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Interrelationships among Language Skills, Externalizing Behavior, and Academic Fluency and Their Impact on the Academic Skills of Students with ED

J. Ron Nelson, Gregory J. Benner, Stern Neill, and Scott A. Stage

Abstract

There is growing interest in understanding the factors that influence the academic achievement of students with emotional disturbance (ED). Structural equation modeling was used to test the interrelationships among language skills, externalizing behavior, and academic fluency and their impact on the academic skills of students with ED. Results showed that language skills exerted a significant proximal effect and distal effect on academic skills. The effect of language skills was mediated through academic fluency (path coefficient = .389) but also had a proximal effect on academic skills (path coefficient = .359). However, externalizing behavior failed to have a statistically significant effect on language skills, academic fluency, or academic skills. Overall, fit indices suggested a marginally acceptable fit of the data. Results and implications are discussed.

A plethora of research has demonstrated that students with emotional disturbance (ED) are likely to have academic skill deficits (Nelson, Benner, Lane,& Smith, 2004). Students with ED consistently show moderate to severe academic skills deficits relative to normally achieving students (Brier, 1995; Gajar, 1979; Greenbaum et al., 1996; Mattison, Spitznagel, & Felix, 1998; Meadows, Neel, Scott, & Parker, 1994; Scruggs & Mastropieri, 1986; Wagner, 1995; Wilson, Cone, Bradley, & Reese, 1986) and students with learning disabilities (e.g., Gajar, 1979; Scruggs & Mastropieri, 1986). For example, Trout, Nordness, Pierce, and Epstein (2003), reviewing studies from a 40-year time frame (i.e., 1961 to 2000), reported that researchers of 91% (i.e., 31 of 35) of the studies reported that students with ED showed substantial deficits in academic skills (i.e., below grade level or 1 or more years behind their peers). In this context, our research explores factors that influence the academic achievement of students with ED.

The findings from a recent synthesis of the research literature have suggested that a majority of students with ED have language deficits (Benner, Nelson, & Epstein, 2002). On average, approximately 90% of elementary-age students with ED had expressive, receptive, and/or pragmatic language deficits. Nelson and colleagues reported that the language deficits of students with ED were stable across age (Nelson, Benner, & Cheney, 2005). Because successful language acquisition is a prerequisite for successful academic learning in all areas (Baker & Cantwell, 1987; Catts, Fey, Xuyang, & Tomblin, 1999), the language deficits of students with ED are likely to have a negative influence on their academic achievement.

Researchers have studied the particular types of problem behavior that are related to the academic skills of students with ED (Barriga et al., 2002; Mattison, Spitznagel, & Felix, 1998; Nelson et al., 2004). The results of this research suggest that externalizing behaviors are related to academic skills, but internalizing behaviors are not. For example, Mattison and colleagues used the *Diagnostic and Statistical Manual of Mental Disorders–Third Edition (DSM-III*; American Psychiatric Association, 1980) to examine categories of problem behaviors that are related to the academic skills of students with ED. These researchers found that conduct/oppositional disorder was related to the academic skills of elementary and secondary age students with ED. Similarly, externalizing behaviors ap-

pear to be related to language skills whereas internalizing behaviors do not (Nelson et al., 2005).

This study builds directly upon the research exploring the language skills of students with ED and the particular types of problem behavior related to their academic and language skills. Following contemporary psychoeducational theories of learning, this study extends this research by including academic fluency. Academic fluency is operationalized to include 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 (see Berninger & Richards, 2002; Mather & Wendling, 2003). Adequate academic fluency enables learners to perform more complex academic tasks. The purpose of this study was to use structural equation modeling to test five hypothesized interrelationships among language skills, externalizing behavior, and academic fluency and their impact on the academic skills of K–12 students with ED. Previous research typically used regression analysis procedures to study the relationship between types of problem behavior and academic achievement or language skills in isolation.

Hypotheses

The hypothesized structural equation model tested in this study is based on the following five empirically based hypotheses:

Hypothesis 1: Externalizing behavior will have a negative effect on language skills.
Hypothesis 2: Language skills will have a positive effect on academic fluency.
Hypothesis 3: Language skills will have a positive effect on academic skills.
Hypothesis 4: Externalizing behavior will have a negative effect on academic fluency.
Hypothesis 5: Academic fluency will have a positive effect on academic skills.

