8-1-2014

Effects of Internalizing Behaviors on Processing Speed and Academic Fluency

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EFFECTS OF INTERNALIZING BEHAVIORS ON PROCESSING SPEED AND ACADEMIC FLUENCY

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A dissertation submitted in partial fulfillment of the requirements for the

Doctor of Philosophy - Educational Psychology

Department of Educational Psychology and Higher Education
College of Education
The Graduate College

University of Nevada, Las Vegas
August 2014

UNLV
UNIVERSITY OF NEVADA LAS VEGAS

Dissertation Approval

The Graduate College
The University Of Nevada, Las Vegas

DEFENSE DATE: MAY 6, 2014

This dissertation prepared by

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entitled

Effects of Internalizing Behaviors on Processing Speed and Academic Fluency

is approved in partial fulfillment of the requirements for the degree of

Doctor of Philosophy – Educational Psychology

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Abstract

This study explored the relationships between internalizing behavior problems, processing speed and academic fluency. Internalizing behaviors are behaviors typically associated with depression and anxiety, such as withdrawal, somatization, and excessive worry. This study focused on the impact of these behaviors on an individual's ability to efficiently process information, as well as perform simple academic tasks quickly. The following measures were used: WISC-IV Coding and Symbol Search scores as a measure of processing speed, WJ-III Tests of Achievement Math Fluency and Reading Fluency scores as measures of academic fluency, and BASC-2 Parent Rating Scale scores for internalizing behaviors. Data gathered from 137 participants ages 8 to 12 were analyzed to determine what types of relationships exist between these three variables. It was expected that (1) internalizing behaviors negatively impact both processing speed and academic fluency; (2) a significant relationship exists between processing speed and academic fluency; and (3) high levels of internalizing behaviors mediate the relationship between processing speed and academic fluency. Results of regression analyses confirmed a predictive relationship between processing speed and academic fluency, but a significant relationship was not found between internalizing behaviors and processing speed, nor internalizing behaviors and academic fluency. Given these results, evidence of internalizing behaviors as a mediator between processing speed and academic fluency was not established.

Acknowledgements

I would like to thank all of my committee members for their feedback, patience, and support as I worked my way through this long journey. I would most especially like to thank Dr. Paul Jones for his guidance, wisdom, encouragement, and lengthy but entertaining personal anecdotes. Without him, I would never have made it to this point.

I want to thank Austin and Elana Nichols for their vital contributions in this process. Austin, thank you for all the chats about statistics and for not making me feel stupid, even though you know so much more than I do. Elana, thank you for your sunshiny personality, your undying faith in me, and for always making me feel like a champion. Without you both, I would have given up on this and started a career folding jeans at Old Navy.

I would also like to thank my fellow doctoral students and best friends, Leslie Hughes and Jill Cohen. Writing a dissertation requires group therapy. Thanks for commiserating with me in person and via text, eating lots of cheeseburgers and donuts with me to relieve stress, and passing notes to me during class to keep me awake. The most important and valuable things I have gained from this program are my friendships with the two of you.

Finally, I would like to thank Taco Bell. Without frequent trips through your drive-thru to get Mountain Dew Baja Blast and nachos, I would never have had the energy to stay awake through my long writing sessions. You are the best.

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Chapter 1: Introduction

In an increasingly demanding academic world, the contribution of speed to learning should be attracting more attention. Students are now expected to achieve higher level educational goals more rapidly and at earlier ages. Whereas in the past expectations for kindergartners did not typically extend beyond mastery of simple tasks such as identifying shapes and coloring within the lines, the new Common Core: State Standards Initiative requires kindergartners to solve addition and subtraction word problems by year's end ("Common Core: State Standards Initiative," 2010). Yesterday's first graders aimed to learn their letters and sounds, but according to the University of Oregon Center on Teaching and Learning's DIBELS Data System, today's first graders are expected to orally read 69 correct words per minute (2012). In order to keep up with the pace and complexity, students need to be able to perform basic academic skills fluidly and accurately.

The ability to perform basic academic skills fluidly and accurately is a construct referred to as *academic fluency*. Academic fluency relies on several operational components, including efficient processing of visual information, working memory and long term memory abilities, and executive functioning skills (Benner, Allor & Mooney, 2008). These components work together to allow one to accurately respond to basic reading, mathematical, and written language stimuli with automaticity (Woodcock, McGrew & Mather, 2001).

While the general pacing of the curriculum demands speed from students, research also shows that in general, academic achievement increases when basic academic skills are fluent. This is evident in the areas of both reading and mathematics achievement. The National Reading Panel decreed that more instructional attention

should be directed towards the development of reading fluency, which is the ability to read with speed and accuracy (2000). Reading fluency is considered to be a trait of skilled readers that facilitates improved reading comprehension. A meta-analysis of other studies examining this relationship confirmed that reading rate leads to improved reading comprehension and achievement (Jodai & Tahriri, 2011).

While the primary focus has been on reading, research is beginning to emerge on the importance of math fluency. Children who have been identified with learning disabilities in mathematics typically perform basic calculations more slowly than students with higher achievement in math (Cowan, Donlan, Shepherd, Cole-Fletcher, Saxton, & Hurry, 2011). Theories behind this suggest that being able to perform basic math calculations with automaticity frees up cognitive resources which can then be used to focus on the remaining calculations of multi-step math problems (Axtell, McCallum, & Bell, 2009).

Processing Speed and Academic Fluency

As stated above, one of the factors contributing to academic fluency is efficiency of processing. Processing speed is also becoming increasingly relevant as the intensity of academic expectations increases, though its precise role in the learning process is still under investigation. As a construct measured by cognitive assessment batteries, processing speed is generally understood to be the ability to perform cognitive tasks automatically and efficiently (Schrank, Flanagan, Woodcock, & Mascolo, 2002). This ability requires more than just speed; it also requires sustained attention and the ability to attend to only relevant stimuli and shut out distracters.

Why is speed so important? It facilitates the function of other cognitive abilities, such as working memory. If information is processed more quickly, more input can be retained in working memory during a short span of time (Passolunghi, 2011). Just like a fast processor in a computer facilitates the overall functioning of the machine, faster processing in the brain facilitates overall cognitive functioning by leaving more space and resources available for storage of information. Studies have found that processing speed impacts both memory span and cognitive development in children (Bjorklund, 2005). When processing is slower and more effortful, as it is for children at younger ages, it is assumed that more of the limited capacity of cognitive resources is used. As processing speed develops with age, children will theoretically increase their available cognitive resources as they progress through their education, allowing them to perform more complex mental tasks. However, students identified as having a limited speed of processing are more likely to consistently experience slower rates of learning and performance, difficulty comprehending new information, and overall mental fatigue (Calhoun & Mayes, 2005).

Given the commonality of automaticity and speed in the two constructs, it would be logical to assume a relationship exists between processing speed and academic fluency. Cattell-Horn-Carroll (CHC) models connecting broad factors to narrow abilities show processing speed as a contributing factor for reading, math, and writing fluency (McGrew & Woodcock, 2001). Further, studies on the Woodcock-Johnson III show that processing speed correlates with academic fluency scores more significantly than any other cluster scores.

Based on these models and findings, it would be easy to assume that the relationship between processing speed and academic fluency is always direct and linear. If a student's assessments indicate a high processing speed, but poor academic fluency, psychologists may assume the student has not yet mastered the academic task to automaticity. This type of assumption is logical and follows the relationships posited by the CHC model (McGrew & Woodcock, 2001), but what if there is more to this relationship? What could explain the relationships that do not follow the logical syllogism – such as a student with a low processing speed score, but a high academic fluency score? What if other variables are playing a role in this relationship – variables which could be modified?

Internalizing Behaviors

Behavioral factors may be considered in evaluations for learning problems, but the exact nature of the relationship between social/emotional factors and cognitive factors is not yet clearly established (Hale & Fiorello, 2004). As studies first emerged about the construct and contributions of processing speed, it was suggested that it is related to variables of personality and behavior and not solely neuropsychological variables (Kaufman, 1994). This indicates a possible connection between processing speed and social/emotional factors.

Though the nature and strength of the relationship is not yet well-defined, educational research has shown a relationship between anxiety and achievement in school (Durbrow, Schaefer, & Jimerson, 2000; Grills-Tacquechel, Fletcher, Vaughn, & Stuebing, 2012). Anxiety encompasses characteristics should as excessive worry or fears, nervousness and self-deprecating thoughts (Reynolds & Kamphaus, 2004). There

are both cognitive and emotional aspects to anxiety (Ormrod, 2008). Cognitively, an anxious state typically involves troubling thoughts, worries, and doubts about being able to handle a particular situation.

The emotional or affective part of anxiety can present itself physically, with an increase in muscle tension, heart rate, and perspiration. Other physical symptoms associated with anxiety are somatic complaints, or an oversensitivity and propensity to report the occurrence of minor physical ailments (Reynolds & Kamphaus, 2004). Anxiety can be a temporary state brought on by a specific situation, such as solving a challenging math problem or reading aloud in front of peers. Anxiety can also be more pervasive, such as with specific phobias (i.e. math, heights, spiders, etc.) or generalized anxiety disorders.

In regards to learning, research indicates that the optimal level of anxiety tends to be higher for simple tasks and lower for difficult tasks (Ormrod, 2008). Anxiety can be facilitating by raising arousal for tasks or debilitating by interfering with performance. Is there an optimal level of anxiety to maximize processing speed? Could the cognitive elements of anxiety tax a child's limited ability to process information quickly and subsequently become an obstacle to a child's learning?

Even though evidence exists that children with learning problems often have a variety of co-morbid social/emotional problems such as anxiety, the research exploring the relationship between anxiety and academic functioning is still rather limited (Grills-Tacquechel et al., 2012). Some preliminary research has emerged investigating this potential cognitive interference, with some arguing that anxiety contributes negatively to cognitive efficiency (Passolunghi, 2011), but the results have led to competing theories,

leaving the specifics of the relationship between anxiety and cognition undetermined (Vytal, Cornwell, Arkin, & Grillon, 2012). Students exhibiting a combination of achievement difficulties and anxiety problems may require a more complex intervention, making this a relationship worth exploring.

Following this same line of thinking and research, it is possible that other related emotional and behavioral problems could cause cognitive interference. Anxiety frequently co-occurs with depression, an emotional problem that also has cognitive components (Reynolds & Kamphaus, 2004). Maladaptive thoughts pertaining to self and one's potential are a key element of depression, along with dysphoric mood, withdrawal from others, feelings of loneliness or sadness, self-reproach, somatic complaints, and an inability to enjoy life. Those dealing with depression typically exhibit lower levels of arousal, energy and motivation (Calhoun & Mayes, 2005). Decrease in school achievement is considered to be a key expression of childhood depression (Reynolds & Kamphaus, 2004), once again linking emotional factors with academic performance.

