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Group Characteristics Impact on Bicycling when Alcohol Intoxicated

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Abstract

There are many studies conducted on cognitive performance and of different aspects that can affect the performance. However, the literature review reveal that there is a knowledge gap in the area of measurements for bicycle stability and in how bicycle stability is affected during acute alcohol intoxication. The aim of this study is, therefore, to investigate if different group characteristics such as cycling experience, physical activity, sensation-seeking, or previous alcohol habits have an effect on bicycle performance or executive functions during acute alcohol intoxication. The method of the study was to measure stability while bicycling on a tread-mill and give participants doses of alcohol until a Breath alcohol concentration (BrAC) level of approximately 0.8‰ was reached. The results showed that cognitive performance was almost unaffected for the different groups studied. The results of bicycle stability were almost equal in effect of time among the four different group characteristics in both Roll and YAW measurements. Three of the group characteristics showed a main effect or a tendency for interaction effect of group by time. The conclusion is that the measure of Roll, the vertical orientation on a bicycle, maybe is the most effective stability measurement for bicycles.

Keywords: *Bicycle stability, acute alcohol inoxication, group charachteristics, cognitive performance, executive funciton*

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List of abbreviations

Abbreviation	Meaning
ANOVA	Analysis of Variance
AUDIT	Alcohol Use Disorder Identification Test
BAC	Blood alcohol concentration
BrAC	Breath alcohol concentration
HBRR	Handlebar Reversal Rate
Hz	Hertz
LIVI	Lugnets Idrottsvetenskapliga Institut
MSB	Swedish Civil Contingencies Agency
MSe	Mean Square Error
SD/Std	Standard deviation
SSS-V	Sensation Seeking Scale form V
SWRR	Steering Wheel Reversal Rate
TPB	Theory of panned behavior
VTI	Swedish National Road and Transport Research institute

1. Introduction

In Europe, there are approximately 195,000 alcohol-related deaths every year (Siliquini, Bert, & Manzoli, 2013), and between the years 2010 to 2018, the number of bicycle fatalities in Europe was 19,450 (Adminaité-Fodor & Jost, 2020). As a lack of reliable data from the European study, the exact number of alcohol-intoxicated bicyclists that have been killed in traffic is hard to establish. However, in one-third of fatally injured bicyclists aged fifteen or older, an elevated blood alcohol concentration (BAC) level was found (Li, Baker, Smialek, & Soderstrom, 2001). Statistics from Swedish Civil Contingencies Agency (MSB) have shown that every year more than 23 000 people in Sweden seek care at an emergency hospital after the incident as a cyclist. There are more males (56%) than females (44%) that are involved in accidents, and it is most common between the ages of 14-20. The risk of dying in a bicycle accident increases with age. Eighty-two percent of bicycle accidents are classified as single accidents and happens in urban areas in the spring and fall (MSB, 2013). The literature shows that there is in general a greater risk of getting hurt in traffic when people are alcohol intoxicated than when people are sober (Asbridge et al., 2014; Martínez-Ruiz et al., 2013).

For over two centuries humans have been riding bicycles (Cain, Ashton-Miller, & Perkins, 2016), riding bicycles is a sustainable way of transportation (MSB, 2013) and has a positive impact on the public health (Trafikverket, 2014). Cycling is also a perfect way to get around in big cities whit limited parking space for cars, and it is also an easy way to get from door to door (Trafikverket, 2014). Since the late 1980´s the number of deaths in bicycle accidents has decreased, but the number of badly wounded cyclists has increased, but this can vary between regions in the country of Sweden (MSB, 2013). The most common diagnosis after a bicycle accident is head trauma (concussion) or fracture and contusion in the upper part of the body like arms and shoulders (MSB, 2013; Niska & Eriksson, 2013). Alcohol intoxication is a contributing factor to why cyclist injure themselves or die in traffic accidents (Wallén Warner & Sörensen, 2019). The Swedish Transport Administration, together with other state-, municipalities, and other interest organizations, wanted to create a common strategy for safer cycling, included as a part of the project called Vision Zero. This is an ongoing project that lasts between the years of 2014-2020 (Trafikverket, 2014).

In Sweden, just as in other countries there is a law that states the limit of how high BAC level you can have in your blood system when you are driving a car or other motor-driven vehicles, that level lies on 0.2‰ (European Transport Safety Council, 2019). But there is no such law or limit that says you can't ride a bicycle when you are drunk that also includes the more and more popular power-driven bicycles as well (Warner, Forsman, Gustafsson, Ihlström, & Nyberg, 2017). According to social norms, it is acceptable to take the bicycle home from a party or a night out with friends, even if you have been drinking alcohol. Drinking alcohol can cloud our judgment, disrupt the performance of our mental capacity, and make people take riskier decisions. For a cyclist, the motor activity/stability is more problematic when a person has been drinking alcohol and is in greater risk to be hurt if they have alcohol in their blood system than if they don't (Asbridge et al., 2014; Hartung, Mindiashvili, et al., 2015; Martínez-Ruiz et al., 2013).

Previous studies have established that social drinkers usually have a common consumption of BAC level that lies a little bit over 0, 7 parts per thousands (Spinola, Maisto, White, & Huddleson, 2017). In an investigation of statistics from Massachusetts Hospitals discharge unit, positive alcohol test was present in 16 % of the cases of adults involved in serious accidents with bicycles between the years of 1993-2000 (Rosenkranz & Sheridan, 2003). There have been many early studies that have indicated that drinking alcohol is a contributing factor for bicycle accidents, but there is not so much knowledge or research on the connection between alcohols impact on bicycling (Warner et al., 2017). Compared to drivers in a motor-driven vehicle, a cyclist is more vulnerable to accidents in the daily traffic, but still, there has been more research about drivers in motor-driven vehicles.

2. Theoretical Background

The purpose of this chapter is to present the theoretical background which this study is based on. The topics that will be addressed in this chapter are cognition, stability, and group characteristics.

2.1 Cognition

Cognitive function is a term that includes different processes to perceive the world, and cognitive functions help us operate in the world and can be both conscious and unconscious (Coviello, 2020; Weisberg & Reeves, 2013). Cognition and cognitive function include multiple cognitive processes that make our brain process different kinds of information, i.e., thinking, language, memory, reason, attention, or perception. With the help of these cognitive processes and by constantly learning new skills, humans can continue to improve our performance on cognitive tasks throughout our lives (Coviello, 2020). The most common cognitive functions that are tested in various cognitive tests and experimental studies are executive functions, memory, attention, and processing speed (Coviello, 2020). This study is focusing on the executive function that is a term that includes different sets of processes that monitor goal-directed behaviors. These goal-directed behaviors include many different processes such as working memory, error detection, planning, problem-solving, attention, and reasoning, and the processes are mainly located in the prefrontal cortex of the human brain (Gazzaniga, Ivry, & Mangun, 2014; Weisberg & Reeves, 2013).

For this study, the working memory is the most interesting of the different processes that are included in the executive function. Our memory is storage; it is a kind of workplace, where we regulate our moment to moment activities. Memory consists of three structures; sensory memory, short-term/working memory, and long-term memory (Gazzaniga et al., 2014). The sensory memory is where the first audio and visual information is stored so that a person can remember what happened right before. The sensory memory has a capacity from milliseconds to seconds, before the working memory system sets in. Our working memory act as short-term storage where our ability to remember and process information is located. The working memory is for a short period of time, approximately from ten seconds up to one minute, and it has a temporary and limited capacity, so it can only hold seven (+-2) items, and it is readily available for conscious awareness. The capacity of the working memory can have a greater span if the information is familiar or meaningful compared to when the information is unfamiliar to the person. An example of meaningful information can be letters or words, and an example of unfamiliar information can be random sounds or shapes. Working memory has a key role in many cognitive processes because it consolidates our memories to long-term memories. The long-term memory consists of two parts, and one part is the declarative memory system that is available for our consciousness and includes personal knowledge and knowledge of the world. The second part is the non-declarative memory system, this includes cognitive and motor skills, and these are not available for conscious reflection (Gazzaniga et al., 2014; Weisberg & Reeves, 2013).

There are multiple ways to measure the executive function processes, such as the working memory capacity. One example is the Wechsler Adult Intelligence Scale (WAIS-R). WAIS-R includes a forward and backward digit-span test (Gundersen, Grüner, Specht, & Hugdahl, 2008). The Wechsler Memory Scale (WMS) is another example and comes in different versions, which also includes a backward digit span test where the subject must repeat a sequence of numbers in reversed order (that have been read to them by the examiner) and the numbers increase with one digit every time the test is completed. The backward spatial span test is a similar version (but spatial), and the test subject needs to repeat a sequence of tapped cubes that the examiner has tapped, but in a reversed order. A Letter fluency task is included as well, and a test subject is asked to in 1 minute to name as many words as they can with a specific letter as the first letter (Parada et al., 2012). But one of the most popular tests that have become a standard measurement of working memory capacity is the N-back task (Jaeggi, Buschkuehl, Perrig, & Meier, 2010; Kane, Conway, Miura, & Colflesh, 2007). The purpose of using the N-back task in this experiment is to investigate how acute alcohol intoxication and executive function are related to bicycling performance.

2.1.1 N-back task

The popular and standardized cognitive working memory measure, the N-back task have originally four load factors; the 0-back, 1-back, 2-back, and 3-back (Jaeggi et al., 2010; Kane et al., 2007). In the N-back task, the participant is presented with a random sequence of letters one at the time, which include letters from the whole International Phonetic Alphabet. The test subject is required to remember if the letter in the random sequence matches the letter that appeared *n* items (0-back to 3-back) ago (Kane et al., 2007). The N-back task is used on computers, and the test subject will answer YES or NO by pressing two different buttons on the keyboard if the letter matches the target letter from *n* items ago. When the test subject is presented a random letter, the answer could be both YES and be correct (if the random letter was the same as the target letter) and No and also be correct (if the random letter was not the same as the target letter). Hence, the N-back can have four different answers, hit, miss, correct rejection, and false alarms. So if the test subject is presented with a C and press YES and C was the target letter *n* items ago, it will be classified as a hit. If the test subject had instead pressed No and the C was the target letter *n* items ago, it would have been a miss. If the test subject was presented with a C and the target letter *n* items ago was not a C, and the test subject pressed NO, the result is a correct rejection. If the test subject instead answered YES when a C was presented and the target letter *n* items ago was not a C, the answer would have been a false alarm. These four possible outcomes of the N-back task can be recalculated into a d-prime value. The d-prime value is a statistic that is used in signal detection theory. The d-prime is estimated by the hit rate and the false alarm rate from the test (Wickens, 2001). The basic idea to use d-prime value is to create a sensitive measure of a valid performance. If a test subject always pressed yes, they would have a perfect score on hits, but at the same time, they would have a lot of false alarms. Such a strategy must be controlled for, and the d-prime is a formula that considers test subjects different strategies to press only either YES or NO buttons when they are unsure.

2.2 Stability

To ride a bicycle after alcohol consumption is not a new phenomenon, and there have been numerous studies about how alcohol affects cognitive performance, how stability is affected by alcohol in motor-driven vehicles, and about stability when riding a bicycle. However, there has been almost no research on bicycling stability during alcohol intoxication.

A study conducted by Hartung et al. (2015) aimed to determine the margin for the inability to ride a bicycle when alcohol-intoxicated is, however, one of the few studies on the topic. The test included 78 participants, 37 females and 41 males, and the subjects were in the ages of 18-56. Practical cycling tests were performed under real-life conditions. Attention to reaction tests such as how long it took to read a 50-word text, and medical examinations (with a Draeger 6510 Breathalyzer were performed at different BrAC levels) was also included in the experiment. The result from the study revealed that there is already a gross motoric disturbance at a blood alcohol concentration of 0, 8‰ compared to a sober state. The cyclist motor stability was even worse when the BrAC level was at 1.4‰, and at this level, none of the participants could achieve or outmatch their driving on the test course in a sober state (Hartung, Mindiashvili, et al., 2015). The ability to ride a bicycle is also slightly negatively affected the day after a high level of alcohol consumption, compared to a sober state (Hartung, Schwender, et al., 2015). One of the questions raised in this work is how different individuals are affected, i.e., how can familiarity with alcohol consumption, or bicycling experience, or other important group characteristics be related to the instability that acute alcohol consumption can produce.

2.2.1 Steering Wheel Reversal Rate

Steering Wheel Reversal Rate (SWRR) is a metric that is used to measure stability in cars, and the SWRR is usually included in the research of road safety. The term steering wheel reversal describes how the steering wheel moves or turn from counterclockwise or clockwise direction or vice versa from a current movement direction (Savino, 2009). These reversals in the driving pattern are often present when a driver is distracted with another secondary task or if the drivers' performance is affected while the primary task is driving the car. Some examples can be talking or texting on the phone, changing the radio station, eating, etc. These reversal movements are measured when they go from the original degree to another degree and then back to the original degree (or angular value); these are called gap sizes. The SWRR is measured by the number of times per minute the steering wheel changes direction that is larger than a certain gap size (Kountouriotis, Spyridakos, Carsten, & Merat, 2016). To determine when these reversals should be measured, a gap size must be determined. In the literature, the most reported gap size from cars is between 0.5-10 degrees (Markkula & Engstrom, 2006; Savino, 2009) The SWRR consist of three different measurements; the Roll rate, YAW rate, and pitch rate. Roll rate is measured in a vertical orientation (the balance in sideways of the bicycle), the YAW rate is measured in a lateral orientation (left and right on the handlebar), and the pitch rate is measured by longitudinal (ups and downs) of the orientation.

