

## The Effect of Teacher-Rated Attention-Concentration Problems in Grade 1 through Grade 6 on Latent Class Growth Trajectories on Marijuana Use and Convictions for Possession with Intent to Distribute a Controlled Dangerous Substance (CDS) at Age 19-21 in a Community-Based Epidemiological Sample.

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### Abstract

*The present study sought to identify early childhood predictors of later problematic outcomes such as drug use and contact with the criminal justice system. There is paucity of research regarding long-term outcomes for those rated by teachers as having attention-concentration problems in childhood. This study is based on data from the Development and Malleability from Childhood through Adulthood Mental Health Study. Children enrolled in Baltimore City public schools were assessed at different time points from childhood into young adulthood. We hypothesized that there will be two developmental trajectories of marijuana use and convictions for possession with intent to distribute a controlled dangerous substance at age 19-21 in a randomized community-based epidemiological sample (n=1317). We also hypothesized that there will be a group of children who enter school with lower levels of attention-concentration problems that escalate into criminal behavior by early adulthood. Lastly, we hypothesized that there will be a second group of children who display a consistently low level of attention-concentration problems and who will show the lowest level of risk for later criminal behavior. Teacher ratings of attention-concentration problems were obtained using the Teacher Observation of Classroom Adaptation-Revised (TOCA-R). The TOCA-R ratings were obtained during a structured interview with a trained assessor. Teachers rated the sample on the attention-concentration subscale of the TOCA-R which included the following items: completes assignments, concentrates, poor effort, works well alone, pays attention, learns up to ability, eager to learn, works hard, and stays on task. Data regarding marijuana use and convictions regarding drug sales were obtained via structured interview. General growth mixture model analysis revealed four classes that are significantly different for marijuana use ( $\chi^2=8.18$ ,  $p=.04$ ) while controlling for first grade aggressive behavior ( $\chi^2=194.12$ ,  $p=.001$ ). We also found two classes that were significantly different for convictions for possession with intent to distribute drugs ( $\chi^2=3.97$ ,  $p=.04$ ) while controlling for first grade aggressive behavior for the entire sample ( $\chi^2=161.40$ ,  $p=.001$ ) and for males while controlling for first grade*

*aggressive behavior ( $\chi^2=3.77, p=.05$ ). Findings are discussed with respect to the need for early interventions addressing attention-concentration problems and the need for prevention programs to reduce the use of marijuana and convictions for possession with intent to sell drugs.*

*The study was conducted with support from the NIDA Drug Dependence Epidemiology Training Program T-32 DA007292. The authors acknowledge the trainees of the Drug Dependence Epidemiology Training Program, Department of Mental Health, The Johns Hopkins University Bloomberg School of Public Health.*

**Keywords:** teacher-rated attention concentration problems, community-based sample, drug use, marijuana use, predictors, drug convictions

## **Introduction**

The relationships between attentional difficulties at age 8 and psychosocial outcomes at age 18 were investigated by Ferguson et al. (1997). Escalating attentional difficulties during middle childhood were associated with an increased risk of academic failure or difficulties and juvenile offending (Ferguson et al., 1997). Siponmaa et al. (2001) in a retrospective study of young offenders with ADHD aged 15-22 years found later contact with the criminal justice system. Offenders were consecutively referred for pre-sentencing forensic psychiatric investigations, and that offenders were referred for these investigations due to being adjudicated for serious offenses. In 2002, Pascual-Castroviejo suggested that the presence of comorbid disorders in ADHD children predisposed them to contact with police and the criminal justice system during their entire life. Connor et al. (2003) found that an early age of onset of ADHD was correlated with a greater rate of aggressive symptoms as reported by parents. Young and Gudjonsson (2005) found a positive correlation between a delinquency scale and ADHD. Pardini et al. (2006) reported that boys in elementary school who exhibited inattention problems were at risk for delinquent behavior. Specifically, inattention problems predicted delinquency persistence.