Depression, anxiety and associated somatic complaints are referred to as *internalizing behaviors*, or behavior problems that are not marked by overt actions (Reynolds & Kamphaus, 2004). Students with this type of behavior problems draw less attention than those with externalizing behaviors for obvious reasons. Unlike the easily observable acting out associated with students with externalizing behaviors, internalizing students overly control their behavior and excessively monitor their actions. Their behavioral hyper-vigilance may keep them under teachers' radar, but they will eventually draw attention to themselves if the associated expense of cognitive resources leads to low academic performance.

Internalizing behaviors may possibly cause or correlate with cognitive deficits (Hale & Fiorello, 2004). Ignoring the contribution of internalizing behaviors may lead to students being mislabeled as slow or inattentive learners. Depression and anxiety have each been linked to lower processing speed (Calhoun & Mayes, 2005; Snyder, 2013; Pussolunghi, 2011). Processing speed has been theoretically tied to academic fluency (McGrew & Woodcock, 2001). Academic fluency contributes to academic achievement (Benner, Allor & Mooney, 2008; Jodai & Tahriri, 2011). What remains to be determined is specifically how internalizing behaviors, processing speed and academic fluency interact and subsequently contribute to learning and achievement.

In order to effectively help students, educational professionals must identify the underlying learning obstacles, not just the academic manifestations of the problem. This allows intervention to take place not only on the academic level, but leads to further interventions addressing psychological barriers, which may be cognitive and/or social/emotional in nature. With more specific and appropriate service plans, students may be able to experience more wide-range, long-term success. Before this step can be taken, more research is needed on the interactions between cognitive ability, emotional problems, and academic achievement.

Purpose of Study

This study will address the following primary research questions: 1) Does a significant relationship exist between a subject's internalizing behaviors and performance on processing speed measures? 2) Does a significant relationship exist between a subject's internalizing behaviors and performance on academic fluency measures? 3) Does a significant relationship exist between a subject's processing speed and academic

fluency? 4) To what degree do internalizing behaviors mediate the relationship between processing speed and academic fluency?

Hypotheses

It is expected that high levels of internalizing behaviors will negatively impact a subject's processing speed and academic fluency due to interference from the cognitive components associated with these behaviors. Given the similarity of the two constructs, it is expected that significant relationship will exist between processing speed and academic fluency. It is also predicted that internalizing behaviors will mediate this relationship and that high levels of internalizing behaviors will be present in subjects whose processing speed and academic fluency performances do not correlate.

Assumptions

It is assumed that all assessment instruments used in the collection of the archived data were administered with fidelity and that true and accurate responses were provided on questionnaires. It is also assumed that the data and scores resulting from the assessments were entered into the database with accuracy.

Limitations

This study is limited by the sample of subjects. The sample was derived from archived data gathered from a private practice. Subsequently, subjects could not be randomly selected. The data was collected on subjects who had been referred for evaluations, so students who had not been referred for any type of evaluation were not included in the sample. Also, all subjects in the sample lived in a large, metropolitan area, so the findings of this study may not generalize to populations living in more rural settings.

The study is also limited by the assessments. Parent rating scales were used as a measure of emotional/behavioral problems. Such scales rely upon responses from participants' parents, which may be influenced by social desirability, personal bias, desire to inflate scores, amount of attention and thought given to items, etc. Subjects were not directly observed or interviewed as part of this study to provide any corroborating evidence of emotional distress. It is assumed that the assessments of processing speed and academic fluency were administered in settings that were novel or unfamiliar to subjects, which may have impacted their levels of anxiety and motivation during testing.

Implications

This study could potentially contribute to a greater understanding of students' processing of simple information. An integral part of a school psychologist's job is to investigate possible reasons for a student's lack of achievement, which requires assimilating information from a variety of assessments (cognitive, academic, social/behavioral, etc.). This daunting puzzle could be made easier if more evidence comes to light about how all the pieces fit together. Existing research shows a relationship between emotional and academic functioning, but is this relationship evidenced in assessment tools used by school psychologists?

More knowledge about the interplay between cognitive, academic and emotional factors will provide school psychologists with a research base within which they can better interpret a student's comprehensive evaluation. Misunderstanding assessment results increases the likelihood of misidentifying weaknesses and problems. A processing speed deficit has been identified as an indicator of a learning disability (Hale & Fiorello, 2004), but what if low scores on processing speed tasks result from other

factors, such as anxiety provoked by timed tasks, lack of arousal and motivation associated with depression, or preoccupation with other worries, rather than a lack of cognitive ability? Cognitive ability is typically seen as stable (Flanagan & Kaufman, 2005), but internalizing behavior problems can potentially improve with proper treatment and intervention. There will always be individual differences to consider, but identifying generalities or frameworks within which to evaluate results will facilitate more accurate interpretations. More specific explanations and identification of problems will subsequently lead to more appropriate educational planning.

Chapter 2: Background Literature

Academic learning is a complex process. Many factors contribute to students' performance in school. Decades of educational research have focused on uncovering these factors and determining their roles in the learning process. The purpose of this review of literature is to synthesize the existing bodies of research on the roles of processing speed, academic fluency, and internalizing behaviors, as well as relationships between each of these three factors.

Impact of Processing Speed and Academic Fluency on Achievement

Being able to process information quickly and accurately is an important skill in academics. Students are constantly presented with visual information in the classroom, whether it is letters in a text or numbers in a math problem. Having efficient processing speed allows students to fluently perform basic academic skills such as identifying words or calculating math facts with automaticity instead of conscious effort. This enables them to focus more of their attention on the more complex aspects of academic tasks such as comprehending written text or solving a multi-step math problem (Benner, Allor & Mooney, 2008). Given these assumptions, a combination of adequate processing speed and academic fluency should be contributing factors driving student achievement.

Neuropsychological research also suggests that deficits in academic achievement can result from an underlying deficit in processing (Hale & Fiorello, 2004). The Woodcock-Johnson assessment model based on CHC theory shows a significant link between processing speed ability and achievement in reading and math (Schrank et al., 2002). Research on this model indicates that efficient speed of processing is essential for achievement in reading, writing, and math in all years of schooling. Limited or impaired

processing speed can cause an individual to more slowly perform simple cognitive tasks. They will likely require more time to learn and retain new material and to make accurate conceptual decisions. These individuals are also more likely to become overwhelmed when presented with complex tasks or events and will require more response time for tasks, even those that they have practiced repeatedly. All of these implications of an impaired processing speed will directly impact one's ability to be successful and achieve in school.

A study in 2000 provided evidence that students who struggle to keep up with the pace and demands of school more easily overload their visual processing systems (Weiler, Harris, Marcus, Bellinger, Kosslyn & Waber, 2000). The study compared the performance of struggling students referred for evaluations to the performance of normally achieving students on a visual filtering task. The task was hierarchically designed to add operational components as it progressed. The significantly slower response times of students who had been referred suggested that they were more vulnerable to processing overload.

Furthermore, response times on the task were found to be reliable predictors of academic and cognitive abilities, but the most reliable predictor was membership in the referred group, establishing a connection between inefficient processing and learning difficulties. A 2001 study resulted in similar findings, showing that students with reading disabilities demonstrated slower rates of visual processing than students with normal reading achievement (Kruk & Willows, 2001).

Many factors can potentially explain why a student is a struggling reader and processing speed may be one of them. Catts, Gillispie, Leonard, Kail, and Miller

examined this possibility in 2002. Comparisons between third grade reading ability groups indicated that students performing poorly in reading also had more difficulty on measures of response time and rapid naming. Struggling readers' poor performance on both linguistic and non-linguistic response time measures suggests that a general deficit in processing speed may be the source of interference on rapid naming tasks, as opposed to other potential factors such as language skills. Some theories have gone so far as to conclude that a deficit in processing speed is the primary cause of dyslexia (Nicolson & Fawcett, 1999). There is still a need for more research to understand the exact connection, but overall this study found that processing speed is responsible for some specific variance in achievement in reading.

This connection between speed and reading achievement may be explained by the significant correlation between reading fluency and reading comprehension (Rasinski, Rikli & Johnston, 2009). Winn, Skinner, Oliver and Hale found that adults who were struggling with literacy skills had poor reading fluency, referring to the ability to read with speed and accuracy (2006). Instruction focused on improving these adults' reading fluency skills led to improvement in overall literacy. This supports the importance of automaticity in the basic skills such as word reading allowing more time and brain "workspace" to retain and process the meaning of the text.

This relationship between speed and academic achievement is not limited to achievement in reading. Children identified with math learning disabilities show impairment in processing speed (Passolunghi, 2011). When administered the Symbol Search task on the Wechsler Adult Intelligence Scale, Third Edition, fourth-grade students with severe difficulties with math calculations showed an overall slower

processing speed. Evidence from this study supported the posited idea that speed of processing affects the overall efficiency of the memory system and corroborated previous studies also demonstrating a lower processing speed in children with math disabilities (D'Amico & Passolunghi, 2009; Swanson & Beebe-Frankeberger, 2004).

Axtell, McCallum and Bell added to this body of research in their 2009 study focusing on development of math fluency. Based on prior studies, they noted multiple advantages for students with high math fluency: (1) higher ability to solve increasingly complex math problems (2) higher performance on achievement tests measuring skill development (3) higher ability to maintain learned skills over time (4) less math anxiety and (5) higher preference for math activities. These advantages make a strong case for the importance of math fluency, but again, more research is needed to the specifics of its contribution.

Cowan, Donlan, Shepherd, Cole-Fletcher, Saxton and Hurry conducted a study in 2011 to explore the relationship between proficiency in math calculations and math achievement. Along with looking at strategy models used in calculation, Cowan et al. also considered relevant factors such as working memory, processing speed, and language skills. They studied a sample of second and third grade children by administering a variety of calculation tasks which allowed them to explore both efficiency and strategy use. To assess processing speed, they administered the Pair Cancellation task from the Woodcock-Johnson Test of Cognitive Abilities – Third Edition and the Symbol Matching task from the Wechsler Intelligence Scale for Children, Third Edition.

Results of Cowan, et al (2011) further indicated that basic calculation proficiency was linked with conceptual knowledge, supporting the original idea that math fluency and achievement are connected. Results also suggested that working memory proved to be an explanatory factor for differences in math achievement, serving as a mediator between basic calculation skills and overall achievement. The role of processing speed was limited to accounting for variation in basic calculation.

Prior to this study, research findings were mixed regarding the role of processing speed in mathematics performance. While some studies show that processing speed is not a significant factor contributing to math fact retrieval (Geary, Hoard & Bailey, 2012), the findings of other studies corroborate the results of Cowan et al. (Fuchs, Fuchs, Compton, Powell, Seethaler, Capizzi & Fletcher, 2006).

This line of research established the link between basic calculation proficiency and conceptual knowledge, but it is important to note that the two are separate and cannot be treated as the same. A 2005 study focusing on math intervention showed that students improved in computation and knowledge after participating in a 16 week tutoring program, but did not increase in math fluency (Fuchs, Compton, Fuchs, Paulson, Bryant & Hamlett, 2005). The study also implicated working memory and phonological processing as contributors to performance in all aspects of mathematics. If similar cognitive processes underlie the different areas of math achievement, it would be logical to assume that similar interventions would effectively improve all areas. Since this study showed that an intervention was effective for all areas except math fluency, it is possible that there are other factors contributing to math fluency that have yet to be identified.

