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EMPIRICAL RESEARCH

The Effect of School Dropout on Verbal Ability in Adulthood: A Propensity Score Matching Approach

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Abstract Compared to high school graduates, adolescents who drop out of school are more likely to have a range of negative outcomes, including lower verbal capacities; however, the true nature of this association is not well-understood. Dropping out of school could have an important effect on reducing verbal skills, or the link between dropping out of school and diminished verbal skills could be a spurious association that is the result of unmeasured confounding variables. The current study tested these two competing perspectives by using propensity-score-matching (PSM) to unpack the association between school dropout and verbal skills among 7,317 respondents from the National Longitudinal Study of Adolescent Health (51% female, 49% male; 62% Caucasian, 38% minority). The results of the PSM models indicated a small yet meaningful statistically significant effect of dropout on verbal skills in adulthood even after taking into account a range of confounders. We conclude by discussing the implications of our results.

Keywords Dropout · Verbal skills · School · Adolescence · Propensity score matching

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The Importance of School Completion

The successful completion of high school is a fundamental criterion of success in American society. For this reason, school dropout is a national concern with broad economic and social consequences for adolescents and society alike. At the individual level, adolescents who drop out of school are at significant risk for delinquency, criminal justice system involvement, and welfare recipiency (Bridgeland et al. 2006) which can lead to a substantial economic drain on society (Dynarski et al. 1998; Heckman and LaFontaine 2008). In addition, years of education are highly correlated with annual earnings and general "upward mobility" in the United States, making education and staying in school important for an individual and society (Coleman 1994; Ream and Rumberger 2008; Rouse 2007; Wilson and Herrnstein 1985). Current technological demands depend on having highly educated, capable employees. To keep up with these demands, students must possess at least average level literacy, verbal, and problem-solving skills which necessitate staying in school.

Concern over school dropout has fueled the need for educators and policymakers to effectively and efficiently intervene. In 2002, the *No Child Left Behind Act* (U. S. Department of Education 2002) was passed and the legislation held school systems accountable for their students' graduation rates. As a result, educators and policy makers have cast even more attention towards America's problem

of children dropping out of school. Increasing the understanding about risk profiles of *who* drops out of school and *why* students drop out of school is a critical step in being able to provide effective prevention and intervention efforts. Providing effective intervention is a difficult task considering that educators and policy makers often face a lack of resources and a well-developed knowledge base regarding effective and worthwhile avenues for intervention. It is essential that we take the first steps to investigate the influence of individual student factors and factors related to the family, school, and community that may influence students dropping out of school. Understanding these issues will help to develop effective prevention and intervention efforts.

School Dropout and Verbal Ability

School dropout may have important effects on verbal ability, which is intimately involved with success in adulthood. Verbal ability encompasses the skills needed for language comprehension and expression and is profoundly important throughout the life course in academic and social settings (Bridgeland et al. 2006; Coleman 1994; Luria 1961). Having poor verbal skills may contribute to difficulties in variety of situations, leading one to experience feelings of academic and social failure. For example, if an individual possesses poor receptive vocabulary, they may not be able to understand directions or comprehend content necessary to succeed in an academic or social setting. Persons may become easily confused or overwhelmed by simple directions or content they are responsible for learning.

Children and adolescents who fail to acquire adequate verbal ability or who are deficient verbally are at risk for a range of maladaptive outcomes (Dionne 2005). Language deficiencies often co-occur with additional limitations, including a clinical diagnosis of attention-deficit-hyperactivity disorder (ADHD), (Cohen et al. 1998; Willcutt et al. 2000), reading disabilities (Tomblin et al. 2000), and emotional problem solving (Cohen et al. 1998). Moreover, deficits in language abilities also are strongly associated with a broad range of problem behaviors (Mensch and Kandel 1988; Moffitt 1990, 1993; Wilson and Herrnstein 1985), including early-life externalizing behaviors (Gallagher 1999), low self-control (Beaver et al. 2008), physical aggression (Dionne 2005), and juvenile delinquency (Davis et al. 1991). Long-term outcomes indicate that verbally-deficient youth are at risk for having reading and writing problems later in life (Stevenson 1996) and are also at risk for school failure (Dworkin 1989; Lloyd 1978). These findings converge with results from clinical-based samples where prior investigations have revealed that greater than 50% of youthful psychiatric patients (Giddan et al. 1996) and approximately 80% of antisocial boys have language impairments (Warr-Leeper et al. 1994). In sum, almost every risky behavior to some degree is related to poor verbal abilities.

It is broadly acknowledged that language problems and behavioral problems are connected. To date, a wide range of studies from diverse disciplinary perspectives point to the comorbidity between language deficits and behavioral problems, and this comorbidity and the problems associated with it often portend deleterious long-term consequences into adulthood. If school dropout acts to reduce the inculcation of verbal abilities needed into adulthood, any examination of its independent effects on verbal abilities will need to take into account the relatively wide array of risks and behavioral problems that are associated with school dropout. This will shed light on the language-behavioral problem nexus.

