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Executive Functioning: Relationship with High School Student Role Performance

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Abstract

BACKGROUND. Student role performance for academic success in secondary education is under represented in the occupational therapy literature, despite the persistently high dropout rate in the United States (Stillwell & Sable, 2013). Executive dysfunction is one of many possible contributors to difficulties in the classroom (Dirette & Kolak, 2004) and is a better indicator of school performance than IQ (Diamond, 2012). This research examined executive functioning of both alternative and traditional high school students to determine if there is a relationship between executive function and academic success as measured by cumulative grade point average.

METHOD. 132 high school students from three different school settings were given the Behavioral Rating Inventory of Executive Function-Self Report (BRIEF-SR). The Global Executive Composite (GEC) and individual subscale scores were compared to GPA.

RESULTS. No significant difference in GEC scores was found among settings. Subscale scores for "inhibition" and "task completion" were significantly different in the alternative school setting. A weak negative correlation was seen between the GEC and GPA. However, academically unsuccessful students scored statistically lower on the GEC.

CONCLUSION. Global executive dysfunction was not predicted by setting but was seen in academically unsuccessful students.

Keywords

executive function, high school, adolescent, academic success, role performance

Cover Page Footnote

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High school graduation rates have been a societal focus in recent years, resulting in Public Law 107-110, commonly referred to as the No Child Left Behind Act of 2001 (NCLB). The NCLB Act holds public schools and educational agencies accountable for meeting the educational needs of low-achieving children, including those with disabilities. It calls for the elimination of the achievement gap between high- and low-performing children and includes the provision of alternatives to enable students to access appropriate education (U.S. Department of Education, 2002). A free and appropriate education (FAPE) is guaranteed to all individuals with disabilities via Section 504 of the Rehabilitation Act of 1973 and includes the provision of related services (e.g., occupational therapy) for the purposes of meeting this mandate (U.S. Department of Education, 2013). Traditionally, efforts have been focused on early childhood and physical challenges. Given the concerns with secondary education performance, it is reasonable to consider the role of related services in student role performance among high school students. Because poor academic performance has been identified as a risk factor for dropping out (Garruto, 2010; Ridings, 2010), sufficient regard for client factors underlying academic performance is paramount. Screening or assessment to identify executive dysfunction (EDF) when student role performance is of concern could be a key to supporting academic success.

High school is a period of significant social, emotional, physical, and cognitive growth and change. This tumultuous period of development coincides with identity formation, which, in turn, is influenced by performance patterns (including role performance) and how they support or interfere with occupational performance (American Occupational Therapy Association, 2014). Role performance in the complex high school environment is critical for academic success; poor role performance in academic and social participation creates high risk for student dropout (Hammond, Linton, Smink, & Drew, 2007). Further, a student who experiences a higher incidence of failure than success begins to shape an identity as a poor student, thus creating risk for reducing volition in student role performance and enhancing volition for behaviors not supportive of academic participation. This sets the stage for potentially dropping out of high school. A dropout is defined as "a student enrolled at any time during the previous school year who is not enrolled at the beginning of the current school year and who has not successfully completed school" (Stillwell & Sable, 2013, p. 2).

Over 514,000 students between grades 9 and 12 dropped out of school in the United States during the 2009-2010 academic school year (Stillwell & Stable, 2013). Poor academic performance has been found to have an impact on dropout as early as the first grade (Alexander, Entwisle, & Horsey, 1997; Ensminger & Slusarcick, 1992; Rumberger, 2011), continuing throughout elementary, middle (Cairns, Cairns, & Neckerman, 1989; Suhyun, Jingyo, & Houston, 2007), and high school (Battin-Pearson et al., 2000; Rumberger, 2011). Additional factors include environmental press, disconnect from the school environment, and feeling bored and unmotivated (Bridgeland, DiIulio, & Burke

Morison, 2006; Ekstrom, Goertz, Pollack, & Rock, 1986; Jordan, Lara, & McPartland, 1994). Quality of life is reduced, and high dropout rates result in societal burden as a consequence of loss of productive workers and higher costs associated with increases in incarceration, health care, and social services (Bridgeland et al., 2006; Carver & Lewis, 2010).

