

Parental Education, Socioeconomic Status, and Cognitive Task Performance in Male International Secondary School Students in Saudi Arabia

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Abstract

This study investigated the correlation between parents' educational level and socioeconomic status (SES) and cognitive task performance in male international secondary school students in Saudi Arabia. Although literature has established the predictive nature of parental education level and SES on cognitive development throughout early childhood, this association is less understood in later development (i.e., late adolescence) and among international school populations. The sample consisted of 212 male high school students aged 15-18, who attended an international secondary school. Cognitive performance was measured using a standard working memory (Backward Digit Recall), inhibitory control (Stroop Task), and verbal fluency (Semantic and Phonemic Fluency). Pearson correlation coefficients assessed relationships between parental education level, SES, and performance on the cognitive tasks. No significant relationships emerged between parental education level and any cognitive task (.p50) or between SES and any cognitive task (.p50). The correlations were near zero and unimportant in magnitude ($< |r| > .10$). The results suggest that the cognition of adolescents enrolled in this international secondary school is not significantly driven by parental educational and socioeconomic background. Interpretations of these findings are discussed in terms of developmentally maturational factors, educational quality control, and the potential construct area buffering provided by international schools. The findings here supplement related debates in the literature in relation to developmental and contextual limitations of SES and cognitive relationships. This study contributes to the social sciences literature by examining direct executive function measures within a standardized international school context in the Middle East, a setting that remains underrepresented in SES–cognition research.

Keywords: Parental Education Level, Socioeconomic Status (Ses), Cognitive Performance, Late Adolescence, International Secondary School Students

Introduction

Overview

Determinants of adolescent cognitive development have long been considered central to the study of educational psychology. A number of cognitive skills, such as working memory, executive control, and inhibitory control, are closely related to high academic achievement, self-regulation, and efficient problem-solving capacity and are associated with achievement,

academic motivation, and adaptive behaviors in the school setting (Best & Miller, 2010; Diamond, 2013; Zelazo & Carlson, 2012). While cognitive development is largely biological, empirical evidence on the effect of the outside environment has frequently pinpointed the family as a significant context for cognition. Among these factors, the indicators of parental and family influence have always been, among others, parents' socioeconomic status (SES) and parents' level of educational attainment. These measures of education have served as indices for the amount and quality of educational resources, cognitively stimulating experiences, and learning opportunities available to youth in the home (Bradley & Corwyn, 2002; Sirin, 2005; McLoyd, 1998). Higher levels of parental education and socioeconomic status (SES) have been associated with increased linguistic stimulation, more accessible learning resources, and better scaffolding and instruction that foster the development of executive skills and other higher-order cognitive dimensions during adolescence (Duncan & Magnuson, 2012; Hackman et al., 2015; Noble et al., 2015). Although family background variables are placed in high focus, results are not completely comparable. More recent studies have indicated that parental education and SES are less influential in contexts of standardized curricula, equitable resource allocation, and homogenous instructional quality (von Stumm et al., 2013; Lareau, 2011). In these respects, proximal classroom contingencies—specifically instructional practices, classroom management, and exposure to high cognitive load-demanding, challenging tasks—may be more important in the evaluation of executive functioning and cognitive control (Raver et al., 2013). These results indicate that the effects of demographics on cognition are context-dependent, rather than deterministic, in nature. The Saudi educational context in international secondary schools in Saudi Arabia provides an appropriate context in which such associations may be investigated. International schools employ a standard curriculum, equivalent assessment methodologies, and fairly equivalent quality resources for educational purposes for all students, irrespective of parental group. Such structural uniformity might moderate institutional variation, thus providing an opportunity to investigate whether the impact of parental educational level and SES on performance on standardized cognitive tasks is independent in a controlled academic setting (OECD, 2018; Sirin, 2005). Studying these associations in a relatively homogeneous educational environment adds fuel to a debate about whether socioeconomic influences on adolescent cognitive development transcend existing research questions at the context level.

Statement of the Problem

Given a specific problem, a good problem statement must be clear and concise. It must identify the nature of the problem and precisely state the steps to be followed to reach a solution, particularly the decision variables. The problem statement must be brief and, at the same time, should not allow for two interpretations. It should lead to a well-built mathematical model. In the general oil industry, there are many problems that can be formulated as optimization problems.

Although much has been written about the connection between family background and cognition, several important unanswered questions remain. For example, most existing research has been conducted in multi-ethnic education systems that differ considerably in terms of school quality, instructional resources, and testing practices (Sirin, 2005; Reardon, 2011). Under such circumstances, it becomes even more challenging to isolate the effects of parents' SES and education level from the overarching institutional inequalities that pervade the educational system. Consequently, relationships between demographic factors and

cognition may simply reflect educational inequalities (Bradley & Corwyn, 2002; Duncan & Magnuson, 2012).

Additional difficulties include the empirical handling of SES and parental education. These two variables, while conceptually distinct, are empirically highly correlated, and the influence of one's socioeconomic standing and parental education is often examined with little regard for contextual moderators. Without appropriate considerations of the circumstances under which family background translates into the development of a child's cognitive capacity, these socioeconomic variables may be over measured in their contributions to our understanding of mental functioning (Hackman & Farah, 2009; Evans & Kim, 2013). Hence, what we know about the influence of family background on standardized educational performance remains limited.