Current Study

One possible risk factor that may sustain poor verbal abilities is school dropout. As such, designing and implementing interventions to prevent school disengagement and dropping out of school can have long-term effects on verbal abilities that are critical to successful functioning into adulthood. The current authors are interested in quantifying the effect of school dropout on verbal ability within the context of other confounds or risk factors to isolate its effect across time. The purpose of this study is to examine the effect of dropout on verbal skills in early adulthood. We hypothesized that school dropout would retain a significant effect on verbal abilities into early adulthood, even while adjusting this effect for a wide swath of competing confounds. Specifically, the current aim was to subject this hypothesis to as conservative a test as possible by including as many potential confounding variables as possible to assess the robustness of school dropout effects occurring during adolescence in relation to verbal skills in adulthood by using propensity score methods within a large nationally representative longitudinal study design. Although we realize school dropout is a complex phenomenon, isolating the effect of school dropout in relation to verbal abilities is critically important.

Method

Participants and Procedures

Data for this study come from the National Longitudinal Study of Adolescent Health (Add Health), which is a

prospective study of a nationally representative sample of youths initially enrolled in grades seven through twelve in 1994–1995 (Udry 2003). Three waves of data have been collected thus far. The first wave of data was collected from a school-based sample, where more than 90,000 students who were attending more than 130 middle or high schools completed self-report surveys. These questionnaires asked youths about a broad range of issues germane to adolescence. This component of the Add Health study is referred to as the wave 1 in-school surveys. To gather more detailed information about some of the respondents, a subsample of adolescents were selected to be re-interviewed at their homes along with their primary caregiver. These interviews, known as the wave 1 in-home surveys, asked questions about the adolescent's social relationships, their involvement in risky and delinquent behaviors, and their family environment. A total of 20,745 adolescents and nearly 17,700 of their primary caregivers participated in the wave 1 in-home component of the Add Health study (Harris et al. 2003).

The second wave of interviews was completed in 1996. Since relatively little time had lapsed since the wave 1 interviews, and since the respondents were still adolescents, the questions asked at the previous wave were still age-appropriate. As a result, youths were asked very similar questions, including items pertaining to their social relationships, their behaviors, and their school experiences. Overall, 14,738 adolescents were successfully interviewed at wave 2. Then, between 2001 and 2002 the third wave of surveys were completed. However, since the respondents were now young adults, the survey instruments used at the previous two waves were redesigned to include questions that were more germane to early adulthood. For instance, participants were asked about their marital status, their childbearing history, and their current employment situation. A total of 15,197 respondents participated in the wave 3 component of the Add Health study (Harris et al. 2003). After cases were removed due to missing values, our final analytical sample size was $N = 7{,}317$.

Measures

Outcome Measure

Verbal Cognitive Ability. The outcome measure of interest in the current study is verbal cognitive ability. During wave 3 interviews, respondents were administered the picture vocabulary test (PVT), a standardized assessment test used to measure individual variation in verbal skills. The PVT is an abridged version of the widely used peabody picture vocabulary test-revised (PPVT-R). Prior research has revealed the PVT to be a reliable and valid way to measure verbal abilities (D'Amato et al. 1988; Dunn and Dunn 1981) and, importantly, previous researchers analyzing the Add Health data have used the PVT scores (Rowe et al. 1999). The PVT scores were available as standardized scores, raw scores, and percentile rank scores. All of these PVT scores were highly intercorrelated, but for ease of interpretation we opted to employ the longitudinal standardized score. The longitudinal standardized scores are designed to be used in longitudinal analysis. The PVT longitudinal standardized scores were created by the Add Health research team and they were estimated by using the wave 1 PVT standardized score to predict the wave 3 standardized score from the wave 3 raw score (National Longitudinal Study of Adolescent Health 2003). Note, however, that the analyses were repeated using the different PVT scores available and the substantive results remained the same.

Treatment Variable

School Dropout. To examine the association between school dropout and verbal skills, a measure of school dropout needs to be available in the data. Although there are multiple ways to operationalize school dropout, we opted to measure school dropout by identifying those respondents who had not earned their high school diploma. Specifically, during wave 3 interviews, respondents were asked to indicate the highest grade of regular school they had completed. Responses ranged from 6 = sixth grade to 22 = 5 or more years of graduate school. We collapsed these responses into two categories. The first category included respondents who indicated that their highest grade of school completed was eleventh grade or lower. This was the school dropout group. The other category included respondents who indicated that their highest grade of school completed was 12th grade or higher. This was the high-school graduate group. In short, school dropout was measured dichotomously, where 0 = respondent's highest level of education was eleventh grade or lower and 1 = respondent's highest level of education was at least twelfth grade. In total, of the 7,317 respondents in our final analytical sample, 807 were school dropouts and 6,510 were high school graduates.

