2022

# DO SLEEP AND EXECUTIVE FUNCTIONING PREDICT INTIMATE PARTNER VIOLENCE? INVESTIGATION OF A MODERATIONAL MODEL

Ayelet Hochman

# DO SLEEP AND EXECUTIVE FUNCTIONING PREDICT INTIMATE PARTNER VIOLENCE? INVESTIGATION OF A MODERATIONAL MODEL

A thesis submitted in partial fulfillment

of the requirements for the degree of

MASTER OF ARTS

to the faculty of the

DEPARTMENT OF PSYCHOLOGY

of

ST. JOHN'S COLLEGE OF LIBERAL ARTS AND SCIENCES

at

ST. JOHN'S UNIVERSITY

New York

by

Ayelet Hochman

Date Submitted _____ Date Approved _____

_____ _____

Ayelet Hochman Andrea Bergman, Ph.D.

## ABSTRACT

DO SLEEP AND EXECUTIVE FUNCTIONING PREDICT INTIMATE PARTNER VIOLENCE? INVESTIGATION OF A MODERATIONAL MODEL

Ayelet Hochman

This study assessed if sleep and the executive function (EF) of response inhibition interact to predict intimate partner violence (IPV) perpetration in emerging adults. This study conducted a secondary data analysis on a sample of college students in romantic relationships who completed a series of EF tasks and self-report measures on emotional and relationship functioning. This study analyzed data from 86 college students (81% female) between the ages of 18-23. Moderational models were tested to evaluate whether deficits in response inhibition and sleep problems interact to predict IPV perpetration. Perpetration of any IPV, only minor forms of IPV, and only severe forms of IPV were evaluated in three separate models. Interaction terms were not significant at the 0.05 level after bias-corrected bootstrapping. These results may point to other EFs as more important risk factors in the perpetration of IPV.

# TABLE OF CONTENTS

## LIST OF TABLES

## Introduction

Intimate Partner Violence (IPV) is a significant public health concern that peaks in emerging adulthood (Johnson et al., 2015). Understanding the risk factors of IPV is crucial for early identification and prevention. Numerous contextual, developmental and relationship risk factors for IPV perpetration have been identified (Capaldi et al., 2012). Recent neuropsychological studies of IPV have revealed deficits in executive functioning (EF) as correlates of IPV perpetration (Humenik et al., 2020). This growing area of research may further elucidate the etiology of IPV perpetration. Sleep problems are independently linked with deficits in executive functioning (Ballesio et al., 2019) and increases in aggressive behaviors (Kamphuis et al., 2012). As sleep problems contribute to failures in executive functioning, and both sleep and EF are independently associated with aggression, studying their relation in emerging adults is imperative to understanding how they interact in predicting IPV to develop targeted preventative interventions.

### Intimate Partner Violence

Intimate Partner Violence (IPV) includes both physical and sexual violence, as well as psychological aggression by a current or past romantic partner. Physical violence is the use of physical force to harm, injure or potentially kill the individual. Sexual violence is the attempted or committed sexual act of one partner towards a non-consenting victim. Finally, psychological aggression is the use of communication to emotionally harm or exert control over a victim (Breiding et al., 2015). Physical, sexual, and psychological aggression will be the focus of this study.

The World Health Organization (WHO) aggregated numerous studies on prevalence of IPV and its consequences in populations worldwide. It estimates a

weighted mean of 37% lifetime prevalence of any type of IPV, 26.4% for physical abuse, 18.1% for sexual abuse, and 21.9 % for psychological abuse. The studies also evaluated numerous adverse health and mental health consequences in victims of IPV (World Health Organization, 2017). A systematic review found that negative health consequences for IPV victims include hormonal, inflammatory, and psychological abnormalities. Some of these abnormalities may contribute to poor medical outcomes such as cardiovascular disease, acceleration of HIV-progression and PTSD that persist years after IPV is perpetrated (Yim & Kofman, 2019). Furthermore, a recent Canadian study found that intimate partner aggression at ages 26-34 was associated with a range of negative outcomes at ages 35-45 for both victims and perpetrators (Simmons et al., 2018). These high rates of IPV and associated outcomes beg the need for greater understanding and targets for prevention and intervention.

**IPV in Emerging Adulthood**

Late adolescence and young adulthood are considered to be periods of increased risk for IPV (Capaldi et al., 2012). With increases in IPV perpetration beginning in late-teen years, the peak of IPV perpetration was found to be as early as 18 years of age in one study (Goodnight et al., 2017), others have found this peak to occur at the age of 20 (Johnson et al., 2015). Rates of IPV perpetration were found to be higher in females than males during emerging adulthood, however as age increased the gender gap narrowed (Johnson et al., 2015). The World Health Organization's aggregation of studies assessing young adults found weighted means for the lifetime prevalence of IPV subtypes to be 26.7% for physical abuse, 18.2% for sexual abuse, and 24.7% for psychological abuse (World Health Organization, 2017). Researchers have also investigated the nature of

relationships in emerging adulthood as important for understanding the context of IPV. As IPV tends to be chronic and recurring in nature, with high rates of re-victimization for individuals who have previously been victims of IPV (Dardis et al., 2018), it is important to understand emerging adulthood as critical period of early IPV victimization and a target for intervention.

**Risk Factors for IPV**

Investigation of IPV etiology has revealed risk factors in several domains. Risk factors for IPV include demographic, contextual, social, and mental health factors (Capaldi et al., 2012). Individuals of younger age, of lower socio-economic status, with exposure to violence, who are socially isolated, with depression, and demonstrate antisocial behavior are at greater risk for IPV perpetration (Capaldi et al., 2012). Similar risk factors for IPV perpetration are found in adolescent and young adult populations **(**Jennings et al., 2017; Renner & Whitney, 2012).