There is a paucity of research regarding long-term outcomes for those rated by teachers as having attention-concentration problems in childhood. Teachers may evaluate children in the classroom for attention-concentration problems in developing, for example, individualized educational plans (IEPs) which delineate accommodations for students with disabilities including children with attention difficulties. The question remains as to what problematic outcomes, if any, present in young adulthood for those evaluated by teachers as having attention-concentration problems during the early formative education years, and specifically, in grades 1 through 6. Studies of outcomes of community-based samples with teacher-rated attention-concentration problems in early childhood are not abundant. Examining a community-based sample over a significant period of time presents both the opportunity to investigate early predictors of problematic outcomes such as drug use and the opportunity to identify the potential utility of teacher-rated childhood attention-concentration problems in relation to developmental outcomes.

The present study was conducted within a developmental epidemiological orientation. The developmental epidemiological orientation reflects the integration of community epidemiology and the life course orientation. The examination of developing risk behaviors in small populations in their natural environments is termed 'community epidemiology.' The life course orientation suggests that there are three types of influences that predispose behavioral development: normative age-graded or ontogenetic influences, normative history-graded influences, and non-normative life events (Kellam and Rebok, 1992).

Normative or ontogenetic influences are comparable events pertaining to the biological maturation and environmental effects that occur in the social fields (i.e., home, school, and peer environments of all individuals within a specific culture or subgroup. Normative history-graded influences include biological

maturation and environmental determinants that are associated with a history or time-graded perspective. There are two types of history-graded influences—those associated with long-term functioning and those that are time or period specific. Finally, non-normative or idiosyncratic influences refer to varied developmental influences or events that act upon an individual's development that are not considered as part of the norm across populations (Kellam and Rebok, 1992).

The developmental epidemiological framework “is intended to allow the mapping of developmental paths within representative samples from a defined community population over significant portions of time” (Kellam and Rebok, 1992, p. 165). This mapping of developmental paths of specific childhood cohorts permits the comparison of those children who develop disorders and those in the same community who do not develop disorders. Thus, the developmental epidemiological approach provides a framework for studying variation in problematic outcomes. The variation is analyzed as it relates to influences in the host, environment, or agent. More specifically, this orientation is a means for “conceptualizing cause or etiology as evolving vulnerability in the person (host), conditions in the environment producing illness (environment), and a causal process (agent) of interaction between the individual and the environment” (Kellam et al., 1991, p. 6).

Research supports the notion that mental health status plays a critical role in the manner in which an individual interfaces with society and how the individual is portrayed by the significant others in his/her life (Kellam et al., 1975). Kellam posits mental health as a function of two distinct developmental pathways or conditions. The process of how an individual interacts with others in his/her social fields is termed ‘social adaptation.’ This refers to the social task demands confronting an individual at various stages of life and is external to the individual. Within this context, the individual's behavioral responses, e.g., rate of adequacy of an individual's social performance at various stages of life as rated by the natural raters encountered in his/her social fields is termed ‘social adaptational status (SAS).’ The natural raters are the socialization agents at different stages throughout the course of life that define the tasks and rate the individual. In this realm, parents are the natural raters in the home environment while teachers are the natural raters in the classroom. The second aspect of an individual's mental health is his/her internal condition, e.g., psychological, physiological, and neuropsychological status. This aspect is termed ‘psychological well-being’ (PWB). This component involves an individual's psychological well-being or that area of inner good feeling and self-esteem, which has been the customary concern of mental health clinicians and whose absence is generally noted by a set of feelings or behaviors traditionally termed ‘symptoms’ or disordered psychological processes. Psychological well-being may interact with an individual's SAS and may play a critical role in social functioning and lead to problematic outcomes. In turn, problems in each domain may result in various long-term outcomes (Kellam and Rebok, 1992).

The current study investigated aspects of SAS. We hypothesized that for males there will be two developmental trajectories of marijuana use and convictions for possession with intent to distribute a controlled dangerous substance at age 19-21. We also hypothesized that there will be a group of children who enter school with lower levels of attention-concentration problems that escalate by early adulthood into criminal behavior. Lastly, we hypothesized that there will be a second group of children who display a consistently low level of attention-concentration problems and who will show the lowest level of risk for later criminal behavior. This study is based on data from the Development and Malleability from Childhood through Adulthood Mental Health Study, a developmental epidemiological investigation assessing the effect of two preventive interventions aimed at improving readings scores and decreasing shy/aggressive behaviors.