In the 2007-2008 school year, 645,500 students were reported to be attending alternative schools in the United States (Carver & Lewis, 2010). Reasons for alternative placement, which can be voluntary, include disruptive behavior, continual academic failure, pregnancy, and mental health needs (Carver & Lewis, 2010). Forty-one percent of these students requested to transfer out of a traditional school and into an alternative program. Parents or district administrators referred the others. Unfortunately, referrals to alternative schools exceeded the resources; one-third of districts reported they had to deny new alternative school enrollments due to space limitations (Carver & Lewis, 2010).

EDF is one of many possible contributors to difficulties in the classroom (Dirette & Kolak, 2004). Executive function is commonly defined as the cognitive process that regulates an individual's ability to organize thoughts and activities, prioritize tasks, manage time efficiently, and make decisions (executive function, n.d.). Experts accept the following definition: "the ability to maintain an appropriate problem solving set for attainment of a future goal" (Welsh & Pennington, 1988, p. 201). Identified factors of EDF include difficulty in areas such as initiation and termination, higher-level thinking, self-control, coping skills (anger management), sequencing, short-term memory, attention span, time management, and multitasking. Disruptive physical and verbal behaviors are often reported (Barton, 2005; Carver & Lewis, 2010; Katsiyannis & Williams, 1998; Kleiner, Porch, & Farris, 2002). There is reciprocal influence between executive functions and emotional regulation (Blair & Diamond, 2008).

Executive function is an essential component to learning. Through the facilitation of complex problem solving, the productive relationship between executive function and learning is realized (Best & Miller, 2010; Best, Miller, & Jones, 2009; Checa, Rodríguez-Bailón, & Rueda, 2008; Jarvis & Gathercole, 2003; St Clair-Thompson & Gathercole, 2006). However, intelligence quotient (IQ) has traditionally been used for a variety of assessment purposes, such as ascertaining the correlation between capacity and performance (Weinberg, 1989). Executive function differs from IQ in that executive function is a broad measurement of one's global ability to function, while IQ is only a measure of one's cognitive ability or intelligence (Diamond, 2012; Plomin, 1999). Thus, IQ is less effective in predicting a student's readiness for school, grades, or success in college (Diamond, 2012), and executive function may provide a more holistic picture of a student's capacity and needs. Executive functioning has been strongly associated with learning and education, and it is believed to be foundational to the successful performance of a variety of roles, including student, worker, parent, and homemaker. Occupational therapists, because of their background in neurology

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and expertise in identifying strategies for improving occupational performance, may be uniquely qualified to meet the cognitive and developmental needs of students and adolescents with EDF (Toglia & Berg, 2013).

Welsh and Pennington (1988) noted that executive function entails mental processes across the domain of frontal lobe functions and also includes gating of attention and memory functions for task performance. Hence, executive function is the collaboration among several areas of the brain: dorsolateral prefrontal cortex, orbitofrontal cortex, anterior cingulate cortex, and parietotemporal association areas (Lundy-Ekman, 2007). Ultimately, executive functioning is a highly complex brain process that eludes an easy operational definition (Barkley, 2012).

Regardless of the inability of experts to agree on an exact definition of executive function, individuals present to clinicians for help with EDF (Maeir et al., 2014; Miranda, Presentación, Siegenthaler, & Jara, 2013; Williamson Weiner, Toglia, & Berg, 2012). A lack of specificity in the definition of executive function is of particular interest to occupational therapists since the deficits in daily performance are a cornerstone to the identification of EDF and effective treatment. According to Barkley (2012):

> people with [prefrontal cortex] disorders and injuries have [executive function] deficits in their daily life activities even if the [executive function] tests do not detect them . . . it is the deficits occurring in daily life, not those manifested on tests, that are the most important to understand and to clinically assess and rehabilitate or manage. (p. 10)

Three foundational functions are accepted as common in assessments for EDF: inhibition, working memory, and shifting (Miyake et al., 2000). Additionally, planning is postulated as a fourth essential function used for task completion (Anderson, 2002), and it can be argued that planning is the overarching skill in executive functioning.