**IPV & Executive Functioning**

A new area of interest is understanding IPV through a neuropsychological framework. Executive functions (EFs) are a set of higher-level neurocognitive abilities that control lower level processes, enabling individuals to perform goal-directed behavior. These skills include response inhibition, interference control, working memory updating, and set shifting. EFs allow the individual to selectively attend to relevant stimuli and ignore irrelevant stimuli, maintain relevant information in working memory and update this information as new relevant stimuli are processed, and perform goal-directed behaviors while inhibiting irrelevant responses (Friedman & Miyake, 2017). Recent understanding of EFs has identified response inhibition as common factor, shared

amongst different executive functions. The ability to maintain task goals and inbihit task-irrelevant information is identified across the variety of EFs, indicating that inhibition is central to broad executive functioning (Miyake & Friedman, 2012). Individuals with EF dysfunction may have greater difficulty problem-solving in complex social situations (Zelazo, 2020). Self-regulation and the ability to inhibit responses is implicated in the perpetration of IPV (Finkel et al., 2009). As EF dysfunction is implicated in difficulty inhibiting responses, it proves an important area of study in understanding the perpetration of aggression and IPV.

Prior research has linked deficits in executive functioning to aggression and anti-social behavior broadly (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). A growing body of research has indicated that neuropsychological impairments are associated with IPV perpetration (Bueso-Izquierdo et al., 2015; Pinto et al., 2010). IPV perpetration has been linked with deficits in EFs, including cognitive flexibility (Romero‑Martínez et al., 2019), inhibition (Cohen et al., 2003; Schafer & Fals-Stewart, 1997), and decision-making (Easton et al., 2008; Humenik et al., 2020; Romero‑Martínez et al., 2019). Studies that accounted for brain injury and substance use found that verbal abilities, memory, impulsivity and cognitive flexibility were linked with IPV perpetration (Bueso-Izquierdo et al., 2015).

**Impact of Sleep**

Sleep is implicated in healthy EF throughout the lifespan (children: Maski & Kothare, 2013, adolescents: Anderson et al., 2009, adults: Kaur et al., 2019) Some studies have highlighted the negative effects of sleep deprivation on cognitive functioning (Drummond et al., 2006; Ratcliff & Van Dongen, 2009). Specifically, poor

sleep or extended periods of wakefulness are associated with difficulties in attention, language, decision-making, memory, and response inhibition (Muzur et al., 2002; Ratcliff & Van Dongen, 2009). Young adults, specifically college students, have high rates of poor sleep (Lund et al., 2010). Wilckens et al. (2014) found that higher sleep continuity was associated with better cognitive functioning throughout the lifespan, and specifically in young adults (20-23) it was associated with better working memory and inhibitory control.

Poor sleep is associated with increased aggression in both children and adults (Kamphuis et al., 2012). Prior studies in forensic inpatient populations found that poor sleep quality and insomnia predicted self-reported impulsivity and aggression, clinician-rated hostility, and aggressive incidents (Kamphuis et al., 2014). In a non-clinical sample, self-reported sleep disturbance was associated with increased hostility (Granö et al., 2008). An experimental assessment of participants' frustration tolerance following a period of sleep deprivation found that sleep-deprived participants demonstrated increased outward expression of aggressive responses and a decreased ability to inhibit impulsive responses to frustration (Kahn-Greene et al., 2006). Case studies (Kamphuis et al., 2012) as well as a study in substance-using adolescent males, suggest that treatment of sleep problems are associated with decreased aggression (Haynes et al., 2006). The association between poor sleep and aggression is similarly found in emerging adults. In a sample of emerging adult males, shorter sleep duration predicted verbal aggression and anger (Randler & Vollmer, 2013)

Notably, poor sleep is implicated in relationship aggression. Female victims of domestic violence reported increased abuse from their partners' after a night of poor

sleep (Hoshino et al., 2009). This phenomenon is similarly found in emerging adults. Female college students in dating relationships who had less sleep engaged in more frequent physical aggression towards their romantic partners (Keller et al., 2014). In a study of married individuals, they found that self-reported poor sleep, mediated by lower self-reported self-control, was associated with increased physical and psychological aggression (Keller et al., 2019). This study demonstrates the relation between sleep and self-regulatory mechanisms in the perpetration of IPV in married individuals. It demonstrates that only when sleep problems are accompanied by deficits in self-regulatory mechanism do they result in increased IPV. However, Keller et al. (2019) did not evaluate the incremental effects that sleep problems may have on self-regulatory resources in predicting the perpetration of IPV. Furthermore, these authors relied on self-report data rather than objective neuropsychological measures of response inhibition. Thus, the current study aims to evaluate sleep as a moderator between the relation of EF deficits on IPV perpetration.

**Present Study**

To better understand the risk for IPV, this study examined relation of sleep problems and EF in predicting emerging adults' IPV perpetration. This study hypothesized that sleep will moderate the effects of EF on IPV perpetration such that the effects of EF on IPV perpetration will be stronger for participants that have poorer sleep. College students' performance on a task of response inhibition, self-reported IPV perpetration, and self-reported sleep problems were analyzed.

This research may have implications for understanding the mechanism through which sleep and EF interact in IPV perpetration. Understanding this mechanism may

promote early identification and prevention for those at risk for IPV. Prior studies have shown that interventions targeting improvements in sleep are associated with decreased aggression in children and adolescents at risk for aggression. Thus, identifying individuals with poor sleep who could be at risk for IPV might aid the development of targeted preventative interventions.

## Methods

### Participants

Data analyzed in this study were collected from a larger study investigating executive functioning and relationship behavior. Undergraduate students in dating relationships at a private northeastern university were recruited for participation from the introductory psychology class participant pool. Participation involved a 1 ½-hour in-person meeting with a research assistant where the participant gave informed consent, completed a battery of EF tasks, and completed self-report questionnaires. Participants ages 18-23 who were administered the relevant self-report and EF tasks were included in current analyses (n=86).