## **METHODS**

### **2.1 Research Design**

In 1983, faculty members of the Johns Hopkins Bloomberg School of Public Health and the Hopkins Prevention Research Center met with the superintendent of the Baltimore City Public Schools. The goal of this meeting was to develop a partnership to conduct research in early childhood development and to determine how to prevent risk behaviors that have been linked to later psychopathological conditions (Kellam and Rebok, 1992).

Five urban areas in east Baltimore were selected with the assistance of the Baltimore City Department of Planning to locate five urban areas thought to represent characteristic variations in ecological conditions, i.e., social class, income, ethnicity, housing, and family structure. Overall, the areas were representative of a cross-section of all urban communities across the United States. Within the five urban areas, schools with similar characteristics of the children enrolled in schools were selected. These school characteristics, in addition to ethnicity and socioeconomic class, included standardized reading and mathematics achievement scores. Schools that showed a decline in enrollment that may result in a closing of that school were not considered. A sample of 19 schools was selected within the five urban areas. Through a random process, schools were assigned to an intervention aimed at improving reading scores or an intervention directed at improving shy/aggressive behaviors while some schools were assigned to a control status. Classrooms within each school assigned an intervention were then randomly assigned an intervention or control status. Assigning external control schools and internal random controls of classrooms reflects the effort to control for an unplanned effect, as well as for differences in the child, family, and community (Kellam and Rebok, 1992).

### **2.2 Participants**

As part of this collaboration, a childhood cohort entering the first grade in the 1985-1986 academic year in 19 eastern Baltimore City elementary schools were followed into adulthood. Our sample (N=1317) is derived from this cohort of children enrolled in Baltimore City public schools who were assigned to a control condition and who were assessed in childhood for attention-concentration problems in Grade 1 through Grade 6 by their teachers, and from whom data regarding hypothesized outcomes were gleaned at age 19-20.

### **2.3 Measures**

Teacher ratings of attention-concentration problems were obtained in the spring of each year, i.e., grades one through grade six, using the Teacher Observation of Classroom Adaption-Revised (TOCA-R; Werthamer-Larson, Kellam, & Wheeler, 1991). In regard to reliability, Werthamer-Larson et al., 1991 reported alphas of .91 and .83 in the fall and spring of first grade. In regard to concurrent validity, Schaeffer et al. (2004) reported that each single unit increase in teacher-rated attention-concentration problems was associated with a twofold increase in risk of teacher perception of the need for medication for such problems. The TOCA-R ratings were obtained during a structured interview with a trained assessor. Teachers rated the sample on the attention-concentration subscale of the TOCA-R which included the following items: completes assignments, concentrates, poor effort, works well alone, pays attention, learns up to ability, eager to learn, works hard, and stays on task. Teachers rated the sample on a 6-point scale (1=almost never, 2=rarely, 3=sometimes, 4=often, 5=very often, and 6=almost always). Data regarding marijuana use and convictions for possession with intent to distribute a controlled dangerous substance were obtained by trained interviewers at age 19-20.

## 2.4 Analytic Plan

We employed general growth mixture models (GGMM's) as described by Muthen et al. (2002) as well as Muthen (2004a, b) in an effort to identify developmental trajectories of problematic outcomes, specifically marijuana use and convictions for possession with intent to distribute a controlled dangerous substance (CDS). Our rationale for using GGMM's is that this analysis clusters growth curves into potentially small number of classes and each may be explained independently. In addition, GGMM offers an opportunity to examine the probability of a distal outcome depending on class while each class of curves provides a pattern of growth that is interpretable based on its mean curve (Petras et al., 2009).

We fit growth mixture models to the six time points in our sample at which time teachers rated students' level of attention-concentration problems. Consequently we evaluated the relationship between class membership and the distal outcomes, in this case, marijuana use and convictions for possession to distribute a controlled dangerous substance (CDS). The goal in growth mixture modeling is to extract classes with attention-concentration problems as the independent variable. All models were run in Mplus version 5.0 (Muthen and Muthen, 1998-2006) with a minimum starts of 100 sets of start values which are increased if the best log likelihood is not replicated for at least three times.