Furthermore, fieldwork studies still focus too heavily on national education systems of the Western world, and too little research has been conducted on international school settings, particularly those of the Middle East. Although international schooling in Saudi Arabia has grown rapidly in recent years, there has been little research on cognitive development in these schools (Hayden & Thompson, 2013; Bunnell, 2017). Since international schools tend to offer the same curriculum, similar instruction styles, and similar availability of learning materials, results of studies in the national settings cannot be easily expected to hold true in the international ones.

Third, most of the previous research has depended on measures of academic success, such as grades or test scores, as indicators of cognitive development. These measures are subject to the effects of non-cognitive factors (motivation, classroom behavior, skills specific to the test or task) that do not, by definition, reflect the core domains of cognition (working memory, inhibitory control, executive functioning) (Duckworth & Seligman, 2005; von Stumm et al., 2013).

The current study attempts to overcome the above-listed limitations by examining the association among parental academic attainment, SES, and adolescents' performance on a cognitive task battery in the context of a single international secondary school in Saudi Arabia. To avoid the pitfalls of school-level confounds inherent in prior studies, the study takes place in a setting where demographics are held relatively constant (i.e., single school) that utilizes comparable curricula and teaching practices. As the main predictor, SES is used as an independent variable against the performance on a battery of cognitive tasks (focused on executive functioning, verbal working memory, and verbal fluency) that is more directly representative of constructs relevant to the current process-oriented understanding of cognitive development (e.g., Best & Miller, 2010; Diamond, 2013). Thus, the current study attempts to contribute to the existing research by offering a more rigorous sort-for-comparison examination of cognition.

Research Objectives

The main aim of this research is to explore the relationship between demographic variables of the student's family background, namely the parents' level of education and SES, on the performance of a variety of cognitive tasks in male international secondary school students in Saudi Arabia. More specifically, I will investigate how the two variables factor into the

prediction of performance on a series of standard cognitive tasks that evaluate working memory, inhibitory control, and executive functioning in a relatively standardized school setting.

Embedding the examined effects within an internationally shared educational environment that is defined by internationally adopted curricula, testing procedures, and similar learning resources, the investigation will, as far as possible, remove control of secondary school factors that might influence the results. This provides an opportunity to contribute to the current discussion in educational psychology regarding the extent to which proximal school effects can be distinguished from distal parental factors in explaining developmental differences. Additionally, this project will test the assumption suggested by much of the literature that higher levels of parental education and SES are directly correlated with higher cognitive performance. By quantitatively measuring cognitively demanding performance, the project tests this relationship in current, standardized educational environments.

Research Questions

This study is guided by the following research questions:

How does parental education level influence male international secondary school students' performance in cognitive tasks in Saudi Arabia?

What is the association between socioeconomic status (SES) and performance on a cognitive task among male international students at a secondary school in Saudi Arabia?

Significance of the Study

This is a meaningful theoretical and empirical contribution to educational psychology as it investigates the relation between parents' education, SES, and cognitive task performance from the perspective of an international secondary school. Most research in this area has indicated the relation between family background variables and test scores or academic achievement (e.g., Bradley & Corwyn, 2002; Sirin, 2005; Duncan & Magnuson, 2012), in heterogeneous educational frameworks in which there are significant differences in the quality of instruction, curriculum, and adaptation of the school to the learners. To elucidate whether parents' education and SES are still meaningful predictors in the case of international secondary schools in Saudi Arabia, where the curriculum, assessment systems, and provision of equal learning opportunities are considerably standardized.

On a theoretical level, the present study addresses longstanding debates about whether distal demographic variables or proximal learning conditions are more salient in influencing adolescent cognitive performance. Much research assumes a somewhat linear interaction between increasing levels of parental education or SES and progression of cognitive engagement and function (Hackman & Farah, 2009). Recently, however, there has been an accumulation of findings demonstrating that cognitive achievement relations with these distal variables are contextual, weakening or disappearing in consistent educational contexts, which may lessen or neutralize differences in quality of instruction and access to educational opportunities (von Stumm et al., 2013; Evans & Kim, 2013). The present demonstration counters a deterministic view on the relation between parental education and socioeconomic status and performance on executive functioning cognitive tasks, as no such association was observed in an international school setting.

From a methodological perspective, this research takes a significant step forward from earlier studies by using direct measures of cognitive functioning, working memory, inhibitory control, and executive functioning, through standardized tasks, rather than academic grades, which serve as indirect measures of cognitive ability (Best & Miller, 2010). Furthermore, the utilization of an all-female sample from a single international school minimizes confounding variability in achievement due to gender and school, which lends internal validity to the present study (Creswell, 2014).

The practical implications for educators and policymakers are similarly significant. The lack of significant relationships between parental education, SES, and achievement in these domains indicates that policymakers and teachers should be cautious when making assumptions about students' cognitive abilities based solely on the family circumstances of the student. Previous research has shown that deficit ideologies based on demographic variables detract from the importance of high-quality instruction and the building of cognitive skills (Hill & Tyson, 2009). This should serve as evidence for educators to invest in the development of executive functions in the classroom environment.

