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Associations between Parenting, Neurobiological Variables, and Adolescent and Young Adult Risk-Taking

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Associations between Parenting, Neurobiological Variables, and Adolescent and Young

Adult Risk-Taking

by

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Abstract

Evidence suggests that adolescence and young adulthood is a transitional stage whereby unique contextual factors may increase the likelihood for certain individuals to engage in risk-taking compared to their peers. In addition to influential environmental aspects (i.e. parenting, societal affiliations, peer influence) an adolescent's and young adult's underdeveloped cognitive control system is unable to successfully inhibit early maturing tendencies such as sensation seeking and reward sensitivity. However, previous research indicates that certain parental mechanisms may serve as protective/promotive agents for stabilizing this neurobiological imbalance. Therefore, the focus of the current research was to examine how parenting behaviors and styles moderate the relations between neurobiological variables and risk-taking during young adulthood. It was expected that authoritarian parenting methods would have adverse effects on young adult behavior by inhibiting maturing cognitive control abilities and exacerbating early developing socioemotional tendencies. Conversely, it was suspected that authoritative parenting would serve as a protective agent against young adult risk-taking by increasing cognitive control abilities and suppressing socioemotional tendencies. Additionally, parental monitoring is a behavior that, depending on context, may serve to either inhibit or exacerbate young adult risk-taking. An online survey was conducted to assess young adults from MTurk. Participants completed a variety of questionnaires regarding parent-child interactions, levels of sensation seeking and self-regulatory abilities, and engagement in risky behavior such as alcohol abuse. In sum, this research may be used to inform parents and caregivers of the influence of parent-child interactions on adolescent and young adult risk-taking.

Keywords: *Parenting, Young Adult, Neurobiological Variables, Risk-taking*

Associations Between Parenting, Neurobiological Variables, and Adolescent and Young Adult Risk-Taking

Adolescence (ages 12-17) is a transitional stage from late childhood to young adulthood (ages 18-25). During this period, adolescents begin to experience a vast array of physical, psychological, and social changes that influence an individual's tendency towards risk-taking. A significant physical change taking place at this time is brain development (Steinberg, 2008). Specifically, the limbic system, which is involved with psychological manifestations of sensation seeking and reward sensitivity, develops at a faster rate than the prefrontal cortex which is largely responsible for self-regulatory behaviors (i.e. impulse control). This neurobiological imbalance helps to explain why adolescents and young adults are more likely to engage in risky behaviors. To our knowledge, previous research has not included social contexts that also matter for risk-taking. Therefore, it is necessary to explore how social contexts, such as parenting, serve as key influential factors for expediting cognitive maturation and decreasing adolescent and young adult risk-taking.

Several aspects of parenting matter for adolescent outcomes. One is parenting type, with authoritative parenting and authoritarian parenting being the focus of the current study. For instance, adolescents reared by warm and firm parents (i.e. authoritative parenting) show better competence and psychosocial adjustment compared to peers raised in harsh households (authoritarian parenting; Steinberg & Morris, 2001). In general, authoritative parents are more likely to have a positive relationship with their adolescents and effectively monitor their behavior. Parental monitoring refers to parents regularly attending to and tracking the child's whereabouts and activities. Concurrently, brain development during adolescence means that adolescent behavior is motivated more by immediate rewards and sensation seeking, resulting in more risk-taking compared to other age groups (Smith, Chein, & Steinberg, 2013). Specifically, risk-taking is defined as actively engaging in negative behaviors such as substance abuse, promiscuity,

gambling, and delinquency (Chein, Albert, O'Brien, Uckert, Steinberg, 2011). The present study addresses how parenting variables might mitigate the effect of neurobiological variables on risk-taking.

The Neurobiological Model of Adolescent and Young Adult Risk-Taking

Adolescent and young adult vulnerability to risky, impulsive, and reckless behavior is attributable in part to divergent developmental courses of two brain systems. This neurobiological imbalance suggests that an early-maturing “socioemotional system” increases sensation seeking or an individual’s drive for reward and likeness for novel, thrilling, and risky activities, whereas an opposing, less mature “cognitive control” system is too underdeveloped for self-regulation or effectively preventing potentially destructive impulses (Steinberg, 2008).

The transition from childhood to adolescence and young adulthood incorporates an increase in sensation seeking that has been linked to changes in dopaminergic activity occurring during puberty. This dopaminergic change, which is largely responsible for social information processing such as the recognition of socially relevant stimuli, affects motivational and affective regulation (Steinberg, 2008). Additionally, the dopaminergic changes and the overlap of neural circuits that mediate social information processing and reward processing help to explain the increase of adolescent sensation seeking and risk-taking during this transitional period (Steinberg, 2008). Previous research has hypothesized that this dopamine imbalance can create a “reward deficiency syndrome” whereby adolescents seek out addictive drugs and environmentally novel and thrilling activities in an attempt to produce reward salience (Gardner, 1999). Conversely, however, other studies propose an alternative hypothesis that suggests sensation-seeking during adolescence is due to an *overload* of dopamine that is insufficiently inhibited (Dumont, Andersen, Thompson, & Teicher, 2004). Thus, adolescents are more sensitive to rewarding events and such rewarding experiences become drastically heightened.

In addition to these dopaminergic influences, evidence for the maturation of late adolescents and young adults' cognitive control system is seen in structural and functional changes that occur in the prefrontal cortex (Steinberg, 2008). These changes support the notion that the reward system eventually becomes desensitized to the effects of pubertal hormones which in turn decreases reward sensitivity (Smith et al., 2013). Further, impulse control continues to mature throughout adolescent development. Thus, impulsive behavior begins to decrease by the mid-20's (Quinn & Harden, 2013). Developed cognitive control systems also provide individuals with a greater ability to implement deliberative decision making (i.e. thinking through various aspects of a decision to avoid negative consequences and achieve a desired situational outcome; Wolff & Crockett, 2011) and reasoning regarding social and emotional situations.

These maturational differences within the dual systems provide support for a biological predisposition for adolescent and young adult risk-taking (Shulman et al., 2016). The dual systems model has been examined in relation to the neural structures involved as well as psychological variables presumably subserved by brain changes, specifically sensation seeking, reward sensitivity, self-regulation, and future orientation.

