A STUDY OF THE RELATIONSHIP BETWEEN CHRONOTYPE, PSYCHOPATHOLOGY, AND PRETERM BIRTH

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JOSLYN CAVITT

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TABLE OF CONTENTS

Page

ABSTRACT....1

ACKNOWLEDGMENTS....2

SECTION

I. INTRODUCTION....3

Chronotype and Psychopathology....3
Preterm Birth and Psychopathology....4
Chronotype and Preterm Birth....4
Gender Differences....5

II. METHODS....6

Primary Data 1....7
Primary Data 2....7

III. RESULTS....9

Chronotype....9
Personality Assessment Inventory (PAI)....9
Triarchic Psychopathy Measure (TriPM)....12
Barratt Impulsiveness Scale (BIS)....15
Boredom Proneness Scale (BPS)....18

IV. DISCUSSION....19

REFERENCES....21

TABLE 1....24

ABSTRACT

A Study of the Relationship Between Chronotype, Psychopathology, and Preterm Birth

Joslyn Cavitt
Department of Psychological & Brain Sciences
Texas A&M University

Research Advisor: Dr. Gerianne Alexander
Department of Psychological & Brain Sciences
Texas A&M University

In recent years, a growing number of researchers have taken an interest in the relationship between psychopathology and sleep. However, few studies have investigated this relationship in vulnerable populations (e.g., preterm births) despite considerable research supporting a greater prevalence of both internalizing and externalizing disorders in at-risk groups. The current secondary data analysis aims to address this deficit of knowledge and to examine the relationship of chronotype with internalizing and externalizing disorder-linked traits in emerging adults, particularly those that were born preterm. Measures include an objective biometric evaluation of sleep (e.g., actigraphy, or electronic monitoring of rest/activity cycles) and subjective measures of internalizing and externalizing disorder traits. Additionally, given evidence of gender-related differences in internalizing and externalizing disorders as well as in chronotype, the study also seeks to investigate whether this relationship varies according to gender. Findings could have implications in better understanding the relationship between chronotype, gender, and psychopathology in a vulnerable population of young adults.

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SECTION I

INTRODUCTION

In recent years, a growing number of researchers have taken an interest in the relationship between psychopathology and sleep. However, few studies have investigated this relationship in vulnerable populations despite considerable research supporting a greater prevalence of both internalizing and externalizing disorders in at-risk groups. The current secondary data analysis aims to address this deficit of knowledge and to examine the relationship of chronotype with internalizing and externalizing disorder-linked traits in emerging adults that were born preterm. Additionally, given evidence of gender-related differences in psychopathology as well as in chronotype, the study seeks to investigate whether this relationship varies according to gender. Findings could have implications in better understanding the relationship between chronotype, gender, and psychopathology in a vulnerable population of young adults.

Chronotype and Psychopathology

Chronotype refers to a person's propensity to sleep and wake at particular times and reflects individual differences in circadian rhythms (Duffy, Rimmer, and Czeisler, 2001). Research has shown that chronotype relates to both mental and physical health in a variety of ways, including health-related behaviors, physical conditions, sleep- and school-related issues, and psychological and psychopathological issues (Fabbian et al., 2016). More specifically, some psychological symptoms and personality traits, such as anxiety, depression, and impulsivity, have been demonstrated to be associated with eveningness (Chelminski et al., 1999; Caci et al., 2005; Gaspar-Barba et al., 2009; Hidalgo et al., 2009; Pabst et al., 2009; Randler, 2008; Tonetti et al., 2009; Tsaousis, 2010).

Preterm Birth and Psychopathology

Considerable research supports a relationship between psychopathology and preterm birth, defined by the World Health Organization (2018) as any birth prior to 37 weeks of gestation. For example, a longitudinal cohort study investigating the long-term consequences of preterm birth in a sample of 903,402 Norwegian infants found that the risk of disability in adulthood, including disorders of psychological development, behavior, and emotion, increased with decreasing gestational age at birth (Moster, Lie, & Markestad 2008). Additional research has revealed a heightened risk for internalizing problems and socially avoidant personality traits as well as a lowered risk for externalizing problems in adults born preterm (Pyhälä et al., 2017).