The study finally expands on the sparse empirical data on cognitive development in international schools in Saudi Arabia. More research has emerged on academic success, whereas little attention has been given to cognitive development in the Kingdom, resulting in a need for contextual data on this subject. The results of the present study can now be used as a base for future international school research.

Literature Review

Introduction

A context-sensitive perspective on neurodevelopment and the environment is important in understanding adolescent cognitive development. Fundamental cognitive processes like working memory, inhibitory control, and, more broadly, executive functions, develop extensively across adolescence, with widely cited links to academic motivation, individual differences in self-regulation, and school success (Best & Miller, 2010; Bull et al., 2008; Luna et al., 2015). Biological maturation supports this developmental pattern; yet adolescent cognitive development is also well established to be highly susceptible to individual differences in environmental and family context (Blair & Raver, 2012; Hackman, Farah, & Meaney, 2010).

In the existing literature, measures of parental socioeconomic status (SES) and parental level of education have been two of the most frequently used measures of family background in research examining cognitive development; these measures have been used mostly as proxies for access to educational resources, the prevalence of cognitively stimulating home environments, and the quantity and quality of learning, including supportive interactions between children and their parents (Bradley & Corwyn, 2002; Sirin, 2005).

Yet the domains and magnitudes of these associations have been shown to wax and wane considerably across educational contexts. With the proliferation of earlier investigations of the impact of parental education and SES, recent findings have begun casting doubts as to whether or not they have any incremental explanatory power within schooling systems which exhibit standardized curricula and time on task, equitable access to learning support, and

consistent instructional quality (see von Stumm et al., 2013; Engel, Claessens, & Finch, 2021). In the latter case, the impact of distal demographic factors on inter-individual variation will likely diminish in favor of more proximal influences: classroom instruction, curriculum equivalence, and student motivation relative to those factors.

This chapter offers a critical overview of empirical research on the association of parental SES and parental education level with the development of cognition during the adolescent years, focusing on the integration of results from studies conducted under highly controlling and uniform conditions in school settings. The integration of converging and divergent evidence provides a theoretical framework for this research which explores the extent to which parental background variables can account for variance in performance on a cognitive task among a sample of male international students in Saudi Arabia.

Cognitive Development and Socioeconomic Status

Socioeconomic status (SES) has historically been viewed as a key contextual variable related to cognitive development (Bradley & Corwyn, 2002). Numerous studies have established relations between socioeconomic risk and poorer performance on a variety of cognitive measures, including language development, working memory, and executive functioning (Duncan & Brooks-Gunn, 1997; Yeager et al., 2021). Children with lower SES backgrounds experience fewer resources and less enrichment, with consequences for cognitive development.

Another important approach to research points to chronic stress experienced with social disadvantages. Evans and Kim (2013) have found that a sustained stress environment, such as financial hardship, dense households, and neighborhood chaos, may impact neural growth and executive function. According to McLoyd (1998), material deprivation and psychological stress may have mediating effects between poverty and cognitive development.

However, some other results point to a different conclusion. Namely, the impact of low SES on the development of cognitive abilities is neither universal nor fixed. Well-established environments for early learning can buffer negative consequences of low SES. In intervention studies, the sample of children that attended formal networks of young children's education showed better cognitive development. Participation in such networks is particularly effective in the case of children with insufficient resources (see Yoshikawa et al., 2016).

In addition, community EC/HV and social support networks are also significant mediators or moderators (Leventhal & Brooks-Gunn, 2000). Leventhal and Brooks-Gunn (2000) found that children being raised in resource-rich dwellings had more cognitively advantageous results than other children living in equally poor households and from disadvantaged neighborhoods, but in more supportive settings. Taken together, these findings suggest that SES impacts cognition through complex interactions within the environment and cannot be reduced solely to direct consequences of impoverishment.

Cognitive Development and Parents' Academic Level

The second family background factor related to children's cognitive development is the parent's level of education. Several studies have shown that children whose parents have higher levels of education tend to score better on cognitive and academic test measures than

children whose parents have lower levels of education, with the effects of parental education exerting an effect over parental income, and through a variety of parent- and child-focused pathways, including expectations for achievement, parent-child interaction, parental involvement in children's learning and development, and the time and amount of interest spent reading with the child (Dearing, McCartney, & Taylor, 2006; Ream & Rumberger, 2008). Active involvement in cognitively stimulating activities with children that take place in the home environment, including shared reading, conversational interactions, and models for problem-solving and learning (Hoff, 2003) also serve as mechanisms through which parental education affects adolescent academic achievement, including language skills, executive functioning, and metacognitive regulation (Bandura, 1997).

Parental education has also been linked to patterns of parenting and educational expectations; Dearing et al. (2006) showed that parents with higher educational levels adopt parenting practices that are more supportive and allow a sense of agency for their children (e.g., providing children more autonomy and support for self-esteem). These types of parenting practices improve innate self-regulatory abilities, adaptive decision-making, and learning strategies (Dearing et al., 2006); all qualities related to fluid intelligence, executive functioning, and cognitive flexibility in secondary school. Parental education has also been related to raw cognitive performance, but the strength of this relationship does not appear to be stable across different environments: Epstein (2011) suggests that "truly successful school-family partnerships [would] palliate the disadvantages of the less educated parent." Accordingly, evidence is accumulating to suggest that well-equipped, standardized school environments can buffer the effects of parental education.