To explore the association between school dropout and verbal cognitive abilities using propensity score matching, it is essential that variables that might confound this association are identified and included in the creation of the propensity score. Eighteen covariates were identified in the Add Health data that may be related to school dropout and to verbal skills and thus meet the requirements of confounding. School dropout is multidimensional in nature. As such, our goal was to include as many risk factors as possible in order to be conservative in isolating an effect.

Covariates

Attention Deficit Hyperactivity Disorder. To take into account the possibility that attention deficit hyperactivity disorder (ADHD) may be confounding the association between school dropout and verbal abilities, we included an eighteen-item ADHD retrospective scale collected during wave 3 interviews ($\alpha = .90$) at wave 3 they did ask eighteen different questions that were designed to measure the degree to which each respondent was hyperactive between the ages of 5 and 12 years old. For example, participants were asked to indicate whether they had difficulty organizing tasks and activities, whether they were reluctant to engage in work that required sustained mental attention, whether they talked too much, and whether they were easily distracted. The response set for each question was as follows: 0 = never, 1 = sometimes, 2 = often, and 3 = very often.

Criminal Father. We included a dichotomous measure of whether the respondent's biological father had ever been incarcerated. This item was drawn from the wave 3 data and captures the genetic and environmental risk factors that are frequently observed in criminal families (Moffitt 2005).

Maternal Disengagement. Children and adolescents who lack strong familial ties with their parents are at risk for a range of maladaptive outcomes. As a result, we included a five-item maternal disengagement scale. During wave 1 interviews, respondents were asked a series of questions that captured how warm and loving their mother was and the overall quality of their relationship with their mother. Responses to these five items were summed together to create the maternal disengagement scale ($\alpha = .84$). This scale has been used previously by Add Health researchers (Beaver 2008).

Maternal Involvement. Mothers who are highly involved in their offspring's lives are more aware of their feelings about school and their performance at school. Consequently, we included a ten-item maternal involvement index. This index was created from wave 1 questions asked to the adolescent. Specifically, they were asked to indicate whether or not they had engaged in ten different activities with their mother during the past 4 weeks. Responses were coded dichotomously, where 0 = no and 1 = yes. Higher scores on this index represent increased maternal involvement ($\alpha = 55$). This index is similar to ones that have been used in previous research (Crosnoe and Elder 2004).

Maternal Attachment. Adolescents who are strongly attached to their parents are at reduced risk for a range of antisocial behaviors. To take this finding into account, we included a two-item maternal attachment scale that has been used previously (Schreck et al. 2004). During wave 1 interviews, respondents were asked how close they feel to their mothers and how much they think their mothers care about them. Responses to these two items were summed together to create the maternal attachment scale ($\alpha = .64$). Higher values on this scale indicate increased maternal attachment.

Parental Permissiveness. To control for the potential confounding effects of a lack of parental supervision, we included a seven-item parental permissiveness index. During wave 1 interviews, adolescents were asked about rules that their parents have put in place governing the clothes they wear, their curfew, and the shows that they watch on television. The responses to the items were summed together to create a parental permissiveness index ($\alpha = .63$), which has been used in previous research (Beaver 2008).

Social Support. During wave 1 interviews, adolescents were asked about the amount of support that they received from their family, friends, and teachers. For example, youths responded to questions asking how much they felt that: adults care about them, teachers care about them, and parents care about them, among others. Responses to each question were coded 1 = not at all, 2 = very little, 3 = somewhat, 4 = quite a bit, and 5 = very much. These eight items were then summed to create the social support scale ($\alpha = .77$).

Academic Performance. During wave 1 interviews, students were asked to report their most recent grades in four subject areas: English or language arts, mathematics, history or social studies, and science. Responses were originally coded as follows: 1 = A, 2 = B, 3 = C, and 4 = D or lower, but they we reverse coded them so that 1 = D or lower, 2 = C, 3 = B, and 4 = A. The grades for each subject were summed together to create the academic performance scale ($\alpha = .75$).

School Attachment. During wave 1 interviews, adolescents were asked items tapping their attachment to school. Specifically, respondents were asked to indicate whether they feel like they are part of their school, whether they are happy to be at their school, and whether the teachers at their school treat students fairly, among others. The items were summed together to create the school attachment scale, where higher values represent greater attachment to school ($\alpha = .76$).

School Trouble. During wave 1 interviews, adolescents were asked a series of questions about their school troubles. For example, adolescents were asked how often they have trouble getting along with teachers, getting along with other students, paying attention, and finishing their homework. These items were factor analyzed, and the results of the analyses indicated that the four variables loaded on a single construct. As a result, all four of the items were summed together ($\alpha = .70$).