The sample included 70 female and 16 male students. The average age was 19.26 (1.345) years old. Participants identified as Caucasian (40%), African-American (26%), Asian-American (22 %), American Indian or Alaska Native (2%), and 10% did not disclose. Seventeen percent of the participants identified as Spanish, Hispanic or Latino. Nearly half (48%) of the participants were freshmen, and the remaining participants nearly equally represented the other class years.

This secondary data analysis was approved by the St. John's University Institutional Review Board.

### Measures

**Response Inhibition**. The color-word Stroop task was computer-administered using the Psychology Experiment Building Language (PEBL; Mueller & Piper, 2014) software system. This task involved the participant naming the color of the ink of a word in congruent (ink color and word were the same) and incongruent (ink color differed from

the written word) conditions. Performance on this task was measured by mean difference between a participant's response time in the congruent and incongruent conditions across three blocks of trials. Higher scores signified poor response inhibition.

**Intimate Partner Violence.** IPV was assessed by the Conflict Tactics Scale-2 Short Form (CTS2S; Straus et al., 1996; Straus & Douglas, 2004), a 40-item self-report questionnaire asking the frequency of several physical and psychological aggressive behaviors in the context of an intimate relationship. Respondents are asked to rate the frequency of their own perpetration as well as victimization for each aggressive behavior on a scale from 0 (*never*) to 6 (*more than 20 times in the past year*). Participants' ratings for each item were converted to frequencies using the midpoint substitution method. Frequencies of respondent-perpetrated aggression scores were summed across various aggressive behaviors (e.g. pushing, kicking, yelling). Perpetration of any aggressive behaviors, only minor aggressive behaviors, and only severe aggressive behaviors, were summed separately and evaluated individually in this analysis.

The CTS2 consists of five subscales that have good internal consistency. The CTS2 Short Form (CTS2S) is an abbreviated version of the CTS2. The CTS2S demonstrates concurrent validity, with high correlation of subscales with the full CTS2. The CTS2 Short Form demonstrates good construct validity, as its subscales correlate with risk factors for IPV similarly to the full CTS2 (Straus et al., 1996; Straus & Douglas, 2004).

**Sleep**. The Pittsburgh Quality Sleep Index (PSQI; Buysse et al., 1989) is a self-report 10-item questionnaire that assesses sleep quality and problems over a 1-month time period. The PSQI yields 7 component scores and one global score. This analysis

used the PSQI global score as a measure of total sleep problems. Higher scores on this measure signified more problems with sleep. This measure demonstrated a high degree of internal consistency (Cronbach's $\alpha = 0.83$) and test-retest reliability. It has acceptable validity, with the cutoff of a global PSQI providing diagnostic sensitivity of 89.6% and specificity of 86.5% in identifying poor sleepers.

**Analytic Plan**

For the purposes of these analyses, three moderational models were tested. The moderator of sleep problems on the relation between response inhibition and intimate partner aggression perpetration was evaluated separately with three dependent variables: 1) any aggression 2) only minor aggression, and 3) only severe aggression. These models were tested using hierarchical multiple regression in IBM SPSS. Three hierarchical multiple regression analyses were run, one for each dependent variable. In each regression analysis sleep problems and response inhibition were entered in step 1 as individual predictor variables. The interaction term (response inhibition by sleep problems) was entered in step 2 of each hierarchical multiple regression.

Coefficients were estimated using bias corrected accelerated bootstrapping (10,000 samples) with 95% confidence intervals and variables were mean-centered to facilitate interpretation of results. No missing data were found for variables in these analyses. No multivariate outliers, high influence points, or high leverage points were found.

## Results

Relations between individual predictor and dependent variables were evaluated using Spearman's rank-order correlations (Table 1). Response inhibition positively correlated with any type of IPV ($r_s = 0.247, p < 0.05$ ), minor IPV ($r_s = 0.234, p < 0.05$ ), and severe IPV ($r_s = 0.260, p < 0.05$ ). The relations between sleep problems and IPV variables were nonsignificant.

Response inhibition, sleep problems, and their interaction were evaluated to predict frequency of intimate partner aggression using hierarchical multiple regression. Three hierarchical multiple regression analyses were conducted to test three different dependent variables: any type of intimate partner violence, only minor forms of violence, and only severe forms of violence.

The first hierarchical multiple regression examined response inhibition, sleep problems, and their interaction in predicting frequency of any type of violence. The full model (Step 2) was significant $F(3,82) = 3.95$, $p = 0.011$, $R^2 = 0.126$. However, the addition of the interaction term in Step 2 did not lead to a statistically significant increase in $R^2$ at the 0.05 level ($\Delta R^2 = 0.036$; $p = 0.069$). Individual predictors within the model were not significant at the 0.05 level in predicting intimate partner violence (Table 2). The interaction term was not significant at the 0.05 level.

The second hierarchical multiple regression examined response inhibition, sleep problems, and their interaction in predicting frequency of minor forms of aggression. The full model (Step 2) was significant $F(3,82) = 4.177$, $p = 0.008$, $R^2 = 0.133$. The addition of the interaction term in Step 2 led to a statistically significant increase in $R^2$ ($\Delta R^2 = 0.047$; $p = 0.037$) at the 0.05 level. Prior to bootstrapping, the interaction term of

response inhibition by sleep problems was significant at the 0.05 level ($B$ = -0.032, β = -0.248, $p$ = 0.037). However, after bias-corrected bootstrapping, the interaction term and individual predictors were not significant at the 0.05 level in predicting intimate partner violence (Table 3).