## 2.5 Missing Data

Mplus, under the assumption that the data are missing at random, uses full information maximum likelihood estimation. The notion of missing at random makes the assumption that the reason for the missing data is either random or is random after the incorporation of other variables measures in this study such as first grade aggressive behavior. All missing data were assigned -999 via syntax so as to make certain that it did not provide an opportunity for the inclusion of missing data in the analysis. This is a widely accepted method of being an appropriate manner to handle missing data (Petras et al., 2009). Muthen and Shedden (1999) report that full information likelihood is widely accepted as an appropriate way of handling missing data and that Mplus will base its estimate on all available time points for given case; thus to assess the extent of missing data, Mplus provides a bivariate covariance coverage matrix that will give the proportion of available observations for each of the indicator variables and pairs of variables. Finally, the minimum coverage necessary for models to converge is 0.10.

## Results

The hypotheses were tested using general growth mixture models. Analyses were conducted for the entire sample and by gender. Table 1 presents the estimated means for teacher-rated attention-concentration problems for Grades 1 through Grade 6 for marijuana use at age 19-20 in a community-based epidemiological sample. Because models with different number of latent classes are not nested, we used the Bayesian Information Criterion (BIC; Schwartz, 1978) to assess the best model for marijuana use as a distal outcome. The four-class solution was optimal (BIC = 17022.76) and showed somewhat good precision in class membership estimation (entropy = .544). Results for the entire sample revealed four classes that are significantly different for marijuana use ( $\chi^2 = 8.18, p=.04$ ). Our findings demonstrate four trajectories of marijuana use, that is, participants who began with low scores and whose scores remained low (30.8%), participants who began with low scores and whose scores dramatically increased (25.8%), participants who began with high scores and whose scores decreased (22.6%), and participants who began with high scores and whose scores remained high (20.8%).

We also found two classes that were significantly different for convictions for possession with intent to distribute drugs for the entire sample ( $\chi^2=3.97, p=.04$ ) while controlling for first grade aggressive behavior ( $\chi^2=161.40, p=.001$ ) as presented in Table 2 and for males ( $\chi^2=3.77, p=.05$ ) while controlling for

first grade aggressive behavior ( $\chi^2=8.66$ ,  $p=.05$ ) as presented in Table 3. We also used the Bayesian Information Criterion (BIC) to assess the best model for convictions for possession with intent to distribute a controlled dangerous substance as a distal outcome in the entire sample, and the two-class solution was optimal (BIC = 17038.08) and showed somewhat good precision in class membership estimation (entropy = .588) as was possession with intent to distribute drugs as a distal outcome in males (BIC = 8661.241) showing good precision in class membership estimation (entropy = .572).

Our results further demonstrate two trajectories for possession with intent to distribute drugs, that is, participants who began with low scores and increased (45.0%) and participants with high scores whose scores decreased for the entire sample as well as two trajectories for possession with intent to distribute drugs for males, that is, participants who began with low scores and increased dramatically (45.5%) and participants with high scores whose scores remained high (55.0%).

## **Discussion**

We hypothesized that for males and the entire sample there will be two developmental trajectories of marijuana use and convictions for possession with intent to distribute a controlled dangerous substance at age 19-21 in a randomized community-based epidemiological sample (N=1337). We also hypothesized that there will be a group of children who enter school with lower levels of attention-concentration problems and that escalate by early adulthood into criminal behavior as a distal outcome. Lastly, we hypothesized that there will be a second group of children who display a consistently low level of attention-concentration problems and who will show the lowest level of risk for later criminal behavior. In this section, we present results by gender and for the entire sample and describe in each instance the proximal effects of attention-concentration problems on the course and distal outcome of criminal behavior. This study found that aspects of mental health measuring social adaptation status, i.e., attention-concentration problems in grades 1-6, predicted an inadequacy in meeting social tasks demands at age 19-20. The present findings support the notion that problems in each domain of the two aspects of mental health as proposed by Kellam and Rebok (1992), in this case, social adaptation status, may result in problematic long-term outcomes.

