MARIJUANA USE AMONG DELAWARE HIGH SCHOOL STUDENTS: ASSOCIATIONS WITH POSITIVE PARENTING TECHNIQUES AND LOW SOCIOECONOMIC STATUS

by

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ABSTRACT

Marijuana has a range of harmful impacts on adolescent development, and yet, it is commonly used by adolescents. Demonstrating the harmful impacts of this drug on adolescent development, it has been shown that marijuana use before the age of 15 can triple the odds of future illicit drug use (Johnston et al., 2016). Additionally, abusing marijuana can produce lasting cognitive deficiencies, educational setbacks, and social problems (King, Fleming, Monahan, & Catalano, 2011; Ratner, & Johnson, 2008). Within Delaware, surveys show that 23.3% of 11th graders currently used marijuana in 2015, surpassing national estimates ranging from 21.7% (Youth Risk Behavior Survey, 2015) to 22.5% (Johnston et al., 2016; DSS, 2015). These numbers remain steady as adolescents report a declining perception of harm surrounding marijuana use (SAMHSA, 2015). Only 34% of Delaware students polled perceive regular marijuana use as a risk, a percentage which has reduced in recent years (DSS, 2015). Given the harmful impacts of marijuana use and its prevalence among youth, intervention strategies are needed to address adolescent marijuana use. As positive parenting techniques have demonstrated protective effects against adolescent substance use (Abar, Jackson, & Wood, 2014; Van et al., 2015), the current study examines associations between Delaware students’ marijuana use and positive parenting techniques. Additionally, given previous work showing that rates of marijuana use vary by socioeconomic status (SES; Leventhal & Brooks-Gunn, 2000) and positive parenting techniques may be more protective for low income youth (Goodman & Huang, 2002), students’ food and shelter security (proxy SES) is also
examined. Theoretically based on Family Interaction Theory (Brook, Brook, Gordon, Whiteman, & Cohen, 1990), it was hypothesized that (1) the positive parenting techniques of parental monitoring and support/warmth are negatively associated with adolescent marijuana use, and (2) that positive parenting techniques may be more protective for low SES students. Data were drawn from a sample of 11th grade Delaware public high school students who participated in the 2017 Delaware School Survey (N=2880). Statistical procedures included logistic regression analyses with an added cluster variable to account for nesting within schools. Findings supported the first hypothesis that positive parenting techniques are protective against current marijuana use. Specifically, more parental monitoring was significantly associated with a lower likelihood of youth currently using marijuana. Higher levels of parental support/warmth were also associated with a lower likelihood of current marijuana use (though only at trend level). Analyses examining heavy marijuana use showed similar results, with increased parental monitoring significantly decreasing the odds that youth would engage in heavy marijuana use. Findings for the second hypothesis were partially confirmed for heavy marijuana use. Socioeconomic status was found to significantly moderate the association for parental support/warmth and heavy marijuana use. Further analyses stratified by SES, however, suggested parental support/warmth is not statistically significantly associated with heavy marijuana use among low SES or mid/high SES youth.
Chapter 1

INTRODUCTION

1.1 National Marijuana Use

When compared to all other drugs, the majority of American adolescents (12 to 17 years old) in substance abuse treatment are seeking help for marijuana abuse (SAMHSA TEDS, 2015). While alcohol and other drugs are showing historic declines, marijuana use frequencies remain unchanged for the majority of students with 6% of youths reporting daily marijuana use and current marijuana use frequencies (use within the past 30 days) ranging nationally from 15.7% (10th grade student average) to 22.9% (12th grade student average; NIDA, 2017). In fact, 2017 is the first year in which daily marijuana use exceeded daily cigarette use among all grades polled (8th grade, 10th grade, and 12th grade; NIDA, 2017). Despite steady marijuana use frequencies, students’ perception of the risks associated with regular marijuana use continues to decline (NIDA, 2017). Since 2008, the perception of risk (defined in the study as students perceiving either great risk or harm in regular marijuana use) for 10th grade students has steadily decreased by 24% (2008 perception of risk was 64.8% compared with 40.6% in 2017). Similarly, 12th-grade students’ perception of risk has been declining since 2005 (when 58% perceived risk in regular use), with only 29% seeing regular marijuana use as risky in 2017 (NIDA, 2017).

1.2 Delaware Marijuana Use

When compared to national results, Delaware high school students show a higher percentage of current marijuana use (use within the past 30 days). Recent surveys show 23.3% of Delaware 11th-grade students meet the criteria for current marijuana use, surpassing a national average of 21.7% (CDC YRBS, 2016) and national 12th-grade student average of 22.5% (Monitoring the Future, 2017; Johnston et al., 2016). Delaware 11th grade students are also reporting decreased perceptions of the risk associated with
marijuana use, with the percentage of students decreasing steadily from 52% disapproval in 2008 to 40% disapproval in 2017. In its entirety, the data suggests that Delaware 11th-grade students are mirroring 12th-grade national averages for both marijuana use and perceptions of risk, a concerning trend that can point to more advanced experimentation at younger ages.

1.3 Consequences of Adolescent Marijuana Use

It is important to note that the adolescent brain is still going through important developmental changes. Throughout adolescence the main highway between hemispheres, otherwise known as the corpus callosum, begins to thicken, facilitating communication among neurons and increasing processing speed (Luders, Thompson, & Toga, 2010). This amplification of activity in the prefrontal cortex sharpens an adolescent’s ability to make mature judgments, and over time a “brake system” begins to take shape allowing the adolescent to quiet impulsivity (Rubia et al., 2000; Casey, Jones, & Hare, 2008). Evidence suggests that marijuana can interfere with this maturation process, delaying vital development and increasing the odds of long-term consequences. An example of one such study exploring marijuana use and its detrimental effects on judgment found that adolescents who initiate marijuana use at age 15 or younger were two times more likely to misuse prescription drugs in the future and three times more likely to misuse harder illicit drugs, such narcotic misuse, when compared those who initiated marijuana use at age 21 (Johnston et al., 2016).