Neighborhood Cohesion. To control for the potential effects that neighborhood-level factors have on school dropout and verbal abilities, we included a neighborhood

cohesion scale. During wave 1 interviews, three questions were asked about the conditions of the adolescent's neighborhood. These items were summed together to create the neighborhood cohesion scale ($\alpha = .66$). Higher scores on this scale represent increased neighborhood cohesion.

Delinquent Peers. To examine whether exposure to delinquent peers could potentially confound the association between school dropout and verbal abilities, we included a three-item delinquent peer measure. During wave 1 interviews, respondents were asked how many of their three closest friends smoke at least one cigarette per day, drink alcohol at least once a month, and smoke pot at least once each month. Responses to each item were coded as 0 = 0 friends, 1 = 1 friend, 2 = 2 friends, and 3 = 3 friends. This additive scale was coded such that higher values reflect greater exposure to delinquent peers ($\alpha = .76$).

Violent Delinquency. To control for the potential effects that delinquency has on both school dropout and verbal abilities, we included a seven-item violent delinquency scale in the analyses. During wave 1 interviews, adolescents were asked to self-report their past-year involvement in acts of serious aggression and violence, such as physical fighting. This scale was coded such that higher values indicate more involvement in acts of violent delinquency ($\alpha = .72$).

Victimization. During wave 1 interviews, respondents were asked to self-report their personal victimization experiences. For example, they were asked how many times in the past 12 months they had been the victim of violence, such as being jumped and having a knife or gun pulled on them. The responses to these items were added together to create the victimization scale, where higher values indicate more victimization ($\alpha = .70$).

PVT (wave 1). Of particular importance is that respondents were also administered the PVT during wave 1 interviews. By including the wave 1 PVT score in the propensity score, we are able to take into account the possibility that adolescents with relatively low PVT scores are more apt to dropout of school. This is a very conservative approach, and one that helps to isolate the effect that school dropout has on verbal skills later in life. Similar to the wave 3 PVT score, the wave 1 PVT score was measured as a standardized score that was created to be used in both cross-sectional and longitudinal analyses (National Longitudinal Study of Adolescent Health 2003).

Demographic Variables. To help control for potential confounding based on individual demographic characteristics, we included three demographic variables in the analyses. Gender was coded as a dichotomous dummy variable (0 = female, 1 = male), age was coded as continuous variable (measured in years), and race was included as a dichotomous dummy variable (0 = Caucasian, 1 = minority).

Analytic Plan

Youths who decide to dropout of school are likely to differ from high school graduates in salient ways. For example, it is quite possible that school dropouts, in comparison with non-dropouts, are likely to have lower verbal skills even before they drop out of school. In this way, the two groups—school dropouts and graduates—are different on a range of characteristics that likely artificially inflate the effect that school dropout would have on cognitive abilities when using traditional statistical techniques. One methodology that takes into account this issue is propensity score matching (PSM; Rosenbaum and Rubin 1983).

PSM seeks to create to compare a treatment group (in this case, the treatment group would be school dropouts) to a comparison group (in this case, the comparison group would be high school graduates) on the outcome measure of interest (in this case, PVT scores). To do so, however, PSM seeks to create two equal groups by matching them on a range of covariates that are thought to affect the propensity to drop out and PVT scores (Rosenbaum and Rubin 1983). More specifically, a logit model is typically estimated predicting the treatment with key covariates. For the current study, we estimated a logit model predicting school dropout with the eighteen covariates described above. From this logit model, each respondent was assigned a conditional probability for dropping out of school. This conditional probability, referred to as the propensity score, is estimated with the following equation:

$$p(\text{dropout}) = \Pr(T_i = 1|X_i) \quad (1)$$

where T_i = if respondent i is a dropout and X_i is the vector of covariates for respondent i that predict school dropout and are thought to be confounding the association between school dropout and verbal cognitive abilities. The value for the propensity score ranges between 0 and 1 and indicates the respondent's propensity to drop out. Scores closer to 1 indicate a very high propensity to drop out of school, while scores closer to 0 indicate a very low propensity to drop out of school.

After the propensity scores were estimated, the next step was to match respondent's from the treated group (i.e., school dropouts) with respondent's from the control group (i.e., high school graduates) using the propensity scores. In the current analysis, we estimated the PSM models using one-to-one nearest-neighbor matching techniques without replacement and with a conventional .05 caliper level. (We also estimated the models using different PSM specifications. For example, we recalculated the models using three-to-one matching techniques and kernel-matching. The substantive results were the same and thus we did not present the results of these PSM models.) Each school dropout was matched to one high school graduate using the

propensity scores to match and the propensity scores for the two respondent's could be no farther than .05 apart. All 807 of the school dropouts were successfully matched.

