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Undergraduate

Sleep Deprivation vs. Alcohol Consumption: Effects on Motor Skills

A Literature Review

By Sasha Tiffany Datta

Abstract

This paper examines the motor impairment seen in sleep deprivation versus alcohol intoxication and determines if the two can be compared or not. There are two opposing ideas in the current literature. The first is that alcohol intoxication and sleep deprivation cannot be compared, and the second idea is that the two can be compared. After using the University of California, Merced's Online Library database, PsycINFO, studies were found that compared motor impairment of subjects who were intoxicated to those who were sleep deprived. Through surveying all relevant articles, it was concluded that motor impairment in sleep-deprived subjects and subjects that are intoxicated could be compared.

Introduction

Psychologists are familiar with the motor impairment caused by alcohol; however, they may not all realize that sleep deprivation can have very similar effects on motor performance. In order to bring attention to the seriousness of the two subjects, empirical studies have been conducted on both subjects to compare their effects. Hack, Choi, Vijayapalan, Davies & Stradling, found that on a steering simulator performance test, motor impairment was seen in both intoxicated and sleep-deprived individuals, however in different patterns of impairment (2001). The results from this experiment have lead to two opposing conclusions. One side argues

that motor impairment between intoxication and sleep deprivation can be compared, while the other side opposes this idea.

The first conclusion states that motor impairment and intoxication are not similar. Krull, Smith, Sinha, & Parsons, found that when measuring reaction times, “sleep deprivation had its greatest effect on...stimulus evaluation, whereas alcohol had its greatest effect on...response activation” (1993, p. 775). Both had separate impacts on different processing areas, which led the researchers to conclude that the subjects could not be compared.

Although some researchers have found differences in sleep deprivation and intoxication, other researchers have found that the two are comparable. Arendt, J.T. et al. (2001) state, “sleepiness, like alcohol, is a factor that impairs functioning at the level of the central nervous system...” (p.337). Alcohol intoxication and sleep deprivation similarly impair the central nervous system. In another study, Elmenhorst et al. (2009) compared the motor effects between the two showed “moderate, repeated sleep deprivation [and] alcohol consumption up to a BAC of approximately 0.8%... led to comparable performance impairments in the reaction time task” (p. 195). Because the central nervous system is impaired from alcohol intoxication, the neurons are delayed in relaying information back to the brain, which also slows down the subject’s reaction time (Elmenhorst et al., 2009). The similarities in impaired motor abilities can be seen in both subjects who are sleep deprived and intoxicated.

Although there is a significant body of evidence suggesting that sleep deprivation and intoxication are distinct and cannot be compared, a thorough review of recent literature demonstrates that sleep deprivation and intoxication *are*, in fact, comparable. This comparison is reasonable because both cause similar motor impairment.

Methods

Articles were gathered through the University of California, Merced's Online Library database, PsycINFO. Articles that included both alcohol intoxication and sleep deprivation in the article title were searched. To narrow down the search even more, motor impairment in the search was included along with the two previously stated topics. Once a variety of these articles were found, the search was narrowed down even more to only include articles that have been published within the last fifteen years because older studies could be proven wrong with more recent research. Experimental studies were found that compared the effects of sleep deprivation versus those of alcohol intoxication. Empirical studies that discussed the motor impairment from sleep deprivation, intoxication, and studies that contrasted the two were also discovered.

1. First Argument: Sleep Deprivation and Alcohol Intoxication cannot be compared

Reaction time to stimuli was measured in both sleep deprived and intoxicated people. Krull, Smith, Sinha & Parsons, (1993), measured each participant's event-related potentials (ERP's), which are commonly used to examine the effects of alcohol and sleep deprivation on complex behavior. Krull et al. found that sleep deprivation slowed down initiation detection of stimuli while alcohol slowed down processing and response activation (Krull, et al., 1993, p. 772). In both cases, however, the decrease of detection and processing response activity impacted motor functioning. Because these responses are delayed, motor functioning is delayed, as it takes longer to detect and respond to stimuli. These studies found that alcohol intoxication and sleep deprivation cause different cognitive impairment. Because their effects were found to alter different aspects of the

brain response, researchers concluded that sleep deprivation and alcohol intoxication could not be compared (Krull, et al., 1993).