Evidence from a recent twin study (Petrill, Logan, Hart, Vincent, Thompson, Kovas & Plomin, 2012) suggested that while math fluency is related to other untimed math measures, it is etiologically different. The study used a sample of 314 sets of 10-year-old twins, and assessments were administered in home visits. Reassessments were administered a year following the original visits. Results of the study indicated that both math fluency and untimed math measures were influenced by home environment and genetic factors, but approximately two-thirds of the variance in math fluency was independent from the untimed math measures, as well as from reading measures and reading fluency measures.

These findings support the claim that math fluency is a unique ability. Knowing all the advantages associated with math fluency, understanding more about it will help educational professionals learn to develop it in students. Once again, though studies imply a connection between processing speed and math achievement, the exact nature and direction of the connection is not yet defined. Students with math disabilities typically show slower performance in basic calculations, but does a general impairment in processing speed lead to this impaired academic fluency?

What is the relationship between processing speed and academic fluency? Cowan et al. (2011) found that processing speed was related to math fluency. A connection has also been made between processing speed and reading fluency. A 2001 study by Torgeson, Rashotte and Alexander indicated that processing speed and the more specific ability to process sight words quickly were factors affecting reading fluency. These findings add weight to existing CHC ability models indicating a direct impact of

processing speed on academic fluency. However, the research on the interactions between these two constructs is still limited.

Impact of Internalizing Behaviors on Achievement

Other factors may be contributing to this relationship between processing speed and academic fluency, such as social-emotional factors. Before one can make a case for such contributions, a link between social-emotional problems and achievement should be established. In a study comparing the reading achievement scores of students with emotional-behavioral disorders (EBD) and students with learning disabilities (LD), students with LD showed significant improvement over the span of five years, while the students with EBD failed to show adequate improvement (Anderson, Kulash, & Duchnowski, 2001). This evidence suggests that there is a relationship between emotional functioning and academic functioning that should be considered when developing and providing services and intervention. Though students with EBD fell short of their average peers in language and academic skills, no specific learning disabilities had been verified in these students (Benner, Allor & Mooney, 2008), leaving the question open of what factors led to their lack of achievement.

Another study examining the relationship of academics and EBD was conducted by Nelson, Tanner, Lane and Smith in 2004. Nelson et al. studied a sample of students who had been classified with EBD to determine the contribution of problematic externalizing (i.e., aggression, delinquency, attention deficits) and internalizing (i.e., withdrawal, anxiety, depression) behaviors to achievement in several academic areas. Multiple regression analyses indicated that 37% of the variance in the mathematics achievement of students with EBD was accounted for using the internalizing and

externalizing scores derived from a teacher's responses on behavior rating scale (Achenbach System of Empirically Based Assessment – Teacher Rating Form). Overall, the study showed that students with EBD who showed problematic externalizing behaviors were more likely to have poor academic achievement than students who exhibited internalizing behaviors. Nelson et al. (2004) reported that the findings of this study supported the results of previous studies linking conduct problems and attention deficits to achievement in academics (Abikoff et al., 2002; Lane, O'Shaughnessy, Lambros, & Gresham, 2001; Mattison, Spitznagel, & Felix, 1998).

Does this rule out internalizing behaviors as potential factors impacting academic achievement? Many children may actually present with learning problems that disguise co-morbid social-emotional problems (Hale & Fiorello, 2004). Internalizing behaviors are easily disguised, since by definition they are not overt. Internalizing problems such as excessive worry and preoccupation with other thoughts, lack of motivation and arousal, negative perceptions of self and the world, fearfulness, nervousness and so on can go easily undetected. However, there is evidence that children who show deficits in nonverbal learning and in math achievement are more likely to have co-morbid internalizing behavior problems (Rourke, 2000). The same connection has been made with students with reading disorders (Willcutt & Pennington, 2000).

The question that remains is the directionality of the connection. Do students develop internalizing behavior problems as a result of the learning difficulties? Or can internalizing behaviors themselves actually lead to learning problems?

Grills-Tacquechel et al. reviewed the impact of anxiety on achievement (2011). One model presents anxiety as interfering with learning, resulting in a negative impact on

achievement. Anxiety may lead to impaired problem-solving skills and a weakened memory state (Bryan, Burstein & Ergul, 2004) which would make learning and retaining new information more difficult. Other studies have found predictive relationships between high levels of anxiety and poor achievement in academics (Everson, Smodlaka & Tobias, 1994; Ialongo, Edelsohn, Werthamer-Larsson, Crockett & Kellam, 1994; von der Embse & Hasson, 2011; Owens, Stevenson, Hadwin, & Norgate, 2012;).

Another possible model presents a bi-directional relationship between anxiety and achievement (Yasutake & Bryan, 1995). In this model, anxiety and achievement work in a negative cycle. For example, poor school performance may lead a student to experience symptoms of anxiety such as worry, fear or nervousness, particularly in school settings. This worry, fear or nervousness would then subsequently interfere with new learning and perpetuate the lack of achievement.

In some cases, the internalizing behaviors are specifically associated with academics, such as with math anxiety. Math anxiety refers to fear or apprehension that leads to impaired math performance (Passolunghi, 2011). Individuals with math anxiety typically experience intense worry and distress when required to perform mathematical tasks or attending math courses. The relationship between math performance and anxiety is likely bi-directional. However, a meta-analysis of research shows that if the anxiety symptoms are treated, performance in math calculations improves, even in the absence of explicit math instruction (Ashcraft, 2002).

While there is evidence of a link between internalizing problems and achievement, there are still many questions left unanswered. The models of this link rely on the theory that cognitive components of emotional problems such as worry and

preoccupation interfere with cognitive processes necessary for achievement. Processing speed is a cognitive process tied to achievement that relies on sustained attention and focus. Could this interference from internalizing behaviors interfere with processing speed and the ability to fluently perform simple cognitive and academic tasks, subsequently leading to decreased achievement?

Impact of Internalizing Behaviors on Speed

The potential relationship between EBD and cognitive functioning is frequently overlooked, despite the fact that children who experience EBD are more likely to also have brain-based disorders (Hale & Fiorello, 2004). Recognizing the interplay between brain and behavior in an academic context is essential for school psychologists. In this case, the question presented is how internalizing behaviors may be affecting the speed and efficiency of brain-based processing of information.

Children exhibiting symptoms of depression have been found to have difficulties with attention, working memory and executive functioning (Lichter & Cummings, 2001; Landro, Stiles & Stevold, 2001), all of which are factors associated with speed of information processing. In a neuropsychological study of internalizing behaviors, children with depression and anxiety were shown to use different areas of the brain requiring more effort when completing problem solving tasks, instead of simply relying on automatic processing (Mayberg, 2001). The areas used instead were the dorsolateral prefrontal cortex and Broca's area, which indicate that these children were engaging in internal self-talk and pondering, both of which detract from performing tasks more efficiently.

Some studies indicate that some level of anxiety can actually improve processing speed by increasing motivation to perform the task well (Calhoun & Mayes, 2005). However, depression typically has the opposite effect, given the fatigue and lack of motivation that is symptomatic of this syndrome. Children with depression were found to have consistently low scores on processing speed indexes (Snyder, 2013). Beyond the cognitive testing setting, these motivation and attention factors are presumed to trump any effects of cognitive strengths or weaknesses identified in test results, again stressing the potentially overriding impact of internalizing behaviors (Schrank et al., 2002).

While anxiety can sometimes facilitate processing speed, this is not always the case. High cognitive load could actually be considered therapeutic for people with certain types of chronic anxiety, providing a welcome distraction (Vytal, Cornwell, Arkin & Grillon, 2012). This theory may apply to some cases, but there is evidence to suggest that it does not apply to all. In particular, subjects who were identified as having social anxiety or post-traumatic stress disorder demonstrated marked cognitive impairments in both executive functioning and working memory.

When administering processing speed subtests on cognitive assessments, examiners are encouraged to look for signs of anxiety (e.g. – shaky hands, heavy pressure on paper, overly tight grasp of pencil), as factors of anxiety are presumed to influence performance on the tasks (Flanagan & Kaufman, 2005). Processing speed tasks require the ability to perform under the constraints of time. This can serve as motivation for some, but can provoke anxiety in others. Distractibility is another factor listed by Flanagan & Kaufman that most likely impacts processing speed performance. Could an

overly anxious student become worried and preoccupied with the time limit, thereby distracting them from efficiently completing the task?

Mattison, Hooper & Carlson (2006) shed more light on the subject when they studied a sample of students with EBD attending a special elementary school for students with disabilities. During their study they administered neuropsychological screening tests. Results of the Speeded Naming subtest of the Developmental Neuropsychological Assessment (NEPSY) indicated that 62.9% of the students with EBD showed evidence of processing speed deficits. While this number is significant, the generalizability of the findings may be limited, given the special population comprising the sample.

The research connecting emotional and behavioral factors to academic fluency is just beginning to emerge. A study by Benner, Allor & Mooney in 2008 sought to examine this topic, defining academic processing speed as "efficient visual processing, working memory, long term memory and executive functioning that is required to produce correct responses to rudimentary reading, mathematical and written language stimuli" (311). They administered two measures of academic processing speed to a sample of school-age subjects with EBD. The first measure was the Rapid Automatic Naming subtest from the Clinical Evaluation of Language Fundamentals – Third Edition, which required subjects to verbally identify a mix of colors and shapes as quickly as possible. The second measure was the Woodcock Johnson Tests of Achievement – Third Edition academic fluency cluster, consisting of reading, math and writing fluency tasks.

The results of their cross-sectional design revealed that only a modest majority of students with EBD demonstrated deficits in academic processing speed (57% of subjects), with the average academic processing speed score falling more than three-

fourths of a standard deviation below that of the norm group. The study also showed statistically significant differences between students with EBD who showed processing speed deficits and those who did not in variables such as IQ, language skills and areas of social development. However, significant differences were not found in the scales of externalizing and internalizing problems.

Grills-Tacquechel et al. (2011) honed in on how internalizing problems affect academic fluency, specifically looking at anxiety. They analyzed the relationship between children's performance on standardized measures of reading fluency and decoding and their responses on an anxiety rating scale. Their findings indicate a positive relationship between anxiety and reading fluency and led them to the conclusion that negative affect will result in inefficient processing (2011).

Future Research

This review has demonstrated that processing speed, academic fluency, and internalizing behaviors are all interrelated factors contributing to learning. However, in the model of these three factors displayed in Figure 1, which ways should the arrows point? Do the worries and fears of an anxious state interfere with efficient and fluid processing of information, thus impeding fluent performance of academic tasks? Do the lack of motivation and arousal common to a depressed state interfere with performance on tasks requiring fluid, automatic performance? Do these internalizing behaviors directly impact both processing speed and academic fluency?