A car driving study that aimed to explore how different alcohol dosage affected curve driving by using SWRR showed that alcohol affects the steering behavior when driving in curves, the participants drove both faster and more unstable (Z. Li, Li, Zhao, & Zhang, 2019). Even if the SWRR is a well-used measuring when measuring car stability, there is a big difference between driving a car and riding a bicycle. The most evident difference is the number of wheels, a car has four wheels, and a bicycle has two wheels. Therefore, cyclists need to control their balance in a different way compared to drivers in a car. The SWRR often uses the YAW measurement to measure the steering wheel input from the drivers in terms of degrees. A bicyclist does not have a steering wheel. The bicyclist uses a handlebar and needs to control

YAW (left and right with the handlebar) but also Roll, where the bicyclist uses their body to lean from right to left when needed. The purpose of this experiment was, therefore, to develop a sufficient measurement for bicycling stability that included both Roll and YAW measures and at different gap sizes, in this case, the Handlebar Reversal Rate (HBRR). The question raised is to understand which measure and gap size that is important for bicycling stability and use the principles behind SWRR for another vehicle type with different characteristics when it comes to stability.

2.2.2 Bicycling and Alcohol Intoxication

The Swedish national road and transport research institute (VTI) has conducted multiple studies on the safety of cyclists, they have investigated the statistics of a previous accident, for example. Together with multiple other state departments, VTI wanted to create a common model for a safer environment for the cyclist in the daily traffic. Later on (2017), researchers at VTI started to investigate the relationship between bicycling and alcohol (Wallén Warner et al., 2018; Wallén Warner & Sörensen, 2019; Warner et al., 2017) and the results revealed that there is too little knowledge of people's behavior and views of cycling during acute alcohol intoxication. There is a huge need for continuing research in this field.

In another study by VTI, the authors examined how people's beliefs, subjective norms, and perceived behavioral control, influence the decision to take the bike after drinking alcohol. One thousand eight hundred questionnaires were sent to a random selection of participants between the ages of 18-65 from all over the country. The study's results were based on answers from 196 participants, 56 % of females and 44 % males, and the authors concluded that alcohol intoxication is a contributing factor to cyclist death or injuries in traffic accidents. It also established that people could be influenced by some external factors to take the bicycle when alcohol-intoxicated, such as little traffic on the roads the time that they would cycle or that other people expected them to cycle after drinking alcohol because they brought the bicycle with them to an occasion (Wallén Warner & Sörensen, 2019). These studies reveal that people use the bicycle as a way for transportation and especially after consuming alcohol, and the studies highlight the importance of understanding bicycling performance during acute alcohol intoxication.

Bicycling during acute alcohol intoxication is considerably associated with an increased risk of fatal or severe injuries and the risk increase along with the BAC level. In an alcohol level of 0.8 g/l and higher, a bicyclist has a heightened risk of twenty percent to sustain serious or fatal injuries (Li et al., 2001). A study conducted in Spain examined nineteen hundred road crashes between the years of 1993-2009 that involved cyclists and other vehicles. The results showed that the use of a substance (alcohol or drugs) increased the risk of any kind of crash. The risk increased especially for cyclists involved in single accidents (Caird, Johnston, Willness, Asbridge, & Steel, 2014; Martínez-Ruiz et al., 2013).

2.3 Group Characteristics

Because of previous almost non-existing research on bicycling stability and acute alcohol intoxication and how that impacts our cognitive performance (here executive functions), an exploratory approach is taken. It is difficult to predict which, and how different individual characteristics affect the stability when alcohol intoxicated. Four characteristics were chosen to be investigated further. These four characteristics were chosen based on the understanding that familiarity, skill, or experience are often strongly related to how people perform on tasks. The idea was to explore how familiarity with bicycling would relate to the ability to bicycle during acute alcohol intoxication. Second, it is not known how physical fitness plays a role in the familiarity of bicycling during alcohol intoxication. Bicycling that is active transportation needs a physical input from the individual, especially when alcohol intoxicated. Third, there is common knowledge that alcohol has an impact on regulating self-control (see sensation-seeking below), and individuals that are high on risk-taking might bicycle when intoxicated more often than individuals that are low on risk-taking. Finally, is familiarity with alcohol consumption related to the ability to bicycle during alcohol intoxication? If a subject is used to the situation of being intoxicated, their bicycle stability might be increased. Therefore, the purpose of this study was to explore how acute alcohol intoxication and stability is related to these four relevant characteristics of bicyclist, i.e., cycling experience, physical fitness, risk-taking personality and alcohol consumption habits. It is not evident in the literature if these four characteristics play an active part in stability performance; however, the literature suggests that familiarity is important.

2.3.1 Cycling Experience

When searching for previous studies related to cycling and cognition, almost all the articles included driving or cycling and the use of mobile phones, which creates a higher mental workload to distract the driver or cyclist (de Waard, Schepers, Ormel, & Brookhuis, 2010).

These kinds of studies have been conducted on both drivers that drive cars and people that are using regular bicycles. However, the cyclist uses auditory stimuli, such as headphones with music as a distraction more often than drivers do (Ahlstrom, Kircher, Thorslund, & Adell, 2016).

There is not much literature that compares skilled cyclist to novice cyclist and how the bicycle is handled by the cyclist, i.e., an individual's stability when cycling. This knowledge may be an important factor to examine when an individual is riding a bicycle during acute alcohol intoxication. A study by Cain et al., (2016) compared balance performance (stability) among skilled cyclists and novice cyclists. The results showed that at low speed, both skilled and novice cyclists performed similarly in balancing tasks. It also showed that at higher speeds skilled bicyclist efficiently used their body to increase their stability (Cain et al., 2016). The skill of riding a bicycle is just one of many things that that can impact bicycle stability. Literature suggests that the comfort of the bicycle, i.e., handlebar height and handlebar style can make a difference in subjective discomfort and make the bicycle feel more unstable (Chen & Liu, 2014). The purpose of including cycling experience was to establish if the familiarity of bicycling would affect the stability when cycling during acute alcohol intoxication.

2.3.2 Physical Activity

There are numerous things that can impact the performance of executive functions, and one of them is physical activity and physical exercise. Physical activity is a planned, repetitive, deliberate, and structured activity to maintain or improve physical fitness (Hötting & Röder, 2013). Physical exercise is a subcategory of physical activity and includes; Aerobic and anaerobic exercise. Aerobic exercise that aims to maximize the oxygen uptake and increase our cardiovascular health, for example, swimming, walking, and cycling. The anaerobic exercise aims to increase the short term muscle strength, interval training, and lifting weights, for example (Hillman, Erickson, & Kramer, 2008). The research and the results on physical activity and the effect that it have on cognitive functions varies. There are many variables involved, such as the intensity of the exercise or what kind of exercise that is being carried out, when the test is conducted, and what kind of test is being used. In a large review by Chang, Labban, Gapin, & Etnier (2012) that analyzed 79 articles with the purpose of establishing how physical activity can affect cognitive functions differently. This review included data from 2072 participants that were between the ages of 20-30 and included 44 different cognitive performance tasks. The tests were taken in three stages, during exercise, immediately after exercise, and after a time-lag (approximately 20 minutes). The results showed varying results; all the three stages of exercise showed a small increase in cognitive performance. The highest effect was measured in executive functions and after a time-lag from the exercise. The results also showed that the fitness level of the participant had a moderate effect on cognitive performance during exercise and immediately after exercise, whereas the high fit participants had better performance on a cognitive test than low fit participants (Chang, Labban, Gapin, & Etnier, 2012). The question is if this effect that exercise has on executive function still evident during acute alcohol intoxication.

When it comes to the relationship between physical activity and bicycling stability, the research results are more unclear. It is, therefore, hard to predict how physical fitness can affect stability during acute alcohol intoxication.

2.3.3 Sensation Seeking

Sensation seeking is a personality trait that can be characterized by an individual's tendency to seek out novel sensations and experiences and can be influenced by both environmental and biological factors. This personality trait may include participation in risky physical activities, potentially addictive activities, and substance use (Hittner & Swickert, 2006). Individuals with a high sensation seeking tend to seek activities with a higher level of arousal i.e., gambling and dangerous sports that include a more risk-taking behavior (Michel et al., 1998). Individuals with a high level of sensation seeking have shown to consume alcohol more frequently and in a higher quantity, and the effect size of sensation seeking and alcohol consumption are stronger in males (Hittner & Swickert, 2006). Humans will base their perception on safety and adapt their risk-taking behavior (Gamble & Walker, 2016). A computer-based training study that aimed to increase young drivers' risk awareness concluded that the drivers increased their risk awareness, however, just in the short term (one to two weeks) after they completed their training (Fisher et al., 2002). There have also been multiple studies regarding the hypothesis if bicycle helmets are associated with risk compensation. The results showed that there is both negative correlation (Esmaeilikia, Radun, Grzebieta, & Olivier, 2019; Radun, Radun, Esmaeilikia, & Lajunen, 2018) and a positive correlation (Billot-Grasset, Amoros, & Hours, 2016; Gamble & Walker, 2016) between using a bicycle helmet/safety equipment and risk compensation.

The sensation seeking scale (SSS) was invented by Marvin Zuckerman in the '60s. The SSS was developed as an attempt to measure the concept of an optimal level of stimulation in terms of arousal, a measurement for individual differences for the need of arousal and stimulation (Roberti, Storch, & Bravata, 2003; Waters & Waters, 1969; Zuckerman, Kolin, Price, & Zoob, 1964). The SS scale originally had 54 questions but was revised, and the latest version of the scale is the SSS-V, and it consists of 40-item forced-choice questions. The forty questions are divided into four subgroups: Thrill sensation seeking, social sensation seeking, visual sensation seeking, and antisocial sensation seeking, with ten questions in each group (Waters & Waters, 1969; Zuckerman et al., 1964; Zuckerman & Link, 1968). In sensation seeking, the SSS-V is the most commonly used method (Viken, Kline, & Rose, 2005). Multiple studies have shown that the total scoring of the test differs among gender and age. A higher total score indicate a higher level of risk taking behavior. Generally, males have a higher total score than females, and the scores decreases with age (Arnett, 1994; Hittner & Swickert, 2006; Michel et al., 1998; Zuckerman, Eysenck, & Eysenck, 1978). The purpose of including the risk-taking instrument SS scale as a classification in the study was to investigate if individuals with high-risk taking were bicycling less or more stable than low risk-taking individuals. The bicycle task used for bicycling in this experiment was quite difficult (see method section for details), and the prediction was that individuals with high-risk tendencies would not concentrate as much on keeping the perfect balance and not stand a higher instability.

2.3.4 Alcohol Use Disorder Identification Test (AUDIT)

The World Health Organization's Alcohol Use Disorder Identification Test (AUDIT) is a ten-item self-report measure that is used for screening of risky drinking habits in the adult population, and it is used in both clinical and community settings (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Lyvers & Tobias-Webb, 2010). The AUDIT questionnaire includes three different types of questions; three questions about alcohol consumption, three questions about alcohol dependence, and four questions that were about alcohol-associated problems. Each question has multiple choice answers and is scored from 0-4, the total score is a sum from all the ten questions, with a possible range from 0-40. The total scores can be divided into four zones or risk levels, and the scoring for each zone is different for males and females. Research indicates that there is a gender difference in AUDIT and that males scores generally higher than females on AUDIT (Lyvers & Tobias-Webb, 2010: see Table 1 below). Each zone has a different interpretation of how to handle alcohol consumption.

TABLE 1.

DIFFERENT ZONES AND INTERPRETATIONS OF AUDIT.

Risk Level	Scores	Interpretations
Zone I	Male 0-7 Female 0-5	Indicating a low to no level of alcohol consumption.
Zone II	Male 8-15 Female 6-13	Alcohol usage in excess of low risk guidelines – behavior need education and brief intervention.
Zone III	Male 16-19 Female 15-17	A harmful or hazardous alcohol consumption – Can be managed with counseling and monitoring, if the subject not respond a possible alcohol dependence may occur.
Zone IV	Male 20 + Female 18 +	Should be referred to a specialist for evaluation and treatment for alcohol dependence.

Source: The Alcohol Use Disorder Identification Test – Guidelines for use in primary care., (Babor et al., 2001).

Literature suggests that alcohol can affect performance in cognitive executive functions. Alcohol intoxication may lead to deficits in our self-regulation behavior, and that can make people take riskier decisions. Alcohol can disrupt the performance of cognitive executive function tests; however, this is not always the case (Spinola et al., 2017). Different BAC levels (Gundersen et al., 2008; Spinola et al., 2017), naturalistic settings (Lyvers & Tobias-Webb, 2010), and even different age groups (Boissoneault, Sklar, Prather, & Nixon, 2014) are things that can affect how alcohol impacts our cognitive performance. Different drinking habits may also be a thing that affects our cognitive performance. A study that was conducted among male and female university students in Spain investigated the relationship between Binge drinking (BD) (heavy episodic drinkers) and persons with normal drinking habits, and cognitive executive functions. The study concluded that heavy episodic drinkers were associated with poorer performance in executive function tests (Parada et al., 2012). Literature can also establish that there can be a difference between genders in some areas, heavy drinking females can show more deficits in response inhibition than heavy/ light drinking males or light drinking females (Nederkoorn, Baltus, Guerrieri, & Wiers, 2009).

3. Research Introduction

This section will present the purpose of the study, the research statement, the research questions and predictions, and the limitations of the study.