In another study, Citek et al. found that “there [was] no evidence that [sleep deprivation] affects eye movements or motor skills assessed with [a field sobriety test]” (2011, p. 1177). Because they found that there was no evidence showing similarities between sleep deprivation and intoxication the authors concluded that the two could not be compared. Another discovery that Citek et al. made was that as alcohol intake and BAC level increases as measured by the Field Sobriety Test, so does the amount of impairment cues (2011, p. 1176). Unlike alcohol intoxication, impairment cues from sleep deprivation do not increase with 24 to 32 hours of sleep deprivation (Citek et al., 2011). Since an increase in blood alcohol concentration level increases impairment cues while sleep deprivation impairment stays constant, researchers concluded that the two could not be compared (Citek et al., 2011). Although Citek et al. came to these conclusions, their test appears to be a weak measure of motor impairment in sleep-deprived subjects. According to Rubenzer (2008), “standardized field sobriety tests are not validated...indicators of loss of normal physical functioning” (p. 307). The field sobriety test has a substantial correlation with blood alcohol concentration levels; however, when measuring motor impairment against the field sobriety test, there is no correlation. The use of the field sobriety test to compare motor impairment in sleep deprived versus intoxicated individuals proved to be a weak study due to its irrelevance in measuring sleep-deprived people (Rubenzer, 2008). Since the FST is a poor measure for comparing intoxication and sleep deprivation, the argument stating that the two cannot be compared is weak and invalid.

II. Second Argument: Sleep Deprivation and Intoxication are Similar

The opposing argument agrees that sleep deprivation can be compared to intoxication. Along with motor impairment, people who are sleep-deprived have decreased reaction time and reduced awareness of surroundings (Yegneswaran, 2007, p. 569). Similarly, alcohol intoxication diminishes cognitive and psychomotor abilities (Brumback, Cao & King, 2007, p. 1-2). The severity of these effects can be mostly seen in car fatalities. In 1997, 39% of car fatalities were from drivers who had a blood alcohol concentration of 0.1%; for sleep, fatalities occurred from as low as 1-3% to as high as 35-42% (Arendt, Wilde, Munt, & MacLean, 2001, p. 337). With such significant statistics, researchers studied the psychomotor effects from alcohol and sleep deprivation. Arendt, Wilde, Munt, & MacLean (2001), studied 18 male participants who drove on a simulated driving task at different blood alcohol concentration levels (p. 339). The researchers then compared the results to a previous study that examined simulated driving performance in one night of sleep deprivation. The final result of the experiment found that the ability to maintain speed or change lanes is affected when a subject is either under the influence of alcohol or is sleep deprived (Arendt, Wilde, Munt, & MacLean, 2001, p. 342). Because the results demonstrated that the two shared similar impairments in motor abilities, specifically in driving, psychologist concluded that the two could be compared.

Response speed has an effect on motor impairment in both sleep deprived and intoxicated individuals. Williamson & Feyer (2001) studied the effects of alcohol and tested the effects of alcohol against the effects of sleep deprivation. The study demonstrated that at a blood alcohol concentration level of 0.05% showed a decrease in response speed by 8-15% (2000, p. 651). Additionally, after 13-23 hours of sleep deprivation, reaction speed decreased by 57%

(Williamson & Feyer, 2000, p. 653). Although the severity of reduced reaction speed is different in alcohol intoxication and sleep deprivation, they still share that similar effect which impairs motor abilities and the ability to react to other stimuli. Elmenworst et al. (2009) found that sleep deprivation and an intoxication of about 0.8% led to comparable performance impairments in reaction time tasks (p. 194). The impairment of reaction time and response speed relate to motor impairment because when response to stimuli and reaction time are slow, motor response will also be slowed. For this reason, psychologists concluded that these findings reinforced evidence that showed that these two factors similarly compromise performance speed.

Conclusion

The evidence shows that motor impairment from alcohol intoxication and sleep deprivation are in fact comparable. The most observable way this comparison can be seen is from car fatalities. Falling asleep is one of the major causal factors in serious crashes (Yegneswaran, 2007, p. 569). Reaction speed reaction time, and response time are all decreased when intoxicated or sleep-deprived. All of these significantly impact the ability to drive. Since reaction and response times are decreased in intoxicated or sleep-deprived individuals, the individuals' response to braking, speeding, lane changing, and observing are all slowed down which can cause dangerous accidents. Although sleep deprivation slows down initial detection of stimuli whereas alcohol slows down processing and response activation, both ultimately lead to fatal accidents.