Inhibition is the ability to suppress a dominant or automatic action or thought as related to cognitive, emotional, and motor control (Cooper-Kahn & Dietzel, 2008; Nigg, 2000). It continues to develop with age and experience, and inhibition is important in order to subvert behaviors that may interfere with task performance and goal achievement (Best et al., 2009). Working memory is the ability to maintain and manipulate information over brief periods of time (Alloway, Gathercole, & Pickering, 2006) and gradually improves from 4 to 15 years of age (Gathercole, Pickering, Ambridge, & Wearing, 2004). Shifting is the ability to shift between mental states, operations, or tasks (Miyake et al., 2000). Planning is the ability to formulate actions in advance and to approach a task in an organized, strategic, and efficient manner (Anderson, 2002).

Development of Executive Functions

Metacognitive skills lay the foundation for the transfer and generalization of learned skills to everyday functioning, are a critical link between cognition and role performance (Katz & Hartman-Maeir, 1997), and can be seen as the behavioral outcomes of executive functions (Jansiewicz, 2008). Metacognition refers to an awareness of personal knowledge coupled with an ability to understand, control, and manipulate that knowledge for deeper understanding (Arslan & Akin, 2014). Metacognition lays the foundation for successful occupational performance.

As the developing brain matures, executive functions improve in response to teaching and intervention strategies (Lodico, Ghatala, Levin, Pressley, & Bell, 1983). Several brain regions begin to process information synergistically and in greater capacities starting in infancy and continuing well into adulthood (Anderson, Jacobs, & Anderson, 2008). Inhibition shows the most improvement during the preschool years and less change as the child moves into adolescence and adulthood. Working memory and shifting emerge in the preschool years. Planning develops primarily in late childhood and adolescence. Task shifting continues to mature into adulthood (Rubia et al., 2006).

This study examined how executive functions influence student role performance as measured by academic performance. Academic performance (GPA) is considered to be an outcome influenced by executive functioning as expressed through student role performance. Varied academic environments are included in order to identify executive functions more accurately as the distinguishing element in academic performance. The hypotheses are: (a) There will be a relationship between executive functioning and traditional, alternative, and independent learning students; (b) there will be a correlation between GPA and executive functioning; and (c) there will be a difference in executive functioning between academically successful and unsuccessful students.

Method

This study used a quantitative descriptive multi-subject case study to examine the relationships between executive function, school placement, and a measure of academic role performance. Descriptive case studies describe the behaviors of individuals, facilitate understanding of causal factors in performance, and are a beginning step in theory development (Kielhofner, 2006; Yin, 1994). This design allows for exploring the role of executive functions across diverse high school environments and functions.

Procedures and Participants

Following Eastern Washington University's Internal Review Board approval, the researchers recruited participants using a convenience sampling procedure (Dickerson, 2006). Based on a power analysis for 80%, the desired number of participants for this study was 168. A total of 175 students were recruited across three school settings: one traditional high school, one alternative high school, and one independent learning program. Alternative schools are any schools that are separate from, and alternative to, the traditional high school (Dirette & Kolak, 2004). Independent learning programs, a subset of alternative schools, are designed to tailor learning to individual needs while studying off campus (California Department of Education, 2013). Inclusion criteria for the study included age (14 to 18 years of age) and current enrollment in high school with a reading level of fifth grade or above (to maintain compliance with the Behavioral

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Rating Inventory of Executive Function-Self Report). Exclusion criteria included enrollment in special education and/or having an individualized education program (IEP) in place. Missing demographic or GPA data resulted in exclusion from the study.

The researchers categorized the population in two ways: school setting and academic success. The school setting category consisted of three groups based on the sample sites. The academic success category consisted of two groups: successful academic group and unsuccessful academic group. For the purposes of this study, academic success was defined as a GPA of 2.0 or higher.

Assessment Tool

The Behavioral Rating Inventory of Executive Function-Self Report (BRIEF-SR) is a standardized 80-item questionnaire designed to assess an individual's perception of his or her own executive functioning skills (Guy, Isquith, & Gioia, 2004). The researchers selected this tool for the following reasons: affordability, ease of administration, presence in the literature, general acceptance of validity, and inclusion of the foundational skills common in EDF assessments (inhibition, working memory, shifting, and planning). Data is derived from the perspective of the participant and, therefore, might be considered less than ideal. However, assessment of performance in natural environments often uncovers difficulties not identified through narrow testing parameters (Barkley, 2012), and the self-reporting nature of this data facilitates insights into performance of daily routines. Ideally, the BRIEF-SR is administered in addition to the BRIEF-Parent Report and/or the BRIEF-Teacher Report, thereby enhancing data rigor. However, the participant schools declined to assist in eliciting parent and teacher participation. Inclusion of these reports would significantly add to the impact of this study; however, the BRIEF-SR represents the lived experience from the students' perspectives and thus constitutes meaningful data.