3.1 Purpose

This study is done by the Swedish National Road and Transport research institute (VTI) on behalf of the Swedish Transport Administration, and both are located in multiple cities around Sweden. VTI is an independent international research institute in the transport sector. VTI has the main purpose of pursuing research and development that is related to infrastructure, traffic, and transport. VTI is an interdisciplinary organization that conducts commissioned research. The Swedish Transport Administration is the organization that is responsible for the overall long-term infrastructure planning of road, rail, sea, and air transports.

The aim of the study is to investigate the effect of acute alcohol intoxication on bicycling performance, executive functions, and abilities. The measurements that were obtained in the study were related to attitudes and intentions that were found in a previous survey study (Wallén Warner & Sörensen, 2019). That study showed that despite being alcohol intoxicated and knowing that their stability, executive function, and the bicycling capabilities are not as good as it used to be, the participants would still take the bicycle. The aim of this study is to investigate if the following group characteristics; cycling experience, physical activity, Sensation seeking, or previous alcohol habits have an effect on bicycle performance or executive functions when acute alcohol intoxicated.

3.2 Research Statement

There has been a lot of research conducted in the area of drinking and driving, or studies with driving and texting/talking on the phone. To drive a motor-driven vehicle has a different legal limit of BrAC levels in different nations, and in Sweden, the limit is set at 0.2‰. In many countries in Europe, the legal limit of BrAC is at 0.5‰, and in the UK, the legal limit to drive a motor-driven vehicle is set at 0.8‰ (European Transport Safety Council, 2019). There is no legal limit that forbids people to ride a bicycle when intoxicated unless there is reckless behavior involved. It is not socially accepted by society to drink and drive a car or other motor-driven vehicles, but it is socially acceptable to take the bicycle home when alcohol intoxicated. Alcohol intoxication has shown to have a negative effect on executive functions that strongly influence the behavior of self-regulation, such as working memory, inhibition, and set-shifting these effects may lead to more risk-taking behavior (Spinola et al., 2017). Alcohol intoxication has also shown to create a motoric disturbance at a BrAC level of 0.8‰ when compared to a sober state (Hartung, Mindiashvili, et al., 2015). Yet there has been almost no research on bicycling stability in relation to acute alcohol intoxication, and how that impacts our cognitive performance (here executive functions).

3.3 Research Questions and Predictions

1. Will there be any differences in the performance on the N-back task during the experiment?
2. Will there be any differences between males' and females' performance on the N-back task?
3. Will previous alcohol habits affect the performance on the N-back task?
4. Will previous cycling habits affect bicycle stability during acute alcohol intoxication?
5. Will the participant's physical activity level affect bicycling stability during alcohol intoxication?
6. Will the participant's level of sensation seeking affect the bicycling stability during acute alcohol intoxication?

The predictions for this studies research question is:

1. Previous research has shown that executive function will decrease during alcohol consumption (Nederkoorn et al., 2009), but research has also shown that there will be no differences in performance up to 0.6‰ (Spinola et al., 2017). So the prediction is, there will be a difference in performance during the experiment at higher BrAC levels.
2. Most of the research indicates that there will be no significant difference between males and females' performance on executive function tests when alcohol-intoxicated (Casbon, Curtin, Lang, & Patrick, 2003).
3. Research has shown that heavy episodic drinkers or Binge drinkers have poorer performance in executive function tests (Parada et al., 2012). But because of a limited number of participants and that this was not a criterion for participating in the study, the results will not show any significant difference in performance on N-back task.

4. Research has shown that there is a difference in stability among skilled and novice cyclists. However, this effect is only at higher speed (Cain et al., 2016).
5. It is unclear if the level of physical fitness has an impact on stability; there is too little if any research on the topic.
6. Individuals with a high level of sensation seeking tend to seek more risk-taking activities (Hittner & Swickert, 2006); however, the effect on stability is unclear.

3.4 Delimitations

Because the study was already planned and conducted, the different group characteristics that are the center of this study are of explorative nature. Because of the limited amount of research in the area of alcohol-intoxicated bicyclists and what consequences alcohol intoxication can bring in multiple areas, a lot of data was collected at the same time. Because of the small number of participants in the study (twenty-two) and the uneven number of participants in the different groups (experimental group (eighteen) versus the control group (four)), the statistical power is rather low.

Other delimitations included finding out what measurements should be used to measure stability in a bicyclist. The SWRR measure of Roll and YAW is, for the most part, used in studies of driving a motor-driven vehicle, such as a car. An unfamiliar bicycle for the participants and an unfamiliar setting can question the validity. Bicycling on a tread-mill is not a natural task. All the participant was unfamiliar with bicycling on a tread-mill. The validity of the BrAC measuring equipment could be questioned, and the limited level of BrAC tested (Limited because of time and ethical principles). It may also be a delimitation because of the different types of alcohol that was used because of the different ingredient. The final delimitation is the possible learning aspect because of repeated measures.

4. Method

This chapter will present the method of the study. The chapter will include sections about participants and ethics, materials, design, procedure, and the analytical methods.

4.1 Participants and Ethics

There were a total of 22 participants that conducted the study, with 55 % women and 45 % men with a mean age of 27.6 years (SD = 2.98, range = 22 - 32). Four of the participants conducted all the parts of the study but did not drink alcohol, so they served as control participants; of these four control participants, 75 % were women and had a mean age of 25.5 years (SD = 4.5, range = 22-32). Eighteen participants conducted the whole study with alcohol; of those, there was 50 % women and 50 % men with a mean age of 28.5 years (SD = 2.25, range = 25 - 32). The participants in the study were recruited through a Facebook advertisement. The potential participants were then directed to a dedicated VTI website where the first step of requirement criteria for participation was checked. All of the required criteria for participation in the study, as set out in the approved ethics committee decision, were met. The participants screening criteria included a minimum age of 20 years old, no history of alcohol or substance addiction, and good health for cycling and measured alcohol consumption.

The selection of participants included several steps, starting with the initial screening mentioned above. Moreover, the participant criteria included living within the town of Falun (to limit taxi costs after the end of the experiment); women were not to be pregnant at the time of the experiment (to avoid possible foetus damage from the alcohol) and were offered the possibility of using a pregnancy test. Other requirements included an experience of cycling and drinking alcohol. The participants also needed to be able to stay onsite for approximately four to six hours so that their post-experiment safety and sobriety could be monitored. When all of the selection criteria were met, the participants were booked in. The participants that completed the whole study with alcohol consumption were compensated for their participation with approximately € 150. The control participants were compensated for their participation with approximately € 75. All participants were also offered a cost-free taxi ride home after the study ended.

This study was approved by the Swedish Ethical Review Authority with the following approval number 2019-01268. All participants gave their written consent before the experiment started.

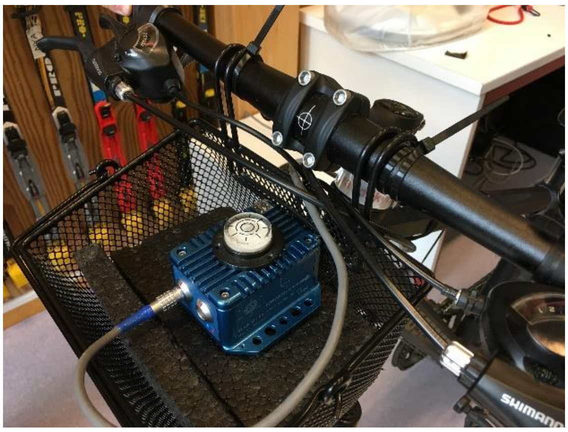
4.2 Materials

In this section, all the materials used in the experiment and will be presented. The experiment was carried out in the sports laboratory at Lugnets Idrottsvetenskapligt Institut (LIVI) in cooperation with Dala Sports Academy in Falun. The data collection was conducted under 2019 during week 28 and week 44. The section materials include, cycling and stability equipment, stability measures, breathalyser equipment, ability ratings, N-back task, pre-surveys, post-surveys.

4.2.1 Cycling and Stability Equipment

The participants cycled on a motor-driven treadmill (Saturn 450/300rs; h/p/Cosmos sports & medical GmbH, Nussdorf-Traunstein, Germany) that had a surface area of 13.5 m^2 and could be tilted to increase physical workload (if necessary). The treadmill's general specifications comprised a running surface of 450 x 300 cm, a speed range between 0 - 40 km/h, an elevation from -5 to +25 % (-2.8 - 14.0°), motor system 30 kW (40.8 HP), and a re-enforced very thick rubber running belt that was also suitable for use with ski rollers, ski poles, spike shoes, as well as bicycles.

The participants cycled on a moderate classed mountain bike (Biltema Yosemite X-dirt 27.5* 2.8-inch wheels) with relatively large wheel dimensions for stability. The brakes were disconnected on the test bicycle for use on the treadmill. The bicycle was equipped with a V-Box (Racelogic 3i) and gyro sensor (Racelogic IMU02) to measure stability with Roll and YAW rate (See figure 1a). The participants wore a pulse sensor (to monitor their physical effort) that was connected to the treadmill system. The participants wore a safety harness that was attached to the gantry above the treadmill. The harness attachment point was connected to a kill-switch to enhance safety. All the participants wore a bicycle helmet (see figure 1b for a picture of setting).

a) 

b) 

FIGURE 1: A) PICTURE OF GYRO SENSOR RACELOGIC IMU02. B) A PARTICIPANTS CYCLING ON THE TREADMILL WITH ASSISTANCE FROM ONE OF THE PROJECTS LEADER. PHOTO CREDIT: C. PATTEN.

4.2.2 Stability Measures

In the experiment, handlebar reversal rate is used because there is no steering wheel, where the measurements are mostly used. The V-Box (Racelogic 3i) is a powerful GPS data logger, its engine can measure GPS parameters with a frequency of 100Hz. The V-Box is gathering further stability data from the gyro sensor (Racelogic IMU02) such as Roll rate (vertical), YAW rate (Horizontal), Pitch rate (longitudinal) of these measurements. The measure of pitch rate was excluded from the data collection because the participants were cycling on a flat surface at the treadmill that made the measure irrelevant. With this collected stability data a Standard deviation (Std.) of Roll and YAW measure was calculated. To measure the Roll and YAW rate, the measurements were conducted at different degrees to measure small and large variations in the cycling stability. The six variations that were measured were 5 degrees, 10 degrees, 15 degrees, 20 degrees, 25 degrees and Std.

4.2.3 Breathalyzer equipment

A Breathalyzer was used during the experiment to measure the breath alcohol concentration (BrAC). The Breathalyzer equipment employed in this study comprised two instruments, a Dräger 6810 (older model) and a Dräger 6820 (newer model). Both models comply with the standards required by the Swedish police (EU Police approval (EN15964) and had valid calibration approval.

4.2.4 Ability Ratings

In the experiment, three ratings were used to estimate different aspects of subjectively. A 20-item Borg scale of perceived exertion (Borg 20) was used right after the participants had been cycling to monitor that the physical load was at a moderate level. Borg 20 rating is a scale that goes from effort 6 (no effort) to 20 (maximal effort) (see appendix A). If the effort was rated with thirteen or higher, the gradient of the tread-mill was adjusted. The second rating was the subjective intoxication rating, a modified version of Borg CR10 (Borg, 1982), where the test participant could rate how intoxicated they felt on a scale from 0 (no intoxication) to 13 (unconscious)(see appendix B). The last rating was a subjective ability assessment scale that included four Likert-type scales questions (Scale 1-5, 1 = No problem, 5

= absolutely not) about manoeuvres they could do when they cycle on the treadmill (see appendix C).

4.2.5 N-back Task

In the experiment, a dual version of the N-back task was used and the test subject is required to remember the letter from 2 trials back. This dual version of N-back task consists of a random sequence of letters that will appear separately for two seconds before the letters will change. The sequence of letters will appear during a one minute time period. The 26 letters that were used was A, B, C, D, E, F, G, H, I, J, K L, M, N, O, P, Q, R, S, T, U, V, W, X, Y and Z. The test subject will press the button S if it is a positive match to the letter two trials back and the button Ö if the letter two trials back do not match (see appendix D) (Jaeggi et al., 2010; Kane et al., 2007). The test had four outcomes, false, hit, correct rejection, and false alarms and in the test there were eight possible hits and eighteen correct rejections. A d-prime value was calculated by hit rate and the false alarm rate from the test (Wickens, 2001).

4.2.6 Pre surveys

Three different demographic pre-test questionnaires were conducted before the experiment. Two questionnaires had questions regarding age, sex, physical health, which type of bicycle they are used to, how often they have been cycling the past year and how often they have been cycling alcohol-intoxicated the past year. The last questionnaire was a Swedish version of AUDIT, where's participants' alcohol habits could be established (see appendix E) (Babor et al., 2001). All the questionnaires included questions that needed multiple choice answers or just yes or no answers.

4.2.7 Post surveys

Two post-test questionnaires were conducted after the experiment. The first questionnaire was based on Theory of Planned Behaviour (TPB) and was extended with an assessment of habit. TPB is a theory that describes how attitudes is related to behaviour (Ajzen, 1991). The TPB instrument was divided into two parts with questions 1-7. In the first part, the participants had to answer the questions and presuppose when they felt the most intoxicated based on their subjective intoxicating rating. The second part, the participants had to answer the same questions but presuppose as if they were more intoxicated than their highest subjective intoxicated rating. The second part had the same questions, but the participant had to answer the questions and presuppose as if they were more intoxicated than their highest subjective intoxication rating. The second questionnaire was Sensation Seeking Scale V translated to

Swedish, and this is a questionnaire that consists of 40 items of A and B statements where the participant must choose one or the other (Zuckerman, 2007).