Additional research suggests that teens who begin using drugs at young ages can become more quickly addicted for greater periods of time, accumulating adverse and long-term effects (Hingson, Heeren & Winter, 2006; Masten, Faden, Zucker & Spear,
Numerous cognitive deficiencies, educational setbacks, and social problems have been linked with marijuana use, including attention and self-control problems (King, Fleming, Monahan, & Catalano, 2011), truancy (Henry, Thornberry, & Huizinga, 2009), decreased executive function (Gruber, Sagar, Dahlgren, Racine, & Lukas, 2012), lower educational attainment (Lynskey & Hall, 2000; Tu, Ratner, & Johnson, 2008; Gotham, Sher & Wood, 2003), future substance use disorder (O’Connell et al., 2011; Guxens, Nebot, & Ariza, 2007; Perkonigg et al., 2008), and antisocial problems (Perkonigg et al., 2008; Collins, Abadi, Johnson, Shamblen, & Thompson, 2011; Fishbein et al., 2006). Additional findings on potentially irreversible long-term consequences have linked chronic adolescent marijuana abuse to increased sensation-seeking, loss of IQ, unconventional behaviors, and emotional dysregulation (Brook, Zhang, Leukefeld, & Brook, 2016).

1.4 Positive Parenting Techniques as Protective Factors

Protective factors are defined as attributes in individuals, families, communities, and larger society that reduce the negative effects of adversity on an outcome (Masten & Reed, 2002). The relationship between a parent and a child has been established as a family-level factor that may help or hinder personal development. Multiple studies demonstrate the positive effects parenting techniques can have on child health and behavioral outcomes (Wiggins, Sofronoff & Sanders, 2009; Lee, 2012; Huurre, Eerola, Rahkonen & Aro, 2007; Abar, Jackson & Wood, 2014). Studies assessing substance use in adolescents have found that positive parental attachments tend to reduce the risks associated with marijuana and other drug experimentation (Kostelecky, 2005; Abar,
Jackson & Wood, 2014; Van et al., 2015; Lee, 2012). Links have also been found between decreased marijuana use and positive parenting techniques such as parental monitoring (i.e., parental awareness of a child’s activities and communication to that child that the parent is concerned about and aware of the child’s activities; Dishion & McMahon, 1998; Abar, Jackson, & Wood, 2014, Barnes et al., 2000; Fletcher, Steinberg, & Williams-Wheeler, 2004; Stattin & Kerr, 2000). Decreased marijuana use has also been linked to positive parental support/warmth (i.e., the expression of interest in children’s activities and friends, involvement in children’s activities, expression of enthusiasm and praise for children’s accomplishments, and demonstration of affection and love; Amato, 1990).

A prevalent theory connecting parenting techniques and adolescent substance use is Family Interaction Theory (FIT; Brook, Brook, Gordon, Whiteman & Cohen, 1990). Family Interaction Theory maintains that parental attachment, social learning, and intrapersonal traits have direct effects on adolescent experimentation with substances. According to Family Interaction Theory, the association between positive parenting techniques and youth substance use includes: 1) supportive or warm parenting techniques; and 2) parental monitoring, which ultimately lead to a decreased risk for adolescent experimentation with drugs (Brook et al., 1990; Masten et al., 2009).

In support of the Family Interaction Theory, both parental monitoring and parental support/warmth have previously been identified as factors that can influence adolescent substance use. Despite the theoretical framework, the majority of studies exploring Family Interaction Theory fail to incorporate the unique effects of both parental monitoring and parental support/warmth (Clark, Thatcher & Maisto, 2004; Jacob &
Johnson, 1997; Rai et al., 2003; Lee, 2012; Tobler and Komro 2010; Pokhrel et al., 2008). Parental monitoring is a primary focus for studies on the subject of parenting techniques and substance use (e.g. Brooks-Russell, 2015; King, Vidourek, & Merianos, 2015), with research consistently finding that parental monitoring plays a significant role in decreasing the risks associated with marijuana use (Brooks-Russell, 2015; King, Vidourek, & Merianos, 2015; Abar, Jackson, & Wood, 2014; Chuang, Ennett, Bauman, & Foshee, 2005; Abar, Jackson, & Wood, 2014). Some evidence also suggests that parental support/warmth can act as a protective factor against marijuana use (Clark & Winters, 2002; Tobler and Komro 2010; Pokhrel et al., 2008) and early experimentation (Abar, Jackson, & Wood, 2014; King, Vidourek, & Merianos, 2015). Likewise, findings from a study examining both constructs and their influence on marijuana use suggested that adolescents with higher amounts of parental monitoring and emotional support/warmth report less marijuana use (Clark & Winters, 2002). The current study adds to existing knowledge by focusing on a new sample of Delaware students, clarifying associations between positive parenting techniques and adolescent marijuana use, and exploring whether SES moderates these associations.

1.5 Socioeconomic Status and Adolescent Substance Use

Numerous studies have found that being raised in a low SES family is associated with increased risk for physical, emotional, and behavioral health problems due in part to
casual factors including higher levels of stress and fewer personal protective resources (Turner & Avison, 2003; Van Gundy et al., 2011; Van Gundy et al., 2015). However, links between SES and substance use are more complex. The direction of relationships fluctuate depending on the types of substances and societal classes compared (Karriker-Jaffe, 2011).

Among studies focused on low SES youth, evidence suggests that adolescents from disadvantaged neighborhoods or large urban communities sometimes respond to perceived increased stress and a lack of resources with substance use. For example, one study found that low SES, community disorganization, and family disruption are associated with higher levels of communal crime and delinquency, including substance abuse (Sampson & Groves, 1989). Similarly, a longitudinal analysis concluded that low family SES and larger family size are linked with a greater likelihood of substance use disorders in early adulthood (Reinherz et al., 2000). There is also evidence to suggest that certain types of parenting techniques can have increased positive impacts for low SES adolescents’ substance use behaviors but not high SES adolescents. Results from a recent univariate analysis compared adolescents from low and high SES backgrounds in order to document how parental and sibling attachments influence substance use. Conclusions support that high parental and sibling attachments corresponded with reductions in substance use for low SES adolescents. However, attachments did not influence relations with higher SES adolescents (Van Gundy et al., 2015).