The BRIEF-SR generates an overall executive functioning score or the Global Executive Composite (GEC). The GEC is comprised of eight non-overlapping subscales of executive function: Inhibition, Shifting, Emotional Control, Task Completion, Working Memory, Planning, Organization, and Self-Monitoring. A Behavior Rating Index score and a Metacognition Index score are also included in the BRIEF-SR. These scores are useful as individual behaviors are considered to influence metacognitive skill performance, which is dependent upon executive functioning skills. Examination of these scores can lend insights useful to the evaluator seeking to help an individual improve executive functioning. Because this study is not looking at intervention, these scores were used in a limited capacity to lend insight into data interpretation.

The tool is standardized and normed for gender and age from 11 to 18 years; responders must have a reading level of fifth grade or above. The assessment contains two inherent validity scales, Inconsistency and Negativity, used to determine the validity of the individual's responses. Internal consistency is moderate to high (.72 - .96) for individual subscales (r or α = .72) and for the full assessment (r or α = .96; Guy et al., 2004).

The BRIEF-SR asks participants to estimate the frequency of certain behaviors over the last six months as "Often," "Sometimes," or "Never" for each of the 80 questions. The participants of this study completed the survey in 10 to 20 min in the classroom setting with at least one researcher present. The researchers encouraged the participants to ask for clarification when needed and monitored the participants to assure that they each completed the assessment independently. The researchers collected and scored the completed forms. Each raw score was converted to a t-score and percentile rank. Higher t-scores are associated with lower executive function skills. The data was entered into version 20 of the Statistical Package for the Social Sciences (SPSS) for analysis.

To test the reliability of the assessment specific to the population in this study, the internal consistency was calculated using Chronbach's α Coefficient. To test the first hypothesis (there will be a difference in executive functioning between traditional, alternative, and independent learning students) a one-way Analysis of Variance (ANOVA) was used to compare mean GEC scores among setting groups (Salkind, 2014). For additional analysis, a two-way ANOVA was used to compare the GEC among setting groups while controlling for the covariate, academic group. Further analysis was completed using multiple one-way ANOVAs to compare the eight subscales of the GEC among the setting groups. A final two-way ANOVA compared GPA among setting groups while controlling for the covariate, GEC. To test the second hypothesis (there will be a correlation between GPA and executive functioning), a Pearson's Product Moment Correlation (Pearson's r) was run to identify the relationship between the GEC score and GPA (Salkind, 2014). To test the third hypothesis (there will be a difference in executive functioning between academically successful and unsuccessful students), a student's t-test was used to compare the GEC scores between the two academic groups for each setting group (Salkind, 2014).

Results

Demographics

Of the 175 recruited students, 132 students across the three school settings met the inclusion and exclusion criteria and were included in this study. One traditional high school did not report individual numeric GPAs, and therefore that student was excluded from the study. The average GPA across all groups was x=2.71 (*SD* = 0.94), and the average GEC score across all groups was x=54.87 (*SD* = 11.35). Group characteristics are reported in Table 1.

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Table 1
Participant Characteristics

Setting Group	N	Mean GPA (*SD*)	Mean GEC (*SD*)	% Male	% Female	% Successful	% Unsuccessful
Traditional	76	3.16 (.76)	53.61 (10.50)	43.1	57.9	88.2	11.8
Alternative	38	2.04 (.79)	57.71 (12.94)	52.6	47.4	44.7	53.3
Independent Learning	18	2.19 (.82)	54.17 (10.76)	55.6	44.4	66.7	33.3

Note. GPA = grade point average; GEC = global executive composite

Internal Consistency

Internal consistency of the BRIEF-SR assessment for the sample population was determined using Chronbach's α Coefficient. Results indicated that the assessment was highly internally consistent (α = .91) across all setting groups. Internal consistency for the traditional, alternative, and independent learning groups was α = .90, .93, and .89, respectively.