Figure 1: Directional Model of Variables

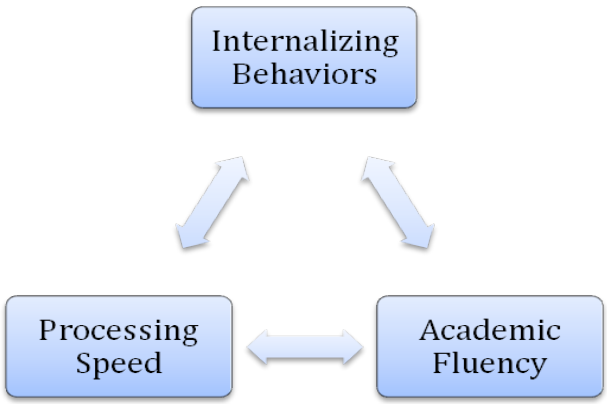

Figure 1. Directional model of interactions between internalizing behaviors, processing speed, and academic fluency.

More research exploring this specific connection between internalizing behaviors, academic fluency and processing speed is needed to help school psychologists more accurately interpret the results of assessments. More accurate interpretation of assessment results would lead to more appropriate interventions and services. If internalizing behaviors are major factors contributing to a student's learning difficulties, interventions focused on managing and alleviating those problems would likely be instrumental in helping students make gains in achievement.

Chapter 3: Research Methods

Purpose of Study

The purpose of the following study is to investigate the potential of a relationship between internalizing behaviors, processing speed, and academic fluency. The study is intended to illuminate the contribution of internal emotional factors on cognitive processes involved in learning. More information on this subject could lead to more specific identification of learning obstacles and subsequently lead to more appropriate interventions and accommodations.

Research Questions

This study will address the following primary research questions: 1) Does a significant relationship exist between a subject's internalizing behaviors and performance on processing speed measures? 2) Does a significant relationship exist between a subject's internalizing behaviors and performance on academic fluency measures? 3) Does a significant relationship exist between a subject's processing speed and academic fluency? 4) To what degree do internalizing behaviors mediate the relationship between processing speed and academic fluency?

Hypotheses

It is expected that high levels of internalizing behaviors will negatively impact a subject's processing speed in both the neutral and academic contexts due to the cognitive components of the behaviors leading to interference. Based on the similarity of the constructs, it is expected that processing speed and academic fluency will show a significant correlation. It is also predicted that high levels of internalizing behaviors will be present in subjects whose processing speed and academic fluency performances do not correlate.

Participants

Data from approximately 137 subjects were used in this study. Participants ranged from age eight to twelve and were selected from a pool provided by a private practice in a large, southwestern metropolitan city. The sample consisted of 92 males and 45 females. Information regarding the race, ethnicity and socioeconomic status of participants was unavailable. The archived evaluation data derived from these this practice was approved for analysis by the university's Institutional Review Board (IRB) and was collected between the years 2003 and 2012. Participants were selected from the database based on the presence of scores from academic, cognitive and behavioral assessments. All data included was free of any identifying information to ensure confidentiality of the children and adolescents.

Instruments

WISC-IV

The Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV) is an individually administered test designed to measure the cognitive ability of individuals' ages six through 16 years-11 months (Flanagan & Kaufman, 2004). A standard administration of the WISC-IV is comprised of ten subtests. From these subtest scores, the WISC-IV provides four separate scales, Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. These four scales all contribute to the Full Scale IQ, which provides an overall measure of the child's current intellectual ability. The Processing Speed Index represents one's ability to perform simple, clerical-type tasks quickly. The Processing Speed Index is comprised of tasks that require the examinee to copy symbols that are paired with numbers according to a key (Coding) and

to identify the presence or absence of a target symbol in a row of symbols (Symbol Search).

Subjects' scores on the Coding subtest were used in this study as a measure of processing speed as a cognitive ability. The Coding task measures short-term nonverbal memory, short-term learning of nonverbal symbols, and visual perception (Nicholson & Erford, 2006). Fine-motor dexterity, speed, accuracy and ability to manipulate a pencil also contribute to successful completion of the task.

For children ages eight to sixteen, Form B of Coding is administered. The task required examinees to copy symbols that are paired with numbers. A key of the number and symbol pairs appeared at the top of the page. The rest of the page contained boxes with numbers in the top and examinees copied the symbol that went with each number in the bottom of the box. They completed as many items as possible within a two-minute time limit.

Subjects' scaled scores on the Symbol Search subtest were also used as a separate measure of processing speed. Like Coding, Symbol Search is considered a measure of processing speed as a broad cognitive ability, but it is also associated with another broad ability: visual processing (Flanagan & Kaufman, 2004). Visual processing specifically taps into the perception, storage and recall of visual patterns and representations. Factors that may influence performance on the Symbol Search task are visual acuity, attention, level of focus and concentration, planning, and capability of working under time constraints.

For children ages eight to sixteen, Symbol Search B is administered. Each item on the subtest consisted of a row of symbols. Two target symbols were presented at the

beginning of each row. The rest of the row contained five symbols that examinees scanned to determine whether or not either of the two target symbols was present. They marked either the "yes" or "no" box at the end of each row to indicate whether or not a target symbol was found in the remainder of the row. Examinees completed as many items as possible within a two-minute time limit.

According to standardized administration procedures (Wechsler, 2003), examinees should have been given a pencil with no eraser and a response booklet for these two subtests. The examiner is to give standardized instructions and model the tasks. The examinee subsequently completes several sample items to show they understand the task. The examinee is then instructed to work as quickly as possible, without making mistakes, until the examiner tells him or her to stop. For Coding, the raw score is the number of items correctly completed within the time limit. For Symbol Search, the raw score is determined by subtracting the number of errors from the number of items answer correctly within the time limit.

Technical analyses of these WISC-IV subtests indicate that they are reliable measures of processing speed (Flanagan & Kaufman, 2004). The coefficient for the Processing Speed Index (PSI) test-retest reliability is 0.86. Internal consistency coefficients were .79, .85 and .88 for Symbol Search, Coding and PSI, respectively.

WJ-III Achievement

The Woodcock-Johnson, Third Edition, Tests of Achievement (WJ-III-Ach) is an assessment battery grade-normed for children starting in kindergarten and age-normed for children starting age 2 years of age (Schrank, McGrew & Woodcock, 2001). It contains 22 subtests measuring skills in reading, mathematics, written language, oral language,

and academic knowledge, as well as two auxiliary writing evaluation procedures. The WJ-III-Ach measures many aspects of academic achievement with a wide variety of relatively brief tests. The resulting information can be used to view an individual's skills in different areas, but also their academic fluency (Schrank, McGrew & Woodcock, 2001).

Academic fluency refers to their ability to perform different academic tasks quickly and efficiently (Schrank, McGrew & Woodcock, 2001). For this study, the Reading and Math Fluency subtests were used as a measure of academic fluency, since there is an existing research base tying reading and math fluency to overall achievement within those academic areas. Technical analyses indicate that these measures are reliable tests of academic fluency. The median coefficients for test-retest reliability are .90 for both reading and math fluency.

The test examiner's manual states that the Math Fluency subtest is a numerical facility task that measures one's ability to solve simple addition, subtraction and multiplication facts quickly (Schrank, McGrew & Woodcock, 2001). Examinees are given a pencil and a student response book. The response book is turned to two full pages of math facts, which progress from simple addition and subtraction to simple multiplication. Standardized instructions are given, instructing the examinee to work as quickly as possible until time is called. The examinee is given a three-minute time limit within which to solve and record the answer to as many facts as possible. The raw score is the total amount of correct responses given within the time limit.

The Reading Fluency subtest measures silent reading speed by having subjects read brief statements and then circling "yes" or "no" to indicate whether or not the

statement is true. Subjects are given a pencil and a response book. Standardized instructions are given and sample items are administered to ensure that the examinee understands the task. Before proceeding with the timed portion, examinees are reminded to work as quickly as possible until time is called. Once the test begins, subjects have three minutes to answer as many items as possible. The raw score is the total amount of correct responses given within the time limit.

Along with these measures of academic fluency, two other WJ-III-Ach subtests measuring basic academic skills were used as variables in the analysis. Reading fluency, processing speed and decoding skills are considered to be closely interrelated (Floyd, Keith, Taub & McGrew, 2007), so the Letter-Word Identification subtest was included in the analysis as measure of decoding skills. The task requires participants to orally read words that increase in difficulty (Schrank, McGrew & Woodcock, 2001). Similarly, math fluency is associated with both processing speed and calculation skills (Cowan, Donlan, Shepherd, Cole-Fletcher, Saxton & Hurry, 2011). The Calculations subtest was used as a measure of participants' basic calculation skills in the analysis. On this subtest, participants are given a pencil and workbook of math calculations to solve independently. The task is untimed, and the items increase in difficulty.

BASC-2

The Behavior Assessment System for Children –Second Edition (BASC-2; Reynolds & Kamphaus, 2004) is designed to measure maladaptive and adaptive behaviors in children from 2.5 to 25 years old. It also measures children's self-perceptions. The assessment consists of five main components: Structured Developmental History, Parent Rating Scale, Teacher Rating Scale, Self-Report of

Personality (for two age groups), and Student Observation System. The BASC-2 includes validity checks to indicate whether or not a child's behavior is very maladaptive or the child was rated more negatively than warranted.

BASC-2 Parent Rating Scales were used in this study as a measure of internalizing behavior problems. The Parent Rating Scale (PRS) measures a child's adaptive and problem behaviors in his or her community and home settings (Reynolds & Kamphaus, 2004). Parents or caregivers can complete forms intended for three different age levels: preschool (ages 2 to 5), child (ages 6 to 11), and adolescent (ages 12 to 21). The PRS contains 134-160 items using a four-choice response format. Parents indicate the frequency of the behavior described in each item by marking *never, sometimes, often,* or *almost always.* The text of this form is written at approximately a fourth-grade reading level.

A number of clinical and adaptive scales can be derived from the PRS, including aggression, attention problems, atypicality, conduct problems, depression, hyperactivity, social skills, somatization, anxiety, and withdrawal. The anxiety scale measured the tendency to be nervous or worried about real/imagined problems, while the depression scale measured the tendency to have feelings of unhappiness and sadness that may result in the inability to carry out everyday activities (Reynolds & Kamphaus, 2004). An Internalizing Problems composite score was also derived from a combination of the anxiety, depression, and somatization scales. This composite was used as a measure of internalizing behaviors in analyses in this study, along with the specific anxiety and depression scale scores.

Technical analyses of the BASC-2 PRS indicate that it is both a reliable and valid assessment of behavior problems. Test-retest reliability coefficients range from .76 to .84 (Reynolds & Kamphaus, 2004). The mean Cronbach's alpha coefficient, which measures internal consistency, is .87 for BASC-2 PRS problem scales (Rescorla, 2009). Further analyses suggest that anxiety, depression and somatic complaints scales demonstrate the strongest evidence of both convergent and discriminant validity (Weis & Smenner, 2007). BASC-2 PRS scores are also significantly correlated with those of another widely used behavior rating scale, the Achenbach System of Empirically Based Assessment: Child Behavior Checklist (ASEBA-CBCL; Reynolds & Kamphaus, 2004).