In contrast to these associations between low SES and substance use, comparisons across SES groups have shown that high SES adolescents are more prone to substance use (Wightman, Schoeni, & Schulenberg, 2012; Goodman & Huang, 2002). Evidence
suggests that higher family SES is associated with alcohol and marijuana use in young adulthood (Wightman, Schoeni, & Schulenberg, 2012). Similarly, recent logistic regression analyses examining the relationship between adolescent SES and specific substance use in adulthood found higher parental education is associated with higher rates of binge drinking, marijuana and cocaine use in early adulthood (Humensky, 2010). Similarly measures of SES including higher parental income were associated with higher rates of binge drinking and marijuana use (Humensky, 2010).

Researchers have called for greater exploration comparing adolescent substance use across levels of SES (Goodman & Huang, 2002; Hanson & Chen, 2007; Van Gundy et al., 2015). Moreover, a majority of studies examining SES and substance use tend to focus on associated risk factors rather than protective factors. As a result, there is a growing body of literature focused on the associated risk factors of low SES adolescent use (Kramer, 2000; Leventhal & Brooks-Gunn, 2000; Sampson & Groves, 1989; Jones-Webb, Snowden, Herd, Short & Hannan, 1997; Herd, 1994), without paying sufficient attention to similar effects with mid or high SES adolescent substance use.

1.6 Current Study

Given the mixed findings of extant studies, additional research is needed to clarify the association between positive parenting techniques and adolescent marijuana use and to explain whether SES moderates this relationship. To explore this further, the current study sought answers to two research questions:

- Does an association exist between perceived positive parenting techniques and marijuana use among 11th-grade public school students in Delaware?
• Does SES moderate the association between perceived positive parenting techniques and marijuana use among 11\(^{th}\)-grade students?

Family Interaction Theory holds that the presence of parental monitoring and emotional support/warmth act to reduce adolescent marijuana use. Based on Family Interaction Theory, the current study hypothesizes that (1) the positive parenting techniques of parental monitoring and support/warmth are negatively associated with adolescent marijuana use, and (2) that positive parenting techniques may be more protective for low SES students.
Chapter 2

METHODS

2.1 Data and Sample

The current study utilizes data drawn from the 2017 Delaware School Survey (DSS). The DSS is an annual survey given to a random sample of students and classrooms. Surveys were completed in 18 of the 19 school districts (with the exception of the Caesar Rodney School District) in the state of Delaware, as well as 24 Charter Schools. The DSS is completed by 5th, 8th, and 11th-grade students in these schools. The objectives of the DSS are: a) to provide estimates of students’ alcohol, tobacco, and other drug use attitudes; b) to provide ongoing adolescent perception and self-report trend data; and c) to provide information for state and local planning and assessment purposes. All data are self-reported by students, de-identified, and available to researchers upon request from the University of Delaware’s Center for Drug and Health Studies. Additional information about the DSS, including yearly state reports, survey measures, and sampling techniques can be found at the University of Delaware’s Center for Drug and Health Studies.

The current study’s analytic sample is comprised of 11th-grade Delaware students who completed relevant portions of the 2017 DSS (N=2880). The sample was further broken down by the 18 public school districts randomly sampled (the original sample consisted of 19 districts with the last school district combining all charter schools across the state; this combination district was dropped within the current sample due to the inability to account for clustering across multiple schools). Thus, out of an original sample of eleventh grade students who completed all relevant portions of the 2017 DSS
(N=3473), all cases characterized as Charter school students were dropped (n=577).

2.2 Measures

2.2.1 Perceived Positive Parenting Techniques

The DSS contains seven items in which adolescents were asked to self-report on positive parenting techniques. A Confirmatory Factor Analysis (CFA) was performed to determine which of these items fit within the two parenting constructs to be used in the current analyses: parental monitoring and parental warmth/support (see Appendix A for details regarding the CFA methods and results).

Based on the results of the CFA, the following items loaded onto the parental monitoring composite: 1) My parents know where I am when I am not in school; 2) My parents’ rules are strictly enforced; and 3) My parents and I get along well together. Response categories for the three items were: 1) Never; 2) Not often; 3) Sometimes; 4) Often; and 5) Most of the time. The original response categories were recoded to a scale ranging from 0 to 4 (where 0=Never and 4=Most of the time).

Based on the results of the CFA, the following items loaded onto the parental support/warmth composite: 1) My parent shows they are proud of me; 2) My parent takes interest in my activities; 3) I can count on my parent to be there when I need them; 4) My parent listens to me when I talk to them. Response categories for the four items included: 1) Never/Almost never; 2) Sometimes; and 3) Always/Almost always. The original responses were recoded to a scale ranging from 0 to 2 (where 0=Never/Almost Never and 2=Always/Almost always).
Scores were averaged across individual students to create the final two composite measures to be used in the analyses (parental monitoring and parental support/warmth). For the final parental monitoring composite, a score of 0 represents low parental monitoring and a score 4 represents the highest amounts of parental monitoring. For the final parental support/warmth composite, a score of 0 represents low parental support/warmth and a score 2 represents the highest amounts of parental support/warmth. The original response options for the DSS yielded different ranges for both measures of perceived positive parenting techniques. In order to maximize the variation allowed for these measures, the original response categories were not reduced.