Although the gap between sensation-seeking and self-regulation begins to substantially decrease by young adulthood, young adults remain vulnerable to both cognitive and situational factors that increase the motivation for risk-taking. Therefore, young adults provide insight into the study of risk-taking that is unique from that of adolescents. Specifically, brain development combined with situational factors such as the opportunities available for individuals to engage in risky behavior broadens the spectrum for understanding the construct of youth involvement in risk-taking. In particular, older adolescents tend to experience less supervision and more accessibility to alcohol, drugs, sex and gambling (Smith et al., 2013). This combination of neurobiological variables and real-world circumstance maintains the increase in young adult participation in risky behaviors. With that said, there is currently a lack of research regarding the

influence of individual and contextual differences (e.g. authoritarian vs. authoritative parental styles) on adolescent risk-taking (i.e. alcohol abuse) from a neurobiological perspective.

Therefore, the current study aims to fill this gap by broadening the understanding of such factors.

Young Adult Alcohol Abuse

As young adults begin to establish independence, they are more likely to have greater opportunity to engage in risk taking, especially that of alcohol use. Research suggests that alcohol consumption is among the top leading preventable causes of death for humans as it is ranked third in the United States (McGinnis & Foege, 1993). Moreover, epidemiological reports indicate a large prevalence of young adult binge drinking which results in variety of short and long-term negative consequences (NIAAA, 2000). Therefore, it is of interest to explore the various types of drinking behaviors such as binge drinking, drinking and driving, and frequency of drinking among young adults in order to identify potential predictors of this behavior.

Considering the risks involved in binge drinking it is important to explore this type of alcohol abuse in depth. An operational definition of binge-drinking is defined as: A pattern of drinking alcohol that brings BAC to 0.08-gram percent or above ($\geq 5/4$ for men/women in 2 hr.) on more than one occasion within the past 6 months (Courtney & Polich, 2009). It is reported that for high-risk children, regular (more than once a month) drinking begins at approximately 15 years of age and 16.5 years of age for low-risk children (Hill, Shen, Lowers, & Locke, 2000). Additionally, the trajectories for lifetime use and misuse of drugs and alcohol peaks during later adolescence and young adulthood. In particular, problematic drinking behaviors including daily use, binge drinking, and daily intoxication are suggested to be highest during young-adulthood (Stone, Becker, Huber, & Catalano, 2012). As mentioned, this type of risk-taking can lead to a variety of physical consequences including an increase in sexually transmitted infections, suicide, and risk of heavy alcohol use in later adulthood. Additionally, there is an increase of negative social

consequences including violence, drunk driving, and a loss in economic productivity (NIAAA, 2000).

A variety of factors including peer associations, educational background, and family history are suggested to contribute to young adult binge drinking. Family history is particularly salient to this study in that it has spurred the search for a genetic link. Interestingly, college students who have been identified as having the short version of the serotonin transporter gene (5-HTT) were far more likely to engage in binge drinking activities compared to college students without this variant (Herman, Philbeck, Vasilopoulos, & Depetrillo, 2003). Moreover, this genetic variation has been correlated with higher levels of anxiety and depression which may explain higher alcohol use for individuals attempting to reduce such stress (Mazzanti, Lappalainen, Long, Bengel, Naukkarinen & Eggert 1998). Overall, young adults experiencing mood disorders such as anxiety and depression may resort to binge drinking behaviors in order to restore neurobiological balance.

Of relevance to this neurobiological imbalance, impulsive behaviors such as sensation seeking has been documented as having a positive relationship with frequency of drinking. Research suggests that higher frequency in alcohol use may be indicative of sensation seekers' motivation to increase arousal, seek out social situations involving heavy alcohol use, and thus maintain an increased willingness to experiment with alcohol (LaBrie, Kenney, Napper, & Miller, 2013).

Conversely, a more effortful system of self-regulation (consisting of pre-meditation and perseverance) has been found to have an inverse effect with young adult alcohol abuse. Kuvass and colleagues (2014) identified four latent drinking classes (light, moderate, heavy and problematic) among college students in order to understand differences in emotional and behavioral self-regulation among these classes. Light drinkers drank less frequently and at a lower

amount than moderate drinkers while moderate drinkers drank less frequently and at a lower amount than heavy and problematic drinkers. It was noted that problematic drinkers did not differ from heavy drinkers in terms of alcohol consumption but rather they experienced higher levels of alcohol-related problems (i.e. less positive life, more external problems, and decreased resilience). Regarding behavioral self-regulation, it was found that light drinkers had the highest self-control and the lowest tendency toward sensation-seeking. Interestingly, compared to moderate and heavy drinkers, problematic drinkers had similar levels of sensation seeking and self-control. However, they did endorse greater emotional dysregulation than each of the other drinking classes. Thus, this study furthers the notion that alcohol related problems may largely result from self-regulatory deficits, particularly those of emotion regulation dysfunction.

Influential Environmental Factors for Adolescent and Young Adult Substance Abuse

As aforementioned, prevalent health problems facing adolescents include alcohol consumption and drug abuse. The National Survey of American Attitudes on Substance Abuse (NSAASA, 2012) reports that 10% of middle schoolers attending schools with prevalent drug activity have experimented with marijuana, are 33 times more likely to smoke cigarettes, and are three times more likely to drink alcohol than those attending schools with little to no drug activity. Some of the influential agents for increasing these risky behaviors include peers, public vs. private schools, and strength of family ties. The NSAASA supports the notion that adolescents who attend public schools have more access to drugs and alcohol through deviant peer relationships. Additionally, weak family ties are also a major contributor to adolescent risk taking. As reported, adolescents who lack quality time with their parents and/or experience regular conflict within the household are more likely to engage in risky behavior, especially substance abuse. The consequences of such behavior include a decrease in motivation, interference of cognitive

processes, enhancement of psychological mood disorders, as well as physical, legal and social damage (Hawkins, Catalano, & Miller, 1992).