The PSM analysis proceeded in three interrelated steps. First, we presented the results for the logit models that were used to create the propensity scores. Second, we examined the mean differences before and after matching. Essentially, these models revealed the differences on each of the eighteen covariates prior to the matching procedure. If confounding was a potential issue, then the covariates should be significantly different before the respondents were matched on the propensity score. The post-matching results revealed the mean differences between graduates and school dropouts after the two groups were matched on the propensity score. If the matching procedure was successful, then there should not be any between-group differences on the covariates. Third, we examined whether there was an association between school dropout and verbal skills before and after matching.

Results

The analysis began by estimating a logit model by predicting school dropout with the eighteen covariates. As Table 1 shows, most of the covariates were statistically significant predictors of school dropout. There were a number of exceptions, including parental permissiveness and social support, but they were retained in the final model used to create the propensity score. Overall, however, thirteen of the covariates reached conventional levels of statistical significance ($p < .05$, two-tailed tests).

Table 1 Logistic regression estimates for propensity score models

Variable	Coefficient	Standard error	*p*-Value
ADHD	0.02	.00	<.001
Criminal father	0.68	.10	<.001
Maternal disengagement	−0.03	.02	<.05
Maternal involvement	−0.11	.02	<.001
Maternal attachment	−0.06	.04	.109
Parental permissiveness	−0.02	.03	.457
Social support	0.01	.01	.325
Academic performance	−0.22	.02	<.001
School attachment	−0.02	.01	.058
School trouble	0.02	.02	.143
Neighborhood cohesion	−0.05	.01	<.001
Delinquent peers	0.13	.02	<.001
Violent delinquency	0.05	.02	<.05
Victimization	0.07	.03	<.01
PVT (wave 1)	−0.04	.00	<.001
Gender	0.11	.09	.094
Age	−0.25	.03	<.001
Race	−0.41	.09	<.001
Constant	8.24	.86	<.001

Table 2 presents the results of the pre- and post-matching *t*-tests. These tables examine whether high school graduates and school dropouts differed significantly on the covariates. As can be seen in the left-hand columns (i.e., the non-matched groups), high school graduates and school dropouts differed significantly on all eighteen of the covariates. These significant between-group differences indicated that confounding may be an issue when examining the association between school dropout and verbal skills. The right-hand columns contained the results of the *t*-tests after matching on the propensity score. As can be seen, the matching procedure was successful because it eliminated the between-group differences on all of the covariates. In the parlance of PSM, the fact that there were not any between-group differences means that the matching procedure achieved balance. As a result, we were now able to examine the association between school dropout and PVT scores.

The results of the final analysis appear in Fig. 1. The left-hand bar charts depict the PVT scores for high school graduates and school dropouts prior to matching. As this figure shows, high school dropouts, on average, received a score of 94.32 on the PVT score administered in adulthood. In contrast, school dropouts, on average, received a score of 102.74 on the PVT. This difference is large and statistically significant ($t = 15.49$, $p < .05$), suggesting that dropping out of school reduces PVT scores by an average of 8.42 points. The bar charts in the right-hand side revealed the between-group differences on the PVT scores after matching. As can be seen, there was still a difference in the average PVT scores, and this difference was still statistically significant ($t = 2.16$, $p < .05$), but the difference was not nearly as large in magnitude. After matching, school dropout was associated with a reduction of PVT scores by an average of 1.76 points.

Discussion

Verbal ability is an important skill needed to communicate effectively in society and can contribute to a person's success in a variety of academic and social situations. Conversely, poor verbal abilities compromise success across the life-course. Although it may seem obvious that dropping out of school would affect verbal abilities, there are other factors that are also associated with the development of poor verbal skills. It was hypothesized that school dropout would retain a significant effect on verbal

Table 2 Achieving balance among high school graduates and school dropouts: pre- and post-test matching *t*-tests using nearest-neighbor matching

	Unmatched sample			Matched sample		
	Graduate	Dropout	*t*-value	Graduate	Dropout	*t*-value
ADHD	12.63	17.10	−13.68*	16.68	17.10	−0.82
Criminal father	0.13	0.28	−11.39*	0.28	0.28	0.28
Maternal disengagement	8.77	9.06	−2.29*	9.13	9.06	0.44
Maternal involvement	4.18	3.57	8.26*	3.59	3.57	0.21
Maternal attachment	9.45	9.29	3.87*	9.30	9.29	0.28
Parental permissiveness	5.07	4.83	4.19*	4.86	4.83	0.26
Social support	32.56	31.38	7.00*	31.32	31.38	−0.25
Academic performance	11.79	9.06	25.62*	8.98	9.06	−0.56
School attachment	18.93	17.55	10.08*	17.49	17.55	−0.32
School trouble	3.88	5.43	−14.75*	5.63	5.43	1.18
Neighborhood cohesion	0.48	−0.93	10.02*	−0.84	−0.93	0.45
Delinquent peers	2.08	3.48	−15.03*	3.56	3.48	0.56
Violent delinquency	0.91	2.26	−17.36*	2.55	2.26	1.64
Victimization	0.77	1.65	−15.94*	1.73	1.65	0.73
PVT (wave 1)	102.03	92.65	17.52*	93.74	92.65	1.52
Gender	0.46	0.55	−4.95*	0.57	0.55	0.80
Age	15.70	15.36	5.41*	15.30	15.36	−0.78
Race	0.33	0.35	−1.55	0.39	0.35	1.29