### 2.2.2 Self-Report Adolescent Marijuana Use

Two criterion, self-report marijuana use variables were created for the current analyses: current marijuana use (i.e., any marijuana use within the past 30 days) and heavy marijuana use (i.e., use of marijuana 6 or more times in the past month). The same original item from the DSS was used to create both criterion variables: How many times have you smoked marijuana (grass, pot, hash, weed, blunts) in the past month? Item response categories included: 1) 0 times; 2) 1-2 times; 3) 3-5 times, 4) 6-9 times; 5) 10-19 times; 6) 20-39 times; and 7) 40+ times. The distribution of responses necessitated the creation of dichotomous criterion variables because only 22.6% reported current marijuana use and 10.2% reported heavy marijuana use. The current marijuana use variable was created by dichotomizing responses from the original item such that students who reported any current marijuana use were coded as 1 and students who reported no use were coded as 0. The heavy marijuana use variable was
also created by dichotomizing responses from the original item such that students who reported current marijuana use of 6 times or more were coded as 1 and students who reported 5 times or less were coded as 0. Following previous studies that documents greater neuropsychological harm in weekly marijuana use before the age of 18 years, heavy marijuana use was classified as 6 times or more to correspond with marijuana use that exceeds once per week (Moffit, Meier, Caspi, & Poulton, 2013; Bruce, Harper, & Fernandez, 2013).

2.2.3 Socioeconomic Status

Due to a lack of measures assessing individual-level household income for students in the 2017 DSS, a proxy SES variable reflecting both food and shelter security was created from two items in the DSS. The item assessing food security asked students: During the past 30 days how often did you go hungry because there was no food in your home? Item responses were on a 5-point Likert scale: 1) Never; 2) Not often; 3) Sometimes; 4) Often; and 5) Most of the time. Due to the fact that only 17% of respondents reported any food insecurity (i.e., reporting 2-5), this item was dichotomized, with any food insecurity coded as 1 (low SES; n=490) and no food insecurity coded as 0 (mid/high SES; n=2390). An additional item assessing shelter security was also used. The shelter security item asked students: During the past 30 days, where did you usually sleep? Item responses included: 1) Parent/Guardian’s Home; 2) Another person’s home; I had to leave my home because my parent/guardian cannot afford it; 3) Shelter/Emergency Housing; 4) Motel/Hotel; 5) Car, Park, or Public place; 6) I do not have a usual place to sleep; and 7) Somewhere else. Due to the low response frequency
and a lack of specificity, answer 7) Somewhere else (n=16) was coded out. The item was then recoded such that respondents who reported living in a parent/guardian’s home were coded as 1 (shelter secure/mid/high SES; n=2828) and all else were coded as 0 (shelter insecure/low SES; n=52).

Due to the fact that only 1.8% of respondents reported shelter insecurity, it was not possible to measure SES as separate measures of food and shelter security, thus a final dichotomous proxy SES measure was created for use in the analyses, with any food and/or shelter insecurity coded as 1 (low SES; n=542) and no food or shelter insecurity coded as 0 (mid/high; n=2338).

2.2.4 Covariates

Demographic variables included in the analyses assessed adolescent age, gender, and race/ethnicity. The measure assessing age asked respondents: “How old are you today?” Item responses ranged categorically with yearly increments from 12 years or younger to 18 years or older. Responses were recoded continuously ranging from 12 to 18 years. Gender was represented as an item asking respondents: What is your gender? Item responses included a choice of either male or female. Item responses were dummy coded such that 0= male and 1= female. Adolescents also reported on their race/ethnicity with the following item: “Which of the following best describes you?” Response categories included: 1) Native American and/or Alaskan Native; 2) Asian; 3) Black non-Hispanic or African American; 4) White non-Hispanic; 5) Mixed; and 6) Hispanic, 7) Other. Based on response distributions, four dummy variables for racial categories were created to represent: Mixed, Black non-Hispanic, Hispanic, and Other (made up of Asian,
Native American and/or Alaskan, and Other), with non-Hispanic White used as the reference category.

2.2.5 Preliminary Analyses

A number of statistical procedures were utilized in the current study. Descriptive statistics were first examined to examine means, standard deviations, and ranges (see Table 1) followed with preliminary analyses to test for the presence of multicollinearity.

2.2.5.1 Analyses for Research Question 1

In order to answer the first research question (Does an association exist between perceived positive parenting techniques and marijuana use among 11th-grade public school students in Delaware?), enter method logistic regressions were utilized. The purpose of the first logistic regression analysis (Model 1) was to test for the main effects of the predictor variables (parental monitoring, parental support/warmth, and SES) on the first criterion variable (current marijuana use). A second logistic regression was run (Model 2) testing main effects of the same predictor variables (parental monitoring, parental support/warmth, and SES) on the second criterion variable (heavy marijuana use). All covariates (age, gender, and race/ethnicity) were included in all models, and a cluster variable was used to account for the nesting of students within districts.

2.2.5.2 Analyses for Research Question 2

In order to answer the second research question (Does SES moderate associations between perceived positive parenting techniques and marijuana use), the logistic regression analyses were replicated, with the addition of product terms to test for
significant interactions between parental monitoring or parental support/warmth and SES with current marijuana use (Model 3) and with heavy marijuana use (Model 4). All continuous variables (parental monitoring, parental support/warmth, and age) were mean-centered for Models 3 and 4.
Chapter 3

RESULTS

Descriptive statistics for the current sample can be found in Table 1. Approximately half (50.8%) of respondents in the analytic sample were male, and the mean age reported was 16.72 years (SD=0.66, range=12 to 18). The majority of students reported a race/ethnicity of White non-Hispanic (43.4%), followed by Black non-Hispanic (22.5%), Hispanic (16.2%), Mixed (12.8%), and Other (5.1%; Asian, Native American and/or Alaskan Native, and Other). Regarding socioeconomic status, 18.8% of students qualified as low SES (replying yes to either food insecurity, shelter insecurity, or both). Regarding marijuana use, 22.6% of students reported current marijuana use, with close to 45% of those with current use reporting heavy marijuana use (i.e., use that occurred 6 or more times per month). Overall, 10.2% of the total analytic sample reported heavy use. The mean parental support/warmth score was 0.79 (SD=0.42, range=0-2), which corresponds to a medium amount of parental support/warmth. The mean parental monitoring score was 3.31 (SD=0.67, range=0-4), which corresponds to high parental monitoring.

Table 3.1: Descriptive Statistics for Sample Demographics and Variable of Interest. Eleventh grade Delaware high school students (N=2880).