Moreover, a meta-analysis of mental health in child, adolescent, and adult survivors of extremely low birth weight (ELBW; < 1,000 g) determined that ELBW was linked to a heightened risk for psychopathology (Mathewson et al., 2017). Specifically, Mathewson et al. (2017) found that children born at ELBW were more vulnerable to internalizing and externalizing symptoms, inattention, hyperactivity, conduct and oppositional disorders, and autistic symptoms; adolescents born at ELBW faced a heightened risk for inattention, hyperactivity, and internalizing symptoms; and adults born at ELBW displayed increased rates of internalizing symptoms.

Chronotype and Preterm Birth

While there is limited research concerning the relationship between chronotype and preterm birth, the few studies that have been conducted have found corresponding results that both together and independently suggest an association between preterm birth and earlier chronotype (Asaka & Takada, 2010; Björkqvist et al., 2014; Hibbs et al., 2014; Strang-Karlsson et al., 2010). These studies have demonstrated a propensity toward morningness in infants,

children, adolescents, and adults born at VLBW, indicating an advanced sleep phase in survivors of preterm birth (Asaka & Takada, 2010; Björkqvist et al., 2014; Hibbs et al., 2014; Strang-Karlsson et al., 2010).

Gender Differences

The relationship between psychopathology and chronotype may have a more negative impact on younger age groups and women (Fabbian et al., 2016). Additionally, gender differences have been observed in chronotype with men showing a greater preference for eveningness than women (Adan & Natale, 2002; Fabbian et al., 2016). There have also been consistent findings supporting the existence of gender differences in psychopathology. For example, a study conducted by Eaton et al. (2012) with a nationally representative sample of 43,093 individuals found systematic differences in disorder prevalence, indicating higher rates of mood and anxiety disorders in women and higher rates of antisocial personality and substance use disorders in men. The researchers' investigation of disorder comorbidity suggests that this disparity in prevalence originates from gender differences in internalizing and externalizing liability, with women showing higher levels of internalization and men showing higher levels of externalization (Eaton et al., 2012).

SECTION II

METHODS

This secondary data analysis was conducted using data collected from a (2015) study conducted by Ashley Yaugher and Dr. Gerianne Alexander at Texas A&M University, "Internalizing and externalizing traits predict changes in sleep efficiency in emerging adulthood: an actigraphy study," (Primary Data 1) as well as Ashley Yaugher's (2017) dissertation at Texas A&M University, "Risk-taking behaviors and impulsivity in emerging adults born prematurely," (Primary Data 2). The former study sought to extend research on the relationship between sleep disruption and psychopathology through examining sleep, impulsivity, antisocial personality traits, and internalizing traits in young adults. The primary objective of the latter study was to investigate the relationship between sleep quality and externalizing disorders in young adults born prematurely.

Although these studies examined the relationship between sleep quality and psychopathology in young adults, they did not consider chronotype, a variable related independently from sleep quality to psychopathology. In order to examine this relationship, the actigraphy data that had been previously collected in both studies by a small accelerometer (Actiwatch, AW64, Philips Respironics) was reanalyzed. These accelerometers recorded the time at which participants transitioned from wakefulness to sleep and vice versa, thus the start- and end-times of an individual's sleep phase were used to calculate an average midpoint of sleep, which allowed a determination of chronotype. With this, the relationship between chronotype, gender, psychopathology, and preterm birth was determined using the statistical software, SPSS 26.0.

Primary Data 1

This data set consisted of 402 records collected from participants with a mean age of 19.13 years (*SD* = 1.01) with a majority of 233 females (58.0%) and 169 males (42.0%). A majority of 67.4% of participants identified their ethnicity as Caucasian or Non-Hispanic (*n* = 262) while 21.3% identified as Hispanic (*n* = 83), 4.4% identified as Asian-American (*n* = 17), 3.6% identified as African-American (*n* = 14), and 3.3% identified as other (*n* = 13).

Participants completed established objective and subjective measures of disorder-linked personality traits and sleep quality (i.e., Personality Assessment Inventory (PAI) subscales, Triarchic Psychopathy Measure (TriPM), Barratt Impulsiveness Scale-11 (BIS), and the Pittsburgh Sleep Quality Index (PSQI)) and were instructed to wear an actiwatch for 7 days. For the purposes of the current study, only actiwatch data and participants' results on the PAI, TriPM, and BIS were analyzed.