Moderation of Demographic Influences on Cognitive Development by Context

Emerging research has begun to link the 'impacts' of family background in growing truly 'educational' systems. In systems where curricula are standardized, instructional quality is uniform, and resources are shared more equally. There have been no positive relationships between SES, parental education, and cognitive measures (von Stumm et al., 2013). Proximal influences in the classroom, such as instructional level, task design, and cognitively relevant opportunity structures, now may outweigh distal influences in determining performance on cognitive measures in these contexts.

A similar line of reasoning could be applied to international school scenarios; the standardized curriculum and assessment practices, as well as the fairly similar materials, may weaken the influence of parental background variables even more. However, there is limited research on cognitive development in international school settings (mainly, there is no research on Middle Eastern settings), thus requiring further empirical research that would examine cognitive processes directly, instead of relying only on measures of academic achievement.

Methodological Considerations in Demographic and Cognitive Research

Persistent methodological issues plague this research delineating the role of demographic variables in cognitive development. Variability in results has often been explained by the failure to control contextual factors, the overly simplistic operationalization of SES and parental education, and the use of academic performance as an index of intelligence (Diamond, 2013). Modern methodologies have sought to control these by attempting to keep

demographic effects in controlled educational settings and by introducing more direct measures of cognitive performance (Best & Miller, 2010).

The current research project anticipates following some of these recommendations, as it concentrates specifically on the socioeconomic status of the parents and academic level of the parents, in a standardized international school setting. Using validated cognitive tasks that provide direct measures of executive functioning, this study endeavors to produce a more accurate test of whether family origin variables maintain explanatory significance when institutional effects are controlled for, thus improving the internal validity of the comparisons and elaborating where demographic factors intersect with the development of adolescent cognitive skills (Maayah, 2025).

Methodology

Introduction

Describes the methods of investigation used to explore the relationship between the academic level of parents, SES, and cognitive task scores of male international secondary school students in Saudi Arabia. This includes research design, sampling, instruments, data collection, and ethical issues.

A quantitative design, causal-comparative, was employed to enable objective measurement and statistical analysis of relationships between a history of college-related variables and cognitive variables. Such a design was suitable because it allows researchers to examine naturally occurring (i.e., unable to be manipulated in an experimental study) demographic variables within an educational setting in an orderly fashion (Creswell, 2014).

Participants of the Study

This current research is also limited to male international secondary school students. Gender was a methodological control variable rather than an analytical one as gender-based differences in cognitive functioning were not the object of this study. A decision was made to exclude or control for gender as a source of extraneous variance to minimize the confound of gender-based differences in certain areas of cognitive functioning that tend to appear in adolescence and arguably serve to increase the internal validity of the present study. There is evidence that gender-related effects in various cognitive areas may only appear as an interaction of gender and developmental stage, and are particularly difficult to parse in adolescent samples; therefore, extracting analyses to include only males reduces the likelihood of the confound of gender differences in cognitive functioning in adolescence (Hyde, 2005; Else, Quest, Hyde, & Linn, 2010).

This choice is also justified given the physical and social/cultural configurations of the Saudi school system, where secondary education is in most cases separated by gender. Male and female students are generally directed to gender-segregated schools that often vary institutionally in terms of their structure and management, teachers' beliefs and instructional practices, and the availability and administration of school resources (Alkhazim, 2003; Hamdan, 2005). Inclusion of students from institutions that are segregated by gender would therefore confound institutional attributes with the research focus, and it is preferable to collect data from only one gender at the institutional level to maintain methodological consistency.

According to principles of causal-comparative research, removing extraneous factors according to the researcher's decision increases the ability of the research to find the impact of a selected independent variable (Creswell, 2014). The findings are therefore limited to the samples used, men attending a Saudi Arabian international secondary school. Future research should attempt to undertake similar research in female samples or other sets of samples.

Research Design

This study's quantitative, causal-comparative design is appropriate to assess the potential effects of variables of family background, which are expected to be pre-existing, on performance on a series of cognitive tasks, without manipulation within an experimental framework. From a single school, the design will allow the researcher to systematically analyze the statistical relationships between students' cognitive performance and family background variables by measuring the effects of each variable within the context of a given controlled educational environment (Creswell, 2014). The variables consist of students' family income level and parents' academic level. The sample was selected from a single international school in Riyadh, Saudi Arabia; the sample only consisted of male students as this was the only gender representation at the school. Choosing only one school minimized the effects associated with curriculum design, faculty quality and management, assessment processes and school facilities to observe the relationship between family background variables and student performance.

Cognitive performance was measured through the use of a standardized battery of empirically validated tasks that measured executive control and working memory. These tasks, which were the Backward Digit Recall Task, the Stroop Task, and Semantic and Phonemic Verbal Fluency tasks, together provided a multidimensional measure of cognitive functioning that measures more than academic achievement and assesses basic executive processes (e.g., self-regulation) that are necessary for learning (Best & Miller, 2010; Diamond, 2013).