<table>
<thead>
<tr>
<th>Gender (%)</th>
<th>Percentages / Mean (SD), Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>49.2%</td>
</tr>
<tr>
<td>Male</td>
<td>50.8%</td>
</tr>
</tbody>
</table>
Race/Ethnicity (%)

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Non-Hispanic</td>
<td>43.4%</td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>22.5%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>16.2%</td>
</tr>
<tr>
<td>Mixed</td>
<td>12.8%</td>
</tr>
<tr>
<td>Other</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

SES (%)

<table>
<thead>
<tr>
<th>SES</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid/High</td>
<td>81.2%</td>
</tr>
<tr>
<td>Low</td>
<td>18.8%</td>
</tr>
</tbody>
</table>

Current Marijuana Use (%)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.6%</td>
<td>77.4%</td>
</tr>
</tbody>
</table>

Heavy Marijuana Use (%)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2%</td>
<td>89.8%</td>
</tr>
</tbody>
</table>

Average Parental Support/Warmth 0.79 (0.42), 0.00 – 2.00
Average Parental Monitoring 3.31 (0.67), 0.00 – 4.00
Age (in years) 16.72 (0.66), 12.00 - 18.00

Notes: Parental monitoring is a composite score assessing parental knowledge of student activities, rule enforcement, and relationship quality. Parental support/warmth is a composite score assessing parent-child relationships including parental pride, communication, interest, and dependability. SES is a dichotomous variable representing food and/or shelter security (mid/high SES=0) vs insecurity (low SES=1). Age is measured in years ranging from 12 to 18. For race/ethnicity, the Other variable includes responses of Asian, Native American and/or Native Alaskan, and Other.

Additional analyses examining bivariate correlations between all variables were run to check for the presence of multicollinearity, with the highest correlation between predictors equal to -0.24 (correlation between low SES and parental monitoring). This constitutes a weak association therefore there were no concerns regarding multicollinearity (Cohen, 1988).
3.1 Results for Research Question 1

Results from the first logistic regression (see Table 3, Model 1) that tested for main effects between predictor variables (parental monitoring, parental support/warmth, and SES) and the criterion variable current marijuana use showed that the overall model was statistically significant according to the Wald Chi-Squared statistic: $\chi^2 (9, N=2880) = 829.01, p<0.001$. A significant negative association between parental monitoring and current marijuana use was found (OR=0.44, SE=0.03, $p<0.001$). This result suggests that increased parental monitoring helps to protect against current marijuana use for Delaware 11th grade students. Specifically, the odds ratio reveals that for every one-unit increase in parental monitoring, the odds that adolescents will engage in current marijuana use are predicted to be 56% lower. Results for parental support/warmth approached significance (OR= 0.84, SE=0.08, $p<0.10$) with the odds ratio showing for every one unit increase in parental support/warmth, the odds of youth’s currently using marijuana are predicted to be 16% lower. No significant association was found between SES and current marijuana use. Out of the sociodemographic variables, the only significant association with current marijuana use was found among students who categorized themselves as Other (Asian, Native American and/or Alaskan Native, and Other; OR=0.21, SE=0.05 $p<0.001$). This odds ratio indicates that the odds of those students categorized as Asian, Native American and/or Native Alaskan, and Other currently using marijuana are about 79% lower than the odds of White non-Hispanic engaging in current marijuana use.

Post hoc analyses were also run testing for differences in current marijuana use between each of the race/ethnicity groups. Results showed that students classified as Other (Asian, Native American and/or Native Alaskan, and Other descents) were
significantly different from all other groups: Black non-Hispanic $\chi^2 (1) = 54.5, p<0.001$, Mixed $\chi^2 (1) = 50.4, p<0.001$, and Hispanic $\chi^2 (1) = 44.1, p<0.001$. When combined with frequencies (current marijuana use frequencies per race/ethnicity group: Other= 8.5%, Black non-Hispanic= 24.8%, Mixed= 24.8%, and Hispanic= 21.3%), these post hoc analyses reveal that the odds that students of Asian, Native American and/or Alaskan Native, and Other descents will report current marijuana use are lower than the odds for Black non-Hispanic, Mixed, and Hispanic students. No other significant differences by race were found.

In order to further explore associations between positive parenting techniques and marijuana use, a second logistic regression was run (see Table 3, Model 2) testing main effects among the same predictor variables (parental monitoring, parental support/warmth, and SES) and the second criterion variable: heavy marijuana use (6 or more times per month). The overall model was statistically significant according to the Wald Chi-Squared statistic: $\chi^2 (9, N=2880) = 305.42, p<0.001$. Results for Model 2 showed similar significant associations among parental monitoring and heavy marijuana use (OR= 0.41, $SE=0.05, p<0.001$). Results indicate that parental monitoring is associated with a lower likelihood of heavy use, revealing that for every one-unit increase in parental monitoring, the odds of heavy marijuana use are predicted to be about 59% lower. No significant associations were found between either parental support/warmth (OR= 0.41, $SE=0.13, p=0.60$) or SES (OR= 1.18, $SE=0.21, p=0.40$) and heavy marijuana use. The same sociodemographic covariates (age, gender, race/ethnicity) were also tested for associations with heavy marijuana use. A positive association was found between age and heavy use (OR= 1.37, $SE=0.11, p<0.001$), suggesting that for every one-year increase
in age, the odds of heavy marijuana use are predicted to increase by 37%. A negative association was found between gender (male=0) and heavy marijuana use (OR=0.72, SE=0.08, p<0.01, revealing that the odds of males engaging in heavy use are 28% higher than the odds of females doing so. Similar negative associations were also found for students categorizing themselves as Hispanic (OR= 0.50, SE=0.14, p<0.01) or Other (OR= 0.17, SE=0.12, p<0.01), suggesting that the odds of Hispanic students engaging in heavy use are predicted to be 50% lower than the odds for White non-Hispanic students, whereas the odds of students in the Other race category (Asian, Native American and/or Native Alaskan, and Other descents) are predicted to be 83% lower than the odds for White non-Hispanic students.