Difference Between GEC and Setting Group

Global executive composite mean scores were compared among settings using a one-way ANOVA. Results of the ANOVA, $F(2, 131) = 1.71$, $p = .19$, indicated no significant difference among the groups.

A two-way ANOVA comparing GEC and setting group while controlling for academic group as a covariate also indicated no significant difference, $F(2, 131) = .78$, $p = .46$, among setting groups. Visual plotting for the independent learning group showed an inverse relationship between the GEC and academic group when compared to the traditional and alternative groups (see Figure 1).

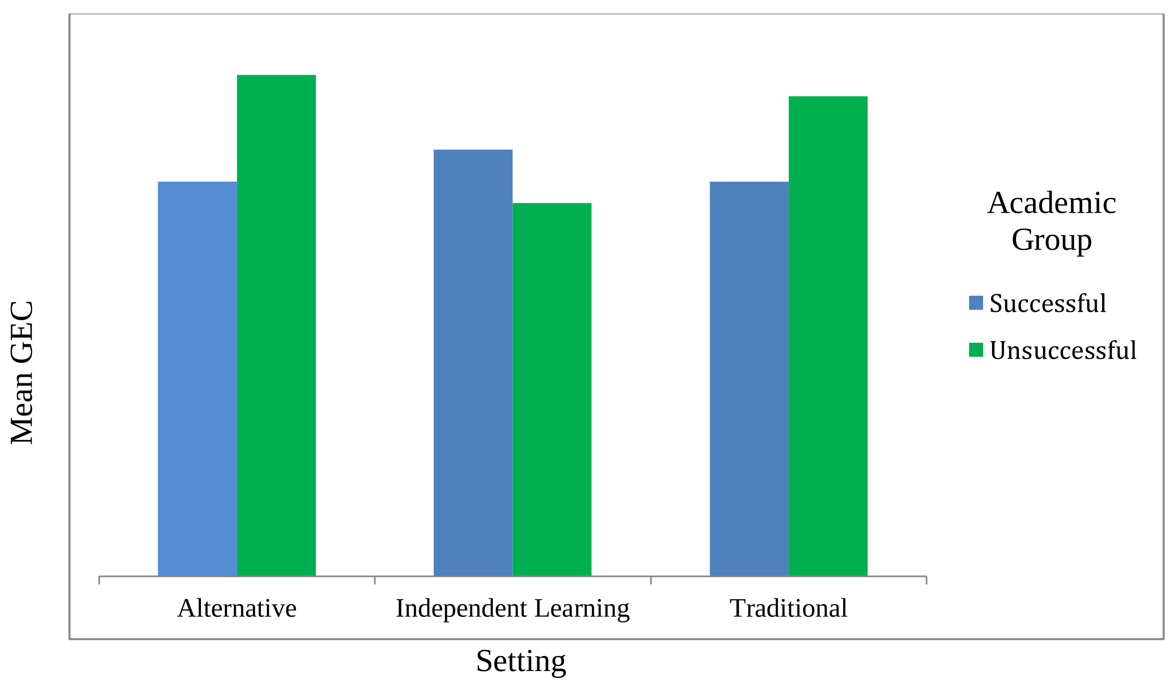

Figure 1. Mean GEC scores among setting groups and based on academic group ANOVA results indicating no significant difference in GEC scores among setting groups ($p = .46$).

Next, the eight subscales (Inhibition, Shifting, Emotional Control, Task Completion, Working Memory, Planning, Organization, and Self-Monitoring) were compared by setting group. Multiple one-way ANOVAs were used to compare the subscales for each setting group.

Significance was found for Inhibition, $F(2, 131) = 3.20$, $p = .04$, and Task Completion, $F(2, 131) = 6.42$, $p = .002$ (see Table 2). Post-hoc analysis was done using Fisher's test of Least Significant Difference (LSD). Inhibition was significantly different between the traditional and alternative setting groups ($p = .04$). Task Completion was also significantly different between the traditional setting and alternative setting groups ($p = .002$).