Individual and Contextual Differences

Cross culturally, adolescents experience heightened reward sensitivity and motivation for sensation seeking (Steinberg, 2014). Although the vulnerability for the manifestation of such tendencies remains constant across adolescents, certain individuals require a more tailored and unique form of nurturing based on their genetic predispositions. Certain adolescents may function more as “dandelions” whereby they are psychologically resilient due to their capability of surviving and thriving under a myriad of circumstances (Boyce & Ellis, 2005). While others might be compared to that of “orchids” in that they are highly context sensitive and biologically reactive. For example, dandelion adolescents may be raised in permissive, neglectful, or dismissive households yet they maintain appropriate cognitive maturation while also engaging in less risk-taking. However, orchid adolescents raised in such an environment may experience inhibited impulse control and an increased drive for risk-taking. Thus, to obtain optimal development, individual assessment of adolescents is necessary. This is accomplished through environmental tailoring based around the individual’s personality characteristics or endophenotypes. Endophenotypes are characterized as heritable, state-independent (present despite the lack of an associated disorder) , biological or psychological constructs that are correlated with a phenotype of interest (Mann, Engelhardt, & Briley et al., 2017) Therefore, to reduce engagement in risk-taking, it is imperative that adolescents with these genetic variations experience parental environments consisting of high levels of nurture, support, and monitoring to thrive and flourish (Boyce & Ellis, 2005).

Influence of Parental Mechanisms on Adolescent and Young Adult Risk-Taking

Authoritative parental mechanisms.

Research on social context indicates parenting as a significant influence on adolescent cognitive and behavioral functioning. Authoritative parental styles, characterized by autonomy support, parental management, and warmth (Purdie, Carroll, & Roche, 2004) are suggested to be the most effective in promoting desirable adolescent outcomes. Specifically, authoritative parenting has been associated with health promoting behaviors in adolescence such as increased exercise, hygiene, and better nutrition. (Kapungu, Holmbeck, & Paikoff, 2006; Simons, Sutton, Simons, Gibbons, & Murry, 2016). Moreover, parents who are more responsive and demanding of their children have been shown to decrease health risk behaviors like smoking, drinking, and risky sexual behavior (Lohaus, Vierhaus, & Ball 2009; Pearson, Atkin, Biddle, Gorely, & Edwardson, 2009). For example, warm, engaged and supportive parents serve as a protective agent against increased sexual partners and lack of condom use among adolescents (Kapungu et al. 2006; Landor et al., 2011). Further, parent management, whereby parents maintain awareness and control over youth's social lives, limits the opportunity for risky sexual behaviors (Capalid, Crosby, & Stoolmiller, 1996; Moilanen, Rasmussen, & Padilla-Walker, 2015).

Other research indicates a small but significantly positive correlation between authoritative parenting styles and adolescent self-regulation. For instance, Purdie and colleagues (2004) provide evidence that parental involvement is the most important factor in helping to develop adolescent self-regulation whereas autonomy granting and strictness have little to no influence on self-regulation. This is most likely due the fact that parental involvement tends to limit the opportunity for risky behaviors. Further, Aluja, Barrio, and Garcia (2005) provide evidence that highly aggressive adolescents recalled their parental rearing as more rejecting, overprotective, favoring, and less warm than more benevolent adolescents. This suggests that adolescents who perceive their upbringing as warm and supportive tend to exhibit more socialized behaviors. Thus, positive

parenting behaviors appear to reduce opportunity to engage in risk behaviors but may also affect risk-taking by moderating the effects of dual brain systems.

Authoritarian parental mechanisms.

Moilanen and Rasmussen (2015) found that authoritarian parenting, characterized as harsh and strict with low responsiveness, was negatively correlated with adolescent self-regulation. It is suggested that hostile parenting with excessively demanding behavior may cause emotional over-arousal in adolescents, thus depleting the adolescent's ability to appropriately self-regulate (Sroufe, 1996). Further evidence suggests that initially excessive levels of parental control and abrasiveness inhibit an adolescent's willingness and ability to appropriately self-regulate (Moilanen et al., 2015). For instance, parental over-control may force adolescents to suppress negative emotions and internalize parental expectations. This may ultimately deprive the adolescent of experiences to engage in self-regulation due to minimal exposure for such opportunities (Grolnick, McMenemy, & Kurowski, 1999). Other studies suggest that such outcomes stem from a cyclical relationship whereby an adolescent's inability to effectively self-regulate produces anger, frustration, and embarrassment in parents. This results in an increase of despotic, authoritarian parental mechanisms, which in turn exacerbates impulsive and inappropriate emotions and behaviors in the adolescent (Zucker, 1994).

Parental monitoring.

Monitoring literature tends to vary in definition and operationalization of the construct, however, this study uses the definition of "the attention to and tracking of the child's whereabouts, activities, and adaptations" (Dishion & McMahon, 1998, p. 61) to highlight the meaning of parental monitoring. It is important to note that parental monitoring is an idiosyncratic concept that is partly related to the age of the child being assessed as well as environmental and contextual differences. In order for parental monitoring to serve as a protective agent against risky behavior, the levels of parental monitoring must be structured to match the child's developmental stages.

For instance, adolescents and young adults that tend to engage in risk taking are likely to require higher levels of parental monitoring as opposed to those who lack such tendencies (Dishion & McMahon, 1998).

Adequate amounts of parental monitoring has been shown to decrease the probability for adolescents to engage with deviant peers in risky social environments (Mann, Kretsch, Tackett, Harden, & Tucker-Drob, 2015). However, although parental monitoring may not eliminate the interaction with deviant peers completely, it does buffer the effects of these interactions while also limiting the environments in which these interactions take place (Mann et al., 2015). Further, parents that are inquisitive of their child's activities, set clear rules, and maintain non-confrontational households drastically decrease adolescent sensation seeking, rebelliousness, substance use and alcohol abuse (Hayes, Hudson, & Matthews, 2004).