* $p < .05$, two-tailed tests

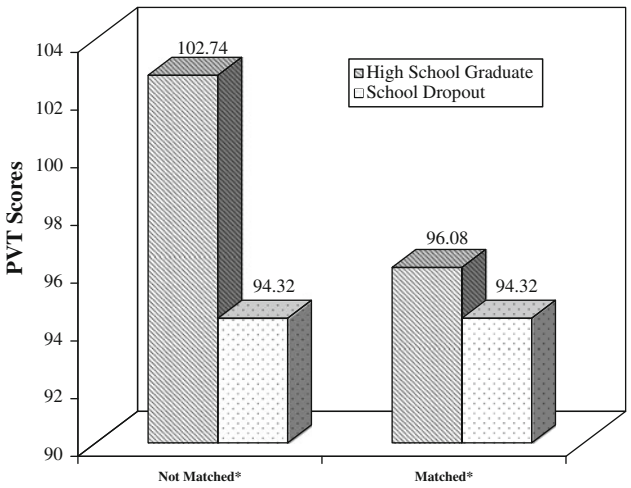

Fig. 1 The Association between school dropout and PVT scores before and after matching. * $p < .05$, two-tailed tests

abilities into adulthood, even while adjusting this effect for competing confounds. The analyses supported this hypothesis by finding that verbal ability remained a significant factor, even after adjustments for a host of other risk factors. Although few studies, to our knowledge, have examined the long-term effects of school dropout on later verbal skills, one older study suggests that the last 2 years of high school were effective in increasing verbal skills of most students (Hotchkiss 1984). Additional research needs to be conducted to confirm the developmental timing of verbal skills development during adolescence. In addition, identification of robust indicators of adulthood functioning based on school dropout requires further elucidation. Although research efforts have been expended in identifying risk factors for school dropout (Gleason and Dynarski 2002), relatively little research have examined the effects of school dropout on various performance measures into adulthood. We suggest that due to its importance, this is a fruitful avenue for future research. School dropout results from a gradual process of disengagement (Finn 1989; Garnier et al. 1997) making it possible and worthwhile for educators to intervene in this process to prevent school dropout; however, designing interventions to intervene with students at-risk for dropping out of school requires knowledge of the multitude of reasons or risk factors that may contribute to school dropout. Between risk factors related to academic performance (i.e., poor grades stemming from low literacy or verbal ability), behavior performance, and risk factors related to family or social reasons (i.e. students become parents, have to get a job to support their families, or have criminal parents), there are a variety of reasons why students may drop out of school and therefore, a variety of risk factors to address (Bridgeland et al. 2006; Rumberger 1995; Rumberger and Thomas 2000). Due to limited resources and time, it is important

that educators hone in and intervene with the most salient risk factors to get the "biggest bang for their buck".

Study findings possess important implications with respect to greater consideration regarding the public health significance of school dropout (Freudenberg and Ruglis 2007). Not only is education in general associated with greater disparities in health via such pathways as reduced unemployment (Molla et al. 2004), but also, diminished receptive verbal abilities can inhibit the ability to attain successful health literacy and communication. Given that diminished verbal abilities have been linked to violent behavior (Dionne 2005), subsequent injury and medical costs are involved. Therefore, decreasing school dropout rates may have a practical effect on later behavioral health outcomes.

Despite the importance of these findings the results should be interpreted in light of several limitations including the fact that, PSM is a data-dependent statistically technique. What this means it that if the Add Health data did not include some potentially salient confounding variables, then the results reported here could be biased. Since the results indicated a statistically significant effect of school dropout on verbal abilities, it is possible that this effect would evaporate had additional covariates been included in the propensity score. Still, based on previous research, most of the main risk factors for school dropout that were available in the data were included in the propensity score. In addition, the inclusion of the PVT score at wave 1 provided a very conservative estimate of the effect of school dropout on verbal abilities later in life. Even when using this very conservative approach, the analysis indicated that dropping out of school produces reductions in verbal skills. The need to dichotomize the school completion group into two groups is another study limitation. Due to dichotomization, information on any incremental effect of higher versus lower levels of school completion without finishing high school is lost.