Post hoc analyses were also run testing for additional race/ethnicity differences in heavy marijuana use with students classified as Other (Asian, Native American and/or Native Alaskan, and Other descents) differing significantly from Black non-Hispanic students $\chi^2 (1) = 5.7, p=0.002$, and Mixed students $\chi^2 (1) = 6.9, p=0.009$. Thus, students of Asian, Native American and/or Alaskan Native, and Other descents also have lower odds of engaging in heavy marijuana use than both Black non-Hispanic and Mixed students (heavy marijuana use frequencies per race/ethnicity group: Other= 2.7%, Black non-Hispanic= 10.2%, Mixed= 12.4%).

Table 3.2: Logistic Regression Results. Logistic regression Model 1 (current marijuana use) and Model 2 (heavy marijuana use) main effects (N=2880, df=9).
Model 1: Current Marijuana Use Main Effects

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>OR (SE)</th>
<th>Model 2: Heavy Marijuana Use Main Effects</th>
<th>OR (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Monitoring</td>
<td>0.44 (0.03)***</td>
<td>0.41 (0.05)***</td>
<td></td>
</tr>
<tr>
<td>Parental Support/Warmth</td>
<td>0.84 (0.08)+</td>
<td>0.92 (0.13)</td>
<td></td>
</tr>
<tr>
<td>Low SES</td>
<td>1.10 (0.15)</td>
<td>1.18 (0.21)</td>
<td></td>
</tr>
</tbody>
</table>

Covariates

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>OR (SE)</th>
<th></th>
<th>OR (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in Years</td>
<td>1.13 (0.09)</td>
<td>1.37 (0.11)***</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.10 (0.11)</td>
<td>0.72 (0.08)**</td>
<td></td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>0.95 (0.15)</td>
<td>0.74 (0.14)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.87 (0.19)</td>
<td>0.50 (0.14)**</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>0.96 (0.13)</td>
<td>0.89 (0.17)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.21 (0.05)***</td>
<td>0.17 (0.12)**</td>
<td></td>
</tr>
</tbody>
</table>

Wald $\chi^2$ 829.01*** 305.42***
Pseudo $R^2$ 0.062 0.083
Log Pseudolikelihood 1464.1 -896.0

Notes: Parental monitoring is a composite score assessing parental knowledge of student activities, rule enforcement, and relationship quality. Parental support/warmth is a composite score assessing parent-child relationships including parental pride, communication, interest, and dependability. SES is a dichotomous variable representing food and/or shelter security (mid/high SES=0) vs insecurity (low SES=1). Age is measured in years ranging from 12 to 18. For race/ethnicity, the Other variable includes responses of Asian, Native American and/or Native Alaskan, and Other. The White non-Hispanic race/ethnicity category was used as the reference group in the analyses. $+$ p < 0.10, * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001.

3.2 Results for Research Question 2

Model 3 (see Table 4, Model 3) tested whether SES moderated the associations between the positive parenting technique predictors (centered parental support/warmth and centered parental monitoring) and current marijuana use. The overall model was statistically significant according to the Wald Chi-Squared statistic: $\chi^2 (11, N=2880) = 1239.43, p<0.001$. While the pattern of effects surrounding the predictors and sociodemographic variables were similar to significant results from Model 1, no significant moderation effects were found.
Model 4 (see Table 4, Model 4) tested whether SES moderated the associations between the positive parenting technique predictors (parental support/warmth and parental monitoring) and heavy marijuana use. The overall model was statistically significant according to the Wald Chi-Squared statistic: $\chi^2(11, N=2880) = 585.87$, $p<0.001$. While no significant interaction was found between parental monitoring and SES, a significant interaction was found between parental support/warmth and SES suggesting that the association between parental support/warmth and heavy marijuana use does differ significantly by SES (OR=1.64, SE=0.39, $p<0.05$).

Table 3.3: Logistic Regression Results Testing Interactions between Parenting Technique Predictors and SES. Logistic regression Model 3 (current marijuana use) and Model 4 (heavy marijuana use) with SES moderations (N=2880, df=11).

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>Model 3: Current Marijuana Use: Moderation by SES</th>
<th>Model 4: Heavy Marijuana Use: Moderation by SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR(SE)</td>
<td>OR(SE)</td>
</tr>
<tr>
<td>Parental Monitoring</td>
<td>0.42 (0.03)**</td>
<td>0.39 (0.05)**</td>
</tr>
<tr>
<td>Parental Support/Warmth</td>
<td>0.84 (0.08)+</td>
<td>0.79 (0.15)</td>
</tr>
<tr>
<td>Low SES</td>
<td>1.18 (0.16)</td>
<td>1.32 (0.20)+</td>
</tr>
<tr>
<td>Parental Monitoring*SES</td>
<td>1.20 (0.20)</td>
<td>1.24 (0.22)</td>
</tr>
<tr>
<td>Parental Support/Warmth*SES</td>
<td>1.05 (0.15)</td>
<td>1.64 (0.39)*</td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in Years</td>
<td>1.13 (0.09)</td>
<td>1.38 (0.12)**</td>
</tr>
<tr>
<td>Female</td>
<td>1.10 (0.11)</td>
<td>0.71 (0.08)**</td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>0.95 (0.15)</td>
<td>0.74 (0.14)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.86 (0.19)</td>
<td>0.50 (0.14)**</td>
</tr>
<tr>
<td>Mixed</td>
<td>0.96 (0.13)</td>
<td>0.90 (0.17)</td>
</tr>
<tr>
<td>Other</td>
<td>0.21 (0.05)**</td>
<td>0.17 (0.12)**</td>
</tr>
<tr>
<td>Wald $\chi^2$</td>
<td>1239.43***</td>
<td>585.87***</td>
</tr>
<tr>
<td>Pseudo R$^2$</td>
<td>0.063</td>
<td>0.085</td>
</tr>
</tbody>
</table>
To further explore the significant moderation effect between SES and parental warmth/support, additional models were run in which the sample was stratified by SES (see Table 5 for results, see Figure 1 for margins plot), thus allowing for associations between parental support/warmth and heavy marijuana use to be examined separately for low SES students (Table 5, Model 5) and mid/high SES students (Table 5, Model 6). Stratified regression analyses were not significant for low SES or mid/high SES students. Results suggested that parental support/warmth was associated with greater odds of heavy marijuana use at low SES (OR=1.28, SE=0.08, p= 0.18) but lower odds of heavy marijuana use at mid/high SES (OR=0.80, SE=0.16, p= 0.24); however, the simple effects of parental support/warmth on heavy marijuana use were not statistically significant at low or mid/high SES.