The third hierarchical regression tested predictors of severe forms of intimate partner violence. This full model (Step 2) of response inhibition, sleep problems, and their interaction was significant $F(3,82) = 2.773$, $p = 0.047$, $R^2 = 0.092$. However the addition of the moderator of response inhibition by sleep problems in Step 2 did not lead to a change in $R^2$ that was significant at the 0.05 level ($\Delta R^2 = 0.010$; $p = 0.334$). After bias-corrected bootstrapping, individual predictors and the interaction term were not significant at the 0.05 level in the final step (Table 4).

## Discussion

The present study examined the interactional relation between sleep problems and response inhibition in predicting perpetration of IPV in an emerging adults sample. This study hypothesized that deficits in response inhibition would predict increased IPV perpetration and this relation would be moderated by sleep problems. Three moderational models were tested separately evaluating predictors for three separate criterion variables: any intimate partner aggression, only minor forms of aggression, and only severe forms for aggression. This hypothesis was not supported in current analyses.

Of the three models tested, similar results were found for the moderational model predicting any IPV and severe forms of IPV. Overall models were significant at the 0.05 level, however individual predictors were non-significant. These results indicate that taken together the variables have more predictive value, though no individual predictor nor the moderator was predictive on its own. For the moderational model predicting minor forms of IPV, the addition of the moderator was significant at the 0.05 level prior to bootstrapping. However, after bias-corrected bootstrapping, individual predictors and the moderator were no longer significant at the 0.05 level. This likely indicates the moderator was influenced by skew in the data and the bias was corrected, the moderator was not found to predict minor forms of IPV.

Prior studies have linked IPV perpetration with neuropsychological deficits, specifically cognitive flexibility, working memory, response inhibition, fluency, and decision-making (Humenik et al., 2020). A recent theory of IPV as posed by Finkel et al. (2009) highlights the importance of impaired self-control, specifically poor response inhibition (Finkel et al. 2012), in the perpetration of IPV. Several studies support the

role of poor response inhibition in IPV perpetration (Cohen et al., 2003; Schafer & Fals-Stewart, 1997) whereas other findings have not supported this relation (Easton et al., 2008; Westby & Ferraro, 1999). The current study builds on this body of research as poor response inhibition positively corelated with all three IPV variables, supporting that poor response inhibition and increased IPV are related.

Finkel et al. (2012) highlight self-regulatory strength depletion as a failure of inhibition that contributes to the perpetration of IPV. Poor sleep is similarly linked to impaired self-control in the perpetration of IPV. Keller et al. (2019) found that sleep problems were associated with marital aggression and that self-control mediated this relation. Prior studies have found that sleep problems are associated with perpetration of aggressive behaviors (Kamphuis et al., 2012) and specifically intimate partner aggression (Hoshino et al., 2009; Rauer & El-Sheikh, 2012). Emerging adults similarly demonstrate increased dating aggression when experiencing sleep deprivation (Keller et al., 2014). As emerging adults' pre-frontal cortex and associated inhibitory control are not fully developed (Arain et al., 2013; Casey et al., 2008), and are prone to sleep problems (Lund et al., 2010), this study aimed to understand the relation of these factors in the perpetration of IPV. However, the current study did not find an association sleep problems and IPV.

Despite prior evidence (Krizan & Herlache, 2016), this study did not find that sleep and response inhibition interact to predict IPV. These results may point to the importance of other executive functions and self-regulatory mechanisms in predicting IPV. Theoretical understanding of aggression and IPV perpetration highlights poor self-control as crucial to understanding perpetration of these behaviors (Denson et al., 2012;

Finkel et al., 2009). Based on this theoretical understanding, this study predicted that the executive function of response inhibition, the ability to inhibit a learned or automatic response, would contribute to an individual's ability to inhibit aggressive behaviors. While the role of response inhibition is partially supported in perpetration of IPV (Cohen et al., 2003; Schafer & Fals-Stewart, 1997), other EFs and self-regulatory mechanisms may play a more substantial role in IPV perpetration.

The ability to inhibit a response in the context of emotionally laden situations may better represent self-control in the context of IPV. Notably, Chan et al. (2010) found that when participants were presented with negative affect stimuli (emotional Stroop) to assess response inhibition, perpetrators of domestic violence demonstrated impaired response inhibition as compared to controls. The authors conclude that IPV perpetrators' impaired ability to inhibit affective stimuli in emotionally-laden contexts may lead them to act irrationally and violently when in conflict with an intimate partner and thus contribute to IPV perpetration. Another measure of impulsivity in an emotionally-laden context is the Iowa Gambling Task (Buelow & Suhr, 2009). Several studies have found that perpetrators of IPV demonstrate more impulsive behavior and risky decision making on this task of decision-making in an affectively "hot" context (Easton et al., 2008; Romero-Martínez et al., 2018; Vitoria-Estruch et al., 2018). These findings regarding IPV perpetrators' impulsivity and ability to self-regulate in emotionally laden-contexts highlights the importance of looking at EFs in affectively "hot" contexts.

Additionally, the EF of cognitive flexibility, has consistently been associated with IPV perpetration. Several studies have found that IPV perpetrators have impaired performance on tasks of cognitive flexibility (Bueso-Izquierdo et al., 2016; Cohen et al.,

2003; Easton et al., 2008; Vitoria-Estruch et al., 2018). Cognitive flexibility is associated with relationship satisfaction (Hill, 2009) and may be associated with improved problem solving in social situations (Holley et al., 2017). Individuals who have greater challenges with social problem solving may resort to more aggressive responses to conflict (D'zurilla et al., 2003). While response inhibition is involved in an individual's ability to flexibly shift from one cognitive set to another (Miyake & Friedman, 2012) the specific EF of cognitive flexibility may be more important in effective conflict resolution and thus individuals who are impaired in this area may be at greater risk for perpetrating IPV.