Data Collection and Analysis

Subjects whose scores on the WJ-III: Tests of Achievement, WISC-IV and BASC-2 PRS were present in the archived database were selected for this study. The age range of participants was limited to 8 to 12 years in order to limit potential variability resulting from different stages of cognitive and academic development. Data from the selected participants was entered into a separate database and then transferred into SPSS Version 21 for analysis. No identifying information of participants was included.

The design of this study is a correlational analysis of data. Multiple statistical analyses were conducted to address the research questions posed by this study. Before performing analyses exploring specific research questions, descriptive statistics were examined to ensure that distributions of scores show univariate normality. Stem-and-leaf plots were used to identify outlying data points that may impact the skewness and kurtosis of the distributions and subsequently affect the results of the tests of hypotheses.

Once outliers were eliminated and a final data set was prepared, linear regression analyses were used to determine the existence of the significant predictive relationships posed by the research questions.

To account for the influence of academic skills on performance on academic fluency measures, WJ-III-Ach Letter-Word Identification subtest scores were used as a measure of decoding skills, and WJ-III-Ach Calculations scores were used as a measure of math calculation skills. Linear regression analyses tested whether or not these academic skills significantly predicted performance on their related academic fluency measures. This test was intended to determine if these scores should be included in the analysis of mediation.

To test whether or not internalizing behaviors significantly impact academic fluency, linear regression analyses will also be run between the BASC-2 PRS measures of internalizing behaviors (Internalizing Composite, Anxiety, and Depression) and both of the academic fluency scores (WJ-III-Ach Math Fluency and Reading Fluency). This procedure was repeated using the BASC-2 PRS internalizing behavior measures and both of the processing speed measures (WISC-IV Coding and Symbol Search). Nonlinear regression analyses were also run to explore the possibility of curvilinear relationships between the variables.

Linear regression analyses were conducted using WISC-IV Coding and Symbol Search scores as independent variables predicting WJ-III-Ach Math Fluency and Reading Fluency scores to test whether or not processing speed significantly predicts academic fluency.

The study also aimed to examine the possibility of internalizing behaviors partially mediating the relationship between processing speed and academic fluency. Data were analyzed using the steps outlined by Baron & Kenny (1986) in establishing mediation.

Chapter 4: Results

The sample analyzed in this study includes participants selected from an archived database provided by a private practice. Subjects were selected from the database based on the presence of scores for each measure used in tests of hypotheses. Age range of participants was restricted to eight to twelve years to limit possible influences of different levels of cognitive and academic development (Floyd, Meisinger, Gregg, & Keith, 2012).

Of the 619 subjects included in the archived data, 140 were initially selected based on the age range and presence of scores. The database differentiated between BASC-2 parent report scores provided by the mother and those provided by the father. Of the 140 selected participants, parent report scores were provided by the mother for 133 participants and provided by the father for 11 participants. Given these numbers, scores derived from the mother's responses were used in this study for the purpose of consistency. However, for seven participants, the only BASC-2 scores provided were those derived from the father's responses. For these seven subjects, scores provided by the father were used in the analysis.

Elimination of participants with outlying scores (outlier detection procedures are explained under Descriptive Statistics and Assumptions of Normality) resulted in a final sample size of 137 participants (see Table 1). The sample consisted of 92 males (67%) and 45 females (33%). Of these participants, data indicate that 93 were enrolled in private school (68%) and 44 were enrolled in public school (32%). The database also indicated whether or not subjects' evaluations resulted in diagnoses, though the specific diagnoses were not included. In the current sample, 29 participants had one diagnosis

(21%), 107 participants had two or more diagnoses (78%), and only one participant remained undiagnosed (1%).

Some specific diagnoses were indicated in the database. According to these records, 23 participants (17%) had been diagnosed with a condition related to internalizing behaviors: five participants were diagnosed with Dysthymic Disorder, two were diagnosed as being in a state of Bereavement, thirteen were diagnosed with Generalized Anxiety Disorder, one was diagnosed with Social Phobia, one was diagnosed with Obsessive Compulsive Disorder, and one was diagnosed with Separation Anxiety.

Table 1
Demographics of Sample

	n
Gender	
Male	92
Female	45
Age	
8 years	25
9 years	33
10 years	28
11 years	23
12 years	28
Diagnoses	
No diagnosis	29
One diagnosis	1
Two or more diagnoses	107
School	
Private	93
Public	44

Note: n = 137.

Descriptive Statistics and Assumptions of Normality

Descriptive statistics of the sample data set are summarized below in Table 2. Each variable measure was analyzed in terms of range and normality. Means and standard deviations of each assessment were compared to the norms upon which the instrument scores are based. Range, mean, and standard deviation scores were also examined to determine if a restricted range of scores existed in the distribution.

Outliers were detected using stem-and-leaf diagrams displaying the distributions of scores for each of the measures used in this study. Extreme scores identified in the diagrams that exceeded two standard deviations above or below the mean were considered outlying data points. If skewness statistics indicated that the outlying data points negatively impacted the assumptions of normality, the outlying point and subsequently all other scores for that participant were eliminated from the sample.

Skewness and kurtosis statistics were also analyzed to support the assumptions of normality and to support the mean as an accurate measure of central tendency. Table 2 shows skewness and kurtosis statistics after significant outliers were detected and eliminated from the sample. Interpretation of skewness statistics followed these ranges (Bulmer, 1979):

- Highly Skewed – skewness is less than -1 or greater than +1
- Moderately Skewed – skewness is between -1 and -1/2 or between +1 and +1/2
- Approximately Symmetric – skewness is between -1/2 and +1/2

Table 2
Descriptive Statistics of Assessments

Variable	Range	Min	Max	Mean	SD	Skew	Kurtosis
WJ-III Reading Fluency	53	75	128	98.81	10.73	.07	-.16
WJ-III Math Fluency	67	70	137	96.93	15.03	.45	-.43
WISC-IV Symbol Search	12	3	15	9.61	2.34	-.01	.18
WISC-IV Coding	15	1	16	8.63	2.42	.00	.28
BASC-2-PRS Internalizing	51	34	85	52.81	11.01	.69	.11
BASC-2-PRS Anxiety	53	30	83	54.12	11.66	.26	-.12
BASC-2-PRS Depression	56	37	93	53.58	11.95	.95	.39

Note: n = 137 for all variables. Standard error of skewness was .21. Standard error of kurtosis was .41.

WISC-IV Processing Speed Measures

WISC-IV subtest scaled score norms are based on a population mean of 10 and standard deviation of 3 (Flanagan & Kaufman, 2004). For the current sample, the mean Symbol Search score was 9.61 with a standard deviation of 2.34 and the mean Coding score was 8.63 with a standard deviation of 2.42.

No extreme scores were identified in a stem-and-leaf plot of the distribution of Symbol Search scores. The skewness of Symbol Search scores was -.01, while the kurtosis was .18, indicating an approximately symmetric distribution. Results of analysis detected two outliers in the distribution of Coding scores. Scores greater than or equal to16 and scores less than or equal to 1 were considered extreme scores. However, given that the distribution of the scale showed a skewness of .00 and a kurtosis of .28, the outliers did not appear to significantly impact the assumption of normality and were therefore retained in the sample.

WJ-III-Ach Academic Fluency Measures

WJ-III-Ach standard score norms are based on a population mean of 100 and a standard deviation of 15 (McGrew & Woodcock, 2001). Participants in the current sample earned a mean Reading Fluency score of 98.81, with a standard deviation of 10.73 and a mean Math Fluency score of 96.93 with a standard deviation of 15.03.

Initial analysis indicated a moderately positive skew for the distribution of Math Fluency scores (Skewness = .70). A stem-and-leaf plot identified extreme scores for Math Fluency as scores greater than 137, which is more than two standard deviations above the mean. One score of 158 was determined to be an extreme outlier contributing to skewness in the distribution of scores. Scores for this participant were eliminated from

the sample. With outliers removed from the data, the distribution of Math Fluency scores showed a skewness of .45, indicating a more approximately symmetric distribution.

The second measure of academic fluency, Reading Fluency, showed a skewness of .30 and a kurtosis of .47 in the distribution of scores. Based on a stem-and-leaf plot of the distribution, one score of 138 was determined to be a significant outlier and was eliminated from the sample. Skewness of the distribution decreased to .07, with a kurtosis of -.16.

BASC-2-PRS Measures of Internalizing Behaviors

BASC-2-PRS composite *T*-score norms are based on a population mean of 50 and a standard deviation of 10 (Reynolds & Kamphaus, 2004). In the selected sample, the mean score for the BASC-2-PRS Internalizing Composite was 52.81 with a standard deviation of 11.01. Internalizing Composite scores showed a skewness of .69, indicating a positively skewed distribution. Kurtosis was .11.

Figure 2: BASC-2-PRS Internalizing Composite Scores

Frequency	Stem & Leaf
1.00	3 . 4
7.00	3 . 5556699
28.00	4 . 0000000111111122233333333344
23.00	4 . 55555666777777788899999
24.00	5 . 000011112222223333333444
17.00	5 . 55555555667778899
15.00	6 . 000000011112344
12.00	6 . 555566788999
2.00	7 . 00
5.00	7 . 55788
2.00	8 . 13
1.00 Extremes	(>=85)

Figure 2. Stem & Leaf plot depicting distribution of BASC-2 PRS Internalizing composite scores.

A distribution of these scores can be seen above in Figure 2. One extreme score of 85 was identified in the distribution. However, this score was not eliminated from the sample, as it is indicative of the behavior problems targeted by the research questions in this study.

Composite scores ranging from 41-59 are considered to be average. Scores falling from 60-69 are considered at-risk, and scores 70 and higher are considered to be indicative of significantly maladaptive behavior (Reynolds & Kamphaus, 2004). In the sample used in this study, 27 participants were rated in the at-risk range for internalizing problems and 10 participants were rated in the clinically significant range. The remaining 100 participants in the sample were rated as average or below for internalizing behaviors (see Figure 2).

Both the BASC-2-PRS Anxiety and Depression scale *T*-scores are based on the same norms and ranges as described above for the Internalizing Composite scores. In the selected sample, the mean score for Anxiety was 54.12 with a standard deviation of 11.66. Skewness for this distribution of scores was .26 with a kurtosis of -.12. Of the 137 participants, 29 were rated in the at-risk range for anxiety and 14 were rated in the clinically significant range for anxiety. Extreme scores were identified as those greater than a *T*-score of 83. One score fell in this range, but was included in the analysis, as it is representative of the type of behaviors studied.

The mean score for the BASC-2-PRS Depression was 53.58 and the standard deviation was 11.95. Skewness for the distribution of scores was .95 and the kurtosis was .39. In the selected sample, 22 participants were rated in the at-risk range for depression

and 17 were rated in the clinically significant range. Extreme scores were identified as those greater than 85. Three scores fell in this range, but were retained for analysis, as they are indicative of the behaviors under study.

Academic Skills

To examine the direct effects of academic skills on performance on academic fluency measures, regression analyses were conducted between measures in reading and in math using SPSS Version 21. Regression analyses provide information about how well a dependent variable can be predicted given an independent variable (Vogt, 2007). Analyses will provide estimates of the total variance in academic fluency predicted by scores on academic skills (R^2 values), as well as the effect size (β values). To determine significance of results, an alpha level of .01 was used.