Table 3.4: Stratified Sample Logistic Regression Results for Heavy Marijuana Use. Logistic Regression Model 5 (low SES) and Model 6 (mid/high SES).

<table>
<thead>
<tr>
<th></th>
<th>Model 5: Heavy Marijuana Use: Low SES</th>
<th>Model 6: Heavy Marijuana Use: Mid/High SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=537, df=8)</td>
<td>(n=2321, df=8)</td>
</tr>
<tr>
<td></td>
<td>OR(SE)</td>
<td>OR(SE)</td>
</tr>
</tbody>
</table>
## Predictor Variables

<table>
<thead>
<tr>
<th></th>
<th>Estimate (SE)</th>
<th>Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Monitoring</td>
<td>0.48 (0.03)***</td>
<td>0.39 (0.05)***</td>
</tr>
<tr>
<td>Parental Support/Warmth</td>
<td>1.28 (0.08)</td>
<td>0.80 (0.16)</td>
</tr>
</tbody>
</table>

## Covariates

<table>
<thead>
<tr>
<th></th>
<th>Estimate (SE)</th>
<th>Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in Years</td>
<td>1.27 (0.09)</td>
<td>1.41 (0.14)***</td>
</tr>
<tr>
<td>Female</td>
<td>0.49 (0.11)**</td>
<td>0.80 (0.10)+</td>
</tr>
<tr>
<td>Black</td>
<td>0.73 (0.15)</td>
<td>0.76 (0.15)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.43 (0.19)</td>
<td>0.51 (0.13)**</td>
</tr>
<tr>
<td>Mixed</td>
<td>1.01 (0.13)</td>
<td>0.85 (0.21)</td>
</tr>
<tr>
<td>Other</td>
<td>0.27 (0.02)</td>
<td>0.22 (0.15)*</td>
</tr>
</tbody>
</table>

| Wald $\chi^2$        | 59.79***      | 246.50***     |
| Pseudo $R^2$         | 0.088         | 0.075         |
| Log Pseudolikelihood | -199.4        | -692.5        |

Notes: Parental monitoring is a composite score assessing parental knowledge of student activities, rule enforcement, and relationship quality. Parental support/warmth is a composite score assessing parent-child relationships including parental pride, communication, interest, and dependability. SES is a dichotomous variable representing food and/or shelter security (mid/high SES=0) vs insecurity (low SES=1). Age is measured in years ranging from 12 to 18. For race/ethnicity, the Other variable includes responses of Asian, Native American and/or Native Alaskan, and Other. The White non-Hispanic race/ethnicity category was used as the reference group in the analyses. + p < 0.10, * p ≤ 0.05 , ** p ≤ 0.01, *** p ≤ 0.001.
4.1 Discussion for Research Question 1

In the current study, it was found that certain positive parenting techniques have protective impacts on Delaware student marijuana use. In response to the first research question (Does an association exist between perceived positive parenting techniques and marijuana use among 11th-grade public school students in Delaware), increased parental monitoring was found to significantly protect against both current marijuana use and heavy marijuana use in Delaware students. For current marijuana use, the odds ratio indicated that for every one-unit increase in parental monitoring, the odds that adolescents will engage in current marijuana use are predicted to be 56% lower. For heavy marijuana use, the odds ratio indicated that for every one-unit increase in parental monitoring, the odds of heavy marijuana use are predicted to be 59% lower.

The findings for research question one add to existing knowledge of protective factors that can impact adolescent marijuana use and help to discern which positive parenting techniques are most influential. While past work has focused on the role of specific parental protective factors in isolation, the current study is the first known study to examine how both parental monitoring and parental support/warmth impact marijuana use among Delaware adolescents, who, according to recent statistics (see Introduction), have been at increased risk for marijuana use. Although similar studies have pointed to the importance of parental monitoring (Cottrell et al., 2003; Vermeulen-Smit, Verdurmen, & Engels, 2015), the current study makes a distinction between parental monitoring and
parental warmth/support, suggesting parental monitoring is more important among this sample of students.

Using the framework of the Family Interaction Theory (Brook, Brook, Gordon, Whiteman, & Cohen, 1990), it was initially expected that both parental monitoring and parental support/warmth had equally important impacts on adolescent substance use, however only parental monitoring was found to be significant. An explanation for these results could be that parental monitoring matters more during this period of development. For example, a previous study found parental support/warmth can buffer against the impacts of substance use for early adolescents, but older adolescents (similar to those in the current study) are more impacted by unstructured time with peers (Crawford & Novak, 2002). Therefore, it may be the case that during eleventh grade parental monitoring is more effective in decreasing the effect of substance using peers, making it important for future studies to take peer impacts into consideration among this age group.

4.2 Discussion for Research Question 2

Findings for research question 2 were partially confirmed (Does SES moderate the association between perceived positive parenting techniques and marijuana use among 11th-grade students?), where the association between parental support/warmth and heavy marijuana use was found to differ significantly by SES level. In order to further explore this significant interaction, associations between parental support/warmth and heavy marijuana use were examined separately for low SES students and mid/high SES students. However, the simple effects of parental support/warmth on heavy marijuana use were not statistically significant at low or mid/high SES, a result that may be due to decreased sample size within each stratified analysis. Further exploration is warranted in
order to fully explore trend with a large and nationally representative sample of students.