Hypothesis 1

It is reasonable to hypothesize that externalizing behavior will have a negative effect on language skills. Language difficulties and ED appear to emerge from the same etiological and environmental risk factors (e.g., Kaiser, Hancock, Cai, Foster, & Hester, 2000; Kaiser & Hester, 1997) and are likely to co-occur (Benner et al., 2002). Furthermore, research suggests that externalizing behaviors are related to language skills whereas internalizing behaviors are not (Nelson et al., 2005).

Hypothesis 2

It is logical to hypothesize that language skills will have a positive effect on academic fluency because language development is not restricted to the acquisition of words or rules (Owens, 2001). To comprehend language, a child must engage in very rapid processing of phonological, lexical/semantic, grammatical, and syntactic information presented by the speaker. The child must also take advantage of the context to access and integrate information over multiple levels, with millisecond timing (Catts et al., 1999).

Hypothesis 3

If Hypothesis 2 is true, it follows that language skills will have a positive effect on academic skills in all areas. A plethora of research has demonstrated that problems with the processes involved in understanding or using language manifest through difficulties with reading, thinking, spelling, speaking, calculating, writing, or listening (Moats, 2000; National Academy of Sciences, 1998). For example, preschoolers with early language impairment develop reading difficulties later, often in conjunction with broader academic achievement problems (Whitehurst et al., 1994). Further, children living in language-deprived homes are more likely to experience academic achievement problems in schools (Hart & Risley, 1995; National Academy of Sciences, 1998).

Hypothesis 4

If Hypotheses 1, 2, and 3 are true, it is realistic to hypothesize that externalizing behavior will be negatively related to academic fluency. Additionally, evidence suggests that externalizing behavior and rapid automatic naming (i.e., ability to make quick visual–verbal associations of stimuli in a left-to-right format), which is a process encompassed in academic fluency, are both predictors of children who are unresponsive to generally effective reading interventions (Al Otaiba & Fuchs, 2002; Nelson, Benner, & Gonzalez, 2003). For example, meta-analytic procedures were applied to a total of 30 studies that met a set of inclusionary and exclusionary criteria (Nelson et al., 2003). Mean Z_r (Fisher z transformed correlation) effect size estimators were computed (Hedges & Olkin, 1985) for seven primary learner characteristic categories, including problem behavior and rapid automatic naming. Rapid automatic naming (Z_r = .51) and problem behavior (Z_r = .46) were the two strongest predictors of responsiveness to generally effective reading interventions.

Hypothesis 5

Ample evidence supports a hypothesis that academic fluency is positively related to academic skills. Academic fluency has been identified as underlying many academic (e.g., decoding, mathematical computation) and cognitive skills (e.g., working memory, verbal ability; Fry & Hale, 1996). For example, in the field of reading, clear evidence suggests that rapid automatic naming is critical to proficient reading (Berninger, Abbott, Billingsley, & Nagy, 2001; Compton, 2003; Sunseth & Bowers, 2002). Automatic nam-

ing skills are the strongest and most consistent predictor discriminating the most difficult and least difficult to remediate students in Grades 1 through 3 (Vellutino, Scanlon, & Lyon, 2003). Additionally, there are theoretical, empirical, and instructional distinctions between academic fluency and academic skills (Mather & Wendling, 2003).

Method

Participants

Participants were 126 (102 boys, 24 girls) randomly selected students (Grades K–12) receiving special education services for ED in a medium-sized urban school district in the Midwest. Informed consent and student assent were obtained in all cases. The means and standard deviations for all of the observed variables (see Construct Definitions and Measures section) are presented in Table 1. One hundred and seven (85%) of the participants were Caucasian, 14 (11%) were African American, 3 (2%) were Latino, and 2 (2%) were Native American. The ethnic makeup of our sample was consistent with the total population of students with ED served by the school district, but underrepresentative of African American and Hispanic/Latino students nationally. Furthermore, the ratio of boys to girls in the sample is consistent with the total population of students with ED served nationally (Kauffman, 2001).