The knowledge that school completion is involved in verbal abilities into adulthood yields important implications for those educators designing prevention and intervention programs. Verbal reasoning can be thought of as a marker for thinking/IQ, which includes vocabulary knowledge, concept knowledge, and ends up playing a large role in comprehension results. This information supports the two-pronged idea that we need to not only take actions to prevent school dropout but also enhance students' verbal ability through intensive interventions beginning at an early age, particularly for children from disadvantaged backgrounds who are at higher risk for school dropout (Bridgeland et al. 2006; Heckman and LaFontaine 2008). Interventions designed to enhance verbal ability may include treatments designed to strengthen comprehension, verbal reasoning (i.e. main idea and summarization strategies), and knowledge of word structure, such as enhancing knowledge of morphology and semantic features of the English language.

Enhancing verbal ability is not an easy task; it can require years of intensive comprehension strategy instruction using a variety of narrative and expository text. In fact, as students get older, verbal reasoning may carry more of the load academically because text structure is more complex and words are harder. Interestingly, Schatschneider's (2004) study on the individual differences in performance on the reading portion of the Florida Comprehensive Assessment Test (FCAT) showed that not only text fluency but *also* text reasoning and verbal knowledge accounted for equal variance on Florida State outcome tests in 7th and 10th grade, whereas text fluency accounted for substantially more variance with 3rd graders. According to Schatschneider's report, as students aged, verbal knowledge and reasoning skills exerted greater academic impact. Based on this information and the current results, it appears worthwhile to design and implement interventions to increase students' verbal ability. Finally, in his seminal treatise on the use of social capital in the creation of human capital, Coleman (1994) empirically showed how family and community resources can bear on school climates to reduce the probability of an adolescent dropping out of high school. Graduation from high school is an important personal, social, and cultural rite with important implications for the maintenance of community and personal health. Dropping out of school in turn denotes many negative consequences, one of which may be a reduction in verbal ability.

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References

Beaver, K. M. (2008). Nonshared environmental influences on adolescent delinquent involvement and adult criminal behavior. *Criminology, 46*, 341–370.

Beaver, K. M., DeLisi, M., Vaughn, M. G., Wright, J. P., & Boutwell, B. B. (2008). The relationship between self-control and language: Evidence of a shared etiological pathway. *Criminology, 46*, 201–232.

Bridgeland, J., DiIulio, J., & Morison, K. B. (2006). *The silent epidemic: Perspectives of high school dropouts*. Washington, DC: Civic Enterprises.

Cohen, N. J., Menna, R., Vallance, D. D., Barwick, M. A., Im, N., & Horodezky, N. B. (1998). Language, social cognitive processing, and behavioral characteristics of psychiatrically disturbed children with previously identified and unsuspected language impairments. *Journal of Child Psychology and Psychiatry, 39*, 853–864.

Coleman, J. S. (1994). Social capital in the creation of human capital. *American Journal of Sociology, 94*(Supplement), S95–S120.

Crosnoe, R., & Elder, G. H., Jr. (2004). Family dynamics, supportive relationships, and educational resilience during adolescence. *Journal of Family Issues, 25*, 571–602.

D'Amato, R. C., Gray, J. W., & Dean, R. S. (1988). Construct validity of the PPVT with neuropsychological, intellectual, and achievement measures. *Journal of Clinical Psychology, 44*, 934–939.

Davis, A. D., Sanger, D. D., & Morris-Friehe, M. (1991). Language skills of delinquent and nondelinquent adolescent males. *Journal of Communication Disorders, 24*, 251–266.

Dionne, G. (2005). Language development and aggressive behavior. In R. E. Tremblay, W. W. Hartup, & J. Archer (Eds.), *Developmental origins of aggression*. New York: The Guilford Press.

Dunn, L. M., & Dunn, L. M. (1981). *Peabody picture vocabulary test-revised*. Circle Pines, MN: American Guidance Service.

Dworkin, P. H. (1989). School failure. *Pediatrics in Review, 10*, 301–312.

Dynarski, M., Gleason, P., Rangarajan, A., & Wood, R. (1998). *Impacts of dropout prevention programs*. Washington, DC: U.S. Department of Education.

Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research, 59*, 117–142.

Freudenberg, N., & Ruglis, J. (2007). Reframing school dropout as a public health issue. *Preventing Chronic Disease: Public Health Research, Practice, and Policy, 4*, 1–11.

Gallagher, T. M. (1999). Interrelationships among children's language, behavior, and emotional problems. *Topics in Language Disorders, 19*, 1–15.

Garnier, H. E., Stein, J., & Jacobs, J. (1997). The process of dropping out of high school: A 19-year perspective. *American Educational Research Journal, 34*, 395–419.

Giddan, J. J., Milling, L., & Campbell, N. B. (1996). Unrecognized language and speech deficits in preadolescent psychiatric inpatients. *American Journal of Orthopsychiatry, 66*, 85–92.

Gleason, P., & Dynarski, M. (2002). Do we know whom to serve? Issues in using risk factors to identify dropouts. *Journal of Education for Students Placed At Risk, 7*, 25–41.