Primary Data 2

This data set consisted of 223 records collected from participants with a mean age of 19.43 years (*SD* = 1.35) with a majority of 153 females (66.5%) and 68 males (29.6%). A total of 135 participants reported preterm birth status, 84 participants reported full term birth status, and four participants reported unknown birth status. For the purposes of the study, preterm birth was defined as birth prior to 39 weeks of gestation. A majority of 60.4% of participants identified their ethnicity as Caucasian or Non-Hispanic (*n* = 139) while 22.6% identified as Hispanic (*n* = 52), 6.5% identified as Asian-American (*n* = 15), 3.9% identified as African-American (*n* = 9), and 3.5% identified as other (*n* = 8).

Participants reported their birth status, completed established objective and subjective measures of disorder-linked personality traits and sleep quality (i.e., Personality Assessment

Inventory (PAI) subscales, Triarchic Psychopathy Measure (TriPM), Barratt Impulsiveness Scale-11 (BIS), Boredom Proneness Scale (BPS), Conners' Continuous Performance Test II (CPT II), Balloon Analogue Risk Task (BART), eye-tracking, and the Pittsburgh Sleep Quality Index (PSQI)), and were instructed to wear an actiwatch for 7 days. For the purposes of the current study, only actiwatch data and participants' results on the PAI, TriPM, BIS, and BPS were analyzed.

SECTION III

RESULTS

Chronotype

Actigraphy measures of 494 participants' sleep phases showed that, on average, the sample slept almost nine hours a night (M = 8.97 hours, SD = 1.99 hours) with a midpoint of sleep at 4:44:45 AM (SD = 1.98 hours). Findings of an independent samples t-test were consistent with those in past literature, indicating a significantly later chronotype in men (M = 5:01:09 AM, SD = 2.25 hours) than in women (M = 4:34:11 AM, SD = 1.78 hours), $t(488) = 2.43$, $p < .05$. However, a nonsignificant difference in the midpoint of sleep was found between those born preterm (M = 4:57:18 AM, SD = 1.95 hours) and those born full term (M = 4:36:41 AM, SD = 1.90 hours), $t(176) = 1.16$, $p > .05$. The interaction between midpoint of sleep, gender, and birth status was also found to be nonsignificant, $F(2, 174) = .35$, $p > .05$.

Personality Assessment Inventory (PAI)

Overall, 316 participants obtained an average score of 21.67 (SD = 11.34) on the anxiety subscale of the PAI. A significant negative correlation between average midpoint of sleep and scores on the PAI anxiety subscale was found specifically in full-term participants, $r(66) = -.25$, $p < .05$. In this group, those with earlier midpoints of sleep, and thus earlier chronotypes, tended to report higher levels of anxiety. No other significant correlations were observed (Table 1). A one-way ANOVA revealed significant differences, based on birth status and gender, among levels of anxiety, $F(3, 204) = 4.25$, $p < .05$. Post-hoc analyses indicated that preterm women demonstrated significantly higher levels of anxiety than preterm men, $p < .05$. Additionally, levels of anxiety reported by preterm women were nearly significantly greater than those

reported by full-term men, $p = .073$. No other significant differences among anxiety were found between preterm men ($M = 17.27$, $SD = 9.25$), full-term men ($M = 18.80$, $SD = 9.31$), preterm women ($M = 24.39$, $SD = 11.14$), and full-term women ($M = 22.52$, $SD = 13.54$). A factorial ANOVA indicated no significant interactions between anxiety, sleep midpoint, and birth status ($F(5, 153) = .99$, $p > .05$) or anxiety, sleep midpoint, gender, and birth status ($F(3, 153) = 1.29$, $p > .05$). A *t*-test for independent samples revealed that 108 male participants ($M = 17.97$, $SD = 9.07$), compared to 206 female participants ($M = 23.54$, $SD = 11.98$), demonstrated significantly lower scores of anxiety, $t(312) = 4.23$, $p < .05$, consistent with past findings. No significant interaction between anxiety, midpoint of sleep, and gender was found, $F(3, 243) = .42$, $p > .05$.