Further evidence suggests that parental monitoring also decreases adolescent reward sensitivity while increasing cognitive control. Parental involvement, specifically maternal presence, has a substantial impact on adolescent brain function and tendency for risky behavior (Telzer, Ichien, & Qu, 2015). For example, adolescents involved in a driving simulation task showed greater activation of the ventrolateral prefrontal cortex (VLPFC; responsible for response inhibition and goal appropriate response selection) and the medial prefrontal cortex (MPFC; responsible for using memory to engage in appropriate responding) brain regions when making safe and/or risky decisions while under the observation of their mother (Telzer et al., 2015). These neurological changes suggest that parental involvement, in this case maternal supervision, enhances self-control and deliberative decision making while supporting the notion that adolescents may evaluate potential reward by first considering the perspective of their mothers (Telzer et al., 2015).

Current Research

The focus of the current research is to understand how parenting behaviors and styles moderate the relations between young adult neurobiological variables including cognitive control (self-regulation) and socioemotional processing (sensation seeking) and risk-taking (specifically, alcohol abuse).

Hypothesis I: Authoritarian Parenting and Neurobiological Variables in the Prediction of Alcohol Abuse

1a. Based on previous research, it is expected that authoritarian (harsh, strict, and low responsiveness) parenting will be positively correlated with alcohol abuse.

1b. It is hypothesized that there will be an interaction between authoritarian parenting and sensation seeking such that participants who report experience with authoritarian parents in combination with high levels of sensation seeking will also report increased engagement in alcohol abuse.

1c. It is hypothesized that young adults who report experience with authoritarian parents in combination with low levels of self-regulation, will report increased engagement in alcohol abuse.

Hypothesis II: Authoritative Parenting and Neurobiological Variables in the Prediction of Alcohol Abuse

2a. It is hypothesized that participants who report high levels of nurturing, warm, and supportive parent-child interactions will report less engagement in alcohol abuse.

2b. It is hypothesized that there will be an interaction between authoritative parenting and sensation seeking such that participants who report experience with authoritative parents in combination with low levels of sensation seeking will also report less engagement in alcohol abuse.

2c. It is hypothesized that participants who report experience with authoritative parents combined with an increased ability to implement via effective self-regulatory processes will report less engagement in alcohol abuse.

Hypothesis III: Parental Monitoring and Neurobiological Variables in the Prediction of Alcohol Abuse.

3a. It is hypothesized that young adults who report moderate levels (as opposed to excessively high or low levels) of parental monitoring will be less likely to engage in alcohol abuse. This is based on the notion that parental monitoring is more effective as it is tailored to fit the child's developmental stages (Dishion & McMahon, 1998).

3b. It is hypothesized that there will be an interaction between parental monitoring and sensation seeking such that participants who report experience with moderate levels of parental monitoring in combination with low levels of sensation seeking will also report less engagement in alcohol abuse.

3c. Lastly, it is hypothesized that young adults who report moderate levels of parental monitoring combined with a greater ability to self-regulate will be less likely to engage in alcohol abuse.

Methods

Participants

The current study uses data from a larger study examining a variety of influential factors (i.e. parental styles, peer influences, and affect disorders) on young adult neurobiological variables and risk taking. Data was collected via the online tool Amazon Mechanical Turk (MTurk). The survey was loaded onto the platform as a Human Intelligence Task whereby participants who match our age requirements may choose to complete the survey. The current research focused on an original sample of 49 young adult participants ages 20-25 ($M_{age} = 22.5$; $SD_{age} = 1.4$). There

were 20 women, 25 men, 2 non-binary, and 2 who reported “other” gender.. However, due to an error in the coding of our survey, some of the participants were not presented with the full version of the survey which omitted a substantial portion of participant responses. Therefore, the sample sizes for analyses testing the hypotheses ranged from 20 to 29. Those who completed the demographic portion of the survey reported themselves as White/Caucasian (20%), Black/African American (12%), Asian (5%), Hispanic (3%), and Other (1%). Informed consent was obtained for each subject according to a protocol approved by the institutional review boards of the University of North Florida, and each received monetary compensation for their participation.

Measures

The young adult sample completed a variety of questionnaires regarding parenting style, neurobiological variables and young adult risk taking.

Parental monitoring questionnaire. Young adult participants reported how often their parents monitored, or attended to and tracked their whereabouts, activities, and adaptations when they were teens ($\alpha = .92$). This questionnaire consisted of 25 items and participants rated parental monitoring on a Likert scale ranging from 1 (Never) to 5 (Always). Items consisted of “Did your parents know where you went when you were out with friends?” and “Did you need to have your parent’s permission to stay out late at night?”

Parenting styles and dimensions questionnaire (PDSQ). In the young adult sample, participants indicated parental mechanisms they experienced as younger adolescents. The PSDQ consisted of 62 items to measure authoritarian and authoritative dimensions.

Authoritative dimension. The authoritative dimension asked questions regarding reasoning/induction, warmth and support, and autonomy granting ($\alpha = .96$). Participants rated items on a 5-point scale ranging from 1 (Never) to 5 (Always). Items consisted of “My parents

were responsive to my feelings and needs” and “My parents/caregivers provided incentives for me to accomplish my goals.”

Authoritarian dimension. The authoritarian dimension consisted of questions based on non-reasoning, physical coercion, and verbal hostility ($\alpha = .90$). Participants rated items on a 5 point-scale ranging from 1 (Never) to 5 (Always). Items consisted of “My parents/caregivers slapped me when I misbehaved” and “My parents/caregivers used threats or punishment with little or no justification.” Previous research has shown PSDQ to have high reliability and construct validity (Robinson, Mandleco, Olsen, & Hart, 2001).

Sensation seeking. Sensation seeking was measured using the sensation seeking subscale of the UPPS Impulsive Behavior Scale ($\alpha = .87$). Participants rated a total of 12 items on a Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). Items consisted of “I sometimes like to do things that are a bit frightening,” and “I would enjoy fast driving.”