Attention-concentration problems are a symptom in a childhood disorder known as Attention Deficit/Hyperactivity Disorder (ADHD; American Psychiatric Association, 1994). Evidence suggests that untreated childhood ADHD may be a risk factor for developing substance use disorders. Findings indicate that ADHD by itself is a significant risk factor for substance dependence disorders and has both important and practical consequences for the understanding and management of neuropsychiatric disorders such as drug use and addiction. Prospective studies of children with ADHD have shown a high level of substance use comorbidity (Retz et al., 2007). Along the same realm, ADHD is associated with earlier onset of substance use disorders independent of psychiatric comorbidity. Individuals who manifest ADHD represent a significant proportion of those seeking treatment for substance use disorders. In addition, a significant overrepresentation of ADHD exists among inpatients with substance use disorders.

Children diagnosed with ADHD or who have attention-concentration problems may develop psychological comorbidity as well as delinquent tendencies as a function of the biological vulnerability created by impaired attention. Although impaired attention is one of the least understood psychiatric symptoms, the behavioral disturbances manifested as a result are well-recognized in ADHD. The American Psychiatric Association estimates that as many as 30% of all school-aged children may be afflicted with attention problems and that 3% to 5% may fit the diagnostic criteria for ADHD, i.e., the inability to sustain attention, impulsivity, and hyperactivity are the three primary symptoms of ADHD (American Psychiatric Association, 1994). Although many early childhood disorders are ephemeral in nature, this is not the case for children diagnosed with ADHD.

The manifestation of maladaptive behavior at the time periods associated with this study may reflect shortsightedness in the decision-making process. Decision making, the process of choosing between options, is a basic human behavior. A common indicator underlying both attention-concentration problems and the decision to use and sell drugs including marijuana is impaired decision-making. The results of the present study suggest impaired decision-making in that those with teacher-rated attention-concentration problems were more likely to say yes to marijuana use, an illegal drug with strong consequences and/or potential ramifications such as possible arrest for such use as well as sell a controlled dangerous substance that may perhaps suggest individuals were unable to base their decision-making on related problematic outcomes. The underlying brain mechanisms that support the process of decision-making may be the result of an imbalance between two separate, yet interacting neural systems: a reactive system that signals pleasure of the immediate prospect of engaging in marijuana use and profit from selling drugs with the amygdala as a key structure, as well as a reflective system that signals pleasure in the future prospect of engaging in marijuana use and monetary profit that involves the prefrontal cortex. Acting through the development and socialization process, as well as an individual's learning of social rules, it is possible for the reflective system to gain control over the reactive system through neural mechanisms, specifically the fronto-parietal system. Heuristically, signals originating in the amygdala may take control of cognitive assets necessary for the normal operation of the reflective system, consequently impairing decision-making relative to the willpower to resist drug use and sales. In this realm, the potential imbalance between the reactive and reflective systems may have implications regarding vulnerability in the individual (host) in relation to social adaptation status and explain the variation in risk of engaging in maladaptive behavior, i.e., marijuana use and possession with intent to distribute (sell) a controlled dangerous substance.

There are several limitations associated with this study. The study is based on teacher perceptions of attention-concentration problems from Grades 1 through 6. Second, attention is not just a single entity, but a set of distinct neural processes or elements. Elements of attention include the ability to focus attention, shifting attention from one stimulus to another, sustained attention or being vigilant, and the ability to recall and reorder information stored in memory (Mirsky et al., 1991). Teacher ratings of attention-concentration problems do not specifically identify any attention element in this study. Lastly, the socioeconomic background of participants was not established in this study; however, it may be posited that the impaired attention may be a factor in the creation of class structure. For example, Tsamis, Rebok, and Montague (2009) found that impaired attention may lead individuals to not pursue higher education. In this case, a selection bias may have been introduced. Moreover, we may have attrition in participants who were no longer available for assessment, but whose attention was not intact to the point of following through with being available for data collection.