On the depression subscale of the PAI, 316 participants obtained an average score of 17.86 ($SD = 10.82$). In men, a significant negative correlation was found between scores on the PAI's depression subscale and average midpoint of sleep, $r(80) = -.21$, $p > .05$. In other words, men with earlier chronotypes tended to report higher levels of depression. No other significant correlations were observed (Table 1). There were also no significant differences found, based on birth status and gender, among levels of depression, $F(3, 205) = .34$, $p > .05$; preterm men ($M = 16.52$, $SD = 12.04$), full-term men ($M = 18.09$, $SD = 10.52$), preterm women ($M = 18.80$, $SD = 10.93$), and full-term women ($M = 18.53$, $SD = 11.49$) all reported similar levels of depression. A factorial ANOVA indicated no significant interactions between depression, sleep midpoint, and birth status ($F(4, 155) = .77$, $p > .05$) or depression, sleep midpoint, gender, and birth status ($F(3, 155) = .63$, $p > .05$). There was no significant difference found between the mean scores of depression in men ($M = 16.75$, $SD = 10.29$) and women ($M = 23.54$, $SD = 11.98$), $t(312) = 1.27$, $p > .05$. Furthermore, a nonsignificant interaction between depression, midpoint of sleep, and gender was found, $F(3, 244) = 1.06$, $p > .05$.

On the PAI's borderline features subscale, 315 participants obtained an average score of 23.82 (*SD* = 10.89). No significant correlations were found between borderline scores on the PAI, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed no significant differences, based on birth status and gender, among levels of borderline features, $F(3, 204) = .18$, $p > .05$. Preterm men ($M = 23.83$, $SD = 12.38$), full-term men ($M = 24.74$, $SD = 12.21$), preterm women ($M = 23.15$, $SD = 10.67$), and full-term women ($M = 23.44$, $SD = 10.30$) all reported similar levels of borderline features. A factorial ANOVA indicated no significant interactions between borderline features, sleep midpoint, and birth status ($F(5, 155) = .68$, $p > .05$) or borderline features, sleep midpoint, gender, and birth status ($F(3, 155) = .39$, $p > .05$). There was no significant difference found between the mean scores of borderline features in men ($M = 24.29$, $SD = 11.46$) and women ($M = 23.50$, $SD = 10.63$), $t(311) = .61$, $p > .05$. A nonsignificant interaction between borderline features, midpoint of sleep, and gender was found, $F(3, 244) = 1.26$, $p > .05$.

Overall, 317 participants obtained an average score of 17.23 (*SD* = 9.10) on the antisocial features subscale of the PAI. In those born preterm, there was a significant positive correlation between scores on the PAI's antisocial features subscale and midpoint of sleep, $r(105) = .24$, $p < .05$, whereas full-term participants demonstrated a significant negative correlation, $r(65) = -.25$, $p < .05$. In other words, in participants born preterm, those with earlier chronotypes tended to report lower levels of antisocial features, contrary to the trend seen in full-term participants in which those with earlier chronotypes reported higher levels of antisocial features. No other significant correlations were found between antisocial scores on the PAI, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were significant differences, based on birth status and gender, among levels of antisocial features, $F(3, 206) =$

10.70, $p < .05$. Post-hoc analyses revealed that preterm women demonstrated significantly higher levels of antisocial features than both preterm men, $p < .05$, and full-term men, $p < .05$. No other significant differences among antisocial features were found between preterm men ($M = 20.80$, $SD = 7.69$), full-term men ($M = 21.71$, $SD = 9.19$), preterm women ($M = 13.82$, $SD = 7.59$), and full-term women ($M = 17.13$, $SD = 9.36$). A factorial ANOVA indicated no significant interactions between anxiety, sleep midpoint, and birth status ($F(5, 156) = 1.03$, $p > .05$) or anxiety, sleep midpoint, gender, and birth status ($F(3, 156) = .93$, $p > .05$). A *t*-test for independent samples revealed that men ($M = 21.28$, $SD = 8.90$) demonstrated significantly greater scores of antisocial features compared to women ($M = 15.18$, $SD = 8.56$), $t(313) = 5.90$, $p < .05$, a relationship consistent with previous literature. A nonsignificant interaction between anxiety, midpoint of sleep, and gender was found, $F(3, 245) = 1.13$, $p > .05$.