Self-regulation. Young adults completed the Self-Regulation Inventory which includes self-report items on the individual’s ability to self-regulate ($\alpha = .64$). This questionnaire consisted of 19 items that assessed the degree to which young adults are able to activate, monitor, maintain, inhibit and adapt their emotions, thoughts, attention, and behavior. Items consisted of “I have a hard time setting goals for myself,” “I don’t seem to learn from my mistakes” and “I put off making decisions.” These items are rated on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Alcohol abuse. Young adult engagement in risky behaviors was measured using the Youth Risk Behavior Survey (YRBS) ($\alpha = .87$). The YRBS monitors four major types of health-risk behaviors that contribute to severe negative consequences among youth and adults. These risky behaviors include alcohol and substance abuse, violence and delinquency, risky sexual behaviors, and tobacco use. The current study specifically addressed the risky behavior outcome of alcohol abuse by creating a factor score of binge drinking, frequency of drinking, and drunk driving

variables. The creation of a factor score allowed for the examination of multiple variables combined in order to gain a broader perspective of young adult alcohol abuse.

Regarding binge drinking, participants were asked “during the past 30 days, on how many days have you had 5 or more drinks in a row, within a couple of hours?” Participants indicated their response on a 7-point Likert scale ranging from 1 (0 days) to 7 (20 or more days). To assess the frequency of drinking, participants were asked “during the past 30 days, what is the largest number of alcoholic drinks you have had in a row, that is, within a couple of hours?” Participants rated their response on an 8-point Likert scale ranging from 1 (I did not drink alcohol in the last 30 days) to 7 (10 or more drinks). Lastly, participants were asked about their tendency to drink and drive (i.e. “during the past 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?) Participants indicated their response on a 6 point Likert scale ranging from 1 (I did not drive a car or vehicle in the last 30 days) to 6 (6 or more times).

Data Analysis

Bivariate correlations were conducted to examine the linear relationships between parenting variables of interest (i.e. authoritative, authoritarian, and parental monitoring) and young adult neurobiological variables (i.e. self-regulation and sensation seeking) and risk taking (i.e. alcohol abuse).

Hierarchical Linear Regressions with interactions were conducted to determine the relative contribution of each independent variable on the outcome of adolescent risk-taking. The presence of a significant interaction indicates that the effect of one predictor variable (i.e. sensation seeking/self-regulation) on the dependent variable (alcohol abuse) is different at different values of the other predictor variable (authoritarian, authoritative, and parental monitoring). This interaction is tested by adding a final term to the model which is the cross product of the two

predictor variables (parenting and neurobiological variable). These interaction variables were also centered at the mean as this reduced the correlation between the interaction terms and the main effect terms in the regression analyses. For example, the regression equation testing the moderating effects of authoritarian parenting (ATN) on sensation seeking (SS) in the prediction of young adult alcohol abuse (AA) is as follows (where b is the regression weight for that variable):

$$AA = a + b_1*SS + b_2*ATN + b_3*SS *ATN$$

Given the small sample size, regressions were broken down into six different analyses as fewer variables analyzed at a time provided a more accurate depiction of the relationships being examined. The dependent variable for each model was alcohol abuse. The parental styles and neurobiological variables were entered at step one. Interaction variables were then entered at step two. As aforementioned, the creation of interaction variables provided insight into whether the effect of parenting styles combined with neurobiological variables accounted for variance on young adult alcohol abuse above and beyond that of these variables alone. Demographic variables of race, gender, and age were unrelated to study variables, so they were omitted from the final models.

Results

Preliminary Analysis

Bivariate correlations were conducted to test hypotheses 1a, 2a, and 3a. Contrary to expected results, results of the analysis (shown in Table 1) did not indicate any significant correlations among the parenting styles (authoritarian, authoritative, and parental monitoring) and the neurobiological variables (sensation seeking and self-regulation). However, there was a significant positive correlation between sensation seeking and young adult alcohol abuse ($r = .34$, $p < .05$) as hypothesized. Additionally, there was a significant negative correlation between

authoritarian and authoritative parenting ($r = -.44, p < .01$) and a significant positive correlation between authoritative parenting and parental monitoring ($r = .53, p < .01$). Interestingly, parental monitoring was found to have a significant positive correlation with sensation seeking ($r = .37, p < .05$).

Regressions Predicting Risk-Taking

Hierarchical Linear Regressions were conducted as an examination of how combinations of parental styles and neurobiological variables might explain variance in the outcome of young adult alcohol abuse. In other words, this allowed for the exploration of the hypothesized relationships between the independent variables (authoritative, authoritarian parenting, parental monitoring, sensation seeking, and self-regulation) as predictors of the risk-taking outcome of alcohol abuse. Therefore, six sets of regression analyses were conducted.

Authoritarian parenting. Hypothesis 1b explored whether authoritarian parenting moderated the relationship between sensation seeking predicting young adult alcohol abuse (shown in Table 2). However, results of the regression did not support this hypothesis. The first model assessing authoritarian parenting and sensation seeking as independent predictors of young adult alcohol abuse was not significant ($F(2,19) = 1.5, p = .26$) nor was the second model which examined the interaction between the two ($F(2,19) = .97, p = .43$).

To test for hypothesis 1c, the second set of analyses examined whether authoritarian parenting served to moderate the relationship between self-regulation predicting young adult alcohol abuse (shown in Table 3). However, authoritarian parenting and self-regulation were not found to be significant individual predictors of young adult alcohol abuse and the model wasn't significant ($F(2,27) = .09, p = .92$). Further, adding the interaction effect between authoritarian parenting and self-regulation predicting young adult alcohol abuse also resulted in a non-significant model ($F(3, 26) = .08, p = .97$).

Authoritative parenting. Hypothesis 2b examined whether authoritative parenting moderated the relationship between sensation seeking predicting young adult alcohol abuse (shown in Table 4). Further, to test for hypothesis 2c the fourth set of analyses examined whether authoritative parenting moderated the relationship between self-regulation predicting young adult alcohol abuse (shown in Table 5). Again, the results of the regressions did not support these hypotheses. It was found that the first model assessing authoritative parenting and sensation seeking as independent predictors of young adult alcohol abuse was not significant ($F(2,18) = 2.8, p = .09$) nor was the second model which included the interaction between the two ($F(3, 17) = .17, p = .20$).

Additionally, the model assessing authoritative parenting and self-regulation as individual predictors of young adult alcohol abuse was not found to be significant. ($F(2,27) = .96, p = .40$) Further, the model assessing the interaction effect between authoritative parenting and self-regulation predicting young adult alcohol abuse was not found to be significant ($F(3, 26) = .66, p = .59$).