4.3 Design

The experimental design for this experiment was a factorial within-subject design for the effects of alcohol intoxication on the participants' performance. The dependent variables were stability (YAW rate and Roll rate); cognitive functions test (N-back score); a subjective level of intoxication (CR10 rating,); and subjective self-rated ability scale. The subjective self-rated ability scale is not a normalized scale but rather a scale that was developed during the pilot study. The subjective self-rated ability scale was not analysed in this thesis (see Andersson et al., n.d., for details). The independent variable was time and the four different aspects that will be presented in the result section. The independent variable time was the five repeated measurements of BrAC that occurred once every 25 minutes loop that the test lasted (see figure 2 for loop). The different aspects was: cycling experience, physical activity, sensation seeking and AUDIT. The participants cycled on the treadmill in ten-minute stints with a 15-minute non-cycling period. The measured stability that was used in the analysis was 8 minutes, because the first and last minute was controlled by the experiment leader by holding the test subjects gantry to stabilize the beginning and the end of every test run. The non-cycling period comprised 1) a subjective intoxication rating, 2) a 20-item Borg rating scale for perceived exertion, 3) an N-back task, 4) a subjective self-rated ability scale 5) time for refreshments and alcoholic beverages if necessary (see figure 2 below), as well as a resting period. There was first a familiarisation period of cycling on the treadmill. This was followed by one experimental condition when the participants were sober and followed by four repetitions of the intoxication experimental condition. The level of intoxication throughout the conditions was not constant.

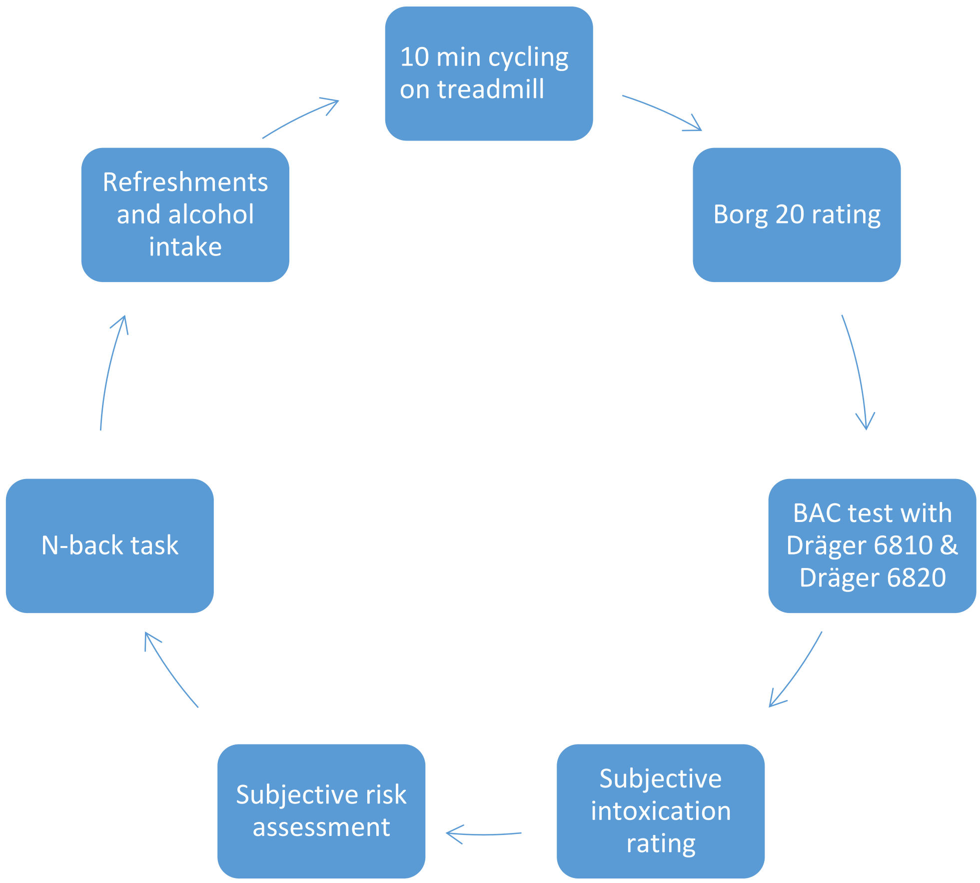


FIGURE 2: 25 MINUTE LOOP: WITH 10 MIN TREADMILL AND 15 MINUTES FOR TEST, ALCOHOL INTAKE AND REST. THIS PROCEDURE WAS REPEATED FIVE TIMES.

4.4 Procedure

The selected participants that fulfilled the recruitment criteria were first given information and instructions and completed and signed an informed consent form. All were measured/screened upon arrival (weight, identity check, 0 ‰ BrAC level, and pregnancy), and a pre-questionnaire was given to the participants. The dose-calculation to reach the target of 0.8‰ was based on the participant's gender and weight (mean quantity of 40%/vol spirits was 197 ml (SD 55.2), range 140 ml to 340 ml). The purpose is to estimate the quantity of spirits needed for each participant. The participants also stated their drink preferences where they could choose between whiskey, white rum, vodka, or gin. The spirits could be mixed with soft drinks to make them more palatable. The participants also completed a health declaration, and they were also asked about any food allergies (snacks were provided). Participants were given the opportunity of changing into training clothes (optional) and to use the toilette before starting.

The participants were given a safety briefing, and the bicycle was adjusted to their height. The safety harness and helmet were donned, and the participants started a ten-minute familiarisation cycle ride on the treadmill. The speed of the treadmill was kept at 20 km/h for all participants; however, the gradient was adjusted between 0.2 and 2.0 degrees (mean = 0.9˚ SD = 0.47) to maintain an even level of physical workload irrespective of fitness. After the cycling, the participants completed a Borg 20 rating, the participants then rinse their mouths with water and did a breathalyzer test with both units, estimated their subjective level of intoxication, rated their subjective self-rated ability level and completed the cognitive function test (N-back). The first dose of the calculated volume of spirits required (approx. 75 % of the estimated dose) was given to the participants to drink. The participants had a total of 15 minutes from the end of the cycling to the commencement of the next test iteration (see figure 3 below for a graphic chart of the procedure). This process was repeated an additional four times with the alcohol intake and the BrAC levels being closely monitored to avoid exceeding the target level of 0.8‰. When the participants had completed a total of five cycling sessions on the treadmill, they completed post-questionnaires (Sensation Seeking Scale, TPB) and other details. The participants remained in the research lab facility until they had become sober (several hours) and were then offered a taxi home for those who wanted. The control group participants were free to leave the laboratory when the whole test was completed.

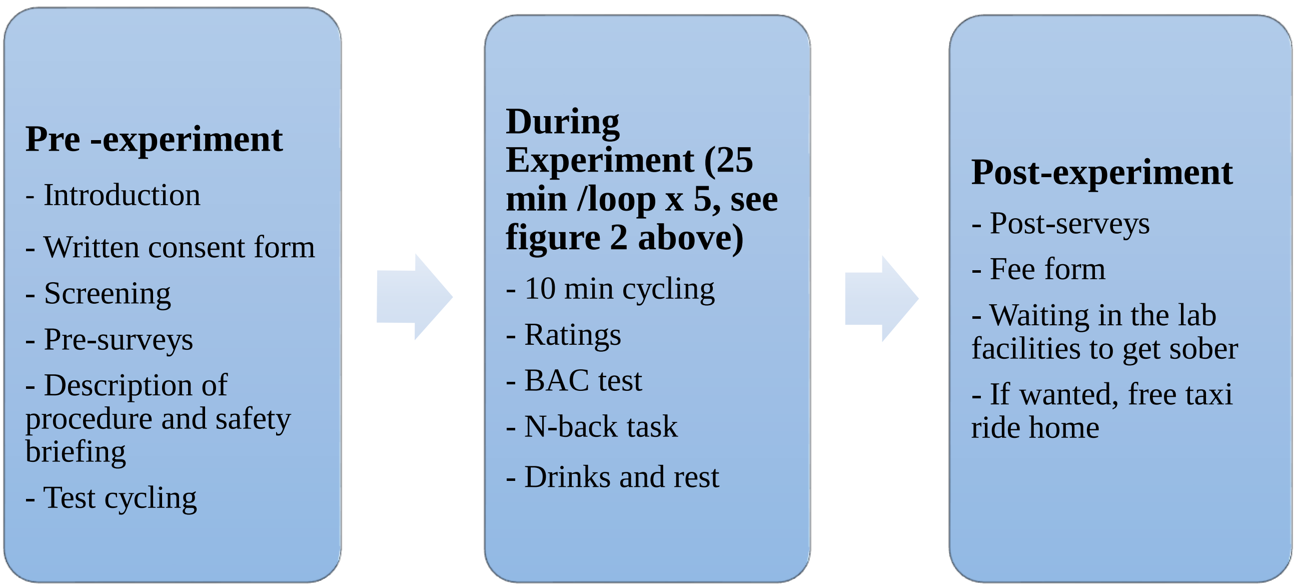


FIGURE 3: **PROCEDURE FOR THE EXPERIMENT.**

4.5 Statistical Analytical Method

All statistical analysis was conducted with IBM SPSS Statistics (version 26). Each variable was examined separately, and based on the research questions, the participants that served as control persons were excluded from the analytical tests. A mixed two-way analysis of variance (ANOVA) with a general linear model with repeated measures was used. In case the repeated measure test was significant ($p < 0.05$), the degrees of freedom were corrected by using Bonferroni correction.

5. Results

This chapter will present the results from the statistical analysis. The results are divided into three sections as follows descriptive statistics of characteristics and groups, N-back, and stability.

5.1 Descriptive Statistics of Characteristics and Groups

By using pre- and post-surveys, demographic data were collected from the participants. With the collected data, four characteristics were found interesting; Cycling experience, physical activity, sensation seeking and AUDIT. All aspects were divided into sub-groups of two or three smaller groups based on how they answered the questions in the pre-survey, the specifics for the aspects and grouping are found in Table 2.

TABLE 2.

Descriptive statistics of aspects and groups consisting of 18 participants that have all been alcohol intoxicated during the experiment.

	Cycling Experience	**Physical Activity**	**Sensation Seeking**	**AUDIT**
Sub-groups	3	3	2	2
Women	9	9	9	9
Men	9	9	9	9
Mean age women	28.3	28.3	28.3	28.3
Mean age men	28.7	28.7	28.7	28.7
SD Women	2.5	2.5	2.5	2.5
SD Men	2.1	2.1	2.1	2.1
No. of Participants	**18**	**18**	**18**	**18**

5.1.1 Cycling Experience

The group of Cycling Experience answered a question in the pre-survey of how many times they had been cycling the past couple of months of snow-free ground during 2019, for example, see appendix F. Based on the answers, Cycling Experience was divided into three subgroups: Group 1, was the group with most experience and cycled four times per week or more and consisted of six participants, three males, and three females. Group 2 was the group that cycled two to three times per week and consisted of eight participants, four males, and four females. Group 3 was the group with the least experience of cycling and cycled two to four times per month or less and consisted of four participants, two males, and two females.

5.1.2 Physical Activity

The group of Physical Activity answered the question of how much they worked out or performed some kind of physical activity during 2019 (for examples, see appendix G). Based on the answers, Physical activity was divided into three sub-groups: Group 1 was the most active and worked out or performed a physical activity four times per week or more and consisted of eight participants, six males, and two females. Group 2 worked out or performed a physical activity two to three times per week and consisted of six participants, one male, and five females. Group 3 was the group that was least physically active and only worked out or performed a physical activity two to four times per month or less and consisted of four participants, two males, and two females.

5.1.3 Sensation Seeking

The group of Sensation seeking has two sub-groups. The groups was divided based on the total score on Marc Zuckerman's Sensation Seeking Scale Form V for example questions, see appendix H. Our scores on Sensation Seeking Scale had a range from 12-29 with 40 as maximum score and was divided into Group 1 high, that consist of eight participants with the highest score, five males with score 24-29 and three females with scores 23-26. Group 2 low, consist of the ten participants with the lowest scores, four males with scores 14-21 and six females with scores 12-21. A person with high scores on sensation seeking scale have a higher tendency for risky behavior then person with low scores in sensation seeking scale.

5.1.4 AUDIT

When AUDIT first was scored and divided into two of the regular zones (four possible zones) based on the total scores, there are different scores for male and females in the four zones. Whit the zone classification I got uneven groups. The first try with zones I got fourteen participants in Zone one (seven males and seven females) and four participants in zone two (two males and two females). In the second try, AUDIT was divided into three groups of six participants, but the groups became uneven in genders where has group one only had one female and five males, and group three only had one male and five females. So instead, the

AUDIT got two sub-groups of nine participants, which was not divided in the regular zones. Group one hade low scores on AUDIT and consisted of four males with scores three to five and five females with score 4. Group two had high scores on AUDIT and consisted of five males with scores six to twelve and four females with the score five to seven.

5.2 N-Back Task

In the analysis conducted to examine the results from each N-Back task over time during alcohol consumption, the four different group characteristics was: Cycling experience that is a mixed 3 (Group) x 5 (Time) ANOVA test, physical activity that is a mixed 3 (Group) x 5 (Time) ANOVA test, Sensation seeking that is a mixed 2 (Group) x 5 (Time) ANOVA test and AUDIT that is a mixed 2 (Group) x 5 (Time) ANOVA test will be analyzed. The N-back results for each participants five measurements was recalculated into a d-prime value. The d-prime value is a statistics that is used in signal detection theory, the d-prime is estimated by hit rate and the false alarm rate from the test (Wickens, 2001). A high d-prime value indicate more correct answers and less false alarms. The test included eight possible hits and eighteen correct rejections.