Triarchic Psychopathy Measure (TriPM)

Overall, 623 participants obtained an average total score of 58.98 ($SD = 15.39$) on the TriPM. No significant correlations were found between total scores on the TriPM, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were significant differences, based on birth status and gender, among levels of overall psychopathy, $F(3, 217) = 14.91$, $p < .05$. Post-hoc analyses revealed that both preterm men ($M = 68.58$, $SD = 16.45$) and full-term men ($M = 68.88$, $SD = 13.87$) demonstrated significantly higher levels of psychopathy than both preterm women ($M = 53.32$, $SD = 17.27$) and full-term women ($M = 59.19$, $SD = 16.14$), all significant at the $p < 0.05$ level. No significant differences were found between preterm and full-term women, $p > .05$. A factorial ANOVA indicated no significant interactions between overall psychopathy, sleep midpoint, and birth status ($F(5, 160) = .96$, $p > .05$) or overall psychopathy, sleep midpoint, gender, and birth status ($F(3, 160) = .74$, $p > .05$). As

expected, males demonstrated higher levels of overall psychopathy. A *t*-test for independent samples revealed that the 236 men scored significantly higher total scores on the TriPM (M = 67.34, SD = 14.18) compared to the 384 women (M = 53.79, SD = 13.73), $p < .05$. A nonsignificant interaction between overall psychopathy, midpoint of sleep, and gender was found, $F(3, 479) = .80$, $p > .05$.

The average participant (n = 625) obtained a total score of 33.64 (SD = 7.90) on the boldness subscale of the TriPM. A significant positive correlation between average midpoint of sleep and boldness scores was found in preterm participants $r(106) = .19$, $p < .05$, however, when analyzed by gender, only the individual correlation in preterm men was found to be significant ($r(22) = .46$, $p < .05$) while the one in preterm women was not ($r(82) = -.06$, $p > .05$). In other words, participants born preterm demonstrated greater levels of psychopathy the later their midpoint of sleep, with a similar relationship seen specifically in preterm men but not preterm women. No other significant correlations were found between boldness scores on the TriPM, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA indicated significant differences, based on birth status and gender, among levels of boldness, $F(3, 217) = 6.23$, $p < .05$. Post-hoc analyses revealed that preterm men (M = 35.40, SD = 9.20) demonstrated significantly greater levels of boldness than preterm women (M = 30.88, SD = 7.39), and full-term men (M = 36.82, SD = 7.38) demonstrated significantly greater levels of boldness than both preterm women and full-term women (M = 31.86, SD = 9.27), all at the level of significance of $p < .05$. A factorial ANOVA indicated no significant interactions between boldness, sleep midpoint, and birth status ($F(5, 160) = 2.22$, $p > .05$) or boldness, sleep midpoint, gender, and birth status ($F(3, 160) = .41$, $p > .05$). As found in past literature, males demonstrated higher levels of boldness than females. A *t*-test for independent samples revealed that 237 men scored

significantly higher total scores on the boldness subscale of the TriPM (M = 37.10, SD = 7.42) compared to 385 women (M = 31.53, SD = 7.44), $p < .05$. A nonsignificant interaction between boldness, midpoint of sleep, and gender was found, $F(3, 481) = .82$, $p > .05$.

An average total score of 11.35 (SD = 7.39) was scored by 625 participants on the meanness subscale of the TriPM. No significant correlations were found between meanness scores on the TriPM, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA indicated significant differences, based on birth status and gender, among levels of meanness, $F(3, 217) = 10.40$, $p < .05$. Post-hoc analyses revealed that both preterm men (M = 16.05, SD = 8.18) and full-term men (M = 15.23, SD = 7.01) demonstrated significantly greater levels of meanness than preterm women (M = 9.14, SD = 7.22) ($p < .05$), but not full-term women (M = 11.85, SD = 7.67) ($p > .05$). A factorial ANOVA indicated no significant interactions between meanness, sleep midpoint, and birth status ($F(5, 160) = .33$, $p > .05$) or meanness, sleep midpoint, gender, and birth status ($F(3, 160) = .52$, $p > .05$). As expected, males demonstrated higher levels of meanness. A t-test for independent samples revealed that the 237 men scored significantly higher scores on the meanness subscale of the TriPM (M = 14.88, SD = 6.98) compared to the 385 women (M = 9.11, SD = 6.70), $p < .05$. A nonsignificant interaction between meanness, midpoint of sleep, and gender was found, $F(3, 481) = 1.53$, $p > .05$.