A standardized demographic questionnaire was used to gather information regarding the educational level and SES of each parent. These two factors were explicitly selected as all existing literature cited them as critical contextual factors impacting cognitive development through access to learning experiences and cognitively stimulating environments (Bradley & Corwyn, 2002; Sirin, 2005). The use of these specific well-established criteria and standardized measures of cognition within the same academic environment allowed for a systemized and easily analyzable structure around the project's research questions.

Research Instruments

Cognitive Assessment Tasks

Cognitive task performance was measured using four standardized cognitive tasks identifying key executive functioning and working memory domains that are ubiquitously used to index cognitive control during adolescence and are closely linked to academic engagement/self-regulation skills (e.g., Best & Miller, 2010; Diamond, 2013).

The Backward Digit Recall Task was used to investigate working memory ability, whereby participants were required to manipulate verbal information in working memory by recalling digits in reverse order. Processing in this task involves both short-term storage of the verbal stimuli and manipulation of this information through maintenance of attention and executive

control and has been correspondingly shown to be a valid assessment of working memory functioning (Baddeley, 2003; Gathercole, Pickering, Knight, & Holt, 2004). The Stroop Task was used to measure executive control of attention through the implementation of selective attention and inhibition, with performance being indicative of this process' efficiency through how well the participant could suppress their automatic response. The Stroop Task is well-researched as a valid measure of inhibitory control in literature of cognitive and educational assessment (Stroop, 1935; MacLeod, 1991).

Semantics retrieved and executive functioning was assessed using the Semantic and Phonemic Fluency Tasks, respectively. During the semantic task, participants were asked to list as many words as they could within a defined category over the course of 60 seconds; this task assesses semantic memory, controlled retrieval, and executive monitoring and regulation (Henry & Crawford, 2004; Troyer et al., 1997). During the phonemic task, participants were asked to list as many words as they could within 60 seconds that shared a common initial letter; this task further emphasizes strategic search, cognitive flexibility, and inhibition of responses that would violate the task requirements.

These measures collectively offer a broad and multiple representation of executive functioning. Using a range of cognitive measures increases construct validity by sampling complementary domains of cognition and limiting correlation effects from individual measures (Miyake et al., 2000). All measures were administered across identical testing environments.

Survey of Demographic Variables

A demographic questionnaire was designed to gather data pertinent to the research questions of the study. The questionnaire asked solely about the parents' education and SES, aligning with the new framework and research questions.

Parental education levels were coded according to pre-established levels of education (e.g., high school, college degree, postgraduate qualification) to facilitate a systematic comparison of the children within each family across study conditions. Previous research has consistently demonstrated that parental education levels are positively associated with home learning conditions, parental expectations about education, and parental involvement in cognitively stimulating activities (Sirin, 2005; Davis & Kean, 2005). For questions pertaining to socioeconomic status (SES), an overarching composite measure was used, consisting primarily of indicators of the parents' education levels, which indexes broader structural forces that influence opportunities for educational access and participation in learning-related activities. Major councils of research on family outcomes have recommended the use of composite measures of SES, rather than single indicators, to account for multi-faceted elements of socioeconomic position (Duncan & Magnuson, 2011; Entwisle & Astone, 1994).

These variables were chosen based on empirical literature showing how they relate to a child's cognitive and educational development, primarily via resource availability, parental support, and cognitively stimulating opportunities (Bradley & Corwyn, 2002; Duncan & Magnuson, 2012). No other demographic variables were included in the model to avoid introducing already known correlates to the current study's narrower scope.

Data Collection Procedures

The data collection was carried out in a school setting with sessions spaced out to reduce participant fatigue and improve the reliability of any measures of cognitive performance. Each participant was given a unique identifier to prevent any breach of confidentiality and to gather data on parents' level of education and socioeconomic status. The procedures of data collection included the delivery of the demographic questionnaire and the standardized cognitive tasks during the same procedural conditions. Participants were given the same instructions, with the procedures administered in the same manner according to the standardized delivery of procedures.

All tests were directly supervised by the researcher to minimize the impact of researcher bias and ensure that all participants were tested according to the standard procedures. This considered the controlled nature of the procedures to ensure that all variation in measure of cognitive task performance is due to family background.

Analysis

The analysis employs both descriptive and inferential statistical techniques, which offer a broad, detailed picture of the data. Descriptive procedures employed will include obtaining frequencies, means, and standard deviations to describe the sample populations and patterns of cognitive functioning. Inferential procedures will then utilize this information in analyzing whether there is any relationship between the prescribed demographic variables and measures of score on the cognitive tasks in a controlled educational context. Where relevant to the analyses, scores will be divided into categories of low, medium, and high for comparison across demographic categories. The results are presented empirically, preferring the use of statistics over inferences.

The following section provides the statistical results relevant to the two questions central to the focus of the study. Correlational analyses were performed to investigate potential relations between selected demographic variables and students' scores on standardized cognitive measures. Cognitive development was operationalized using measures of working memory, inhibitory control, and verbal fluency, as observed through the Backward Digit Recall Task, Stroop Task, Semantic Fluency Task, and Phonemic Fluency Task.

