Sleep-Impulsivity Research Proposal

**Background**

Adolescence is a crucial developmental period involving emotional and behavioral regulation. Defined as the period of time between 10 and 24\* years of age, adolescence spans the transition from childhood to adulthood, bookended by the start of puberty and roughly the end of major neurocognitive development.1 As a whole, this era in one's life contains significant physical and emotional turmoil.

Sleep is an especially important aspect of this developmental process, with less sleep being linked with decreased cognitive performance and emotional regulation alongside associated structural effects.2 Despite the importance of adequate sleep, American adolescents tend to get significantly less sleep than recommended.3 Furthermore, sleep duration is generally lower in the adolescent period compared to both children and early adults.4

The importance of sleep for impulse control is well documented.5 While adolescence generally is a period of increased risk-taking behavior, poor sleep is specifically involved in behavior dysregulation, including poor impulse control.6 In the opposite direction, impulsivity has been shown to increase insomnia severity.7

It rationally follows, then, that there is a reciprocal relationship between impulsive behavior in response to negative affect and sleep difficulty.8 This bidirectional relationship points towards a negative cycle in which poor impulse control worsens sleep problem while, at the same time, worsened sleep complements impulsivity.

However, to my knowledge, no study has looked at the longitudinal, bidirectional association between the multiple dimensions of impulsivity and components of sleep difficulty. In this study, I intend to utilize the ABCD study dataset to examine this relationship.

**Hypothesis and Research Questions**

Hypothesis 1: Negative and positive urgency and lack of perseverance are facets of impulsivity that will be negatively correlated with sleep over time.

Hypothesis 2: Sleep initiation will be primarily affected by impulsive behavior.

**Specific Aim**

To determine the longitudinal relation between facets of impulsive behavior and components of sleep health in adolescents

**Methods**

Data:

This study will use data from the longitudinal Adolescent Brain Cognitive Development (ABCD) study. A more detailed overview of the study can be found on the study website and in various publications. In summary, the data are collected from 21 sites around the United States, including over 11,000 children recruited between ages 9-10 with an annual follow-up for at least 10 years. This study will use the 5.1 data release, which includes 7 timepoints (baseline, 6-month, 1-year, 18-month, 2-year, 30-month, and 3-year follow-up).9 In this study, participants without sociodemographic information or sleep disturbance and impulsivity measures will be excluded.

Analysis:

In the first part of the analytic approach, the five metrics of the UPPS-P will be entered into Random-Intercept Cross-Lagged Panel Models (RI-CLPMs) along with the Difficulty Initiating and Maintaining Sleep (DIMS) scale, which includes sleep duration. These models will allow us to examine the significance of the bidirectional relationship between sleep difficulty and the five facets of impulsivity: negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency.10 The Random-Intercept variant of the Cross-Lagged Panel Model was chosen based off of prior literature suggesting that CLPMs do not adequately delineate within-person and between-person variance.11,12 RI-CLPMs have been explicitly suggested for use with the ABCD study data as a way of more appropriately capturing variance that may occur within an individual over time or between two people at a given time point.

In the second part of the analysis, we will break down the broader category of sleep difficulty and explore their associations with facets of impulsivity. The DIMS scale will be separated into three categories: sleep duration, difficulty initiating sleep, and difficulty maintaining sleep. These measures will be inputted as nodes into a network analysis, in which the strength of the association between each node will be estimated. This allows us to determine the underlying relationship between these variables. Specifically, we will look at the strength of association between components of sleep difficulty and the impulsivity factors affected by sleep difficulty broadly defined. These contemporaneous networks will be complemented by temporal networks that track the development of these trends over time.

**Expected Results and Limitations**

Results:

First, I expect to find a reciprocal, longitudinal association between positive/negative urgency and lack of perseverance that increases over time. This finding will demonstrate the hypothesized negative cycle of sleep problems and impulsive behavior. Second, I expect to find that sleep initiation and sleep duration will be strongly associated with the relevant facets of impulsivity identified in the first part.

Limitations:

There are several notable study limitations. First, that the sleep metrics are self-reported by parents. Future studies may improve in this aspect by directly, objectively observing sleep behavior. Second, although potential sociodemographic covariates were included, external factors like significant life events that may have an effect on the temporal progression of observed metrics were not considered. Third, the impulsivity examined in this study represents only one facet of a complex, multifactorial construct. The five facets of impulsivity defined in the UPPS-P test look at impulsive behavior as a personality trait while it has also been described in terms of motor impulsivity and delay-discounting. 13–15

**Statement of Scientific Impact**

Sleep is a fundamental component of health, especially during the pivotal developmental period of adolescence. At the same time, adolescents are known for engaging in impulsive behavior as the regulatory parts of the brain develops. These results provide valuable insight into the nature of the interplay between these two aspects of adolescent health. The longitudinal analysis allows for examination of these this relationship over time while accounting for between-subject variance such as personality.

However, neither sleep quality nor impulsivity are complete descriptions by themselves. Sleep problems have various components, as does impulsive behavior. This study aims to explore the facets within these complex constructs. The better we understand the specific factors at play, the better we are able to address them.

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