The results of the cycling experience analysis, a mixed 3 (Group) x 5 (Time) ANOVA test showed a tendency for an interaction effect between group and time $F(8, 60) = 1.835$, $p > 0.088$, $MSe = 1.640$ (see figure 4). This result show a difference in the curve in Group 3 that is the least experienced in cycling that is the opposite of the curve from the groups 1 and 2. The results are hard to interpret and it needs further research to establish why this occurs.

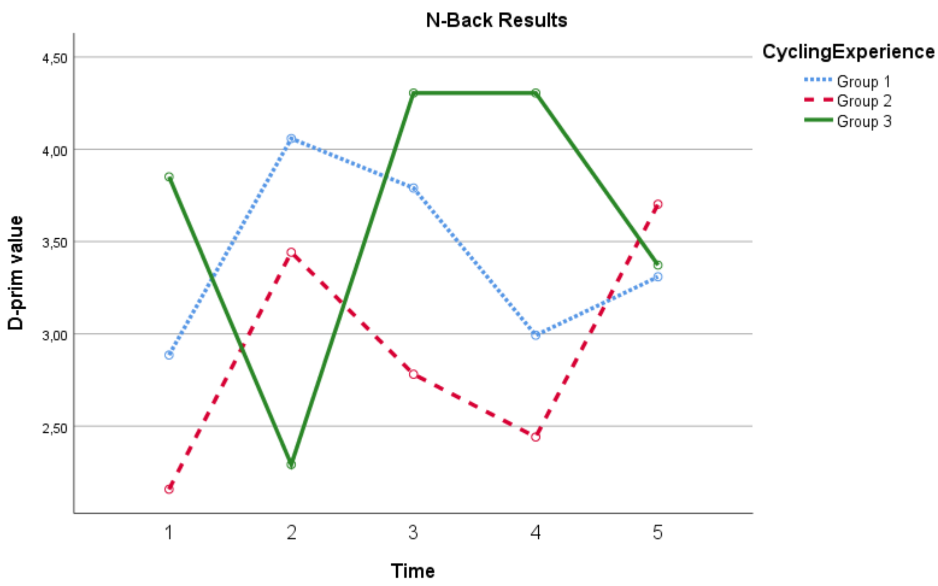


FIGURE 4: GRAPH SHOWING THE INTERACTION BETWEEN CYCLING EXPERIENCE GROUPS AND TIME.

The different analysis that was conducted found that there was no significant effect in the other aspects of physical activity, Sensation Seeking, and AUDIT.

Taken together, of the four group characteristics there was only a tendency for effect of groups in cycling experience and N-Back results. There was no effect over time for the groups. This indicate that alcohol consumption over time has no effects on executive functions between the four different characteristics. However, the Andersson et al., (submitted) revealed that intoxicated participants (overall) were negatively affected by acute alcohol intoxication compared to sober participants (Andersson et al., n.d.).

5.2.1 Gender Differences

A further investigation was conducted to investigate if there was any difference in results on the N-back task between males and females. Hence a mixed 2 (Group) x 5 (Time) ANOVA test were conducted and the result for this analysis showed that there were no significant effect between genders when they were at the same level of intoxication.

5.3 Stability

To examine how well the participants were cycling during alcohol consumption, stability was measured with HBRR Roll and YAW. The measures were conducted by multiple mixed two way ANOVA tests among the four aspects: Cycling experience, Physical activity, Sensation seeking, and AUDIT and between the six different variations that were used; and the measures were 5 degree gap, 10 degree gap, 15 degree gap, 20 degree gap, 25 degree gap and standard deviation (Std.) in both Roll and YAW. Each following section consist of twelve analysis and will start with the analysis of Std. for both YAW and Roll followed by the ten analysis of the different gap size degrees for Roll and YAW. The x-axis in graphs represent number of times measured. The y-axis in graphs for Roll represent the number of times the leaning of the cyclist exceed a given gap size. The y-axis in graphs for YAW represent the number of times the cyclist exceed a given gap size with the handlebar.

5.3.1 Stability in Cycling Experience

Two 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different cycling experience and stability measured in Std. in Roll and Std. in YAW. The results showed a significant main effect of time in Std from both Roll $F(4, 60) = 5.918$, $p < 0.000$, $MSe = 0.295$

(see figure 5) and from Std. YAW $F(4, 60) = 5.573$, $p < 0.001$, MSe = 0.624. Indicating that participants in all groups of cycling experience become more unstable with time as they drink alcohol.

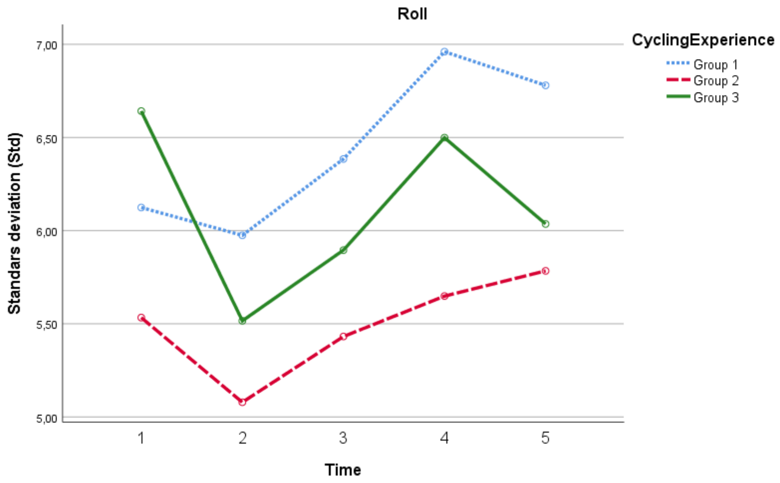


FIGURE 5: **GRAPH OF ROLL STD OVER TIME IN CYCLING EXPERIENCE.**

In order to examine the stability measured in Roll and YAW 5 - 25 degrees gap among the group cycling experience, ten mixed two way ANOVA tests was conducted.

Five mixed 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different cycling experience and stability in Roll 5 degree gap, 10 degree gap, 15 degree gap, 20 degree gap, 25 degree gap. The result showed a significant main effect of time in Roll gap 15 degrees $F(4, 60) = 3.147$, $p < 0.020$, MSe = 8583.583 (see figure 6), Roll gap 20 degrees $F(4, 60) = 4.315$, $p < 0.004$, MSe = 8188.513 and in Roll gap 25 degrees $F(4, 60) = 4.517$, $p < 0.003$, MSe = 4449.074 with similar curves in all three graphs. These results indicate that with time all three groups get more unstable and wobble more in the bigger degrees of Roll rate but not in the smaller degrees.

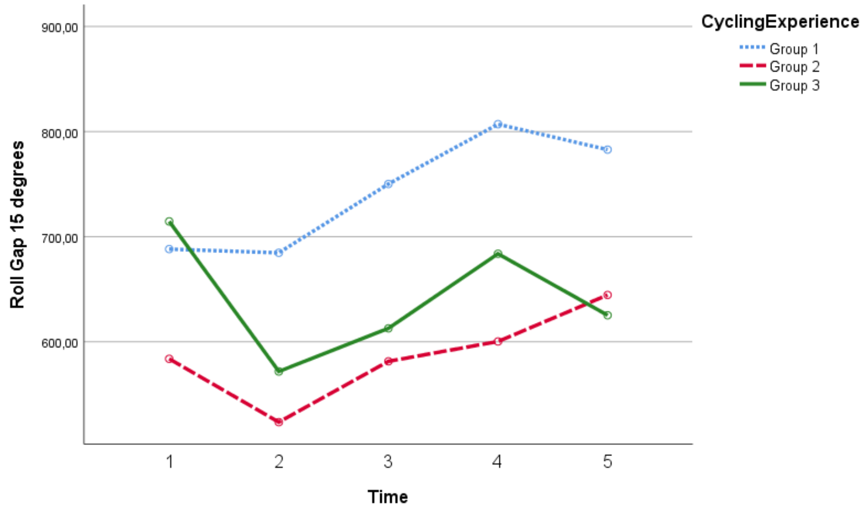


FIGURE 6: **GRAPH OF ROLL GAP 15 DEGREES**

The results also showed a tendency for interaction between group and time in Roll gap 25 degrees F(8, 60) = 1.776, p > 0.100, MSe = 4449.074. This result shows a difference between the first measure and the second measure between group 3, the least experienced group on cycling and between groups 1-2 that have more experience in cycling; later on, from measure two to five the curves follow a similar path (see figure 7). This indicate that there may be a learning effect in group 3 from the first to the second measure. It is hard to interpret why this occurs, but is seems that the participants with the least experience have greater learning effect.

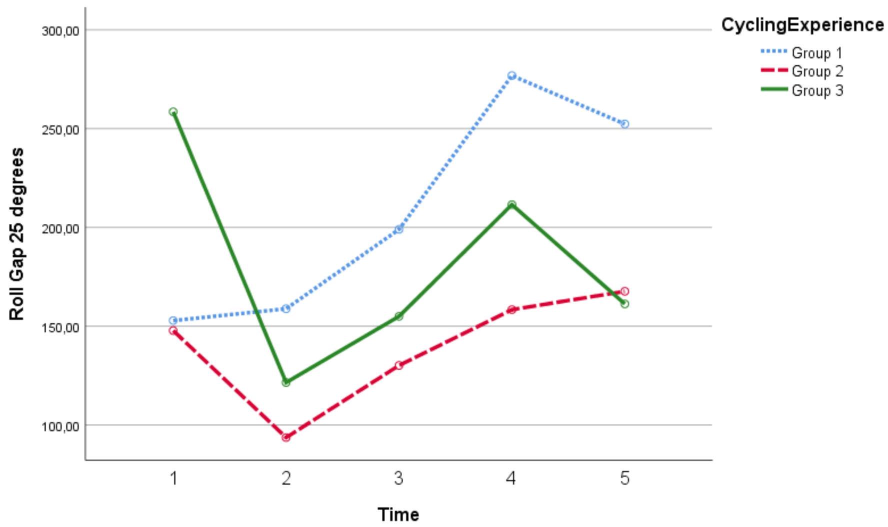


FIGURE 7: **GRAPH FOR TENDENCY IN MEASURE ROLL GAP 25 DEGREES.**

Five mixed 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different cycling experience and stability in YAW 5 degree gap, 10 degree gap, 15 degree gap, 20 degree gap, 25 degree gap.

In the mixed two way ANOVA tests that were conducted to examine different cycling experiences and stability measured YAW with a 5 degrees gap, the results showed a tendency of effect on time $F(4, 60) = 2.230$, $p > 0.076$, $MSe = 3956.443$. These results show a difference between measure one and measure two between group 1 that was the most experienced in cycling and group 2-3 that had less experience in cycling (see figure 8). Between measures 2-5, the groups are in line with each other. It is hard to interpret why this occurs, it may be by coincidence because the curve goes from better to worse. In the study as a whole the five degree gap measurements had little to no importance.

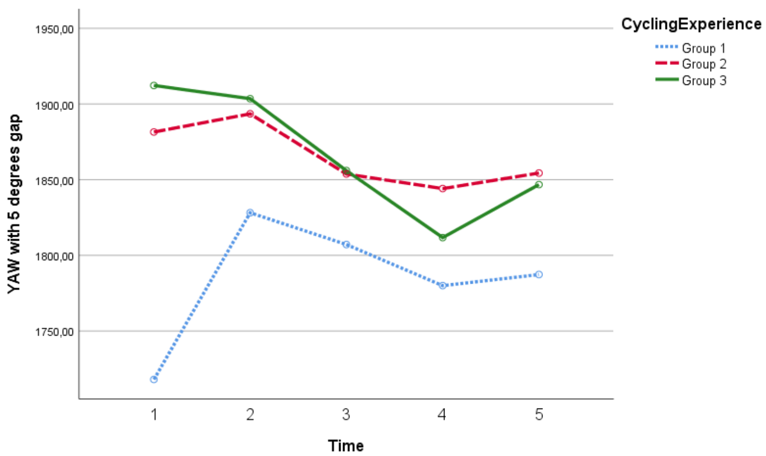


FIGURE 8: **GRAPH OF YAW WITH 5 DEGREE GAP OVER TIME.**

The result showed a significant main effect of time in YAW gap 20 degrees $F(4, 60) = 3.005$, $p < 0.025$, $MSe = 10198.079$ (See figure 9) and in YAW gap 25 degrees $F(4, 60) = 4.054$, $p < 0.006$, $MSe = 12159.548$ both with similar graphs. The results indicate that over time all groups wobble more in the large gap degrees of YAW rate than in small gap degrees.

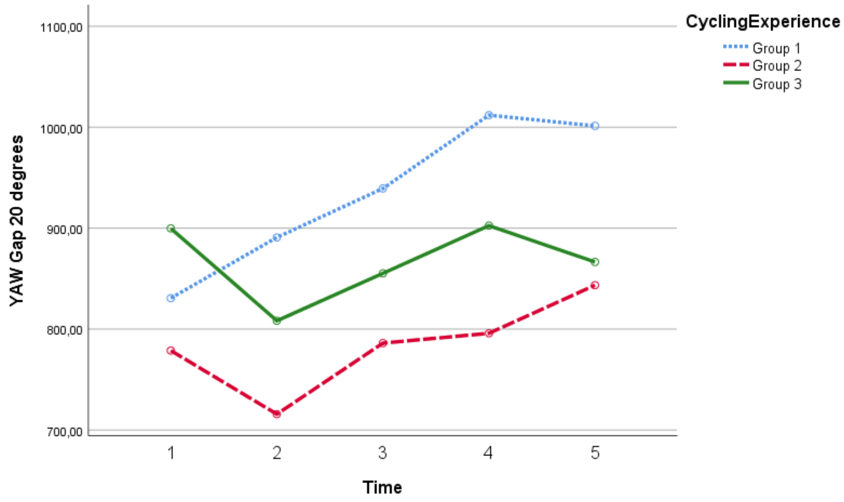


FIGURE 9: GRAPH OF YAW WITH GAP 20 DEGREES.

