best way to predict whether a student will successfully respond to intervention (Vellutino et al., 2003; Fuschs, & Young, 2006). Specifically, previous research has indicated that looking at the areas of rapid automatized naming and phonological awareness are better predictors of students' response to intervention than an overall IQ score (Stage, et al., 2003).

It was hypothesized that students with higher IQ's would perform significantly better than students with lower IQ's on their SOL reading assessment after receiving intervention. The results were in contrast to many of the studies previously conducted on the subject of IQ in relation to intervention. However, these studies did not use a broad cognitive assessment to obtain an overall intelligence score (Share, McGee, & Silva, 1989; Hoskyn & Swanson, 2000). It was thought that the use of an assessment based on the theory of a cognitive processing model would yield an overall intelligence score that better predicted students' response to intervention. This is consistent with previous research (Vellutino, et al.; Fuschs, & Young, 2006; Stage, et al., 2003).

The results of this study indicate that students with higher IQ's had significantly higher scores than students with lower IQ's on the SOL reading assessment. These findings support the hypothesis. However, these results are in contrast to the previous research which indicated an overall IQ score would not be a factor in students' response to intervention (Share, McGee, & Silva, 1989; Hoskyn & Swanson, 2000). The results of this study also indicate that there is a moderate positive correlation between the students' IQ and SOL reading scores. This suggests that the student's IQ and SOL reading scores are related in some way. The results of this study also found IQ to be a significant predictor of SOL reading test scores. However, IQ only accounted for 30.8% of the test scores. This indicates that there are other variables which contribute to the students' scores on the SOL reading assessment.

When interpreting the results of this analysis there are a few limitations that must be taken into consideration. First, the sample of students selected from a school system in Virginia may not reflect the overall population of other students in the United States. This limits the ability of the findings to be generalized. Second, the number of students in this study was 22. A larger number of students may reflect different results. Third, the students in the study were given different cognitive interventions based on identified areas of cognitive weakness. The specific types of interventions were not controlled for in the study. These factors should be taken into consideration.

Future research should include an examination of the effectiveness of varied cognitive interventions on students with both high and low IQ's. Previous research indicates that weaknesses in individual cognitive processes may effect a students' responsiveness to intervention more than an overall intelligence score (Vellutino, et al., 2003; Fuschs, & Young, 2006). Further studies examining cognitive weaknesses and cognitive interventions designed to

target these weaknesses may yield important results in understanding students' responsiveness to intervention and overall achievement. Individual cognitive weaknesses could also be examined to determine the amount of intervention needed to increase achievement. Future studies should also examine the relationship between achievement and various learning styles. Studies have also shown that previous grade retention is correlated with low student SOL reading scores (Billups, 2013).

This study found that students with higher IQ's performed better than students with lower IQ's on a reading assessment. These findings contradict previous research that indicates a student's overall IQ score does not significantly predict how the student will respond to intervention. This study indicates that IQ may significantly impact how a student responds to intervention and how their reading achievement is impacted by their IQ score. This study also illustrates the need for more research to be conducted on the role of intelligence and response to intervention. Understanding the role intelligence within an RTI framework may help future educators predetermine how a student will respond to intervention. An understanding of this role will also help play an important part in increasing a student's overall achievement.

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Appendix

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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 17, 2012

Fred Krieg, Ph.D.
Psychology Department

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

Dear Dr. Krieg:

Protocol Title: [274494-2] Targeted Based Cognitive TIER II Interventions to Increase Student Achievement

Expiration Date: October 19, 2013

Site Location: MU

Submission Type: Continuing Review/Progress   APPROVED
Report
Review Type: Exempt Review

The above study was approved for an additional 12 months by the Marshall University Institutional Review Board #2 (Social/Behavioral) Designee. The approval will expire October 19, 2013. Since this approval is within 30 days of the expiration date, the fixed anniversary date of 10/19 was maintained. Continuing review materials should 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.