Construct Definitions and Measures

Three standardized scales were used to measure each of the four constructs: Externalizing behavior, academic fluency, academic skills, and language. The construct definitions and descriptions of the associated measurement scales follow.

Externalizing Behavior. The construct of externalizing behavior refers to problem behavior that is manifested in a child's outward behavior and reflects the child's negatively acting on the external environment (Walker & Severson, 1990). The *Child Behavior Checklist: Teacher Report Form* (Achenbach, 1991) Delinquent Behavior, Aggressive Behavior, and Attention Problem narrow-band scales were used to measure the externalizing behavior of participants. The teacher rates the child on each scale item by indicating the severity of the problem on a scale of 0 (*no problem*) to 2 (*severe problem*). The internal consistency values for the Delinquent Behavior, Aggressive Behavior, and Attention Problem narrow-band scales are .86, .92, and .89, respectively (Achenbach, 1991).

Academic Fluency. The construct of academic fluency refers to the ability to work quickly and maintain focused attention when measured under pressure (Fry & Hale, 1996). The *Woodcock Johnson–III Tests of Achievement* (WJ-III; Woodcock et al., 2001) Math Fluency, Reading Fluency, and Writing Fluency subtests (the WJ-III Academic Fluency cluster) were used to measure the academic fluency of participants while performing rudimentary academic tasks. For the Math Fluency subtest, students write the answers to basic addition, subtraction, and multiplication facts within a 3-min time limit. Students read a series of statements and circle *yes* or *no* to indicate whether they are true or false within a 3-min time limit for the Reading Fluency subtest. For the Writing Fluency subtest, students write sentences describing what is depicted in stimulus pictures within a 7-min time limit. The test–retest reliabilities for the WJ-III Math Fluency, Reading Fluency, and Writing Fluency subtests are .90, .90, and .88, respectively (Woodcock et al., 2001).

Academic Skills. The construct of academic skills refers to fundamental reading, mathematical, and spelling skills that underlie more advanced achievement competencies such as math reasoning and reading comprehension (Kameenui & Simmons, 1990). The WJ-III Letter-Word Identification, Calculation, and Spelling subtests (the WJ-III Academic Skills cluster; Woodcock et al., 2001) were used to measure the academic skills of participants. The Letter-Word Identification scale requires students to identify and pronounce isolated words and letters. The Calculation scale requires students to complete computations from simple addition facts to complex algebraic equations. The Spelling subtest requires students to spell words presented orally. The test–retest reliabilities for the Letter-Word Identification, Calculation, and Spelling subtests are .94, .86, and .90, respectively (Woodcock et al., 2001).

Language. The construct of language refers to the ability to understand and use words effectively either orally or in writing (Owens, 2001). The *Clinical Evaluation of Language Fundamentals–Third Edition* (CELF-III; Semel, Wiig, & Secord, 1995) Receptive and the *Wechsler Intelligence Scale for Children* (WISC-III; Wechsler, 1991) Verbal scale were used to measure the language skills of participants. The CELF-III subtests include Sentence Structure, Word Structure, Concepts and Directions, Formulated Sentences, Word Classes, Recalling Sentences, Sentence Assembly, and Semantic Relationships. The CELF-III's Receptive (Sentence Structure, Concepts and Directions, and Word Classes) and Expressive (Word Structure, Formulated Sentences, and Recalling Sentences) subtests for students 6 to 8 years differ from the Receptive (Concepts and Directions, Word Classes, and Semantic Relationships) and Expressive (Formulated Sentences, Recalling Sentences, and Sentence Assembly) subtests for students 9 years and older. Regardless of age, the Receptive and Expressive scale scores are based on the sum of the three respective subtest scores. The test–retest reliabilities of the Receptive and Expressive scales are .86 and .88, respectively (Semel et al., 1995). Additionally, the WISC-III Verbal scale includes the General Information, General Comprehension, Arithmetic, Similarities, Vocabulary, and Digit Span subtests. The test–retest reliability of the Verbal scale is .94 (Wechsler, 1991).