Taken together: The stability in different groups of cycling experience shows a main effect of time in both Std. Roll and in Std. YAW. The results also shows a main effect of time in the higher gap degrees for both Roll and YAW. This indicates that the participants gets more unstable as the time goes and they get more intoxicated than they were in the beginning of the experiment. There may be a bigger learning effect for least experienced groups 2 and 3 than it is for group 1 in stability. Generally the groups with the least experiences of cycling have the greatest learning effect throughout the study. The tendency for effect in the results is hard to explain but may be something to investigate further.

5.3.2 Stability in physical activity

Two mixed 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of physical activity and stability measured in Std. Roll and Std. YAW. The results showed a significant main effect of time in Std from both Roll $F(4, 60) = 6.357$, $p < 0.000$, $MSe = 0.285$ and YAW $F(4, 60) = 5.436$, $p < 0.001$, $MSe = 0.603$ (See figure 10) indicating that over time the participants in physical activity groups gets more unstable as they drink alcohol.

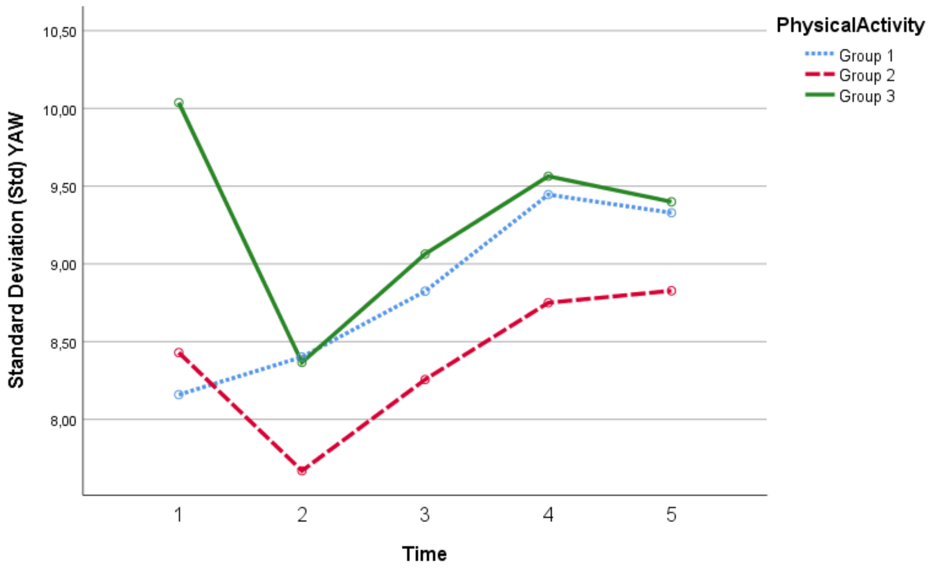


***FIGURE 10*: GRAPH OF STD YAW OVER TIME IN PHYSICAL ACTIVITY.**

In order to examine the stability measured in Roll and YAW 5 degrees gap, 10 degrees gap, 15 degrees gap, 20 degrees gap and 25 degrees gap among the groups physical activity, ten mixed two way ANOVA tests was conducted.

Five mixed 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of physical activity and stability in Roll gap 5 - 25 degrees. The result showed a significant effect of interaction between group and time in Roll gap 5 degrees $F(8, 60) = 3.053$, $p < 0.006$, MSe = 2293.153 (see figure 11). This result shows that group 2 and 3 which was the groups with moderate to little physical activity gets better stability and that indicate that there may be a learning process. Meanwhile group 1 that is the most physically active have almost the same stability along the experiment in 5 degree gap. The results also showed a significant main effect of time in Roll gap 15 degrees $F(4, 60) = 3.808$, $p < 0.008$, MSe = 8157.211, Roll gap 20 degrees $F(4, 60) = 4.874$, $p < 0.002$ (see figure 12), MSe = 8023.470 and in Roll gap 25 degrees $F(4, 60) = 4.812$, $p < 0.002$, MSe = 4524.752 these results indicate that the participants in all groups of physical activity is more unstable in the higher gap degrees of Roll rate than in the small gap degrees.

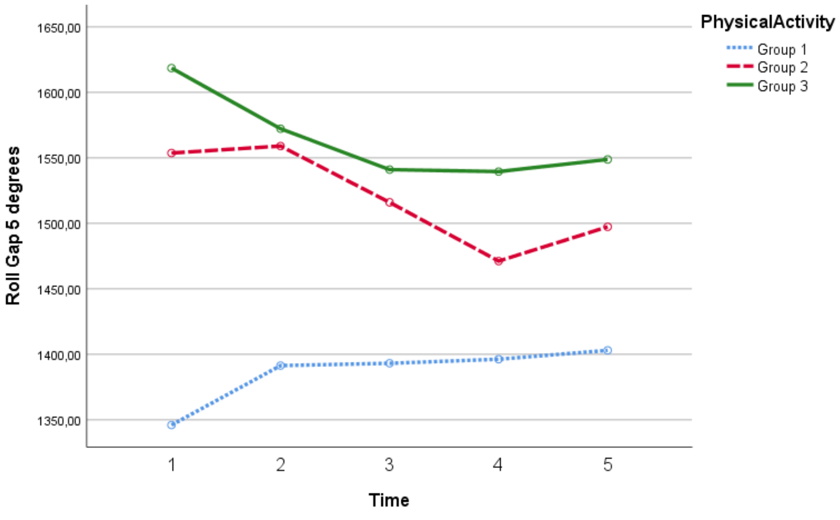


FIGURE 11: **ROLL GAP 5 DEGREES, WITH MAIN EFFECT ON GROUP.**

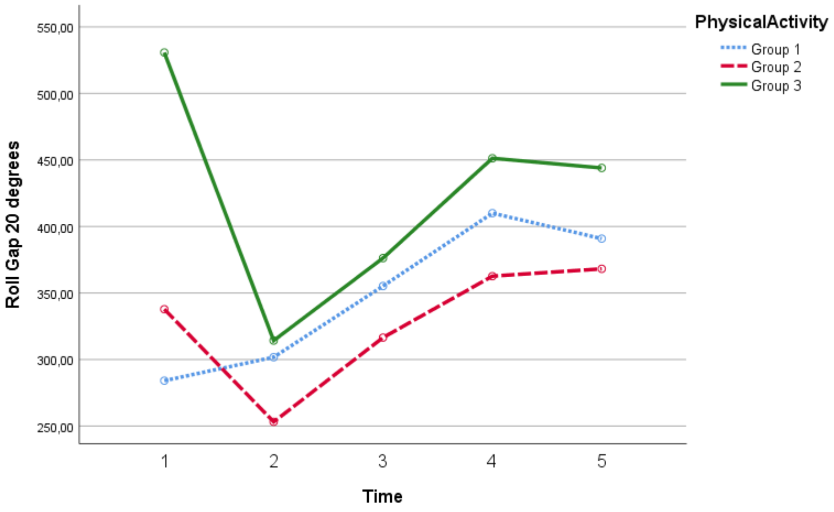


FIGURE 12: **GRAPH OF ROLL GAP 20 DEGREES.**

Five mixed 3 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of physical activity and stability in YAW gap 5 - 25 degrees. The result showed a significant effect of interaction between group and time in YAW gap 5 degrees $F(8, 60) = 2.870$, $p < 0.009$, $MSe = 3457.361$ (see figure 13) and a tendency for effect in YAW gap 10 degrees $F(8, 60) = 2.039$, $p > 0.057$, $MSe = 3788.278$ that indicate that in smaller degrees of wobbling in both the measure Roll and YAW the groups 2 and 3 that have moderate to low physical activity gets better over time and group 1 that is the most physically active does not.

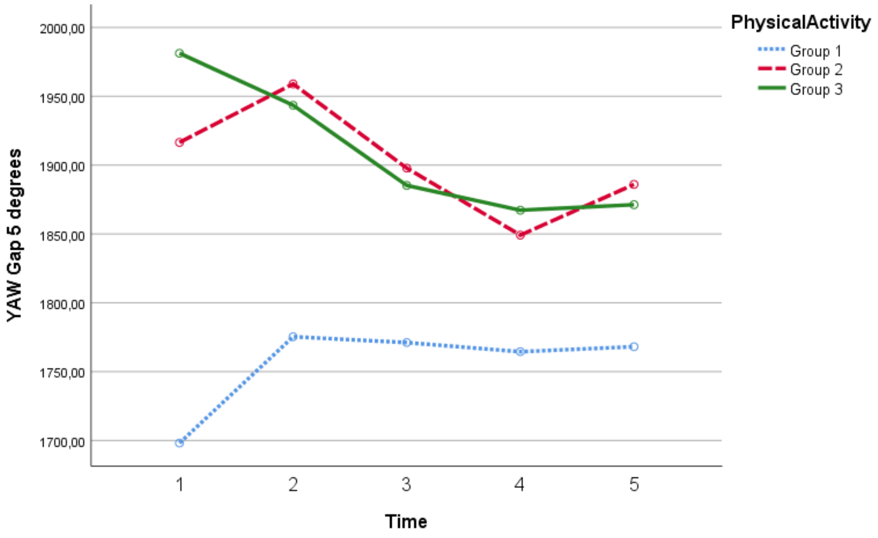


FIGURE 13: GRAPH OF YAW GAP 5 DEGREES.

The results also showed a significant main effect of time in YAW gap 5 degrees $F(4, 60) = 2.995$, $p < 0.025$, $MSe = 3457.361$, in YAW gap 20 degrees $F(4, 60) = 3.312$, $p < 0.016$, $MSe = 9727.677$ and in YAW gap 25 degrees $F(4, 60) = 4.381$, $p < 0.004$, $MSe = 11658.235$. These graphs is not identical but similar to the graph of the measurement Roll gap20 degrees in figure 12.

Taken together, the results of stability among the different groups of physical activity shows a main effect of time in Std. Roll, Std. YAW and in the larger gap degrees in both Roll and YAW indicating that participants with different physical activity all become more unstable from start to end of the experiment. The results also shows a main effect of groups in Roll and YAW with 5 degree gap and a tendency of effect in group in YAW 10 degree gap. This results indicate that the participants with lower degree of fitness can become better in small gap sizes over time meanwhile the most physically active participants have almost the same stability throughout the whole experiment in the small gap sizes. The results of the analysis show that the participants with low to moderate physical activity have a better learning effect than the participants with the most physical activity.

5.3.3 Stability in Sensation Seeking

Two mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of sensation seeking and stability measuring Std. Roll and Std. YAW. The results showed a significant main effect of time in Std from both Roll $F(4, 64) = 5.217$, $p <$

0.001, MSe = 0.313 (see figure 14) and YAW F(4, 64) = 5.008, $p < 0.001$, MSe = 0.654 indicating that over time participants in both high and low sensation seeking becomes more unstable when cycling intoxicated.

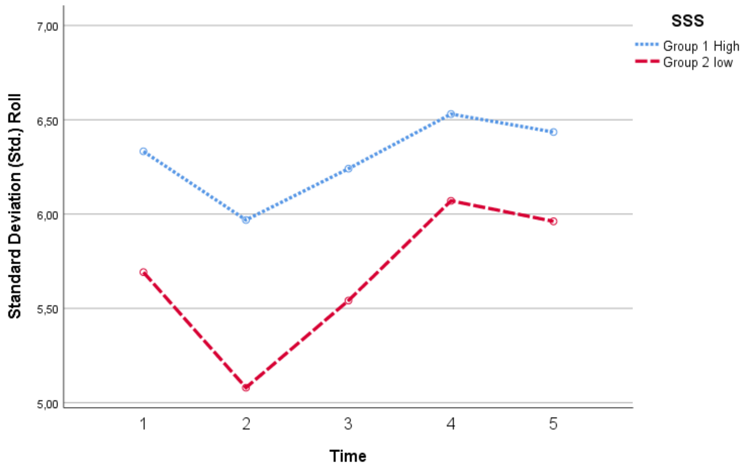


***FIGURE 14*: GRAPH OF ROLL STD. IN SENSATION SEEKING GROUPS.**

In order to examine the stability measured in Roll and YAW 5 degrees gap, 10 degrees gap, 15 degrees gap, 20 degrees gap, and 25 degrees gap among the groups of sensation seeking, ten two way ANOVA tests were conducted.

Five mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of sensation seeking and stability in Roll gap 5 - 25 degrees. The result showed a significant effect on time in Roll gap 15 degrees F(4, 64) = 3.089, $p < 0.022$, MSe = 8904.106, Roll gap 20 degrees F(4, 64) = 3.927, $p < 0.007$, MSe = 8981.346 (see figure 15) and in Roll gap 25 degrees F(4, 64) = 3.869, $p < 0.007$, MSe = 5098.989. Which indicate that both groups in sensation seeking becomes more unstable in larger gap sizes in Roll measurement.