Parental monitoring. Hypothesis 3b examined whether parental monitoring moderated the relationship between sensation seeking predicting young adult alcohol abuse (shown in Table 6). The results of the regression did not support these hypotheses. It was found that the first model assessing parental monitoring and sensation seeking as independent predictors of young adult alcohol abuse was not significant ($F(2,25) = 1.3, p = .30$) nor was the second model which examined the interaction between the two ($F(3, 24) = 1.2, p = .98$).

Finally, to test for hypothesis 3c, the sixth set examined whether parental monitoring moderated the relationship between self-regulation predicting young adult alcohol abuse (shown in Table 7). Additionally, parental monitoring and self-regulation were not found to be significant individual predictors of young adult alcohol abuse ($F(2,27) = .51, p = .61$). Further, an interaction

effect between parental monitoring and self-regulation predicting young adult alcohol abuse was not found ($F(3, 24) = .33, p = .80$).

Although no significant interactions were found, what follows is an example of interpreting the results based on the model with sensation seeking and authoritarian parenting. We had hypothesized that higher levels of authoritarian parenting combined with higher levels of sensation seeking would result in greater young adult alcohol abuse. The resulting regression formula was:

$$AA = .08 + .53*SS + -.11*ATN + -.27*SS*ATN$$

The intercept, .08, is the mean alcohol abuse when sensation seeking, authoritarian parenting, and their interaction is 0. The regression coefficient for sensation seeking means that for every 1-unit increase in sensation seeking, alcohol abuse increases by .53 controlling for authoritarian parenting and their interaction. The regression coefficient for authoritarian parenting means that for every 1-unit increase in authoritarian parenting, alcohol abuse decreases by .11 controlling for sensation seeking and their interaction. The regression coefficient for the interaction between authoritarian parenting and sensation seeking means that for every 1-unit increase in authoritarian parenting combined with young adult sensation seeking, alcohol abuse decreases by .27.

Therefore, the slope of the interaction will indicate how much change occurs in young adult binge drinking as authoritarian parenting and sensation seeking increases.

For individuals who experienced average authoritarian parenting ($M = 2.47, SD = .56$) the effect of average sensation seeking ($M = 2.66, SD = .61$) on alcohol abuse is $.08 + (.53 * 2.66) + (-.11 * 2.47) + (-.27 * 2.47 * 2.66) = -.55$. However, for individuals who experienced higher levels of authoritarian parenting, the effect of average sensation seeking on alcohol abuse is $.08 + (.53 * 2.66) + (-.11 * (2.47 + .56)) + -.27 * 2.66 * (2.47 + .56) = -1.02$. Lastly, for individuals who

experienced high levels of authoritarian parenting, the effect of high levels of sensation seeking on alcohol abuse is $.08 + (.53*(2.66+.61)) + (-.11* (2.47+.56)) + (-.27*(2.66 + .61)*(2.47+.56)) = -1.20$. To find the simple slope for individuals low in authoritarian parenting the procedure would be repeated with $(2.47 -.56) = 1.91$ for authoritarian parenting inserted into the equation.

In the example above, if the interaction had been significant, those who had high sensation seeking and high authoritarian parenting would have had lower alcohol abuse compared to those with average sensation seeking and high authoritarian parenting and also those with average sensation seeking and average authoritarian parenting. Due to this interaction, the slopes of the regression lines between authoritarian parenting and sensation seeking vary based on the different levels of authoritarian parenting. In other words, the effects of sensation seeking would be different if the young adult experiences higher vs. lower levels of authoritarian parenting.

Discussion

The primary goal of this study was to examine the relationships between social and neurobiological influences on young adult risk-taking. Previous research suggests that authoritative parental styles (Purdie et al., 2004) are the most effective in promoting desirable adolescent outcomes (Kapungu et al., 2006; Simons et al., 2016) as well as decreasing potentially dangerous health risk behaviors (Lohaus et al., 2009; Pearson et al., 2009).

Conversely, authoritarian parenting was anticipated to be negatively correlated with adolescent self-regulation as it is suggested that excessively demanding and controlling behavior may cause emotional over-arousal in adolescents which leads to depletion of the adolescent's ability to appropriately self-regulate (Sroufe, 1996). In addition, it is suggested that such outcomes result from a cyclical relationship whereby parental anger, frustration, and embarrassment stems from the adolescent's inability to effectively self-regulate. This produces an increase in despotic, authoritarian parental mechanisms, which in turn exacerbates impulsive and inappropriate emotions and behaviors in the adolescent (Zucker, 1994). Therefore, it is reasonable to expect that

parents who exhibit such harsh and strict control over their youth will increase the motivation for young adults to participate in risky-behavior.

Another parental behavior of interest was parental monitoring. Ample research suggests that parental monitoring is effective in reducing the opportunities for adolescents and young adults to associate with deviant peers, especially in risky environments (Mann et al., 2015). Further, parents that are involved in their child's daily activities and maintain non-confrontational households drastically decrease adverse adolescent behavior like alcohol abuse (Hayes, Hudson, & Matthews, 2004). Based on this research, it was expected that adequate (as opposed to excessive) levels of parental monitoring would serve as a preventative mechanism in decreasing young adult risk-taking.

Regarding the neurobiological component of the current study, The Dual Systems Model (Steinberg, 2008), specifies that an increase in adolescent and young adult risk taking is due in large part to a greater activation of the socioemotional system (i.e. limbic system) during early stages of adolescents compared to that of the cognitive control system (i.e. prefrontal cortex). Based on this model, it was hypothesized that authoritarian parental styles would exacerbate socioemotional tendencies (i.e. sensation seeking) while decreasing cognitive control abilities (i.e. self-regulation) which would predict an increase in adolescent and young adult motivation for novel, thrilling, and risky behaviors. Conversely, it was hypothesized that authoritative parental styles as well as appropriate levels of parental monitoring would serve to decrease socioemotional tendencies while increasing cognitive control which would then reduce adolescent and young adult engagement in risk-taking.