Results indicated that math calculation skills are a significant predictor of math fluency, based on linear regression analyses using WJ-III Ach Calculations scores as the independent variable and WJ-III Ach Math Fluency scores as the dependent variable (R^2 = .26, Adjusted R^2 = .25, β = .50, p = .00). Decoding skills were found to be a significant predictor of reading fluency, based on linear regression analyses using WJ-III-Ach Letter-Word Identification as the independent variable and WJ-III-Ach Reading Fluency scores as the dependent variable (R^2 = .38, Adjusted R^2 = .38, β = .62, p = .00). These relationships were established prior to further mediation analysis involving academic fluency.

Tests of Hypotheses

The following data analyses aim to address four specific research questions: 1) Does a significant relationship exist between a subject's internalizing behaviors and

performance on processing speed measures? 2) Does a significant relationship exist between a subject's internalizing behaviors and performance on academic fluency measures? 3) Does a significant relationship exist between a subject's processing speed and academic fluency? 4) To what degree do internalizing behaviors mediate the relationship between processing speed and academic fluency?

Establishing the relationships addressed in the first three research questions sets the foundation for a model of mediation (see Figure 3). To show that a variable mediates the relationship between an independent and dependent variable, significant relationships must be demonstrated between each of the variables.

Figure 3: Model of Mediation Analysis

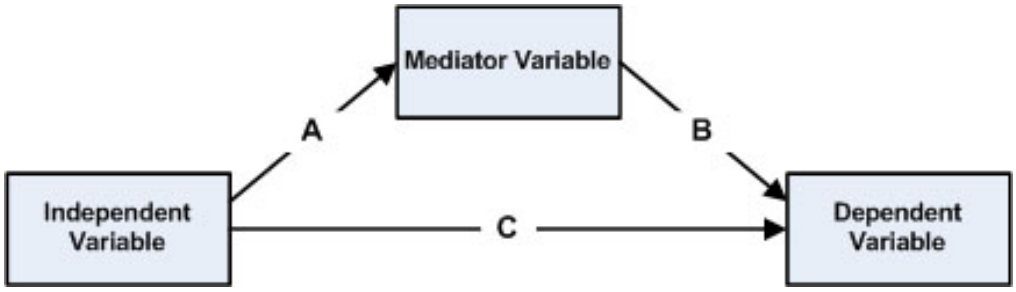

Figure 4. Model of mediation analysis. Reprinted from Mediation (Statistics) In *Wikipedia*, n.d., Retrieved March 25, 2014, fromhttp://en.wikipedia.org/wiki/File: Mediation.jpg . Copyright 2006 by Dan Soper. Reprinted with permission.

First, analysis must demonstrate that the causal variable predicts the outcome (Baron & Kenny, 1986), or in the case of this study, that processing speed predicts academic fluency. Then a relationship must be established between the suspected

mediating variable (internalizing behaviors) and the causal variable (processing speed), as well as a relationship between the mediator (internalizing behaviors) and the outcome variable (academic fluency). This study used linear regression analyses to test these suspected relationships.

Hypothesis 1

It was expected that high levels of internalizing behaviors negatively impact a subject's processing speed and academic fluency. To test for this relationship, simple linear regression analyses were conducted. An alpha level of .05 was used to determine significance. Results suggested that internalizing behaviors did not significantly predict a subject's processing speed, based on linear regression analyses using BASC-2-PRS Internalizing Composite scores as the independent variable and WISC-IV Coding scores as the dependent variable ($R^2 = .00$, Adjusted $R^2 = .00$, $\beta = -.06$, $p = .50$), as well as linear regression analyses using BASC-2-PRS Internalizing Composite scores as the independent variable and WISC-IV Symbol Search scores as the dependent variable ($R^2 = .01$, Adjusted $R^2 = .00$, $\beta = .10$, $p = .27$).

Along with the linear regression analyses, these measures were analyzed to test for a possible curvilinear relationship. Curve estimation results did not indicate that a significant curvilinear relationship exists between the independent variable of BASC-2-PRS Internalizing Composite scores and the dependent measure of WISC-IV Coding scores ($F(1, 135) = .45$, $p = .50$) nor between the independent variable of BASC-2-PRS Internalizing Composite scores and the dependent measure of WISC-IV Symbol Search scores ($F(1, 135) = 1.23$, $p = .27$).

Regression analyses using the BASC-2-PRS Anxiety and Depression scale scores yielded mixed results. Linear regression analyses using BASC-2-PRS Anxiety scale scores as the independent variable and WISC-IV Coding scores as the dependent variable did not indicate a significant predictive relationship ($R=.00$, Adjusted $R^2=.00$, $\beta=.06$, $p=.49$), but a significant relationship was found between BASC-2-PRS Anxiety scale scores and WISC-IV Symbol Search scores ($R=.04$, Adjusted $R^2=.03$, $\beta=.19$, $p=.03$). Linear regression analyses using BASC-2-PRS Depression scale scores as the independent variable and WISC-IV Coding scores as the dependent variable suggested a significant predictive relationship ($R=.04$, Adjusted $R^2=.03$, $\beta=-.20$, $p=.02$), but analyses using the Depression scale scores and WISC-IV Symbol Search scores did not result in significant findings ($R=.00$, Adjusted $R^2=-.01$, $\beta=-.03$, $p=.73$).

Results also indicated that internalizing behaviors did not significantly predict a subject's performance on academic fluency measures, based on linear regression analyses using BASC-2-PRS Internalizing Composite scores as the independent variable and WJ-III-Ach Reading Fluency scores as the dependent variable ($R^2 = .00$, Adjusted $R^2 = -.00$, $\beta = .06$, $p = .51$) and linear regression analyses using BASC-2-PRS Internalizing Composite scores as the independent variable and WJ-III-Ach Math Fluency scores as the dependent variable ($R^2 = .00$, Adjusted $R^2 = -.01$, $\beta = .00$, $p = .98$). Therefore, the data in this study do not support this hypothesis internalizing behaviors significantly impact performance on academic fluency measures.

These scores were also analyzed to test for a possible curvilinear relationship. Curve estimation results did not indicate a significant relationship between the independent variable of BASC-2-PRS Internalizing Composite scores and the dependent

variable of WJ-III-Ach Math Fluency scores ($F(1, 135) = .00$, $p = .98$) nor between the independent variable of BASC-2-PRS Internalizing Composite scores and the dependent variable of WJ-III-Ach Reading Fluency scores ($F(1, 135) = .43$, $p = .51$). These results also fail to support the hypothesized impact of internalizing behaviors on academic fluency.

Additional analyses were conducted using the BASC-2-PRS Anxiety and Depression scale scores. These analyses also failed to indicate the presence of a significant relationship between internalizing behaviors and academic fluency. Results of linear regression analyses using BASC-2-PRS Anxiety scores as the independent variable and WJ-III-Ach Math Fluency scores as the dependent variable were not significant ($R=.01$, Adjusted $R^2=.00$, $\beta=.10$, $p=.26$), nor were results from analyses using Anxiety scores as the independent variable and WJ-III-Ach Reading Fluency scores as the dependent variable ($R=.02$, Adjusted $R^2=.01$, $\beta=.12$, $p=.15$). Regression analyses using BASC-2-PRS Depression scores as the independent variable and WJ-III-Ach Math Fluency scores as the dependent variable ($R=.01$, Adjusted $R^2=.00$, $\beta=-.10$, $p=.29$) and regression analyses using Depression scores as the independent variable and Reading Fluency scores as the dependent variable ($R=.00$, Adjusted $R^2=-.01$, $\beta=-.01$, $p=.95$).

Hypothesis 2

It was expected that a significant relationship exists between processing speed and academic fluency. A simple linear regression analysis was performed to examine the direct effects of processing speed on academic fluency. To determine significance of results, an alpha level of .05 was used.

Results support the hypothesis that processing speed significantly predicts academic fluency, based on linear regression analyses using WISC-IV Symbol Search scores as the independent variable and WJ-III-Ach Reading Fluency scores as the dependent variable ($R^2 = .07$, Adjusted $R^2 = .06$, $\beta = .26$, $p = .00$), linear regression analyses using WISC-IV Symbol Search scores as the independent variable and WJ-III-Ach Math Fluency scores as the dependent variable ($R^2 = .12$, Adjusted $R^2 = .11$, $\beta = .34$, $p = .00$), linear regression analyses using WISC-IV Coding scores as the independent variable and WJ-III-Ach Reading Fluency scores as the dependent variable ($R^2 = .10$, Adjusted $R^2 = .10$, $\beta = .25$, $p = .00$), and linear regression analyses using WISC-IV Coding scores as the independent variable and WJ-III-Ach Math Fluency scores as the dependent variable ($R^2 = .18$, Adjusted $R^2 = .18$, $\beta = .43$, $p = .00$). These results support the hypothesis that processing speed significantly predicts performance on measures of academic fluency.

Hypothesis 3

It was predicted that internalizing behaviors act as a mediating variable in the relationship between processing speed and academic fluency. Prior to conducting analyses for a mediating effect, relationships must be established showing that the causal variable correlates with the mediating variable (Baron and Kenny, 1986). Of the regression analyses described in the preceding sections, only two indicated a significant relationship between processing speed and internalizing behaviors (see Table 3). Results suggested that the BASC-2-PRS Anxiety subscale is a significant predictor of performance on WISC-IV Symbol Search, while the BASC-2-PRS Depression subscale appears to be a significant predictor of performance on WISC-IV Coding. As these

findings established a connection between processing speed and internalizing behaviors, these relationships could be used in further analysis of a possible mediating relationship between processing speed, academic fluency, and internalizing behaviors.

However, an impact must also be established between the predicted mediating variable and the outcome variable. Regression analyses did not suggest that internalizing behaviors had a significant impact on academic fluency (see Table 3). Given the lack of a significant relationship between the suspected mediating variable and the outcome measures, no further regression analyses were conducted to test for a mediating influence.

Table 3
Regression Analyses of Predicted Relationships

Relationships	R^2	Adj. R^2	β	Sig.
Coding (IV) and Math Fluency (DV)	.18	.18	.43	.00
Coding (IV) and Reading Fluency (DV)	.10	.10	.32	.00
Symbol Search (IV) and Math Fluency (DV)	.12	.11	.34	.00
Symbol Search (IV) and Reading Fluency (DV)	.07	.06	.26	.00
Internalizing (IV) and Coding (DV)	.00	.00	-.06	.50
Internalizing (IV) and Symbol Search (DV)	.01	.00	.10	.27
Internalizing (IV) and Math Fluency (DV)	.00	-.01	.00	.98
Internalizing (IV) and Reading Fluency (DV)	.00	.00	.06	.51
Anxiety (IV) and Coding (DV)	.00	.00	.06	.49
Anxiety (IV) and Symbol Search (DV)	.04	.03	.19	.03
Anxiety (IV) and Math Fluency (DV)	.01	.00	.10	.26
Anxiety (IV) and Reading Fluency (DV)	.02	.01	.12	.15
Depression (IV) and Coding (DV)	.04	.03	-.20	.02
Depression (IV) and Symbol Search (DV)	.00	-.01	-.03	.73
Depression (IV) and Math Fluency (DV)	.01	.00	-.10	.29
Depression (IV) and Reading Fluency (DV)	.00	-.01	-.01	.95

Note: IV = Independent Variable. DV = Dependent Variable.