Results

Means, Standard Deviations, and Correlations of Observed Variables

The descriptive data and correlation matrix of the observed variables used in the structural equation model are shown in Table 1. All means are reported in standard score units (i.e., M = 100, SD = 15) except for the narrow-band scores from the TRF, which are reported in T-score units (i.e., M = 50, SD = 10). Review of the descriptive data shown for each variable indicated that each scale was relatively normally distributed. Bivariate correlation coefficients among observed variables by language (i.e., verbal intelligence, verbal expression, and verbal reception), externalizing behavior (i.e., attention problems, delinquent behavior, and aggressive behavior), academic fluency (i.e., writing, reading, and math fluency) and academic skills (i.e., letter-word identification, calculation, and spelling) were all moderate in magnitude. Correlation coefficients between observed variables from different constructs, such as language with academic fluency, language with academic skills, and academic fluency with academic skills, were positive and moderate (ranging from .33 to .72). Bivariate correlation coefficients between observed variables from the externalizing behavior construct with other observed variables were weak to moderate (range = –.04–.40).

Structural Equation Model

Structural equation modeling was used to test the hypothesized interrelationships among language skills, externalizing behavior, academic fluency and their impact on the academic skills of students with ED using *Mplus* (Muthen & Muthen, 2004). This technique allowed for the simultaneous examination of the series of interrelated dependence relationships among these constructs.

The chi-square test of model fit from baseline to the specified model in Figure 1, $\chi^2(66, N = 126) = 958.197$, p = .001, and $\chi^2(48, N = 126) = 144.323$, p = .001, respectively, was determined by dividing the chi-square by the degrees of freedom with values less than 2, indicating good fits compared with baseline models. In this case, the value was 3 for the specified model, suggesting a less than optimal fit. Additional indices of fit were used. The comparative fit index (CFI = .892) and the Tucker- Lewis Index (TLI = .852) results suggested a marginally adequate fit (Hu & Bentler, 1995). TLI is also called the nonnormed fit index (NNFI) because the measure can lie outside the 0 to 1 range. A cutoff value of .90 is generally accepted for both TLI and CFI; the values in the range found in the specified model are considered marginally acceptable.

The model in Figure 1 shows the observed variables (rectangles) that produced the latent variables (ovals). The degree of association between the observed variables and latent variables is shown as well as the path coeffi-

Table 1. Mean, Standard Deviations, and Correlations of Observed Variables

Variable	VIQ	REC	EXP	ATTP	DEL	AG	WF	RF	MF	LW	CAL	SP
VIQ	—											
REC	.52	—										
EXP	.45	.66	—									
ATTP	–.19	–.20	–.21	—								
DEL	–.19	–.27	–.23	.48	—							
AG	–.06	–.06	–.04	.58	.68	—						
WF	.35	.39	.52	–.40	–.22	–.14	—					
RF	.46	.52	.59	–.38	–.28	–.19	.7	—				
MF	.33	.47	.52	–.29	–.15	–.01	.68	.65	—			
LW	.47	.55	.60	–.29	–.27	–.11	.56	.72	.53	—		
CAL	.44	.56	.40	–.25	–.17	.01	.49	.52	68	.46	—	
SP	.45	.44	.50	–.19	–.27	–.18	.56	.67	.57	.81	.50	—
M	96.6	89.9	81.9	61.9	62.4	65.8	91.6	92.3	85.6	97.2	94.1	94.6
SD	16.7	18.3	15.2	7.9	8.3	10.2	16.4	14.4	16.6	14.3	16.3	18.6

Correlations ≥ –.19, $p < .05$; ≥ –.23, $p < .01$; ≥ –.27, $p < .001$.

VIQ = Verbal intelligence, REC = verbal reception, EXP = verbal expression, ATTP = attention problems, DEL = delinquent behavior, AG = aggressive behavior, WF = writing fluency, RF = reading fluency, MF = math fluency, LW = letter-word identification, CAL = calculation, and SP = spelling.

All mean scores are reported in standard score units (i.e., M = 100, SD = 15) except ATTP, DEL, and AG, which are reported in T-score units (i.e., M = 50, SD =10).