Table 4.1

Parents' educational level

Parents' Educational Level	Frequency	Percent	Valid Percent	Cumulative Percent
Ph.D.	17	8.0	8.0	8.0
M.A.	45	21.2	21.2	29.2
B.A.	144	67.9	67.9	97.2
Diploma	1	0.5	0.5	97.6
No degree	5	2.4	2.4	100.0
Total	212	100.0	100.0	—

Table 4.1 presents the distribution of academic classifications of parents within the sample (N = 212). The most commonly reported educational qualification was a bachelor's degree (n = 144; 67.9%), indicating that the majority of parents in the sample possessed a university level

education. This was followed by a master's degree ($n = 45$; 21.2%) and a doctorate ($n = 17$; 8.0%), with very few parents reporting an educational qualification below this level (a diploma at $n = 1$; 0.5% and none reporting any degree at $n = 5$; 2.4%).

Parental academic level is conceptually defined in the body of prior research as a basic proxy of educational capital, academic expectations, and availability of resources in the home to foster cognitively enriching learning experiences (Bradley & Corwyn, 2002; Sirin, 2005; Davis & Kean, 2005). With respect to Research Question 1, this distributional profile offers critical contextual information related to the presence or absence of any relationship between variation in academic level and performance on standardized cognitive assessments of working memory, inhibitory control, and executive function in the context of an international school setting. The concentration of students with university-educated parents also bears importance due to the well-established inverse relationship between range restriction in parental SES and the strength of its influence in predicting academic outcomes in well-developed educational systems (von Stumm et al., 2013).

Table 4.2

Parents' socioeconomic status

Parents' Socioeconomic Status (SES)	Frequency	Percent	Valid Percent	Cumulative Percent
High	39	18.4	18.4	18.4
Medium	173	81.6	81.6	100.0
Total	212	100.0	100.0	—

Table 4.2 describes the distribution of SES of participants, $N = 212$. The majority of students belonged to a medium SES household ($n = 173$; 81.6%). A smaller proportion of students were from high SES households ($n = 39$; 18.4%). There were no students from low SES households. Socioeconomic status (SES) is a common variable studied in research on education and development as a proxy variable for access to cultural and educational capital, stability of resources, and experience in socially supportive environments (Bradley & Corwyn, 2002; Duncan & Magnuson, 2012; Hackman & Farah, 2009). To answer Research Question 2, however, the lack of variability in SES present in this sample was sociologically and statistically significant, as research done with stratified samples suggests that SES-related differences in cognitive functioning are magnified by socioeconomic inequality (Sirin, 2005; Evans & Kim, 2013). Educational resources and research beyond our sample context of standardized schooling and lack of low SES individuals in the sample help explain the diminished utility of SES in elucidating children's performance on working memory, inhibitory control, and executive functioning tasks within our sample (von Stumm et al., 2013)

Table 4.3

The Effect of Demographics on Cognitive Development

Demographic Variable	Backward Digit Recall	Stroop Task	Semantic Fluency	Phonemic Fluency
Parents' Academic Level (r)	-0.020	0.040	-0.088	-0.043
p-value (2-tailed)	0.768	0.565	0.204	0.535
Parents' Socioeconomic Status (SES) (r)	0.026	-0.043	0.004	-0.006
p-value (2-tailed)	0.707	0.529	0.949	0.933

The correlation analysis examined how mothers' and fathers' levels of education, and family SES on four standardized cognitive tests of working memory, inhibitory control, and verbal fluency—backward digit recall, the Stroop, semantic fluency, and phonemic fluency—related to one another. As per our iteration of the research questions, no other demographic variables were used in this analysis. In general, both parents' levels of education and family SES were weakly related and not significant correlates of performance on any of the four cognitive measures.

Measures of performance on the backward digit recall task reflecting working memory capacity and executive manipulation were unrelated to any parental variable. Parental education was negatively associated with working memory capacity and was not significantly related ($r = -0.020$, $p = 0.768$), while SES was positively, albeit weakly, correlated with working memory capacity ($r = 0.026$, $p = 0.707$) nonsignificantly. These results indicate that sex differences in working memory in the present sample are not accounted for by parental levels of education or socio-economic status, findings that are consistent with others who have shown that executive working memory in particular may not be sensitive to distal, school-related demographics in classrooms with equal treatment and access to learning items (von Stumm et al., 2013; Engel et al., 2021).

Similar results emerged for performance on the Stroop task, which measures selective attention as well as inhibitory control. The academic levels of parents were weakly positively correlated with performance ($r = 0.040$, $p = 0.565$) and SES was weakly negatively correlated with performance ($r = -0.043$, $p = 0.529$); neither correlation was significant. This finding is consistent with previous suggestions that the development of inhibitory control in adolescence is more influenced by specific cognitive task requirements and self-regulation strategies of the individual than family SES differences, especially in a highly organized educational setting (Diamond, 2013; Miyake et al., 2000).