Chapter 5: Discussion

Research demonstrates that internalizing behaviors, processing speed and academic fluency all impact academic achievement. While research also has established some connections between these three variables, the specific nature and direction of their interactions is yet undefined. The purpose of this study was to help clarify the relationships between the three constructs by testing for significant predictive relationships between them. It was expected that processing speed would predict academic fluency and that internalizing behaviors would serve as a mediating variable in that predictive relationship. Limitations of the study are discussed below, followed by discussion of results and recommendations for future research.

Limitations

Limitations of Sample

This study is limited by the convenience sample drawn from an archived database. Subjects selected had all been referred for psychological evaluations and 99% of them received at least one diagnosis. The sample was also 62% male. Therefore, the general population may not be well represented by the data used in this study.

The age of participants was restricted to a range of 8 to 12 years for the purpose of limiting the variability of levels of cognitive and academic development while maintaining a sufficient sample size for analysis. However, despite this restriction, the age range still includes a variety of developmental levels in terms of reading skills, math

skills and cognitive abilities. This limitation may have impacted the results of the analysis.

Despite identifying and eliminating extreme outliers, the distribution of Math Fluency scores showed moderate positive skewness and negative kurtosis, suggesting a possible non-normal distribution. Future research exploring the questions posed by the current study should be done using a more representative sample with established univariate normality for all variables.

A distribution of BASC-2 PRS scores for Internalizing problems used in this study showed that only 27% of participants were rated as at-risk or showing signs of significantly maladaptive behavior, while 46% of the participants received composite *T*-scores of 50 or below. The large proportion of subjects not rated as exhibiting signs of internalizing problems may have impacted results of analyses targeting the potential impact of these behaviors.

Limitations of Assessments

This study is also limited by the assessments. BASC-2 rating scales used in this study were obtained from responses from parents of participants. The BASC-2 PRS composite scores for internalizing behaviors and their associated subscales are derived from a report of behaviors based on parents' observations and not the subjects' reported experiences. Responses may also have been influenced by social desirability, bias or amount of attention and thought given to each item.

Given that the BASC-2 scores in this study came from an archived database, responses to specific items on the BASC-2 were not accessible. This prevented any more specific analyses of effects of particular response items or clusters of items.

With regards to the anxiety component of internalizing problems, anxiety can be a temporary state for some or it can be more pervasive for others (Reynolds & Kamphaus, 2004). Subjects with pervasive anxiety would be more likely to be rated higher for internalizing behaviors on the BASC-2, given that it assesses behavior that is most typical for an individual. However, the actual level of anxiety these subjects were experiencing at the time of assessment is unknown. Participants who may only experience certain temporary states of anxiety may not have been rated as high for internalizing behaviors on the BASC-2, but whether or not the assessments provoked a state of anxiety is unknown.

Subjects were not directly observed or interviewed as part of this study to provide any corroborating evidence of emotional distress. The mood or emotional state of subjects at the time of testing is also unknown. It is assumed that the assessments of processing speed and academic fluency were administered in settings that were novel or unfamiliar to subjects, which may have influenced their levels of anxiety, effort and motivation during testing.

Overall, the measure of internalizing behaviors used in this study may not be sensitive enough to detect the specific levels and variations of these behaviors that are needed to understand the relationships explored.

Discussion

Research Question 1

Does a significant relationship exist between a subject's internalizing behaviors and performance on processing speed measures? Regression analyses conducted using BASC-2 PRS Internalizing Problems composites as the predictor and WISC-IV Coding

and Symbol Search scores as the outcomes did not yield significant results. Thus, the expectation that internalizing behaviors would have a significant, negative impact on processing speed was not confirmed by these tests.

Previous studies on this subject have resulted in conflicting results and theories (Vytal, Cornwell, Arkin & Grillon, 2012). While anxiety can either facilitate processing speed by increasing motivation (Calhoun & Mayes, 2005) or negatively impact cognitive efficiency through interference (Passolunghi, 2011), depression has consistently been shown to impair performance on processing speed measures (Snyder, 2013). Results of these studies suggest that anxiety and depression may impact speed of processing in different ways, which warrants further separate analysis of these two constructs. The internalizing composite used in analyses in this study combines the two emotional problems into one score, which may have affected the significance of results.

Given these differences between the suspected impacts of anxiety and depression, regression analyses were also conducted using the BASC-2-PRS Anxiety and Depression scales. Results were mixed. A significant relationship was found between Anxiety and WISC-IV Symbol Search, as well as between Depression and WISC-IV Coding. However, results of analyses testing the relationship between Anxiety and Coding and the relationship between Depression and Symbol Search were not significant.

While these tests provide some evidence that internalizing behaviors may impact processing speed, the findings are not consistent and more research is needed to tease apart the specific components of this impact.

Research Question 2

Does a significant relationship exist between a subject's internalizing behaviors and performance on academic fluency measures? While it was expected that high levels of internalizing behaviors would negatively impact performance on academic fluency measures, results of regression analyses using scores BASC-2 PRS Internalizing Problems as the predictor and WJ-III-Ach Reading Fluency and Math Fluency scores as outcome variables failed to confirm this hypothesis. Further analyses using BASC-2-PRS Anxiety and Depression scale scores as predictors and WJ-III-Ach Reading Fluency and Math Fluency scores as outcome variables also failed to confirm this hypothesis.

When analyzing students with emotional behavior disorders in 2008, Benner, Allor & Mooney found that a modest majority of participants showed deficits in academic fluency, but failed to find significant group differences in the scales of externalizing and internalizing problems derived from Achenbach Teacher Report Forms. These findings along with the findings of the current study may imply that the internalizing composites on behavior assessment scales may be too broad to detect the specific differences and relationships in question.

Regarding anxiety, theories suggest that there is an optimal level of anxiety for tasks, with higher levels of anxiety facilitating performance on simple tasks and lower levels of anxiety facilitating difficult tasks (Ormrod, 2008). Anxiety can be a facilitating factor by increasing arousal or it can be a factor of interference. This could lead to numerous individual differences that may prevent a general trend from showing in the data.

For example, if a participant perceived the math fluency task as difficult and experienced elevated anxiety at the time of testing, anxiety would have been an inhibiting

factor on task performance. On the other hand, if another participant also experienced elevated anxiety at the time of testing but perceived the math fluency task as simple, performance on the task would have been facilitated. Even if subjects demonstrated the necessary academic skills to correctly answer the items on math fluency and reading fluency tasks, whether or not they perceived the tasks as difficult is an unknown factor.

While anxiety may at times be a facilitating factor for academic performance, depression is consistently viewed as an inhibitor, as it is expressed by low arousal, energy and motivation (Calhoun & Mayes, 2005). Children experiencing depression typically show a decrease in school achievement (Kovacs, 2011). Again, the level of dysphoric or depressed mood experienced at the specific time of testing is unknown. Also, a higher level of depressed mood may have led students to feel incapable of performing the task and therefore perceive the task as difficult. Returning to the theories of anxiety as an inhibitor or facilitator, this perception of the task may have played a role in individual differences.

Research Question 3

Does a significant relationship exist between a subject's processing speed and academic fluency? The results of this study suggest that processing speed significantly predicts academic fluency, based on regression analyses conducted between both measures of processing speed (WISC-IV Symbol Search and Coding) and both measures of academic fluency (WJ-III-Ach Reading Fluency and Math Fluency), even despite the moderately skewed distribution of Math Fluency scores.

These findings confirm the initial hypothesis that a significant relationship exists between these two constructs. This expectation was based on the fact that both rely on

similar abilities such as efficient processing of visual information, working memory, and sustained attention (Benner, Allor & Mooney, 2008). These results also support CHC models connecting processing speed to fluency measures (McGrew & Woodcock, 2001), as well as empirical studies establishing a connection between speed of processing and the ability to read fluently (Floyd, Meisinger, Gregg & Keith, 2012) and perform math calculations efficiently (Cowan et al., 2011).

Neuropsychological theories suggest that deficits in academic achievement can result from an underlying deficit in processing (Hale & Fiorello, 2004). Limited speed of processing leads students to experience slower rates of learning and performance, difficulty comprehending new information, and overall mental fatigue (Calhoun & Mayes, 2005). Given the findings of the current study, part of this slower rate of performance resulting from low processing speed may specifically be identified as impaired academic fluency. This illuminates a specific way that processing speed indirectly impacts overall learning and achievement.

Research Question 4

To what degree do internalizing behaviors mediate the relationship between processing speed and academic fluency? It was predicted that high levels of internalizing behaviors would mediate this relationship by causing cognitive interference. As discussed above, regression analyses did not result in significant relationships between internalizing behaviors and any of the measures of processing speed or academic fluency. Therefore, the data in this study do not demonstrate the expected mediation.

Findings from other studies show that internalizing behavior serves as a mediator in relationships between cognitive and academic factors. In 2014, Ganley and Vasilyeva

studied anxiety as a mediator between working memory and achievement. Their results indicated that the worry component of anxiety interfered with visuospatial working memory resources, which subsequently impacted performance on math assessments.

Findings such as these and the fact that processing speed facilitates the functioning of working memory (Passolunghi, 2011) support the expected hypothesis that internalizing behaviors would also mediate the relationship between processing speed and academic performance. However, the Ganley and Vasilyeva (2014) study included analyses of the role of gender differences and the specific worry component of anxiety, while analyses in the current study did not tease apart these components. This may have contributed to the lack of significant findings regarding this hypothesized mediation.

Another factor to consider is the influence of specific types of internalizing problems. A 2012 study by Macher, Paechter, Papouesk and Ruggeri found that students with anxiety specific to statistics showed lower achievement on tests in their statistics courses. Results suggested that statistics anxiety was higher predictor of performance in the course than other variables such as learning strategies and interest in statistics. The findings of this study corroborate other findings about the negative impacts on performance associated with anxiety specific to academic contexts, such as math or testing, (Passolunghi, 2011; von der Embse & Hasson, 2012). The measure of internalizing problems used in this study may not have reflected context specific anxiety, which may have influenced the significance of analyses.

Implications and Future Research

Connecting Processing Speed and Academic Fluency

The results of this study leave several important implications for school psychologists. The study adds support to the theory that processing speed is a significant factor contributing to fluent performance of academic tasks, which has been shown to increase overall academic achievement (Calhoun & Mayes, 2005). Establishing this connection builds a stronger case for the importance of processing speed in learning.