Contrary to expected results, it was found that young adults who experience authoritarian parental styles are no more likely to engage in alcohol abuse compared to those who experience moderate levels of parental monitoring or authoritative parental styles. In other words, parental

monitoring, and warm, and supportive parenting were no more influential in decreasing young adult risk-taking than harsh or neglectful parenting.

This may be explained by the notion that parental mechanisms alone are not significant moderators of the relationship between young adult neurobiological variables and their motivation for risk-taking. Rather, these mechanisms combined with other factors such as family history, genetics, education level, peer influences, and SES may have a greater influence on predicting this relationship.

To our knowledge, this study is among the first to examine these relationships in conjunction with one another. Although, results did not provide support for a direct relationship between parenting, neurobiological variables and adolescent and young adult risk-taking, it is none-the-less surprising that parental mechanisms were not more consistently associated with risk-taking. Perhaps despite the notion that high levels of warm, supportive and nurturing parental styles have been linked to less risk-taking in adolescents and young adults (Kapungu et al. 2006; Landor et al. 2011) it is possible that these mechanisms are less effective for specific types of risky behaviors such as alcohol abuse especially for young adult populations. Additionally, it was surprising that parental monitoring was not found to be a significant predictor of young adult risk taking considering findings from previous research (Mann et al., 2015). However, this may be explained by the fact that parental monitoring substantially decreases during young adulthood which in turn increases the opportunity for young adults to engage in risky-behaviors like alcohol abuse. This notion should be considered for future research.

Limitations

Although the current study addressed several gaps in the literature, there are also limitations that should be acknowledged. First, the current data set was missing a considerable amount of data. This was initially realized upon data analysis when it was discovered that there

was an error in programming of the survey flow whereby majority of the participants were not presented with the survey in its entirety. This error resulted in a substantial decrease in sample size. Secondly, the model underlying the current studies theory is focused largely around the adolescent population. In particular, the neurobiological imbalance discussed is most prominent during the early to mid-adolescent age range and this gap begins to close by the emergence of young adulthood. Therefore, the current data collected solely from a young adult sample may not be an ideal fit for the model used. With that said, it is likely that with an appropriate adolescent sample the results of this study would change significantly.

Regarding methodological limitations, all measures were based on young adult self-reports, which are subject to a variety of potential downfalls including reporter bias and shared method variance. In particular, the parental portion of the survey is retrospective while the neurobiological portion is current information. Therefore, this discrepancy could potentially alter the accuracy of responses. Further, despite honest intent, participants could potentially lack introspective ability which may lead to an inability to accurately depict the dynamics of the relationships being assessed. Rating scales are also a potential downfall associated with self-reports. Individuals may interpret and uses scales differently whereby some people are “extreme responders” and others tend to gravitate around the midpoints while rarely using the outer most points of the scale. This then indicates differences among scores that are likely not consistent with what the questionnaire intended to measure. Considering the studies interest in structural and functional cognitive changes, neuroimaging techniques (i.e. fMRI) in combination with parental interview and adolescent self-report would be beneficial in providing a more cohesive and in depth understanding of the variables of interest.

Future Research

The present study does not imply that parenting styles are uninfluential in adolescent and young adult risk-taking. Rather, due to an insufficient sample size, it is believed that a larger sample would indicate a greater influence of such mechanisms on youth's behaviors. This, combined with a longitudinal examination of the transition from adolescence to young adulthood, would be helpful in better assessing parental influence during these critical stages of life. Therefore, it is encouraged that future research conducts a more in-depth exploration of these dynamics.

Moreover, parental mechanisms should be analyzed in combination with other potential factors such as family history, genetics, education level, peer influences, and even SES as this combination of factors may have a greater influence on predicting the relationship between neurobiological variables and risk-taking. For example, there is evidence to suggest that utilizing authoritarian parental mechanisms in impoverished neighborhoods and households results in the same positive outcomes produced by authoritative mechanisms (Browning, Leventhal, & Brooks-Gunn, 2005). Additionally, gene identification efforts have been successful in finding interactions between genes and behavioral disorders that could be moderated by certain environmental factors. For instance, an adolescent with the genotype 5-HTTLPR has higher vulnerability for adverse health phenotypes including increased anger, violence, depression and anxiety (Brody, Yu, Beach, Kogan, Windle, & Philibert, 2013.) Thus, carriers of this genotype who also experience stressful parental interaction tend to be unable to refrain from violent activities and thought processes while also experiencing symptoms of depression and anxiety (Brody et al., 2013). This indicates that potential third variables need to be assessed.

Correlational analysis also indicated that parental monitoring was positively correlated with sensation seeking. This may be explained by the notion that young adults still experiencing parental monitoring may be more inclined to view this behavior as excessive which in turn may

exacerbate their motivation for sensation seeking. Therefore, this relationship remains of interest for future study.

It is also possible that authoritarian and authoritative parental mechanisms are less effective for specific types of risky behaviors. In other words, authoritative parenting may not serve as a strong buffer between sensation seeking and young adult alcohol abuse for various reasons. For instance, as young adults obtain more independence from parental control more opportunity to engage in risk-taking may be presented; making risks like alcohol far more accessible as they reach the legal age to drink. Therefore, future research should consider examining multiple types of risky-behaviors (i.e. drug use, delinquency, risky sexual behaviors) for both the adolescent and young adult populations. Previous research shows that sexual risky behaviors (i.e. lack of condom use, multiple sexual partners, casual or non-monogamous relationships, and sex in non-committed relationships (Turpyn & Chaplin, 2016) peak in late adolescence to early adulthood. The consequences of such behaviors can result in unplanned pregnancies, sexually transmitted infection, as well as domestic violence (Crandall, Magnusson, Novilla, Novilla, & Dyer, 2017). Considering that both adolescent and young adult populations tend to engage in such risky behavior, future research may benefit from attempting to understand how authoritarian and authoritative parenting influences this particular outcome.

As aforementioned, only young adult self-reports were used in this study. Future research might consider combining young adult self-report with those from the parent/caregiver and even teachers or other family members. This may ameliorate some of the self-report downfalls previously mentioned as multiple perspectives provide unique vantage points on the relationships being examined. Finally, the data collected for the current study consisted of Mturk participants who may represent a distinct sample. This limits the scope into social and cultural differences that could greatly affect results. To address this issue of generalizability, future research should focus

on including adolescents and young adults from different geographical regions in order to obtain a more representative sample.