Some study limitations here may have contributed to these results. While this study aimed to investigate deficits in response inhibition and sleep problems in predicting IPV perpetration, the temporal relation between these three variables could be improved in future research. In the present analyses, sleep problems were measured for the past month, whereas IPV was measured for the past year. Looking at these variables in better-aligned time frames could be improved in future studies. Furthermore, taking a longitudinal approach and examining measures of sleep and executive function prior to IPV at time points over the course of an extended period of time may better evaluate the predictive nature of sleep and EF in predicting IPV.

Additionally, objective measures of sleep such as actigraphy, polysomnography (Marino et al., 2013), or even daily sleep diaries may be more temporally accurate than retrospective measures of sleep. Measures that evaluate whether a bad night of sleep the previous night influences couple interaction the next day may better elucidate the more direct relation between sleep and IPV.

Furthermore, as studies have evidenced IPV in couples is often reciprocal (Renner & Whitney, 2012), collecting data on both partners in a relationship may elucidate the etiology of IPV and how it occurs reciprocally in couples.

The small sample size of the study may have contributed to our results, and future studies with more participants may better detect individual differences in a general population sample. Due to the infrequency of IPV perpetration in a general population sample, several prior studies that investigated predictors of IPV perpetration examined the outcome variable of aggressive inclination measured in a laboratory setting. Specifically, some studies administered a voodoo doll task (DeWall et al., 2013) as a measure of IPV, where participants were permitted to place pins in a voodoo doll that represented their romantic partners (Finkel et al., 2012; Keller et al., 2019). The voodoo doll task is a validated measure that correlates with IPV perpetration (Finkel et al., 2012). Adding this task as an outcome variable may help detect present aggressive inclinations that may not be captured by a retrospective self-report measure.

This study aimed to elucidate the neuropsychological underpinnings of self-regulatory failures in the perpetration of IPV. It investigated the neuropsychological ability to inhibit responses combined with self-regulatory strength depletion (sleep) that may interact to predict IPV in an emerging adult population. As results of this study did not demonstrate relation between these variables, future studies should evaluate other neuropsychological mechanisms that may interact with situational factors that increase the risk for IPV perpetration. As IPV perpetration remains a significant public health issue and emerging adults are at significant risk, future studies should continue to evaluate these mechanisms.

## APPENDICES

**Table 1**

***Spearman Correlations for Response Inhibition, Forms of IPV, and Sleep Problems***

| | Response Inhibition | Any IPV | Minor IPV | Severe IPV | Sleep Problems |
|---|---|---|---|---|---|
| Response Inhibition | -- | | | | |
| Any IPV | 0.247* | -- | | | |
| Minor IPV | 0.234* | 0.987** | -- | | |
| Severe IPV | 0.260* | 0.549** | 0.453** | -- | |
| Sleep Problems | -0.106 | 0.044 | 0.024 | 0.059 | -- |

*p < 0.05, **p < 0.01

**Table 2**

***Effects of Response Inhibition and Sleep on Frequency of Any Intimate Partner Violence***

| | | | | 95% CI | |
|---|---|---|---|---|---|
| Step | Predictors | B | *p* | LL | UL |
| 1 | Response Inhibition | 0.73 | 0.173 | -0.042 | 0.166 |
| | Sleep Problems | 3.752 | *0.124* | 0.103 | 8.098 |
| 2 | Response Inhibition | 0.031 | 0.755 | -0.176 | 0.215 |
| | Sleep Problems | 2.874 | 0.147 | -0.097 | 5.902 |
| | Response Inhibition x Sleep Problems | -0.041 | 0.477 | -0.136 | 0.053 |

**Table 3**
***Effects of Response Inhibition and Sleep on Frequency of Minor forms of Intimate Partner Violence***

| | | | | 95% CI | |
|---|---|---|---|---|---|
| Step | Predictor | B | *p* | LL | UL |
| 1 | Response Inhibition | 0.065 | 0.121 | -0.021 | 0.137 |
| | Sleep Problems | 2.207 | 0.154 | -0.141 | 5.175 |
| 2 | Response Inhibition | 0.032 | 0.656 | -0.114 | 0.158 |
| | Sleep Problems | 1.514 | 0.218 | -0.506 | 3.558 |
| | Response Inhibition x Sleep Problems | -0.032 | 0.419 | -0.1 | 0.033 |

**Table 4**

***Effects of Response Inhibition and Sleep on Frequency of Severe forms Intimate Partner Violence***

| | | | | 95% CI | |
|---|---|---|---|---|---|
| Step | Predictor | B | *p* | LL | UL |
| 1 | Response Inhibition | 0.008 | 0.634 | -0.024 | 0.043 |
| | Sleep Problems | 1.545 | 0.106 | 0.099 | 3.266 |
| 2 | Response Inhibition | -0.001 | 0.979 | -0.063 | 0.07 |
| | Sleep Problems | 1.36 | 0.118 | 0.08 | 2.739 |
| | Response Inhibition x Sleep Problems | -0.009 | 0.637 | -0.04 | 0.025 |

## References


Anderson, B., Storfer-Isser, A., Taylor, H. G., Rosen, C. L., & Redline, S. (2009). Associations of Executive Function with Sleepiness and Sleep Duration in Adolescents. *Pediatrics*, *123*(4), e701–e707. https://doi.org/10.1542/peds.2008-1182

Arain, M., Haque, M., Johal, L., Mathur, P., Nel, W., Rais, A., Sandhu, R., & Sharma, S. (2013). Maturation of the adolescent brain. *Neuropsychiatric Disease and Treatment*, *9*, 449–461. https://doi.org/10.2147/NDT.S39776