One of the major roles of epidemiology is to serve as the basis for developing policies that prevent and/or control pathological conditions that affect human health while criminal justice programs seek to decrease a particular behavior through interventions or prevention programs that put individuals in contact with the criminal justice system. Due to the nature of the findings in this study, it is suggested that policies be designed from both an epidemiological perspective and a criminal justice perspective. Once populations at an increased risk are identified, and the cause of the predisposition is ascertained, the next step is whether a population-based or a high-risk approach should be considered in formulating policy to address the health problem. Selection is guided by the cost and benefits of reducing exposure. In other words, whether or not a prevention program or an intervention is implemented is influenced by political and economic influences, as well as the value that society places on a particular problem. In addition, the prevalence of the problem must be taken into account in that it is estimated that as many as 30% of all school-aged children present with attention-concentration problems while 3% to 5% meet the diagnostic criteria for ADHD (American

Psychiatric Association, 1994). It is suggested that a policy for both prevention and interventions addressing attention-concentration problems is vital and necessary in creating a strategy to reduce maladaptive behaviors such as attention-concentration problems in an effort to reduce drug use and, in turn, decrease contact with the criminal justice system.

**Conclusion**

The present study found that those participants with higher teacher-rated attention-concentration problems were more likely to have said yes to marijuana use as well as be convicted for possession with intent to sell drugs. Because children may be more vulnerable as a result of attention-concentration problems to use marijuana, early intervention programs should address a decrease in such problems while prevention programs should address a reduction in drug use and drug sales. The present findings present a unique opportunity to create an innovative working relationship between the fields of public health and criminal justice given the set of behaviors that have been termed maladaptive behavior by mental health researchers have been linked to problematic outcomes that criminologists may eventually refer to as delinquency and criminality.

Table 1  
 Estimated Means for Teacher-Rated Attention-Concentration Problems in Grades 1 through 6 for Marijuana Use at Age 19-21 in a Community-based Epidemiological Sample Controlling for First Grade Aggressive Behavior

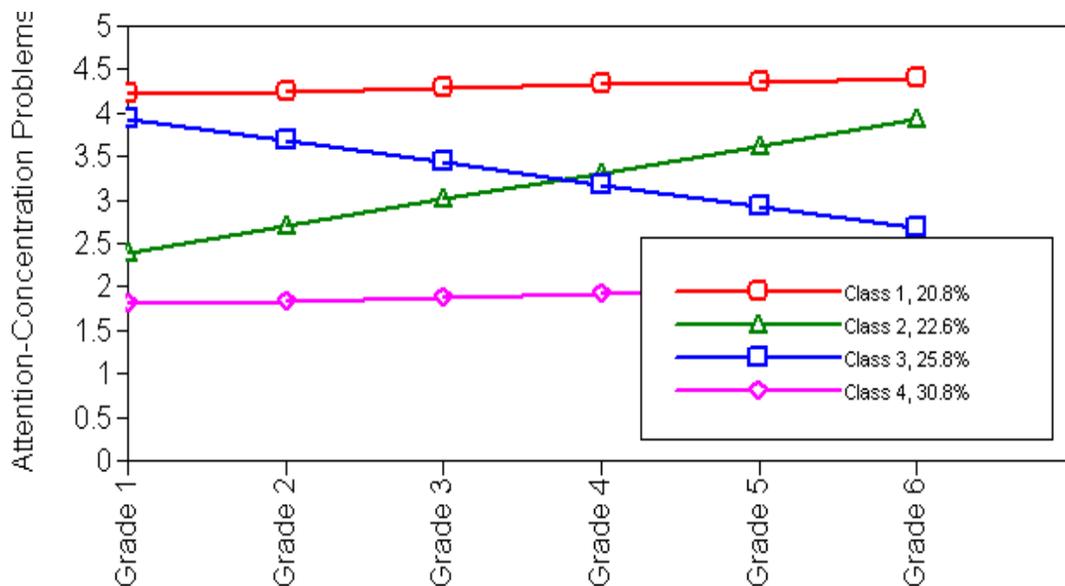


Table 2  
 Estimated Means for Teacher-Rated Attention-Concentration Problems in Grades 1 through 6 for Possession with Intent to Distribute Drugs for the Entire Sample at Age 19-21 in a Community-based Epidemiological Sample Controlling for First Grade Aggressive Behavior