Similar patterns were revealed by the association of semantic fluency task scores with the parental variables. Parental education was slightly and negatively related to the semantic fluency scores ($r = -0.088$, $p = 0.204$), whereas the association with SES was essentially zero ($r = 0.004$, $p = 0.949$). The lack of significant relations indicates that parental educational variables and SES do not distinguish the semantic lexical retrieval in the task, nor the category-oriented verbal production in this controlled educational sample. These results coincide with the interpretation of previous research that the consistency of formal education and different degrees of linguistic exposure, rather than family background measures, shapes the semantic verbal executive function (Gathercole et al., 2016; Bialystok, 2017).

Similar results were obtained for phonemic fluency. Parental education was weakly negatively correlated with phonemic fluency scores ($r = -0.043$, $p = 0.535$), and SES was by and large uncorrelated with scores at all ($r = -0.006$, $p = 0.933$). The effects of minimal magnitude, non-significance show that retrieval of lexical items in strategic search processes, as well as executive search strategy itself, are relatively unaffected by parental education or SES here. This null result has been observed in previous studies of verbal fluency tasks thought to be unaffected by socio-economic differences in high SES, high-resourced, highly standardized educational systems (Ardila et al., 2006; Hackman et al., 2015).

In conclusion, the pattern of results from the correlational analysis offers converging evidence that parental education and socioeconomic level are non-significant predictors of performance on cognitive tasks assessing working memory, inhibitory control, and verbal fluency in a sample of male international secondary school students in Saudi Arabia. This finding directly pertains to the hypotheses posed in Research Questions 1 and 2 and lends itself well to supporting the rationale that when operating in a study-specific context of standardized international education and a largely egalitarian SES, traditional markers of family background offer little predictive utility for the performance variables of interest herein. This outcome lends support to the trend in literature suggesting that cognitive functioning during adolescence is somewhat insulated from demographic factors such as parental education levels, and significantly more correlated to proximal factors of educational quality and cognitive control processes (Sirin, 2005).

Discussion and Conclusions

Research Question 1: How does the academic level of parents relate to the performance of the cognitive tasks among male international secondary school students in Saudi Arabia?

No significant relationships were found between parental education level and any of the cognitive test scores (Backward Digit Recall: $r = -0.020$, $p = 0.768$; Stroop Task: $r = +0.040$, $p = 0.565$; Semantic Fluency: $r = -0.088$, $p = 0.204$; Phonemic Fluency: $r = -0.043$, $p = 0.535$). All correlations were extremely small in magnitude ($|r| < 0.10$), and all were non-significant. These data suggest that maternal educational level was unrelated to working memory, inhibitory control, or verbal fluency in this sample of male adolescents aged 15 to 18 years who attended Saudi international schools.

This result seems, at first glance, to run counter to the extensive literature demonstrating associations between parental education and children's cognitive development. More frequent are the studies that have shown associations between parental education and various indicators of executive functioning, language, and academic achievement during childhood (e.g., Ursache & Noble, 2016; Lawson et al., 2018). The developmental window within the sample is: research from 2015 and later suggests that correlations between parental education and specific executive functions weaken in mid- to late adolescence. Early childhood is considered a sensitive period in which environmental input, especially linguistic and cognitive stimulation, has the biggest impact on the growth and development of prefrontal neural structures (Noble et al., 2015). In contrast, in later adolescence, executive functions tend to resemble early adult forms, and differences between individuals are less closely related to parental education and more directly related to teacher quality, classroom climate, and individual learning strategies.

Indeed, neurodevelopmental models suggest that while socioeconomic and educational inequalities influence early neural structure and functioning, the influence of parental education on executive performance is reduced as adolescents gain increased autonomy and cognitive independence (Hackman et al., 2015; Piccolo et al., 2016). Late adolescents have increased autonomy over executive functioning themselves and less direct scaffolding from parents; thus, developmental effects may be present here that restrict the direct relationships we observed with parental education.

The second explanation is related to the general educational homogeneity of international schools. When studying the effect of home education on measures of executive function, the standardized curricula (such as IBD, British, or American) and assessment methods as well as instructional practices of international secondary schools may have minimized differences in cognitive and academic expectations and demands. If children are subjected to similar levels of academic expectations, cognitive demands, and instruction, then home education differences in executive function measures would thus be minimal. Education studies conducted in highly standardized settings indicate that the more equity-focused and challenging schooling is, the more family effects are diminished (OECD, 2019). Not only does the level of parental education correlate with academic achievement (e.g., GPA, test scores), but also the level of parental education may predict executive tasks more weakly than general academic achievement in older adolescents. Several known studies reveal that executive function tasks such as Stroop or backward digit span have limited ecological validity when related to variables such as academic achievement (Snyder et al., 2015).

Furthermore, considerations of cultural and contextual factors should not be overlooked. Our sample included a cohort of international school students from varying nationalities. Families who elect to plan for an international school education (independent of cohort level) typically exhibit a strong desire for formal education and graduate support. Parental support and beliefs within this environment would tend to be more appropriate indicators of parental influence than parental education per se. Recent research (Zhao et al., 2023) demonstrates that parental educational involvement (rather than parental education) predicts academic achievement through its mediating effect on working memory. In addition, range restriction might have been a factor in the observed relationships. International schools often serve a range of middle- to high-SES families but may be recruiting from a non-representative segment of that range. A lack of parental degree variation would have reduced the observed associations.