Ballesio, A., Aquino, M. R. J. V., Kyle, S. D., Ferlazzo, F., & Lombardo, C. (2019). Executive Functions in Insomnia Disorder: A Systematic Review and Exploratory Meta-Analysis. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00101

Breiding, M., Basile, K. C., Smith, S. G., Black, M. C., & Mahendra, R. R. (2015). *Intimate partner violence surveillance: Uniform definitions and recommended data elements. Version 2.0* (cdc:31292). https://stacks.cdc.gov/view/cdc/31292

Buelow, M. T., & Suhr, J. A. (2009). Construct Validity of the Iowa Gambling Task. *Neuropsychology Review*, *19*(1), 102–114. https://doi.org/10.1007/s11065-009-9083-4

Bueso-Izquierdo, N., Hart, S. D., Hidalgo-Ruzzante, N., Kropp, P. R., & Pérez-García, M. (2015). The mind of the male batterer: A neuroscience perspective. *Aggression and Violent Behavior*, *25*, 243–251. https://doi.org/10.1016/j.avb.2015.09.009

Bueso-Izquierdo, N., Hidalgo-Ruzzante, N., Daugherty, J. C., Burneo-Garcés, C., & Pérez-García, M. (2016). Differences in executive function between batterers and

other criminals. *Journal of Forensic Psychology Practice*, *16*(5), 321–335. https://doi.org/10.1080/15228932.2016.1219216

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Capaldi, D. M., Knoble, N. B., Shortt, J. W., & Kim, H. K. (2012). A Systematic Review of Risk Factors for Intimate Partner Violence. *Partner Abuse*, *3*(2), 231–280. https://doi.org/10.1891/1946-6560.3.2.231

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*, 111–126. https://doi.org/10.1196/annals.1440.010

Chan, S.-C., Raine, A., & Lee, T. M. C. (2010). Attentional bias towards negative affect stimuli and reactive aggression in male batterers. *Psychiatry Research*, *176*(2), 246–249. https://doi.org/10.1016/j.psychres.2008.12.013

Cohen, R. A., Brumm, V., Zawacki, T. M., Paul, R., Sweet, L., & Rosenbaum, A. (2003). Impulsivity and verbal deficits associated with domestic violence. *Journal of the International Neuropsychological Society : JINS; Cambridge*, *9*(5), 760–770.

Dardis, C. M., Dichter, M. E., & Iverson, K. M. (2018). Empowerment, PTSD and revictimization among women who have experienced intimate partner violence. *Psychiatry Research*, *266*, 103–110. https://doi.org/10.1016/j.psychres.2018.05.034

Davidson, R., & MacKinnon, J. G. (1993). Estimation and Inference in Econometrics. In *OUP Catalogue*. Oxford University Press. https://ideas.repec.org/b/oxp/obooks/9780195060119.html

Denson, T. F., DeWall, C. N., & Finkel, E. J. (2012). Self-Control and Aggression. *Current Directions in Psychological Science*, *21*(1), 20–25. https://doi.org/10.1177/0963721411429451

DeWall, C. N., Finkel, E. J., Lambert, N. M., Slotter, E. B., Bodenhausen, G. V., Pond Jr., R. S., Renzetti, C. M., & Fincham, F. D. (2013). The voodoo doll task: Introducing and validating a novel method for studying aggressive inclinations. *Aggressive Behavior*, *39*(6), 419–439.

Drummond, S. P. A., Paulus, M. P., & Tapert, S. F. (2006). Effects of two nights sleep deprivation and two nights recovery sleep on response inhibition. *Journal of Sleep Research*, *15*(3), 261–265. https://doi.org/10.1111/j.1365-2869.2006.00535.x

D'zurilla, T. J., Chang, E. C., & Sanna, L. J. (2003). Self-esteem and social problem solving as predictors of aggression in college students. *Journal of Social and Clinical Psychology*, *22*(4), 424–440.

Easton, C. J., Sacco, K. A., Neavins, T. M., Wupperman, P., & George, T. P. (2008). Neurocognitive Performance Among Alcohol Dependent Men With and Without Physical Violence Toward Their Partners: A Preliminary Report. *The American Journal of Drug and Alcohol Abuse*, *34*(1), 29–37. https://doi.org/10.1080/00952990701764326

Finkel, E. J., DeWall, C. N., Slotter, E. B., McNulty, J. K., Pond Jr., R. S., & Atkins, D. C. (2012). Using $I^3$ theory to clarify when dispositional aggressiveness predicts

intimate partner violence perpetration. *Journal of Personality and Social Psychology*, *102*(3), 533–549. https://doi.org/10.1037/a0025651

Finkel, E. J., DeWall, C. N., Slotter, E. B., Oaten, M., & Foshee, V. A. (2009). Self-regulatory failure and intimate partner violence perpetration. *Journal of Personality and Social Psychology*, *97*(3), 483–499. https://doi.org/10.1037/a0015433

Friedman, N. P., & Miyake, A. (2017). Unity and Diversity of Executive Functions: Individual Differences as a Window on Cognitive Structure. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*, *86*, 186–204. https://doi.org/10.1016/j.cortex.2016.04.023

Goodnight, J. A., Bates, J. E., Holtzworth-Munroe, A., Pettit, G. S., Ballard, R. H., Iskander, J. M., Swanson, A., Dodge, K. A., & Lansford, J. E. (2017). Dispositional, demographic, and social predictors of trajectories of intimate partner aggression in early adulthood. *Journal of Consulting and Clinical Psychology*, *85*(10), 950. https://doi.org/10.1037/ccp0000226

Granö, N., Vahtera, J., Virtanen, M., Keltikangas-Järvinen, L., & Kivimäki, M. (2008). Association of hostility with sleep duration and sleep disturbances in an employee population. *International Journal of Behavioral Medicine*, *15*(2), 73–80. https://doi.org/10.1080/10705500801929510

Hayes, A. F. (2017). *Introduction to Mediation, Moderation, and Conditional Process Analysis: Second Edition: A Regression-Based Approach*. Guilford Press. https://www.guilford.com/books/Introduction-to-Mediation-Moderation-and-Conditional-Process-Analysis/Andrew-Hayes/9781462534654

Hayes, A. F., & Cai, L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior Research Methods*, *39*(4), 709–722. https://doi.org/10.3758/BF03192961

Haynes, P. L., Bootzin, R. R., Smith, L., Cousins, J., Cameron, M., & Stevens, S. (2006). Sleep and aggression in substance-abusing adolescents: Results from an integrative behavioral sleep-treatment pilot program. *SLEEP-NEW YORK THEN WESTCHESTER-*, *29*(4), 512.