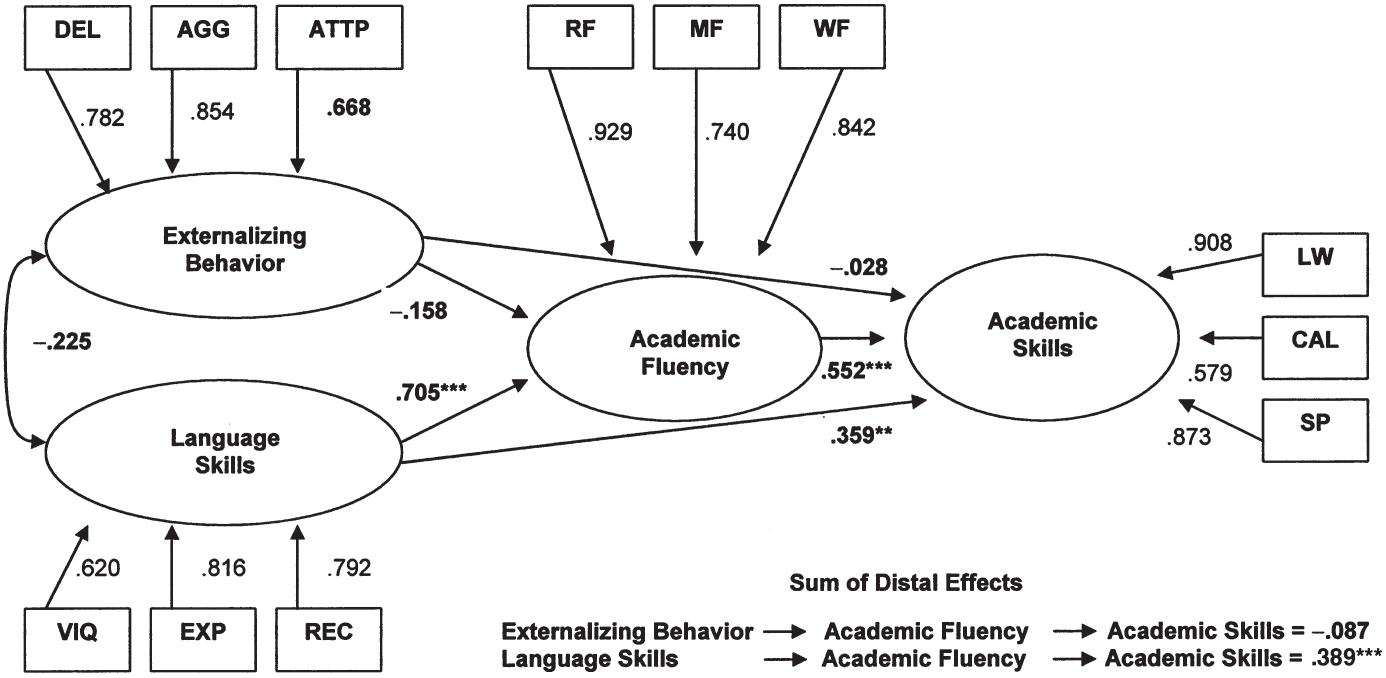

Figure 1. Structural model depicting the interrelationships among language skills, externalizing behavior, academic fluency and their impact on academic skills. Observed coefficients represent the variance associated with the latent variables and the bold represent the path coefficients between latent variables. VIQ = Verbal intelligence, REC = verbal reception, EXP = verbal expression, ATTP = attention problems, DEL = delinquent behavior, AG = aggressive behavior, WF = writing fluency, RF = reading fluency, MF = math fluency, LW = letter-word identification, CAL = calculation, and SP = spelling. * $p < .05$. ** $p < .01$. *** $p < .001$.

cients (bold text) that indicate the relationships between the constructs. To test the hypotheses as to the relationships among the latent constructs, each standardized path coefficient was statistically tested for its proximal and distal effect on the academic skills construct. Tests of distal effects are labeled in the figure. Academic fluency had a statistically significant proximal effect on academic skills. Language skills had both a distal effect on academic skills through academic fluency and a proximal effect on academic skills of equal magnitude. The effects of externalizing behavior on the other constructs were not statistically significant.