Table 2

Comparison of Mean Subscale Scores Among Settings

Executive Function Subscales	F	P	Traditional Setting Group Means (*SD*)	Alternative Setting Group Means (*SD*)
Inhibit	3.20	.04	51.57 (10.96)	56.82 (12.10)
Shift	1.53	.22	52.13 (10.14)	56.00 (13.41)
Emotional Control	.77	.46	51.39 (10.15)	54.53 (16.51)
Monitor	.50	.61	51.78 (10.49)	52.00 (11.68)
Working Memory	2.69	.07	52.96 (10.49)	58.00 (11.56)
Plan/Organize	.04	.97	55.64 (10.95)	56.18 (11.03)
Organization of Materials	.05	.96	53.21 (10.49	53.68 (10.58)
Task Completion	6.42	.002	49.14 (9.94)	56.42 (11.50)

A two-way ANOVA was used to compare GPA and setting group while controlling for the GEC as a covariate. Results, $F(2, 131) = 29.31$, $p < .001$, indicated a significant difference among the groups. Fisher's LSD results demonstrated a significant difference between the traditional and alternative setting groups ($p < .001$) and between the traditional and independent learning groups ($p < .001$), indicating the traditional setting group had the highest mean GPA (see Table 1 for the mean values for each setting group).

Relation Between GEC and GPA

Results, $r = -.33$, $p < .001$, indicated a medium negative correlation between GEC and GPA.

Difference Between GEC and Academic Group

The student's t-tests indicated there was a significant difference in GEC scores between the successful and unsuccessful academic groups, $t = -3.63$, $p < .001$.

Discussion

Significant deficits in global executive functions may or may not be the driving factor for alternative high school placement as no statistical differences among the various student groups were found. Composite executive function scores (GEC) were not specific to academic setting. The BRIEF-SR scores specific to inhibition and task completion in the alternative school group, when compared to the traditional school group, were lower, suggesting executive functions may be a driving factor in alternative school placement.

Poor executive functioning was associated with low GPA regardless of setting as a correlation between GPA and executive function was statistically represented. This supports findings in the literature (Blair & Diamond, 2008).

A difference in executive functioning

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between academically successful and unsuccessful students was substantiated by the data. As expected, differences in executive function among groups are significant, particularly in the areas of inhibition and task completion. Seven of the participants demonstrated a discrepancy of greater than 12 t-score points between the Behavior Rating Index Score and the Metacognition Index Score, which may obscure GEC scores (Guy et al., 2004). We do not believe including these participants in data analysis significantly impacted outcomes; however, this should be considered in future studies.

The importance of considering behaviors exhibited by low-achieving students must be highlighted for two primary reasons. First, it is natural to develop coping strategies when faced with environmental demands that are difficult to meet. Second, it is natural for those observing these coping strategies to interpret their meaning based on their ability to understand them. Together, these items create a missed opportunity between students and teachers for improving student role performance. Behaviors reported by teachers are accurate; their interpretation of the meaning of these behaviors and what to do about them is lacking (Mann & Burwash, 2014). Adding to this difficulty, low-achieving students engage in behaviors designed to provide short-term relief from an uncomfortable situation lived out in front of peers. In adolescence, motivation for successful management of social consequences can often trump motivation for successful academic performance.

Difficulties with inhibition may result in behaviors interpreted as interruptive and impulsive. Students with difficulties in these areas are often labeled as oppositional or having problem behaviors (Dirette & Kolak, 2004). Difficulties with task completion may be present as missing homework assignments, poor test performance, needing extra time for assignments, or lack of follow through. Adults may interpret poor student role performance as "poor motivation, laziness, lack of responsibility, or some other behavioral (or moral) deficit, as opposed to a skill deficit within the child" (Dawson & Guare, 2010, p. 162).

Misconceptions and inaccurate labeling of adolescents represents a form of occupational injustice for a sub-set of students with EDF, which is essentially an invisible disability. Students with unrecognized EDF may not struggle until performance demands increase and environmental supports decrease based on age rather than ability (Dawson & Guare, 2010). Marginalization occurs as a result of external behaviors and is associated with a failure to address salient client factors that disrupt role performance.