Overall, 625 participants obtained an average total score of 13.96 (SD = 6.92) on the disinhibition subscale of the TriPM. A significant positive correlation was found between disinhibition scores on the TriPM and midpoint of sleep, $r(490) = .12$, $p < .05$, indicating that overall, the later a participant's midpoint of sleep, the greater their disinhibition. No other significant correlations were found between disinhibition scores on the TriPM, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were significant

differences, based on birth status and gender, among levels of disinhibition, $F(3, 217) = 3.43$, $p < .05$. A factorial ANOVA indicated no significant interactions between disinhibition, sleep midpoint, and birth status ($F(5, 160) = ..94$, $p > .05$) or disinhibition, sleep midpoint, gender, and birth status ($F(3, 160) = 2.23$, $p > .05$). As expected, males demonstrated higher levels of disinhibition. A *t*-test for independent samples revealed that the 237 men scored significantly higher scores on the disinhibition subscale of the TriPM ($M = 15.31$, $SD = 7.29$) compared to the 385 women ($M = 13.11$, $SD = 6.57$), $p < .05$. A nonsignificant interaction between disinhibition, midpoint of sleep, and gender was found, $F(3, 481) = .19$, $p > .05$.

Barratt Impulsiveness Scale (BIS)

A total of 625 participants obtained an average overall score of 61.89 ($SD = 9.95$) on the BIS. A significant positive correlation was found between total scores on the BIS and midpoint of sleep, $r(490) = .09$, $p < .05$, indicating that overall, the later a participant's midpoint of sleep, the greater their impulsivity. No other significant correlations were found between total impulsivity scores on the BIS, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed significant differences, based on birth status and gender, among levels of overall impulsivity, $F(3, 217) = 4.10$, $p < .05$. Post-hoc analyses revealed that preterm men reported significantly greater levels of impulsivity than preterm women, $p < .05$. No other significant differences among impulsivity were found between preterm men ($M = 67.24$, $SD = 11.33$), full-term men ($M = 63.89$, $SD = 10.66$), preterm women ($M = 60.35$, $SD = 9.89$), and full-term women ($M = 61.58$, $SD = 9.50$). A factorial ANOVA indicated no significant interactions between overall impulsivity, sleep midpoint, and birth status ($F(5, 160) = 1.20$, $p > .05$) or overall impulsivity, sleep midpoint, gender, and birth status ($F(3, 160) = .26$, $p > .05$). As expected, males demonstrated higher levels of overall impulsivity; a *t*-test for independent

samples revealed that the 237 men scored significantly greater overall scores on the BIS (M = 63.34, SD = 9.66) compared to the 385 women (M = 60.97, SD = 10.06), $p < .05$. A nonsignificant interaction between overall impulsivity, midpoint of sleep, and gender was found, $F(3, 481) = .16$, $p > .05$.

Overall, 625 participants obtained an average score of 17.50 (SD = 3.76) on the attentional subscale of the BIS. No significant correlations were found between attentional scores on the BIS, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were no significant differences, based on birth status and gender, among levels attentional impulsivity, $F(3, 217) = .80$, $p > .05$. A factorial ANOVA indicated no significant interactions between attentional impulsivity, sleep midpoint, and birth status ($F(5, 160) = .66$, $p > .05$) or attentional impulsivity, sleep midpoint, gender, and birth status ($F(3, 160) = .15$, $p > .05$). A t-test for independent samples indicated no significant difference in attentional impulsivity between the 237 men (M = 17.77, SD = 3.84) and the 385 women (M = 17.32, SD = 3.71), $p > .05$. A nonsignificant interaction between attentional impulsivity, midpoint of sleep, and gender was found, $F(3, 481) = .35$, $p > .05$.