However, the inconsistent directionality of the correlations (two negative, two positive) effectively demonstrates a lack of systematic relations. For instance, the potentially negative correlation between parental education and semantic fluency was weak ($r = -0.088$) and not statistically significant, suggesting a negligible, non-directional relationship. Overall, it appears that together, these data do not provide any conclusive evidence that parental academic achievement directly impacts performance on measures of executive control, working memory, or verbal fluency, at least in the adolescent population attending an international school. Perhaps schooling environment, developmental maturation, and more proximal factors such as peers are more salient influences at this point.

Research Question 2: How does cognition based on task administration vary by socio-economic status (SES) in male international secondary school students in Saudi Arabia?

Second, the null findings extended to the other measures, with no statistically significant associations between maternal/paternal SES and the Backward Digit Recall ($r = 0.026$, $p = 0.707$), Stroop Task ($r = -0.043$, $p = 0.529$), Semantic Fluency ($r = 0.004$, $p = 0.949$), and Phonemic Fluency ($r = -0.006$, $p = 0.933$). All effects were negligible ($|r| < 0.05$), showing no linear relationship between SES and these measures of cognition in the sample. The extant literature reports consistent relationships between SES and childhood executive functioning. Less affluent samples tend to perform more poorly on assessments of working memory,

attention control, and language development, through a series of pathways involving heightened stress and less cognitive stimulation and educational resources (Ursache & Noble, 2016; Lawson et al., 2018). Structural neuroimaging has demonstrated SES-related variance in prefrontal and language-related cortical regions in younger samples of children (Noble et al., 2015). However, several contemporary hypotheses can help account for the present null results. The attenuation hypothesis is unique in emphasizing a decline in SES effects during adolescence as children are exposed to more similar educational institutions. As adolescents spend less time at home and more time in school and peer groups, the influence of family wealth may be reduced compared to previous life stages.

Secondly, the effects of executive functions, working memory, and inhibitory control may be mediated by cumulative academic experience and exposure to structured cognitively stimulating experiences rather than SES itself. International school curricula, activity options, academic demands, and interactions may serve as enriching experiences that counteract lower household income levels. We know from international educational resilience research that schools themselves may serve as moderating factors by providing structured, cognitively demanding spaces in which at-risk children can reach academically and cognitively 'standards of excellence' (Siraj & Mayo, 2014). Third, SES may operate indirectly via the cognitive benefits of chronic stress reduction and parental involvement; explicit educational mediators may be the responsibility of parents' world experiences, in which case the confound would dissipate. Lastly, if higher SES families are more familiar with and able to navigate the bureaucratic constraints of contemporary educational institutions, SES may no longer be a significant factor for student success.

Alternatively, SES effects may have a more profound impact on measures of academic achievement than they do on laboratory-based cognitive measures. Executive function tasks generally require one-time performance at given time points in a lab setting and may only serve as a proxy for the aggregate impact of the environment. Of particular interest is the lack of a significant correlation for semantic fluency ($r = 0.004$, $p = 0.949$). This task is strongly related to verbalization and education. The lack of an association with SES may indicate that within this specific population, language exposure is more ubiquitous throughout SES. Perhaps the students studied here are enrolled in bilingual or trilingual classes. Students studying at international schools are largely exposed to curricula that utilize the English language.

Further, measurement issues should also be considered. Socioeconomic status is a multidimensional construct, including income, occupation, education level, and wealth; composite index scores of SES can hide meaningful subdomains. If subdomains such as parental stress, neighborhood deprivation, or access to enrichment activities are not measured, subtle associations with adolescent executive functioning may not be revealed. Finally, adolescence can be a time of expanding independence. Peer group effects, technology use, and school-based self-regulation may have more impact on adolescent executive functioning than household income. Literature on adolescent brain maturation points to increased sensitivity to peer influences and motivation systems at this age (Crone & Dahl, 2012). As such, SES differences may be overshadowed by adolescent-specific factors operating within a school context.

Conclusions

This study investigated how parental education level and family SES affected the performance of cognitive tasks with a sample of 212 male international secondary students living in Saudi Arabia aged 15 to 18 years. There were no significant correlations. Both parental education level and SES variables produced correlation coefficients close to 0 with all four measures of working memory, inhibitory control, and phonemic and semantic fluency.

This finding indicates a potential diminishing association of parental education and SES with executive and verbal cognitive skills during mid- to late adolescence among students in international schools with highly standardized national curricula. Knowledge accretion from the developmental maturation of executive functions, standardized quality of school education, and shared academic experiences of these students may diminish gaps associated with family educational background. Overall, these results also imply that there is a well-established association between SES, parental education, and early cognitive development, but these top-down constructs might operate differently at the task-specific executive levels in late adolescence depending on the information processing context (Maayah, 2025).

In summary, this study informs the current debate about the limits of contextual effects of socioeconomic status on cognition. It highlights the significance of considering developmental stages, the type of educational institution, and sociocultural differences while exploring SES-cognition associations. Studies with different methodologies such as longitudinal approaches, use of more comprehensive SES measures (e.g., multiplier indices), as well as more extensive outcome measures (e.g., academic achievement) are warranted to better elucidate the pathways through which variables of family background influence cognition during adolescence across different countries.

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