Implications for Occupational Therapy Practice

It is time for a paradigm shift in occupational therapy practice to expand our orientation to early intervention (EI). In school settings, qualification for services is frequently based on motor skills performance (Ruiz, Graupera, Gutiérrez, & Miyahara, 2003), and the role of occupational therapists is marginalized to the original ideals of the Individuals with Disabilities Education Act (IDEA) of 1975, which qualifies students for school services based on the diagnosis of a disability (U.S. Department of Education,

2013) without regard for performance. The contemporary version of IDEA fails to reflect advances in medical care and improved birth outcomes. The evidence of these advances demonstrates a decline in physical dysfunction outcomes and an increase in cognitive dysfunction outcomes (Ruiz et al., 2003). The changes in hallmark negative birth outcomes are difficult to identify because of a lack of clarity and consistency in the collection of morbidity data related to developmental conditions; however, physicians note a decrease in the number of patients they see with cerebral palsy (Edelson, 2007). Caseloads among pediatric therapists reflect a change from a caseload dominated by children with marked cerebral palsy to those with essentially normal motor function, IQ in the normal range, and challenges with executive functions often manifesting as behavioral difficulties. This includes children with diagnoses that fall on the pervasive developmental delay continuum. The pediatric medical community is becoming more sensitive to the need to address developmental-behavioral conditions (Sheldrick, Merchant, & Perrin, 2011). As such, access to a free and appropriate education is no longer about the physical environment; it is about the learning environment and how effectively EDF is supported. Just as advances in EI in the 0 to 3 age population has successfully improved functional outcomes, early intervention for EDF in the pre-adolescent and adolescent population demands equivalent attention. Occupational therapy can contribute to meeting this need by:

- Identifying critical developmental periods for EDF screening and establishing screening protocols
- Screening for EDF in Child-Find activities at the elementary, middle, and high school levels
- Establishing Response to Intervention programs for students identified as at-risk
- Providing continuing education to occupational therapists on EDF and its relevance to access to a free and appropriate education
- Developing practice expertise specific to the needs of this population
- Expanding private sector options
- Advocating at the policy level for mandatory inclusion of screening for EDF as part of child-find activities
- Providing program development at the population health level to improve consumer awareness and facilitate advocacy

Limitations and Future Research

Geographical diversity is not represented by this study and reflects a community of middle-class Caucasian individuals. Over half of the participants were 15 years of age (ninth grade) resulting in disparities of age representation across the study. Executive functions continue to improve via neurologic maturation into early adulthood and greater representation of older adolescents should be included in future studies. Finally, the BRIEF-SR was completed without accompanying Parent and/or Teacher versions and administered in a group setting, limiting privacy and possibly creating a sense of urgency to complete the assessment. Future studies should consider individualized administration of assessment tools. Whenever possible, the BRIEF-SR should be administered in tandem with the BRIEF-Parent Report and/or BRIEF-Teacher Report to enhance rigor and validity of findings. Considerations for future studies include (a) incorporating the parent and/or teacher forms of the BRIEF, (b) isolating the eight subscales on which academically unsuccessful students scored low, and (c) further exploring independent learning programs in relation to academic success.

Incorporating the parent and teacher form would provide a broader perspective and more accurate indication of executive function (Guy et al., 2004). Isolating the eight subscales based on academic success would provide a clearer picture of the nature of student difficulties and, more important, determine where the educational system needs to implement additional resources in order to support student learning. Although not significantly different, visual data analysis revealed that the independent learning students had an inverse relationship between GPA and executive functioning (see Figure 1). In this setting, academically unsuccessful students had higher executive functioning skills than their academically successful counterparts. Further exploration may provide insight into this phenomenon.

Researchers should also consider exploring the current participants' personal environments to determine any environmental factors of significance. Finally, using a performance-based assessment of executive function rather than a response-based assessment would provide more detailed information with regard to how executive function deficits impact performance (Williamson Weiner et al., 2012).

Conclusion

Executive function is not dictated by setting but is related to GPA. Poor academic performance is a strong indicator of deficits in executive functions. To maximize role performance, environmental influence should be viewed as a means of scaffolding and developing executive function skills. Environments of interest include administrative and classroom policies, especially in regard to their impact on the interplay between person (student, teacher) and role performance (student, teacher). Occupational therapists can play a vital role in identifying and supporting students with poor executive functions which may result in improved occupational performance in the student role and across multiple contexts.

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