Hill, A. (2009). *Predictors of relationship satisfaction: The link between cognitive flexibility, compassionate love and level of differentiation* [Ph.D., Alliant International University, Los Angeles]. http://search.proquest.com/docview/305171671/abstract/EA606049D0784595PQ/1

Holley, S. R., Ewing, S. T., Stiver, J. T., & Bloch, L. (2017). The Relationship Between Emotion Regulation, Executive Functioning, and Aggressive Behaviors. *Journal of Interpersonal Violence*, *32*(11), 1692–1707. https://doi.org/10.1177/0886260515592619

Hoshino, K., Pasqualini, J. C., D'Oliveira, É. P., Silva, C. P. da, Modesto, Â. E., & Silveira, R. S. M. (2009). Is sleep deprivation involved in domestic violence? *Sleep Science*, *2*(1), 14–20.

Humenik, A. M., Grounds, Z. K., Mayer, H. M., & Dolan, S. L. (2020). A systematic review of executive cognitive function in intimate partner violent offenders.

*Aggression and Violent Behavior*, 101407. https://doi.org/10.1016/j.avb.2020.101407

Jennings, W. G., Okeem, C., Piquero, A. R., Sellers, C. S., Theobald, D., & Farrington, D. P. (2017). Dating and intimate partner violence among young persons ages 15–30: Evidence from a systematic review. *Aggression and Violent Behavior*, *33*, 107–125. https://doi.org/10.1016/j.avb.2017.01.007

Johnson, W. L., Giordano, P. C., Manning, W. D., & Longmore, M. A. (2015). The Age-IPV Curve: Changes in Intimate Partner Violence Perpetration during Adolescence and Young Adulthood. *Journal of Youth and Adolescence*, *44*(3), 708–726. https://doi.org/10.1007/s10964-014-0158-z

Kahn-Greene, E. T., Lipizzi, E. L., Conrad, A. K., Kamimori, G. H., & Killgore, W. D. S. (2006). Sleep deprivation adversely affects interpersonal responses to frustration. *Personality and Individual Differences*, *41*(8), 1433–1443. https://doi.org/10.1016/j.paid.2006.06.002

Kamphuis, J., Dijk, D.-J., Spreen, M., & Lancel, M. (2014). The relation between poor sleep, impulsivity and aggression in forensic psychiatric patients. *Physiology & Behavior*, *123*, 168–173. https://doi.org/10.1016/j.physbeh.2013.10.015

Kamphuis, J., Meerlo, P., Koolhaas, J. M., & Lancel, M. (2012). Poor sleep as a potential causal factor in aggression and violence. *Sleep Medicine*, *13*(4), 327–334. https://doi.org/10.1016/j.sleep.2011.12.006

Kaur, S., Banerjee, N., Miranda, M., Slugh, M., Sun-Suslow, N., McInerney, K. F., Sun, X., Ramos, A. R., Rundek, T., Sacco, R. L., & Levin, B. E. (2019). Sleep quality mediates the relationship between frailty and cognitive dysfunction in non-

demented middle aged to older adults. *International Psychogeriatrics*, *31*(06), 779–788. https://doi.org/10.1017/S1041610219000292

Keller, P. S., Blincoe, S., Gilbert, L. R., Haak, E. A., & DeWall, C. N. (2014). Sleep Deprivation and Dating Aggression Perpetration in Female College Students: The Moderating Roles of Trait Aggression, Victimization by Partner, and Alcohol Use. *Journal of Aggression, Maltreatment & Trauma*, *23*(4), 351–368. https://doi.org/10.1080/10926771.2014.896838

Keller, P. S., Haak, E. A., DeWall, C. N., & Renzetti, C. (2019). Poor sleep is associated with greater marital aggression: The role of self control. *Behavioral Sleep Medicine*, *17*(2), 174–180.

Krizan, Z., & Herlache, A. D. (2016). Sleep disruption and aggression: Implications for violence and its prevention. *Psychology of Violence*, *6*(4), 542–552. https://doi.org/10.1037/vio0000018

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep Patterns and Predictors of Disturbed Sleep in a Large Population of College Students. *Journal of Adolescent Health*, *46*(2), 124–132. https://doi.org/10.1016/j.jadohealth.2009.06.016

Marino, M., Li, Y., Rueschman, M. N., Winkelman, J. W., Ellenbogen, J. M., Solet, J. M., Dulin, H., Berkman, L. F., & Buxton, O. M. (2013). Measuring Sleep: Accuracy, Sensitivity, and Specificity of Wrist Actigraphy Compared to Polysomnography. *Sleep*, *36*(11), 1747–1755. https://doi.org/10.5665/sleep.3142

Maski, K. P., & Kothare, S. V. (2013). Sleep deprivation and neurobehavioral functioning in children. *International Journal of Psychophysiology*, *89*(2), 259–264. https://doi.org/10.1016/j.ijpsycho.2013.06.019