Discussion

There is growing interest in identifying the factors that influence the academic achievement of students with ED. These students tend to experience significant academic achievement deficits in all areas (Nelson et al., 2004). Structural equation modeling was used to test five hypothesized interrelationships among language skills, externalizing behavior, and academic fluency and their impact on the academic skills of K–12 students with ED. Hypotheses 1 and 4 regarding the effects of externalizing behavior on language skills (Hypothesis 1) and academic fluency (Hypothesis 4) were not supported. Externalizing behavior as measured by the narrow-band scales of delinquent behavior, aggressive behavior, and attention problems did not have a statistically significant effect on language skills, academic fluency, or academic skills. Even when the statistical power was enhanced by using a multiply determined latent construct, review of the bivariate correlations suggest that the relationship with the other observed variables was poor to moderate at best. Our finding that externalizing behavior had little or no influence on the other constructs is consistent with recent research (Vitaro, Brendgen, Larose, & Tremblay, 2005). Vitaro et al. found that parental child-rearing practices mediated the relationship between the disruptive behaviors of kindergarten and noncompletion of high school.

Hypotheses 2 and 3 concerning the effects of language skills on academic fluency (Hypothesis 2) and academic skills (Hypothesis 3) were supported. Language ability had a statistically significant effect on academic fluency and academic skills (as suggested by neuropsychological research; Berninger & Richards, 2002). Finally, Hypothesis 5, regarding the effect of academic fluency on academic skills, was supported. Academic fluency had a statistically significant effect on academic skills.

In consideration of the entire model, it can be seen that academic fluency mediated the influence of language ability on academic skills. Obviously, students' ability to effi-

ciently process academic information and produce appropriate responses facilitated the students' academic abilities (Berninger & Richards, 2002; Fry & Hale, 1996). The interrelationships regarding language, externalizing behavior, fluency, and academic skills lead to a pragmatic postulate: Up to 45% of students with ED are likely to have concomitant language ability deficits (Nelson et al., 2005). The model described in this article suggests that students with ED would benefit academically from interventions directed at developing their language ability. Because the most common forms of intervention with students with ED is through the use of language, it would seem paramount that public school professionals assess these students' language skills and offer interventions for students with ED with concomitant communication disorders.

Limitations

The findings have several limitations that should be noted. First, the sample size of 126 for the structural equation model is small. Traditional estimates suggest that a sample size of 300 is good (Comrey, 1973). Second, the sample of children was drawn from one school district in one geographic location and may not be representative of the general population of public school students with ED. It is possible that the findings may not generalize to other students in other geographical regions and schools. Indeed, the sample population slightly underrepresented the proportion of African American and Hispanic/Latino students that would be found nationally in the population of students with ED. Therefore, sample populations with more diverse students might yield different findings. Future research is needed to replicate these findings across varied contexts. Third, the mixed support for the five hypothesized relationships and marginally acceptable fit indices for this structural equation model suggests that these findings are in fact just one test of a possible model explaining the interrelationships between language ability, externalizing behavior, academic fluency, and academic skills. The interrelationships among language, externalizing behavior, and academic fluency and their influence on academic skills may vary if these variables are operationalized in different ways. The results of research on rapid automatic naming indicates that the processing of object or color stimuli is more involved than the processing of letter or digit stimuli (Wolf & Bowers, 1999). Future studies should use measures that operationalize the constructs studied in this article in various ways. It would be interesting to study, for example, what would happen to the mediating effect of academic fluency if the number and categorical clarity of the stimuli were varied.

Implications

With the above limitations in mind, implications for practices are evident. The model described in this article suggests that students with ED would benefit from interventions directed at developing their language ability. This would appear to benefit students with ED in terms of developing their academic skills but not in terms of reducing their externalizing problem behavior. It seems paramount that public school professionals assess the language skills of students with ED and offer interventions for students with ED.

The model described in this article also suggests that students with ED would benefit from interventions directed at developing their academic fluency in academic skill areas. Instructional activities directed at improving the academic fluency integrate accuracy (mastery) and speed (fluency). Educators should use instructional techniques that enhance students' ability to effortlessly complete foundational academic tasks without conscious thought to step-by-step process (i.e., automaticity). These tasks could be structured around reading, mathematics, and writing. When foundational academic tasks become automatic, the brain recognizes these simple and familiar tasks, processes the information, and automatically applies the correct rules to the procedure without immense cognitive effort. Researchers have found that building automaticity with reading tasks not only improves overall academic functioning but also increases neurological activity in the area of the brain that deals with automatic retrieval of information (Berninger & Richards, 2002).

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