Processing speed as a cognitive ability is generally interpreted as a relatively stable ability by age nine (Floyd, Meisinger, Gregg & Keith, 2012), though it eventually decreases with age (Flanagan & Harrison, 2005). A recent study testing the effectiveness of processing speed interventions demonstrated success in stabilizing or improving the ability (Wolinsky, vander Weg, Howren, Jones & Dotson, 2013). While these intervention studies most often target the older population in an effort to prevent significant cognitive decline, new studies are emerging to test interventions aimed at improving processing speed in children and adolescents.

A study by Benner, Ralston, and Feuerborn (2012) tested the effectiveness of processing speed interventions on a sample of students with emotional and behavioral disorders. They implemented Language for Thinking, a language-based intervention, with the goals of improving processing speed and decreasing behavior problems. The study resulted in statistically significant improvement in processing speed performance, as measured by the processing speed cluster on the Woodcock-Johnson, Third Edition, Normative Update Tests of Cognitive Abilities. Data analyses indicated that the group mean score on this cluster improved by almost one standard deviation following the intervention.

Studies such as this are breaking new ground for interventions specifically targeting abilities beyond the academic context. The results of the current study suggest that academic fluency is significantly predicted by processing speed ability, which implies the possibility that solely providing academic intervention may not be addressing the root of the problem in all cases. For example, students who consistently struggle with math fluency, no matter how much drill and practice, may require these types of interventions as the key to improving in automaticity of calculations. Following the connections established earlier, this improvement in processing speed and subsequently math fluency would likely to lead to increased overall achievement in math (Benner, Allor, & Mooney, 2008).

Interpreting Relationships of Social/Emotional and Cognitive Factors

The nature of the relationship between social/emotional factors and cognitive factors is not yet well defined (Hale & Fiorello, 2004). This study leaves a caution for school psychologists in drawing conclusions about how internalizing behaviors may affect performance on processing speed and academic fluency measures. While the cognitive aspects of internalizing problems lead to a logical argument that they could interfere with other cognitive abilities and thereby impact academic performance, that connection is not yet solidified by data and research. Though results are still inconclusive at this point, future research may lead to more answers and help establish an empirically based framework for interpreting assessment results.

Future Research

Using other measures of internalizing behaviors, such as self-report measures, physiological measures and direct observations should be considered in future studies to

help ascertain what specific aspects and levels of internalizing problems may impact cognitive efficiency. Studies have found physiological measures such as electromyography which measure muscle activity, as well as observations of eye movements such as fixation and saccade rates, are indicators of continuous anxiety level (Tichon, Wallis, Riek & Mavin, 2013). These measures could be used at the time of testing to get a more accurate idea of anxiety levels experienced during the tasks. While this study's analyses yielded mixed results from analyzing Internalizing Behaviors in separate components of depression and anxiety, other measures specifically targeting these two different constructs may lead to different findings. As discussed, anxiety studies show mixed results regarding the impact on processing speed (Vytal, Cornwell, Arkin & Grillon, 2012), while depression consistently shows a negative impact (Snyder, 2013).

Regarding anxiety in particular, using different measures may allow the differences between impacts of state and trait anxiety may be explored. The measures used in this study did not directly differentiate between subjects who generally experience a state of elevated anxiety and those who only experience high anxiety in response to certain stimuli or situations. Taking a test, performing under time constraints, performing math calculations or other aspects of the assessments may serve as anxiety provoking conditions for some participants (von der Embse & Hasson, 2012), though they may not experience problematic levels of anxiety in general. As previously mentioned, those who experience state anxiety, but not trait anxiety may not have been rated high for internalizing problems on a behavior rating scale that measures general tendencies (Reynolds & Kamphaus, 2004).

Deeper analysis into the specific responses on the BASC-2 may provide more insight. Analysis of responses to individual items on the measure of internalizing behaviors may show whether or not certain aspects of depression or anxiety impact speed of processing and academic performance. In the 2012 study by Macher, Paechter, Papouesk and Ruggeri, self-report scores for trait anxiety positively correlated with academic performance. However, analysis of the specific components of the anxiety scale indicated that only the aspects of anxiety not related to the academic subject correlated positively with achievement. Anxiety regarding the academic subject correlated negatively with achievement.

These findings lend support to the idea that anxiety is multidimensional with a hierarchy of associated factors (Noel, Lewis, Francis & Mezo, 2013). Too broad of an analysis may not give a clear picture of its impact on academic performance. It is possible that only certain aspects or components of anxiety and depression would impact processing speed and academic fluency.

The idea that internalizing behaviors negatively impact achievement by tying up cognitive resources necessary for efficient automatic processing is the underlying assumption of this study, based on research demonstrating that efficient processing facilitates learning (Calhoun & Mayes, 2005; Axtell, McCallum, & Bell, 2009; Jodai & Tahriri, 2011). Therefore the cognitive components of internalizing problems, such as excessive worry, fear or self-deprecating thoughts (Reynolds & Kamphaus, 2004), may be key elements that must be present to impact speed of processing. Worry specifically has been shown to interfere with other executive functioning skills such as working memory (Ganley & Vasilyeva, 2014).

Different populations and groups should be sampled and used in future studies. Are there between groups differences when comparing the processing speed and academic fluency of subjects diagnosed with anxiety disorders or depression and that of subjects without those diagnoses? Existing studies tended to focus on students with emotional-behavioral disorders (Anderson, Kulash & Duchnowski, 2001; Nelson, Tanner, Lane & Smith, 2004; Benner, Allor & Mooney, 2008). Expanding to compare these students with other groups may yield different results. Other more specific groupings may be analyzed in the context of this study, such as subjects with specific types of anxiety disorders (Vytal, Cornwell, Arkin & Grillon, 2012) and subjects with co-morbid internalizing and learning problems (Anderson, Kulash & Duchnowski, 2001).

Previous research establishing gender differences in internalizing behaviors suggests future studies should include separate analyses for gender groups. Gender differences in math performance have been associated with heightened anxiety in females, particularly the worry component of anxiety (Ganley & Vasilyeva, 2014). Depression and academic achievement have shown a bidirectional relationship, but only in females (Verboom, Sijtsema, Verhulst, Penninx & Ormel, 2014). Including gender as a factor in analysis may lead to more significant findings.

Conclusion

Many unanswered questions remain about the interactions between internalizing behaviors, processing speed and academic fluency. Existing research has established that all three of these factors have an impact on a student's educational achievement. Results of this study indicate that processing speed is a significant predictor of performance on

academic fluency measures, but analyses of other relationships between the variables failed to show significant relationships.

How the three factors may work together to impact a student's achievement is still yet to be determined. Important implications would result from gaining understanding about these interactions. Clarifying the connections between cognitive, academic and emotional factors would allow school psychologists to more accurately interpret assessment results, better identify problems and recommend more appropriate interventions. The current study resulted in more questions than answers, leaving much opportunity for future studies to explore these connections and relationships.

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PhD Educational Psychology
Specialization: School Psychology
University of Nevada – Las Vegas
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Dissertation: Effects of Internalizing Behaviors on Processing Speed and Academic Fluency
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Expected August 2014

MS Educational Psychology
University of Nevada – Las Vegas
NASP-approved program
December 2009
GPA: 4.0

MEd Elementary Education
University of Florida
May 2006
GPA: 3.9

BS Psychology
Minor in Criminology
Univesity of Florida
August 2004

CREDENTIALS AND CERTIFICATES:

Professional Educator License
Utah State Board of Education
Licensed Area of Concentration: School Psychologist (K-12)
Issued 11/04/13

License for Educational Personnel
State of Nevada
License Number: 0000098432
Endorsement: School Psychologist
Issued 09/08/13

FIELD EXPERIENCES IN SCHOOL PSYCHOLOGY

School Psychologist, Washington County School District, 2013-Present
St. George, UT
Provide a range of psychological services to children in grades K-12

- Consult and collaborate with teachers, administrators, school counselors, and parents about students with academic and social/emotional concerns
- Provide training for school faculty on Response to Intervention and help lead school intervention teams
- Conduct comprehensive evaluations, including cognitive, academic, adaptive and social/emotional assessments
- Participate in multi-disciplinary team determinations of eligibility for special education and assist in the development of appropriate services
- Provide individual counseling that focuses on issues relating to self-esteem, anxiety, study skills and social skills
- Assist in the development and implementation of behavior intervention plans

School Psychology Intern, Washington County School District, 2012-2013
Marci Olsen, EdS, Supervising School Psychologist
Completed a 1500-hour doctoral internship where I provided a range of psychological services to children in grades K–12

- Consulted and collaborated with teachers, administrators, and parents about academic and social/emotional concerns
- Participated in school intervention team meetings
- Conducted comprehensive evaluations, including cognitive, academic, adaptive and social/emotional assessments
- Participated in multi-disciplinary team determinations of eligibility for special education
- Provided individual counseling that focused on issues related to self-esteem, study skills and social skills development

School Psychology Practicum Student, UNLV Psycho-educational Clinic, 2009-2012
Rhiannon Rager, EdS and W. Paul Jones, EdD, Supervising Faculty Members

- Completed psycho-educational evaluations in a clinic setting for school age children and adults; evaluations included cognitive, academic, neuropsychological, personality, and social/emotional assessments
- Conducted intake and feedback interviews with parents and clients

GRADUATE ASSISTANTSHIP

Teaching Assistant, UNLV, School Psychology Program, 2009-2012
Scott Loe, PhD and W. Paul Jones, EdD, Supervising Faculty Members

- Taught labs and discussion sections for graduate level school psychology courses in cognitive and academic assessment
- Taught undergraduate courses in assessment for classroom teachers

Research Assistant, UNLV, School Psychology Program, 2008-2009
Joe Crank, PhD and Ralph Reynolds, PhD, Supervising Faculty Members

- Performed clerical tasks and gathered literature for research reviews
- Assisted as member of research teams by interviewing teachers, transcribing interviews, conducting classroom observations and assessing student literacy skills

RELATED EXPERIENCE

Special Education Teacher, Marion County Schools, 2006-2008
Fort McCoy School, Fort McCoy, FL

- Co-taught seventh and eighth grade inclusion science classes with general education teachers
- Instructed sixth grade science classes for students with disabilities
- Created Individualized Education Plans for students with disabilities
- Served as Special Education Department Chair in the 2007-2008 school year

PRESENTATIONS AND PUBLICATIONS

Bjork, K. A. (2011, February). *Conscientiousness. A predictor of online reading performance?* Poster presented at the annual convention of the National Association of School Psychologists, San Francisco, CA.

Reynolds, R. E. & the Empowerment Research Team* (2009, November). *The influence of school culture on teaching and learning: challenges and opportunities.* Paper presented at the annual meeting of the Southwest Consortium of Innovative Psychology in Education, Las Vegas, NV. (*Hall, G., Marchand, G., Parker, R., Putney, L., Bjork, K., Hamilton, N., Hughes, L., Khilnani, T., Kuch, F., & Surwill, V.).

HONORS, AWARDS, AND MEMBERSHIPS

Member, National Academy of Neuropsychology, October, 2010 - Present
Member, National Association of School Psychologists, June 2010 - Present
Recipient, Lampros Scholarship, 2004-2005 School Year
Recipient, Florida Bright Futures Scholarship, August 2000 – May 2004

REFERENCES

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