Miyake, A., & Friedman, N. P. (2012). The Nature and Organization of Individual Differences in Executive Functions: Four General Conclusions. *Current Directions in Psychological Science*, *21*(1), 8–14. https://doi.org/10.1177/0963721411429458

Morgan, A. B., & Lilienfeld, S. O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review*, *20*(1), 113–136. https://doi.org/10.1016/S0272-7358(98)00096-8

Mueller, S. T., & Piper, B. J. (2014). The Psychology Experiment Building Language (PEBL) and PEBL Test Battery. *Journal of Neuroscience Methods*, *222*, 250–259. https://doi.org/10.1016/j.jneumeth.2013.10.024

Muzur, A., Pace-Schott, E. F., & Hobson, J. A. (2002). The prefrontal cortex in sleep. *Trends in Cognitive Sciences*, *6*(11), 475–481. https://doi.org/10.1016/S1364-6613(02)01992-7

Ogilvie, J. M., Stewart, A. L., Chan, R. C. K., & Shum, D. H. K. (2011). Neuropsychological Measures of Executive Function and Antisocial Behavior: A Meta-Analysis*. *Criminology*, *49*(4), 1063–1107. https://doi.org/10.1111/j.1745-9125.2011.00252.x

Pinto, L. A., Sullivan, E. L., Rosenbaum, A., Wyngarden, N., Umhau, J. C., Miller, M. W., & Taft, C. T. (2010). Biological correlates of intimate partner violence

perpetration. *Aggression and Violent Behavior*, *15*(5), 387–398. https://doi.org/10.1016/j.avb.2010.07.001

Randler, C., & Vollmer, C. (2013). Aggression in young adults—A matter of short sleep and social jetlag? *Psychological Reports*, *113*(3), 754–765. https://doi.org/10.2466/16.02.PR0.113x31z7

Ratcliff, R., & Van Dongen, H. P. A. (2009). Sleep deprivation affects multiple distinct cognitive processes. *Psychonomic Bulletin & Review*, *16*(4), 742–751. https://doi.org/10.3758/PBR.16.4.742

Rauer, A. J., & El-Sheikh, M. (20120402). Reciprocal pathways between intimate partner violence and sleep in men and women. *Journal of Family Psychology*, *26*(3), 470. https://doi.org/10.1037/a0027828

Renner, L. M., & Whitney, S. D. (2012). Risk factors for unidirectional and bidirectional intimate partner violence among young adults. *Child Abuse & Neglect*, *36*(1), 40–52. https://doi.org/10.1016/j.chiabu.2011.07.007

Romero‐Martínez, Á., Lila, M., & Moya‐Albiol, L. (2019). The importance of impulsivity and attention switching deficits in perpetrators convicted for intimate partner violence. *Aggressive Behavior*, *45*(2), 129–138. https://doi.org/10.1002/ab.21802

Romero-Martínez, Á., Lila, M., Vitoria-Estruch, S., & Moya-Albiol, L. (2018). Can Attention and Working Memory Impairments of Intimate Partner Perpetrators Explain Their Risky Decision Making? *Journal of Interpersonal Violence*, 0886260518814263. https://doi.org/10.1177/0886260518814263

Schafer, J., & Fals-Stewart, W. (1997). Spousal violence and cognitive functioning among men recovering from multiple substance abuse. *Addictive Behaviors*, *22*(1), 127–130. https://doi.org/10.1016/S0306-4603(96)00012-3

Simmons, S. B., Knight, K. E., & Menard, S. (2018). Long-Term Consequences of Intimate Partner Abuse on Physical Health, Emotional Well-Being, and Problem Behaviors. *Journal of Interpersonal Violence*, *33*(4), 539–570. https://doi.org/10.1177/0886260515609582

Straus, M. A., & Douglas, E. M. (2004). A short form of the Revised Conflict Tactics Scales, and typologies for severity and mutuality. *Violence and Victims*, *19*(5), 507–520.

Straus, M. A., Hamby, S. L., Boney-McCoy, S., & Sugarman, D. B. (1996). The Revised Conflict Tactics Scales (CTS2): Development and Preliminary Psychometric Data. *Journal of Family Issues*, *17*(3), 283–316. https://doi.org/10.1177/019251396017003001

Vitoria-Estruch, S., Romero-Martínez, A., Lila, M., & Moya-Albiol, L. (2018). Differential cognitive profiles of intimate partner violence perpetrators based on alcohol consumption. *Alcohol*, *70*, 61–71. https://doi.org/10.1016/j.alcohol.2018.01.006

Westby, M. D., & Ferraro, F. R. (1999). Frontal Lobe Deficits in Domestic Violence Offenders. *Genetic, Social, and General Psychology Monographs*, *125*(1), 71–72.

Wilckens, K. A., Woo, S. G., Kirk, A. R., Erickson, K. I., & Wheeler, M. E. (2014). The role of sleep continuity and total sleep time in executive function across the adult

lifespan. *Psychology and Aging*, *29*(3), 658–665. https://doi.org/10.1037/a0037234

World Health Organization, I. T. (2017). *Violence Studies*. http://apps.who.int/violence-info/studies

Yim, I. S., & Kofman, Y. B. (2019). The psychobiology of stress and intimate partner violence. *Psychoneuroendocrinology*, *105*, 9–24. https://doi.org/10.1016/j.psyneuen.2018.08.017

Zelazo, P. D. (2020). Executive function and psychopathology: a neurodevelopmental perspective. *Annual Review of Clinical Psychology*, *16*, 431-454.

Vita

| | |
|---|---|
| Name | *Ayelet Hochman* |
| Baccalaureate Degree | *Bachelor of Arts*, *Barnard College, Columbia University, New York City*<br>*Major: Neuroscience & Behavior* |
| Date Graduated | *May, 2016* |