Conclusions

This study makes a dedicated attempt at understanding parental influences on adolescent and young adult neurobiological variables and risk-taking. Notably, it is among the few to examine the direct link between two major styles of parenting and adolescent and young adult cognition. Despite the lack of support for the current studies hypotheses, it is still reasonable, based on previous research findings, to encourage parents and caregivers to implement parental mechanisms that support and expedite cognitive maturation during an adolescent's transition to adulthood. These mechanisms may then serve as a protective agent for genetic predispositions that increase the likelihood of adolescent risk-taking and faulty decision making (Romer, 2010).

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Table 1
Correlations Between Parental Mechanisms, Neurobiological Variables and Young Adult Risk-Taking

	Authoritarian	Authoritative	Parental Monitoring	Self-Regulation	Sensation Seeking
Authoritative	-.44**	-			
Parental Monitoring	-0.10	.53**	-		
Self-Regulation	0.00	-0.15	0.03	-	
Sensation Seeking	0.06	-0.04	.37*	0.32	-
Alcohol Abuse	-0.01	0.08	-0.08	-0.01	.34*

**Correlation is significant at the .01 level (2-tailed).

*Correlation is significant at the .05 level (2-tailed).

Table 2
 Summary of Hierarchical Linear Regressions Analysis for Authoritarian Parenting and Sensation Seeking Predicting Young Adult Alcohol Abuse ($N = 21$)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Authoritarian	-0.06	0.47	-0.03	-0.11	0.5	-0.05
Sensation Seeking	0.62	0.37	0.36	0.53	0.45	0.31
Authoritarian * Sensation Seeking				-0.27	0.73	-0.10
R^2		0.13			0.14	
<i>F</i> for change in R^2		1.5			0.14	

Note: Authoritarian and Sensation Seeking were centered at their means.

* $p < .05$. ** $p < .01$.

Table 3
Summary of Hierarchical Linear Regressions Analysis for Authoritarian Parenting and Self-Regulation Predicting Young Adult Alcohol Abuse (N = 29)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Authoritarian	-0.02	0.37	-0.01	-0.02	0.38	-0.01
Self-Regulation	-0.28	0.67	-0.08	-0.22	0.72	-0.06
Authoritarian * Self-Regulation				-0.45	1.80	-0.05
<i>R</i> ²		0.01			0.01	
<i>F</i> for change in <i>R</i> ²		0.01			0.00	

Note: Authoritarian and Self-Regulation were centered at their means.

p* < .05. *p* < .01.

Table 4
Summary of Hierarchical Linear Regressions Analysis for Authoritative Parenting and Sensation Seeking Predicting Young Adult Alcohol Abuse (N=20)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Authoritative	0.4	0.37	0.23	0.39	0.4	0.22
Sensation Seeking	0.81	0.37	0.45	0.82	0.43	0.46
Authoritative * Sensation Seeking				-0.05	0.75	-0.02
R^2		0.24			0.24	
<i>F</i> for change in R^2		2.8			0.01	

Note: Authoritative and Sensation Seeking were centered at their means.

* $p < .05$. ** $p < .01$.

Table 5
Summary of Hierarchical Linear Regressions Analysis for Authoritative Parenting and Self-Regulation Predicting Young Adult Alcohol Abuse (N = 29)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Authoritative	0.34	0.26	0.25	0.33	0.27	0.24
Self-Regulation	-0.14	0.65	-0.04	-0.18	0.67	-0.05
Authoritative * Self-Regulation				0.33	0.99	0.06
R^2		0.66			0.96	
<i>F</i> for change in R^2		0.7			0.11	

Note: Authoritative and Self-Regulation were centered at their means.

* $p < .05$. ** $p < .01$.

Table 6
Summary of Hierarchical Linear Regressions Analysis for Parental Monitoring and Sensation Seeking Predicting Young Adult Alcohol Abuse (N = 27)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Parental Monitoring	-0.34	0.30	-0.24	-0.37	0.30	-0.26
Sensation Seeking	0.62	0.43	0.3	0.63	0.43	0.3
Parental Monitoring * Sensation Seeking				-0.35	0.35	-0.19
R^2		0.09			1.30	
<i>F</i> for change in R^2		0.13			0.98	

Note: Parental Monitoring and Sensation Seeking were centered at their means.

* $p < .05$. ** $p < .01$.

Table 7
Summary of Hierarchical Linear Regressions Analysis for Parental Monitoring and Self-Regulation Predicting Young Adult Alcohol Abuse (N = 27)

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Parental Monitoring	0.05	0.28	0.04	0.06	0.29	0.05
Self-Regulation	-0.81	0.82	-0.2	-0.83	0.84	-0.2
Parental Monitoring * Self-Regulation				0.13	0.97	0.03
<i>R</i> ²		0.04			0.51	
<i>F</i> for change in <i>R</i> ²		0.04			0.02	

Note: Parental Monitoring and Self-Regulation were centered at their means.

p* < .05. *p* < .01.

Curriculum Vitae

Meghan McClanahan received her undergraduate degree from the University of North Carolina at Greensboro in 2015 before relocating to Florida and attending the University of North Florida for her Master's Degree in Psychological Science. While attending UNF, she was hired as a Graduate Research Assistant and Data Analyst for the College of Education and Human Services where she collected, analyzed and reported data regarding alumni performance on the Florida Teacher Certification Exams and Florida Education Leadership Exam, teaching efficacy and teacher satisfaction. She is currently working with Dr. Jennifer Wolff on a potential publication regarding the effects of parental monitoring on adolescent risk-taking.

Meghan is working towards establishing a career in Industrial and Organizational Psychology as a research analyst and executive consultant. She completed an internship at a local consulting firm where she was responsible for analyzing and interpreting employee workstyles assessments, identifying potential leads and enhancing client relations, developing business strategies, and facilitating leadership training. Her future research interests revolve around human attitudes and behaviors regarding traveling and tourism.

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