Overall, 625 participants obtained an average score of 21.27 (SD = 3.85) on the motor subscale of the BIS. A significant positive correlation was found between scores on the motor subscale of the BIS and midpoint of sleep, $r(490) = .13$, $p < .05$, indicating that overall, the later a participant's midpoint of sleep, the greater their motor impulsivity. However, only the individual correlation in men was found to be significant ($r(183) = .15$, $p < .05$), while the one in women was not ($r(302) = .09$, $p > .05$). No other significant correlations were found between motor impulsivity scores on the BIS, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were significant differences, based on birth status and gender,

among levels of motor impulsivity, $F(3, 217) = 6.17$, $p < .05$. Post-hoc analyses revealed that both preterm men ($M = 22.85$, $SD = 4.00$) and full-term men ($M = 22.58$, $SD = 4.26$) demonstrated significantly greater levels of motor impulsivity than preterm women ($M = 20.19$, $SD = 3.60$) but not full-term women ($M = 20.51$, $SD = 4.01$). A factorial ANOVA indicated no significant interactions between motor impulsivity, sleep midpoint, and birth status ($F(5, 160) = .88$, $p > .05$) or motor impulsivity, sleep midpoint, gender, and birth status ($F(3, 160) = .91$, $p > .05$). Consistent with previous research, men demonstrated greater levels of motor impulsivity. A *t*-test for independent samples indicated a significant difference in motor impulsivity between the 237 men ($M = 22.02$, $SD = 3.75$) and the 385 women ($M = 20.79$, $SD = 3.80$), $p < .05$. A nonsignificant interaction between motor impulsivity, midpoint of sleep, and gender was found, $F(3, 481) = .65$, $p > .05$.

On the nonplanning subscale of the BIS, 625 participants obtained an average score of 22.69 ($SD = 4.58$). No significant correlations were found between nonplanning scores on the BIS, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed that there were significant differences, based on birth status and gender, among levels of nonplanning impulsivity, $F(3, 217) = 4.52$, $p < .05$. Post-hoc analyses revealed that preterm men demonstrated significantly greater levels of nonlanning impulsivity than preterm women, $p < .05$. No other significant differences among nonplanning impulsivity were found between preterm men ($M = 24.39$, $SD = 4.71$), full-term men ($M = 22.51$, $SD = 4.30$), preterm women ($M = 21.18$, $SD = 4.34$), and full-term women ($M = 22.19$, $SD = 4.13$). A factorial ANOVA indicated no significant interactions between nonplanning impulsivity, sleep midpoint, and birth status ($F(5, 160) = 1.49$, $p > .05$) or nonplanning impulsivity, sleep midpoint, gender, and birth status ($F(3, 160) = .27$, $p > .05$). Men demonstrated significantly greater levels of nonplanning impulsivity, consistent with

previous literature. A *t*-test for independent samples indicated a significant difference in nonplanning impulsivity between the 237 men ($M = 23.20$, $SD = 4.23$) and the 385 women ($M = 22.39$, $SD = 4.77$), $p < .05$. A nonsignificant interaction between nonplanning impulsivity, midpoint of sleep, and gender was found, $F(3, 481) = .33$, $p > .05$.

Boredom Proneness Scale (BPS)

Overall, 223 participants obtained an average total score of 96.06 ($SD = 17.86$) on the BPS. No significant correlations were found between total scores on the BPS, birth status, gender, and midpoint of sleep (Table 1). A one-way ANOVA revealed no significant differences, based on birth status and gender, among levels of boredom proneness, $F(3, 217) = 1.89$, $p > .05$. A factorial ANOVA indicated no significant interactions between boredom proneness, sleep midpoint, and birth status ($F(5, 160) = .56$, $p > .05$) or boredom proneness, sleep midpoint, gender, and birth status ($F(3, 160) = .90$, $p > .05$). As expected, males demonstrated higher levels of boredom proneness. A *t*-test for independent samples revealed that the 68 men scored significantly higher total scores on the BPS ($M = 99.88$, $SD = 18.17$) compared to the 153 women ($M = 94.20$, $SD = 17.56$), $p < .05$. A nonsignificant interaction between boredom proneness, midpoint of sleep, and gender was found, $F(3, 172) = .32$, $p > .05$.