The first argument stating that alcohol intoxication and sleep deprivation are not comparable is a weak argument because the standard field sobriety test is solely used to determine if an individual is intoxicated or not. Using this test on a sleep-deprived individual is not an appropriate measure when trying to compare effects with intoxication

because the field sobriety test is specifically made to measure how intoxicated an individual is. Also, there is very little research that supported this side. Through research, there were only two articles found that supported this argument.

Overall, motor impairment from alcohol intoxication and sleep deprivation can be compared. Although this is true, more research must be done on the subject. The two were found to be comparable, however the levels at which they are comparable (hours without sleep and BAC levels) were not found to be consistent in all studies. It is important to note that the two are comparable because it is known that a significant amount of car accidents have occurred due to both sleep deprivation and alcohol intoxication. The only difference is that law enforcement can legally punish people who are found to be intoxicated behind the wheel. If intoxication and sleep deprivation are comparable, why is there no legal punishment for being sleep-deprived behind the wheel? These are some of the aspects of alcohol and sleep deprivation that must be thought of and studied further in the future to ensure more safety for the driver and everyone else on the road.

References

- Arendt, J.T., Wilde, G.J.S., Munt, P.W. & MacLean, A.W. (2001). How do prolonged Wakefulness and alcohol compare in the decrements they produce on a simulated driving task? *Accident Analysis and Prevention*, 33, 337-344.
- Brumback, T., Cao, D., King, A. (2007). Effects of Alcohol on Psychomotor Performance and Perceived Impairment in Heavy Binge Social Drinkers. *Drug Alcohol Depend.* 91(1), 1-17.
- Citek, K., Elmont, A. D., Jons, C. L., Krezelok, C. J., Neron, J. D., Plummer, T. A., & Tannenbaum, T. (2011). Sleep deprivation does not mimic alcohol intoxication on field sobriety testing. *Journal of Forensic Sciences*, 56(5), 1170-1179.
- Dawson, D. & Reid, K. (1997). Fatigue, Alcohol and Performance Impairment. *Nature*, 388, 235.
- Elmenhorst, D., Elmenhorst, E.M., Luks, N., Maass, H., Mueller, E.W., Vejvoda, M., Wenzel, J., & Amsel, A. (2009). Performance Impairment During Four Days Partial Sleep Deprivation Compared with the Acute Effects of Alcohol and Hypoxia. *Sleep Medicine*, 10, 189-197. Retrieved from http://ac.els-cdn.com/S1389945707004480/1-s2.0-S1389945707004480-main.pdf?_tid=c037cd7c-a3f8-11e3-9019-00000aab0f02&acdnat=1393977632_18f9bbddc951f6946beb0f0014527095.
- Hack, M.A., Choi, S.J., Vijayapalan, P, Davies, R.J.O., Stradling, J.R. (2001). Comparison of the effects of sleep deprivation, alcohol and obstructive sleep apnea (OSA) on simulated steering performance. *Respiratory Medicine*, 95-7, p. 594-601.

- Krull, K. R., Smith, L. T., Sinha, R., & Parsons, O. A. (1993). Simple reaction time event-related potentials: Effects of alcohol and sleep deprivation. *Alcoholism: Clinical and Experimental Research*, 17(4), 771-777. Retrieved from <http://search.proquest.com/docview/618436576?accountid=14515>.
- Rubenzler, S. J. (2008). The standardized field sobriety tests: A review of scientific and legal issues. *Law and Human Behavior*, 32(4), 293-313. doi: <http://dx.doi.org/10.1007/s10979-007-9111-y>.
- Vakulin A; Baulk SD; Catcheside PG; Anderson R; van den Heuvel CJ; Banks S; McEvoy RD. Effects of Moderate Sleep Deprivation and Low-Dose Alcohol on Driving Simulator Performance and Perception in Young Men. *SLEEP* 2007;30(10): 1327-1333.
- Williamson, A.M. & Feyer, A.M. Moderate Sleep Deprivation Produces Impairments in Cognitive and Motor Performance Equivalent to Legally Prescribed Levels of Alcohol Intoxication (2001). *Professional Safety*, 46 (1), 17.
- Yegneswaran, B. (2007). Do Sleep Deprivation and Alcohol have the Same Effects on Psychomotor Performance? *Journal of Psychosomatic Research*, 63 (6), 569-572. <http://dx.doi.org/10.1016/j.jpsychores.2007.06.020>.

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