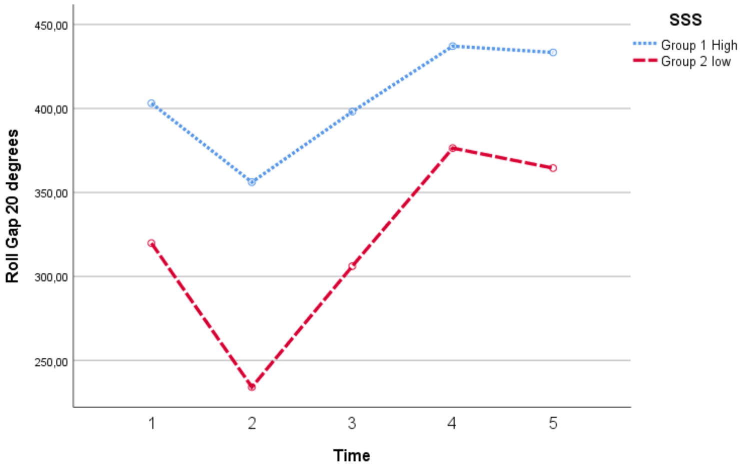


FIGURE 15: GRAPH OF ROLL GAP 20 DEGREES.

Five mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of sensation seeking and stability in YAW gap 5 - 25 degrees. The result showed a significant effect on time in YAW gap 20 degrees $F(4, 64) = 3.251$, $p < 0.017$, $MSe = 10449.621$ and in YAW gap 25 degrees $F(4, 64) = 4.137$, $p < 0.005$, $MSe = 12979.222$ (see figure 16). Both gap sizes 20 and 25 degrees had similar graphs. This results indicate that both groups of sensation seeking becomes more unstable over time in the larger gap degrees of the YAW measuring.

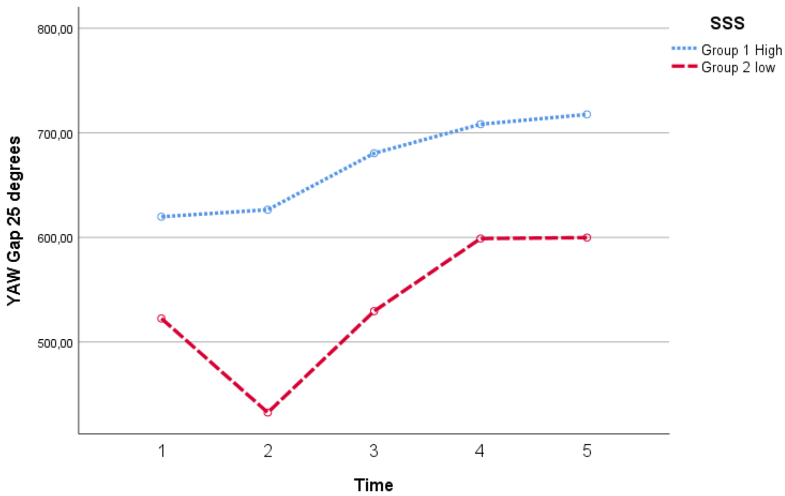


FIGURE 16: GRAPH OF YAW WITH 25 DEGREES GAP OVER TIME.

Taken together, the results of the analyses on participants in the high sensation seeking group and the participants in the low sensation seeking group shows an main effect of time and that the participants becomes more unstable during the experiment in Std. Roll, Std. YAW and in the larger gap degrees of both Roll and YAW measuring. There was no interaction effect between group and time in each of separate analysis. However, by examining all the graphs made in the analysis of sensation seeking groups, the assumption that the participants in group 2 (with low scores sensation seeking) is generally more careful and takes lesser risks can be made.

5.3.4 Stability in AUDIT

Two mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of AUDIT and stability measuring Std. in Roll and YAW. The results showed a significant main effect of time in Std from both Roll $F(4, 64) = 5.814$, $p < 0.000$, $MSe = 0.303$ and in YAW $F(4, 64) = 5.521$, $p < 0.001$, $MSe = 0.643$ (see figure 17). These results indicate that both high score (group 2) and a low score (group 1) on AUDIT become more unstable over time as they drink alcohol.

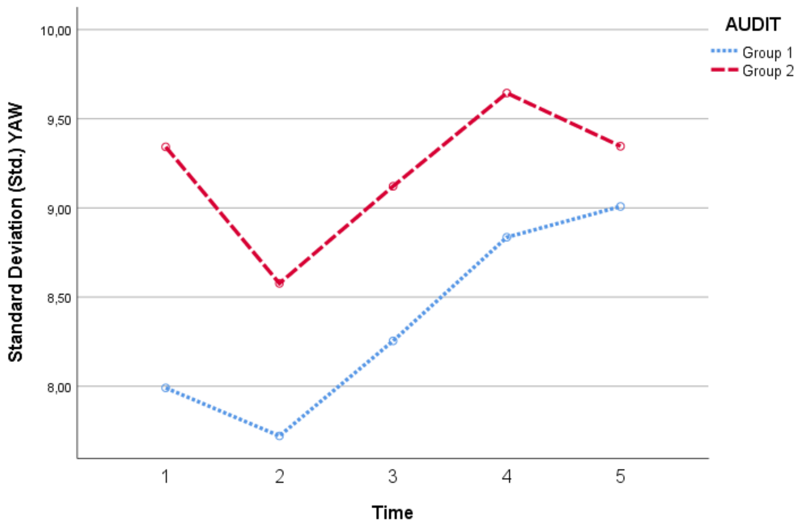


FIGURE 17: GRAPH OF YAW STD. IN AUDIT GROUPS OVER TIME.

In order to examine the stability measured in Roll and YAW 5 degrees gap, 10 degrees gap, 15 degrees gap, 20 degrees gap, and 25 degrees gap among the groups of sensation seeking, ten mixed two way ANOVA tests were conducted.

Five mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of AUDIT and the stability in Roll gap 5 - 25 degrees. The result showed a significant effect on time in Roll gap 15 degrees $F(4, 64) = 3.638$, $p < 0.010$, $MSe = 8195.927$

(see figure 18), Roll gap 20 degrees F(4, 64) = 4.642, p < 0.002, MSe = 8156.085 and in Roll gap 25 degrees F(4, 64) = 4.417, p < 0.003, MSe = 4737.541. This results indicate that participants become more unstable with time in the higher gap degrees of Roll measuring.

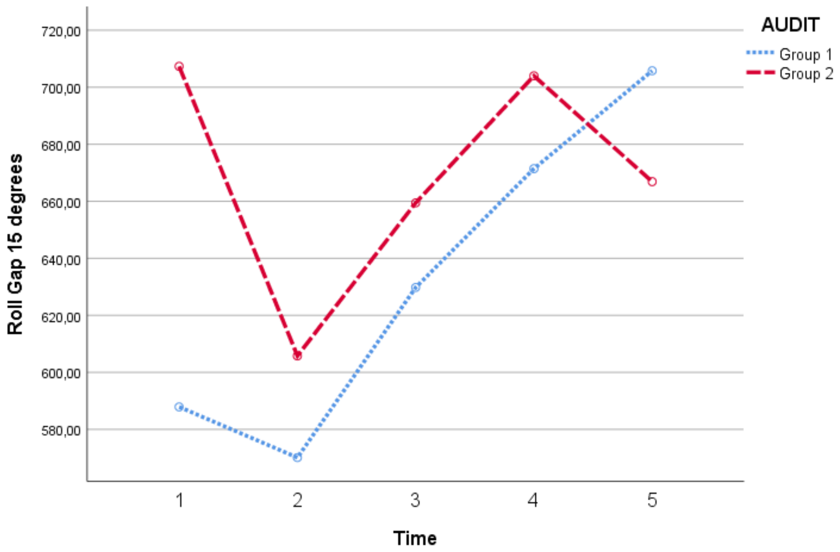


***FIGURE 18*: GRAPH OF ROLL WITH 15 DEGREE GAP OVER TIME.**

Five mixed 2 (Group) x 5 (Time) ANOVA tests were conducted to examine different groups of AUDIT and stability in YAW gap 5 - 25 degrees. The result showed a significant effect on time in YAW gap 20 degrees F(4, 64) = 3.827, p < 0.008, MSe = 9549.038 (see figure 19) and in YAW gap 25 degrees F(4, 64) = 4.806, p <0.002, MSe = 11888.561. This indicates that both groups of AUDIT becomes more unstable with time in the higher gap sizes of YAW measuring.

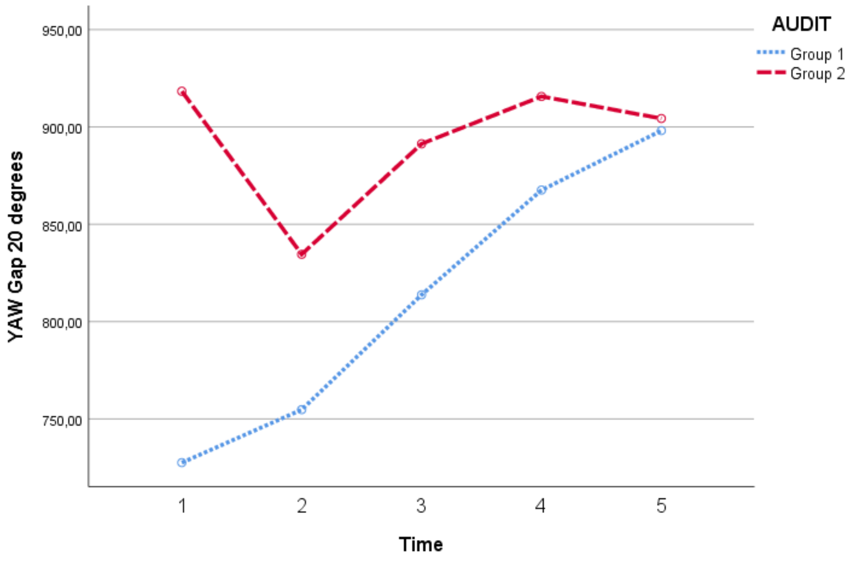


***FIGURE 19*: GRAPH OF YAW WITH 20 DEGREE GAP OVER TIME.**

The results also showed a tendency for effect in the interaction between groups and time in YAW gap 20 degrees $F(4, 64) = 2.207$, $p > 0.078$, MSe 9549.038 and in YAW gap 25 degrees $F(4, 64) = 2.039$, $p > 0.099$, MSe =11888.561. These results show a difference between measure one and measure two between group 1 and group 2 (see figure 20). Between measures 2-5, the groups are in line with each other. Where the group 2 becomes better in their stability between measuring one and two, then they becomes more unstable again. Because it is just a tendency, it is hard to interpret why this occurs.

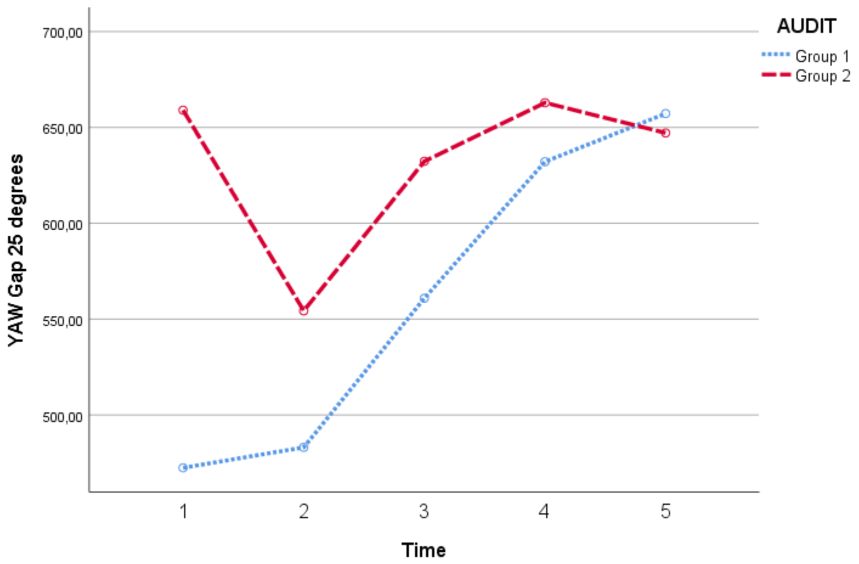


FIGURE 20: GRAPH OF YAW WITH 25 DEGREE GAP OVER TIME.

Taken together, the results of the analysis of stability among the different group of AUDIT shows a main effect of time in Std. Roll, Std. YAW and in the higher gap degrees of both Roll and YAW indicates that participants become more unstable when they are cycling from the start of the experiment to the end of the experiment. The tendency of interaction between the high and low AUDIT group is harder to interpret when one group first gets better then worse. This need further investigation for a better answer. The results of the analysis also indicates that the participants in group 1 that are drinking less alcohol have curves that increase throughout the hole study while group 2, that are drinking more and more often level out or gets better again in the end of the study.

6. Discussion

This chapter will discuss the results of the study in relation to the research questions and predictions presented in the research introduction. It will also include a section on future studies.

6.1 Result Discussion

The purpose of this study was to examine if different group characteristics i.e., cycling experience, physical fitness, sensation seeking, and previous alcohol habits, had an effect on the bicycle performance (stability) and cognitive performance (executive function) during acute alcohol intoxication. From this purpose and from the research statement that establishes that there were some gaps in the literature, six research questions were particularly interesting to examine. Each question will be answered separately and is followed by a general discussion of the results.