Harris, K. M., Florey, F., Tabor, J., Bearman, P. S., Jones, J., & Udry, J. R. (2003). The national longitudinal study of adolescent health: Research design [www document]. URL: http://www.cpc.unc.edu/projects/addhealth/design.

Heckman, J. J., & LaFontaine, P. A. (2008). *The declining American high school graduation rate: Evidence*. sources, and consequences. Cambridge, MA: National Bureau of Economic Research.

Hotchkiss, L. (1984). Effects of schooling on cognitive, attitudinal, and behavioral outcomes. technical report, *High School and Beyond (NCES)*, 166 pp.

Lloyd, D. N. (1978). Prediction of school failure from third-grade data. *Educational and Psychological Measurement, 38*, 1193–1200.

Luria, A. R. (1961). *The role of speech in the regulation of normal and abnormal behavior*. New York: Basic Books.

Mensch, B. S., & Kandel, D. B. (1988). Dropping out of high school and drug involvement. *Sociology of Education, 61*, 95–113.

Moffitt, T. E. (1990). The neuropsychology of juvenile delinquency: A critical review. In M. Tonry & N. Morris (Eds.), *Crime and justice: An annual review of research* (Vol. 12). Chicago, IL: University of Chicago Press.

Moffitt, T. E. (1993). The neuropsychology of conduct disorder. *Development and Psychopathology, 5*, 135–151.

Moffitt, T. E. (2005). The new look of behavioral genetics in developmental psychopathology: Gene-environment interplay in antisocial behaviors. *Psychological Bulletin, 131*, 533–554.

Molla, M., Madans, J., & Wagener, D. (2004). Differentials in adult mortality and activity limitation by years of education in the United States at the end of the 1990s. *Population and Development Review, 30*, 625–646.

National Longitudinal Study of Adolescent Health. (2003). *Wave III add health PVT*. Carolina Population Center, University of North Carolina at Chapel Hill.

Ream, R. K., & Rumberger, R. W. (2008). Student engagement, peer social capital, and school dropout among Mexican American and Non-Latino white students. *Sociology of Education, 81*, 109–139.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observation studies for causal effects. *Biometrika, 70*, 41–55.

Rouse, C. E. (2007). Consequences for the labor market. In C. R. Belfield & H. M. Levin (Eds.), *The price we pay: Economic and social consequences of inadequate education* (pp. 99–124). Washington, DC: Brookings institution.

Rowe, D. C., Jacobson, K. C., & Van den Oord, E. J. C. G. (1999). Genetic and environmental influences on vocabulary IQ: Parental education level as moderator. *Child Development, 70*, 1151–1162.

Rumberger, R. W. (1995). Dropping out of middle school: A multilevel analysis of students and schools. *American Educational Research Journal, 32*, 583–625.

Rumberger, R. W., & Thomas, S. L. (2000). The distribution of dropout and turnover rates among urban and suburban high schools. *Sociology of Education, 73*, 39–67.

Schatschneider, C. (2004, November). Predicting reading comprehension: A study of third, seventh, and tenth grade students. Paper presented at the Florida Center for Reading Research Conference on Vocabulary and Reading, Captiva Island, FL.

Schreck, C. J., Fisher, B. S., & Miller, J. M. (2004). The social context of violent victimization: A study of the delinquent peer effect. *Justice Quarterly, 21*, 23–47.

Stevenson, J. (1996). Developmental changes in the mechanisms linking language disabilities and behavior disorders. In J. H. Beitchman, N. J. Cohen, M. M. Konstantareas, & R. Tannock (Eds.), *Language, learning, and behavior disorders: Developmental, biological, and clinical perspectives*. New York: Cambridge University Press.

Tomblin, J. B., Zhang, X., Buckwalter, P., & Catts, H. (2000). The association of reading disability, behavioral disorders, and language impairment among second-grade children. *Journal of Child Psychology and Psychiatry, 41*, 473–482.

Udry, J. R. (2003). *The National Longitudinal Study of Adolescent Health (Add Health), Waves I and II, 1994–1996; Wave III, 2001–2002 [machine-readable data file and documentation]*. Chapel Hill, NC: Carolina Population Center, University of North Carolina.

U.S. Department of Education. (2002). *No Child Left Behind Act of 2002*. (Pub. L. No. 107-110, 115 Stat. 1425).

Warr-Leeper, G., Wright, N. A., & Mack, A. (1994). Language disabilities of antisocial boys in residential treatment. *Behavioral Disorders, 19*, 159–169.

Willcutt, E. G., Pennington, B. F., & DeFries, J. C. (2000). Twin study of the etiology of comorbidity between reading disability

and attention-deficit/hyperactivity disorder. *American Journal of Medical Genetics, 96*, 293–301.

Wilson, J. Q., & Herrnstein, R. J. (1985). *Crime and human nature: The definitive study of the causes of crime*. New York: Simon & Schuster.

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