SECTION IV

DISCUSSION

The aim of the current study was to examine the nature of the relationship between chronotype, gender, birth status, and traits of both externalizing (i.e., impulsivity and psychopathy) and internalizing (i.e., anxiety and depression) traits in young adults. This secondary analysis used data previously collected for a (2015) study conducted by Ashley Yaugher and Dr. Gerianne Alexander at Texas A&M University, "Internalizing and externalizing traits predict changes in sleep efficiency in emerging adulthood: an actigraphy study," in addition to Ashley Yaugher's (2017) dissertation at Texas A&M University, "Risk-taking behaviors and impulsivity in emerging adults born prematurely." As expected, compared to women, men demonstrated later chronotypes and reported higher levels of psychopathic traits and antisocial behavior as well as lower levels of anxiety and depression (Adan & Natale, 2002; Eaton et al., 2012; Fabbian et al., 2016). Also consistent with previous research, greater levels of impulsivity and disinhibition were demonstrated by those with later chronotypes (Caci et al., 2005).

In addition to supporting previously established relationships, this study's findings suggest that several specific relationships vary according to birth status and gender. Previous studies have found greater levels of anxiety in those with earlier chronotypes (Randler, 2008); however, this relationship was only found in participants born full-term, despite some research suggesting generally greater levels of anxiety in adults born preterm (Pyhälä et al., 2015). Additionally, this study's results indicated opposing correlations between chronotype and antisocial traits based on birth status, with earlier chronotypes relating to the lower levels of antisocial features found in preterm adults but greater levels of antisocial features in those born

full-term. Another relationship between chronotype and psychopathology was found solely in the preterm group: preterm adults with later chronotypes scored higher on the boldness subscale of psychopathy, however this pattern was specifically seen in preterm men and not preterm women. Furthermore, although research suggests a greater prevalence of depression in those with later chronotypes (Hidalgo et al., 2009), the correlation in this study was exclusively demonstrated by men. Similarly, results indicated a relationship between increased motor impulsivity and later chronotype, though, when analyzed specifically by gender, this pattern was not observed in women.

Use of the average midpoint of sleep as a determinant for chronotype may have been a limitation in the current study due to possible disparities between undergraduate students' natural propensities to sleep and wake at particular times and their realistic sleep schedules, affected by their various social obligations.

In sum, findings contribute to increasing evidence of a relationship between chronotype and internalizing and externalizing disorders. This data also suggests that such relationships may vary due to birth status and gender. These results could have implications in better understanding the relationship between chronotype and psychopathology in a vulnerable population of young adults.

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Table 1

Correlations between self-report measures and midpoint of sleep

		Preterm			Full-term			Overall		
Assessment	Subscale	Women	Men	Overall	Women	Men	Overall	Women	Men	Overall
PAI	Anxiety	.17	-.33	-.05	-.34*	-.06	-.25*	-.02	-.15	-.07
	Depression	.16	-.40*	-.07	-.18	-.24	-.20	.01	-.21	-.07
	Borderline Features	.25*	-.16	.10	-.34*	-.16	-.23	.05	-.06	.02
	Antisocial Features	.14	.26	.24*	-.35*	-.24	-.25*	-.01	-.01	.02
TriPM	Total	.00	.21	.17	-.20	-.21	-.15	.03	.01	.06
	Boldness	-.06	.46*	.19*	-.04	-.17	-.05	-.03	-.04	.00
	Meanness	-.06	-.07	.03	-.21	-.17	-.17	-.01	-.07	.01
	Disinhibition	.14	-.05	.12	-.19	-.02	-.10	.10	.13	.12**
BIS	Total	-.03	-.04	.03	.03	.09	.06	.08	.08	.09*
	Attentional	-.01	.01	.02	-.01	.04	.03	.08	.00	.05
	Motor	.02	.15	.14	.10	.07	.11	.09	.15*	.13**
	Nonplanning	-.08	-.21	-.06	-.06	.08	-.01	.03	.05	.05
BPS	Total	.11	-.11	.05	-.23	-.15	-.16	-.02	-.11	-.03

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).