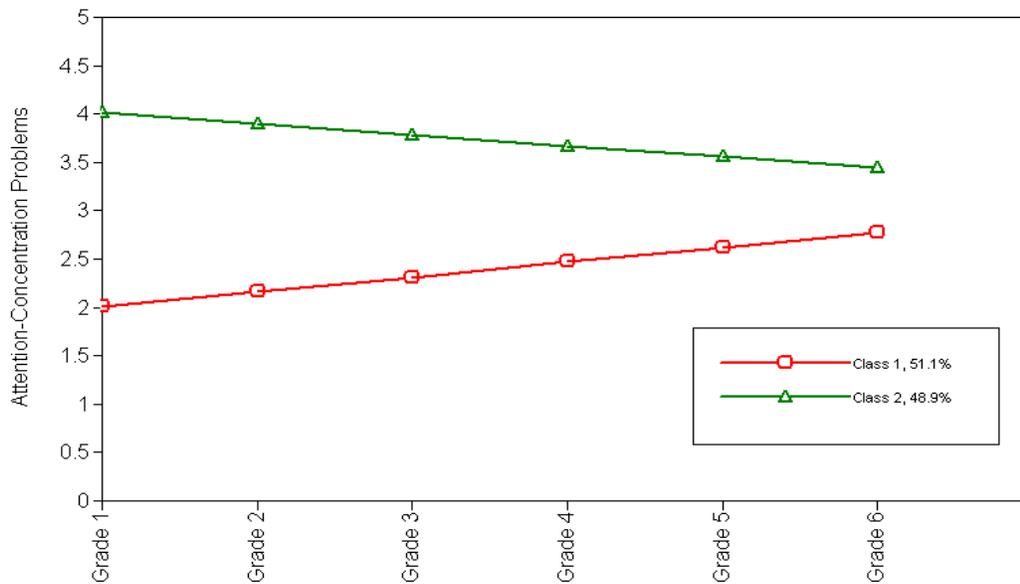
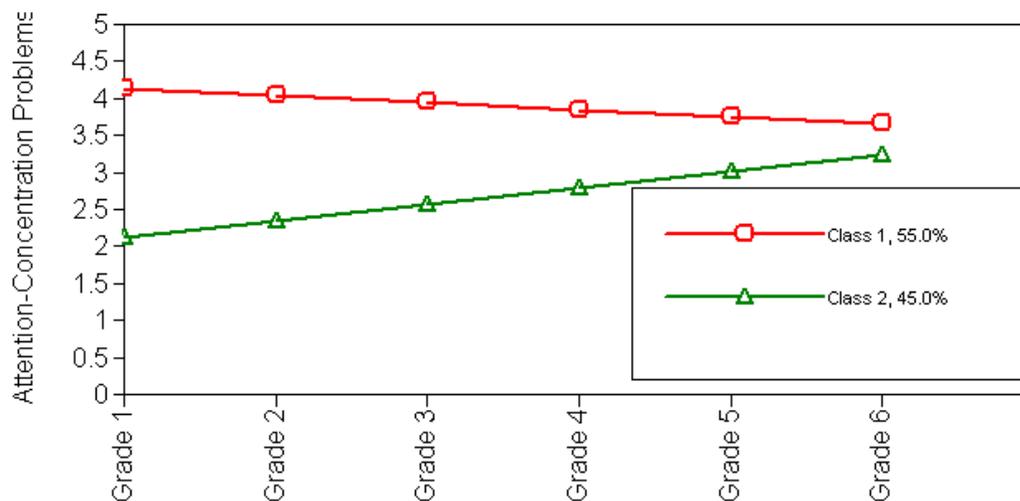


Table 3

Estimated Means for Teacher-Rated Attention-Concentration Problems in Grades 1 through 6 for Possession with Intent to Distribute Drugs for Males at Age 19-21 in a Community-based Epidemiological Sample Controlling for First Grade Aggressive Behavior



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