Against expectation, the current trend could suggest that parental support/warmth may buffer against heavy marijuana use for students from mid/high SES, but not for students of low SES. This goes against the hypothesized direction, in which positive parenting techniques were expected to be more protective for low SES students. One explanation for this contradiction may be that the current study did not take broader environmental factors into account. Previous studies have found that certain positive parenting techniques such as increased parental monitoring are especially influential in protecting against low SES student substance use in dangerous, high stress environments (Le et al., 2008; Chen & Miller, 2013). It may be the case that environmental context plays a role in this interaction, therefore future studies comparing positive parenting techniques and substance use outcomes should take neighborhood and school environment into account. Likewise, previous studies have found that peer influences are more impactful at this stage of adolescence and can possibly counteract positive parenting techniques (Simons-Morton, 2007). One study looking at peer and parental effects on adolescent substance use over time found that negative relationships between certain positive parenting techniques and adolescent substance use were mediated by a growth in the number of substance using friends. Over time, adolescent substance use predicted growth in substance using friends, and growth in substance using friends predicted adolescent substance use (Simons-Morton, 2007). Therefore, future studies looking into this subject matter should also take peer use into account, in order to explore possible SES differences in peer and parental impacts on substance use.

Overall, the findings for research question two contribute to a current need for
studies comparing adolescent substance use outcomes across SES groups (Goodman & Huang, 2002; Hanson & Chen, 2007; Van Gundy et al., 2015). The results help to highlight how the effects of positive parenting techniques may (or may not) vary across SES groups and will further knowledge on the differential effects of protective parenting techniques on adolescent marijuana use. Further exploration into this subject matter will continue to help disentangle complex links between positive parenting techniques, SES, and adolescent substance use, and define which types of positive parenting techniques are most influential depending on the types of substances and societal classes compared.

4.3 Implications

Overall, the current study’s results highlight the importance of parental monitoring across SES level. Specifically, results suggest that increased parental monitoring is associated with reductions in current adolescent marijuana use and heavy adolescent marijuana use for both low SES students and mid/high SES students. Thus, intervention strategies to address adolescent marijuana use might promote monitoring skills among parents of adolescents, especially during eleventh grade. An example of a relevant intervention aimed at bolstering positive parental monitoring is the Family Check-Up model. The Family Check-Up model is a preventative, family-based intervention aimed at targeting low SES families who have young children at risk for child behavioral misconduct. Several studies have shown the effectiveness of the Family Check-Up model with evidence that reductions in substance use can be attributed to increased parental monitoring (Fosco et al., 2013; Connell, Dishion, & Deater-Deckard, 2006; Dishion, Nelson & Kavanagh, 2003). Findings from this study suggest that programs such as the Family Check-Up Model can be effective in helping families across
SES levels. Traditionally such programs have primarily targeted low SES families, however, it has been well established that Substance Use Disorder does not discriminate based on SES and other demographic characteristics. Therefore, combined with the current results, adaptations of similar interventions aimed at bolstering parental monitoring is warranted regardless of family demographics.

4.4 Limitations and Future Directions

The current study offers insight into the complex nature of associations between positive parenting techniques, SES, and adolescent marijuana use. The results from the study furthers work into adolescent substance use issues with specific emphasis on marijuana, the most commonly used drug among adolescents, and demonstrates how parental monitoring techniques impacts Delaware student marijuana use. Although focusing on Delaware students is arguably important given established high rates of marijuana use, these results may not generalize to all American adolescents. Future research on adolescent substance use, positive parenting techniques, and SES might address this limitation by utilizing national datasets.

A second limitation to report is the restricted scope of certain variables. The measure of SES in the current study was a composite of food and housing insecurity. As it has been reported that associations between SES and substance use outcomes vary depending on the type of SES measure used (e.g., utilizing composite measures of SES rather than a single SES indicator; Karriker-Jaffe, 2011), future research might test similar research questions with more complex, multi-item SES composite measures (e.g., encompassing parental education level, district or school level SES census reports, food
and shelter security; Karriker-Jaffe, 2011). Also, of note, the reliability of the measure of parental monitoring was low (α=0.58), however there were no other available measures within the DSS. In order to bolster future measures of parental monitoring valid and reliable measures from multiple sources can be utilized including census data for school and neighborhood environment, observation, teacher report, and parental report.

Finally, future studies may want to assess similar research questions with a broader theoretical framework such as the socioecological model (Bronfenbrenner, 1995). As mentioned previously, there are multiple factors not explored within the current study that could have impacted adolescent substance use, most notably peer substance use (Simons-Morton, 2007) and school or neighborhood environments (Le et al., 2008; Chen & Miller, 2013). The socioecological model (Bronfenbrenner, 1995) can allow researchers to control for the unique effects of certain contexts, while also considering how specific periods of adolescent developmental periods may impact substance use over time.
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Appendix A

CFA METHODS AND RESULTS

A confirmatory factor analysis (CFA) as used to evaluate the model rather than an exploratory factor analysis because it provides a more rigorous examination of a scale’s factorial structure than exploratory factor analytic procedures (Bryne, 2012; Schmitt, 2011). Factor correlations were freely estimated, error terms were uncorrelated, and metrics of the latent variables were set by fixing one path to unity. All models were assessed using the STATA/IC (version 15). Full-Information Maximum Likelihood (FIML) estimation was employed utilizing default standard errors to uncover underlying constructs (Jöreskog, 1969, 1977).

The CFA evaluated whether items measuring positive parenting techniques could be combined to form two factors (parental monitoring and parental warmth/support) as suggested by Family Interaction Theory. An inspection of CFA factor loadings linking each variable to their respective factors revealed that the reliability of the measure for parental monitoring ($\alpha=0.58$) was low while the reliability for the measure of parental support/warmth ($\alpha=0.70$) was large ($\geq 0.70$). Moreover, following recommendations, multiple measures of fit were considered (Tanaka, 1993). While the chi-square test was significant ($\chi^2 [13]=102.5, p=0.001$), this measure alone is not always accurate, especially within the current large sample size. Additional fit indices reveal a good fitting model for parental monitoring (RMSEA=0.04; SRMR=0.03; TLI=0.96; CFI=0.97).