- *Will there be any differences in the performance on the N-back task during the experiment?*

It was predicted that executive function would be negatively affected and decrease during alcohol consumption (Nederkoorn et al., 2009), and the literature described that this would only happen when the individual reaches a certain BrAC level (Spinola et al., 2017). This BrAC level that should affect executive function was reached, and among the four different group characteristics, it was only one then had a tendency of effect. The tendency of effect was shown in the interaction between the three different groups in cycling experience. It was the least experienced group of cyclists, group 3, which had an entirely opposite curve than the two other groups that were more experienced cyclists. Exactly why this occurred is hard to interpret, but it can be a good thing to take into consideration in future studies. There was no other group characteristic i.e., physical activity, sensation seeking, and AUDIT that showed a negative effect or a tendency for negative effect over time or between groups during acute alcohol intoxication in the N-back task. These results indicate that the intoxicated participants, divided into these four characteristics were unaffected by the BrAC level in their cognitive performance during this experiment. The results may have been a result of familiarity with the test because it was conducted multiple times.

- *Will there be any differences between males' and females' performance on the N-back task?*

The prediction was that, according to the literature, there would not be a significant difference between males and females on their cognitive executive performance. As predicted, the results showed the same; in this experiment, there is no difference in cognitive performance between genders when they were equally intoxicated.

- *Will previous alcohol habits affect the performance on the N-back task?*

The prediction for this question was that there would not be a significant negative effect in cognitive performance, even if the literature suggests that individuals with previous habits of drinking a great deal of alcohol can have poorer performance in executive function tests (Parada et al., 2012). The results of the analysis did not show any significant effect of previous alcohol habits. A possible explanation could be that this study did not include the criteria for heavy or light drinking habits in the recruitment of participants, so the group characteristic of AUDIT could not have that classification hence the prediction.

- *Will previous cycling habits affect bicycle stability during acute alcohol intoxication?*

The prediction of different stability levels among skilled and novice cyclists (Cain et al., 2016) that the literature support, was not evident in the present study. However, the results showed that there is a main effect of time—the stability decrease over time as the alcohol level increase. The results showed the effect of time in both Std. Roll and in Std. YAW and in the higher gap degrees for both Roll and YAW, it also showed a tendency for effect in time on the small five-degree gap in the measure YAW. The results also shows a tendency for effect in the interaction between groups in the high 25-degree gap in the measure of Roll, indicating that there is a difference in stability in the first measure between the least experienced cycling group and the other two groups, from the second to the fifth measure the three groups follow the same curve. In the analysis, it is generally evident that there is a bigger learning aspect in stability throughout the experiment in the groups with less experience (groups 2 and 3) than the most experience group (group 1) that rid a bicycle four times a week or more. Generally, the groups with the least experiences of cycling have the greatest learning effect throughout the study. One thing to take into consideration when interpreting the results is that the setting of the experiment, i.e., bicycling on a tread-mill and on a plane surface in a controlled setting, is not a natural way of bicycling. Bicycling in a more naturalistic setting out in the real world, the results of the measurements and the gap sizes may not be the same.

- *Will the participant's physical activity level affect bicycling stability during acute alcohol intoxication?*

Because of a limited amount of research on what effect different physical fitness levels could have on bicycle stability, a prediction on the outcome was not possible. The results show as in cycling experience, the main effect in time and that the stability decreased as the BrAC level increased. The main effect of time was shown in both Std. Roll and in Std. YAW and in the higher gap degrees for both Roll and YAW. However, in physical fitness, even the low five gap degree showed a main effect of time in the measure of YAW. These results indicate that the participants get more stable in the small gap degree of YAW, the lateral stability (right and left with the handlebar), but the stability decrease, and the participants get more unstable in the higher gap sizes. The results also showed a main effect of interaction between the different groups of physical fitness in the smaller five-degree gap in both Roll and YAW and a tendency in YAW 10 degree gap, and these results indicate that the performance participants in the two groups with the least amount of physical activity increases in small gap sizes over time and in the meantime the most physically fit participants performance is almost unaffected. The result can establish that participants with low to moderate levels of physical activity have a better learning effect than participants with high physical fitness. As in the previous question, the experiment setting must be considered when interpreting the results.

- *Will the participant's level of sensation seeking results affect their bicycling stability during acute alcohol intoxication?*

The literature indicates that individuals with a higher level of sensation seeking to seek more risk-taking activities (Hittner & Swickert, 2006) and the experiment with the unfamiliar setting with bicycling on a tread-mill, that was according to the participants dictum, no easy task. But there has been no evidence or research that correlates sensation seeking to bicycle stability; therefore, no prediction of the outcome could be made. The results on the analyses of stability and sensation seeking generally indicate that the participants in both groups (low and high sensation seeking scores) stability decrease as the BrAC level increase during the experiment. The results showed a main effect of time in both Std. Roll and in Std. YAW and in the higher gap degrees in both measurements. The analysis shows that the low sensation seeking groups curve always are below the high sensation seeking group, this can indicate that the low sensation seeking group is generally more careful and take lesser risks than the high sensation seeking group.

All four studied group characteristics were analyzed the same way, with the same measurements, and because of a limited amount of research question, the stability of previous alcohol habits was not a specific research question. But still, there are results from twelve different measures of Roll and YAW and previous alcohol habits. The results of the different AUDIT groups showed the same results as the previous characteristics, a main effect of time in Std. Roll, Std. YAW and in the higher gap degrees of both Roll and YAW. This indicates that the stability decrease as the BrAC level increase. The results on AUDIT also showed a tendency for effect in the interaction between the high and low score groups and time, in the higher gap degrees of YAW. The results indicate that the participants in the low score group (group 1) that drinks less have curves that increase from start to finish and indicate that the stability gets worse in a steady curve. Meanwhile, the high scored AUDIT group (group 2) first gets an increase in stability to the second measurement, and then the stability decreases again in a similar way as the low scoring group. Generally, along with all the analysis, the Roll measure, the vertical stability (balance in sideways on the bicycle) was affected in the earlier gap degrees (15, 20, 25) than the YAW measure (20, 25), the horizontal stability (left and right with the handlebar). This indicates that the Roll measure, the measure of balancing on the bicycle, might be a more important measure as the literature suggested (Cain et al., 2016).

A critique of the study is the number of participants, which create a small statistical power. If the was a larger sample size, there might have been a more evident group correlation among the different characteristics. The use of a treadmill task can also be a critique to the study.

6.2 Future Studies

Physical fitness is a characterization that should be investigated further; this is because of the many significant effects of both time and by the interaction between different, physically active individuals. Different groups of alcohol habits are also characteristics that should be investigated further. In the future studies with analysis on gender differences in stability measures among the four group characteristics. A future study could also include a placebo group where the participants will be served a drink that masked all the alcohol taste, for example, a screwdriver. The participant will be served only juice but with a touch of alcohol on the edge of the glass so that the participant will feel the smell of alcohol.

7. Conclusion

In conclusion, the purpose of the study was to examine if different group characteristics i.e., cycling experience, physical fitness, sensation seeking, and previous alcohol habits, had an effect on the bicycle performance (stability) and cognitive performance (executive function) during acute alcohol intoxication. The results showed that the cognitive performance among the four different group characteristics was almost unaffected by their increasing BrAC level when compared to each other – not compared to sober participants The results of bicycle stability were almost equal in the independent variable time among the four characteristics in both Roll and YAW measurements. Three of the characteristics also showed a main effect or tendency for the main effect among the different groups. The results, along with the literature, suggest that the measure of Roll i.e., the measure of vertical orientation (balancing in sideways on the bicycle), is the most important measure of stability on bicycles. The interpretation of the results should take into consideration that the experiment was in a controlled setting and that it was not naturalistic for regular bicycling.

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Appendices

Appendix A – Borg 20 scale

Borgs RPE-skala®

- en skattning av den egenupplevda fysiska ansträngningsgraden

6	**Ingen ansträngning alls**
7	**Extremt lätt**
8	
9	**Mycket lätt**
10	
11	**Lätt**
12	
13	**Något ansträngande**
14	
15	**Ansträngande**
16	
17	**Mycket ansträngande**
18	
19	**Extremt ansträngande**
20	**Maximal ansträngning**

Appendix B – Borg CR-10 rating

Berusningsskala (självskattning)

(utifrån CR-10 skalan):

0 **Ingen berusning alls.** (Du känner dig helt nykter och opåverkad)
0.5 **Något berusad** (Du känner dig varm, avspänd och väl till mods)
1 **Svag berusning** (Du känner dig upprymd och hämningarna släpper)

2

3 **Måttlig berusning** (Du börjar bli högljudd och yvig i dina rörelser)

4

5 **Stark berusning** (Du sluddrar och är sämre på att kontrollera muskler och känslor)

6

7 **Mycket stark berusning** (Du harsvårt att hålla balansen och du kan ramla omkull)

8

9

10 **Extremt stark berusning - Maximal** (Du har svårt att prata och gå upprätt, ser dubbelt)

11 (Du uppfattar inte vad som händer och sker och är på gränsen till medvetslös)

12

13 (Du är medvetslös. Du andas långsamt och riskerar att dö av alkoholförgiftning)

- Absolut max

Appendix C – Subjective self-rated ability scale

Riskbedömning

Du ska besvara några frågor på en 5 gradig skala från ***INGA PROBLEM*** till ***ABSOLUT INTE,*** som har att göra med hur svårt du tycker det är att hålla balansen.

Inga Problem = 1, Med Små Problem = 2, Kanske = 3, Med Stora Problem = 4, Absolut inte = 5

Du svarar alltså med en siffra genom att ringa in ditt svar nedan.

Ska bedömas vid varje block

1. ***Skulle du kunna förflytta dig 50 cm åt vänster på cykeln och tillbaka om du ville?***

Inga problem	Med små problem	Kanske	Med stora problem	Absolut inte
1	2	3	4	5

2. ***Skulle du kunna cykla stående om du ville?***

Inga problem	Med små problem	Kanske	Med stora problem	Absolut inte
1	2	3	4	5

3. ***Skulle du kunna cykla med en hand på styret om du ville?***

Inga problem	Med små problem	Kanske	Med stora problem	Absolut inte
1	2	3	4	5

4. ***Skulle du kunna cykla slalom om du ville***

Inga problem	Med små problem	Kanske	Med stora problem	Absolut inte
1	2	3	4	5

Appendix D – N-back task instructions

N-Back instruktioner

Bokstäver kommer att presenteras en och en i en ström med 2.5 sekunders intervall på en skärm

A, B, C, D, E, H, I, K, L, M, O, P, R, S, och T kommer att användas och de presenteras i slumpvis ordning.

Din uppgift är att säga JA om bokstaven som presenteras för tillfället på skärmen presenterades för två bokstäver sedan. Figuren nedan visar en bokstav och under står det vad du ska svara. För de två första bokstäverna behöver du inte svara något eftersom det inte finns två tidigare bokstäver.

C	D	G	D	I	B	I	A
		Nej	Ja	Nej	Nej	Ja	Nej

Varje Bokstav kommer att presenteras i 2 sekunder, därefter presenteras nästan direkt nästa bokstav.

Du säger således Ja eller Nej efter varje bokstav, där JA betyder att bokstaven du ser presenterades 2 bokstäver tidigare – se figur ovan.

Bokstäverna kommer att presenteras i en ström under ca 1 minut.

Appendix E – AUDIT Questionnaire

AUDIT

Här är ett antal frågor om dina alkoholvanor.

Vi är tacksamma om du besvarar dem så noggrant och ärligt som möjligt genom att markera det alternativ som gäller för dig.

Med ett "standardglas" menas

HUR GAMMAL ÄR DU? ________ ÅR ❑ MAN ❑ KVINNA

1. Hur ofta dricker du alkohol?	Aldrig ❑	1 gång i månaden eller mer sällan ❑	2–4 gånger i månaden ❑	2–3 gånger i veckan ❑	4 gånger/vecka eller mer ❑
2. Hur många "standardglas" (se exempel) dricker du en typisk dag då du dricker alkohol?	1–2 ❑	3–4 ❑	5–6 ❑	7–9 ❑	10 eller fler ❑
3. Hur ofta dricker du *sex* sådana "standardglas" eller *mer* vid samma tillfälle?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
4. Hur ofta under det senaste året har du inte kunnat sluta dricka sedan du börjat?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
5. Hur ofta under det senaste året har du låtit bli att göra något som du borde för att du drack?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
6. Hur ofta under senaste året har du behövt en "drink" på morgonen efter mycket drickande dagen innan?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
7. Hur ofta under det senaste året har du haft skuldkänslor eller samvets-förebråelser på grund av ditt drickande?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
8. Hur ofta under det senaste året har du druckit så att du dagen efter inte kommit ihåg vad du sagt eller gjort?	Aldrig ❑	Mer sällan än en gång i månaden ❑	Varje månad ❑	Varje vecka ❑	Dagligen eller nästan varje dag ❑
9. Har du eller någon annan blivit skadad på grund av ditt drickande?	Nej ❑		Ja, men inte under det senaste året ❑		Ja, under det senaste året ❑
10. Har en släkting eller vän, en läkare (eller någon annan inom sjukvården) oroat sig över ditt drickande eller antytt att du borde minska på det?	Nej ❑		Ja, men inte under det senaste året ❑		Ja, under det senaste året ❑

HAR DU BESVARAT ALLA FRÅGOR? – TACK FÖR DIN MEDVERKAN!

Översatt och bearbetat av professor Hans Bergman vid Karolinska Institutet.

Appendix F – Question of cycling habits/experience

4. Hur ofta har du cyklat under barmarksperioden 2019?

Aldrig	1 gång i månaden eller mer sällan	2-4 gånger i månaden	2-3 gånger i veckan	4 gånger i veckan eller mer
☐	☐	☐	☐	☐

Appendix G – Question of physical activity

7. Hur ofta har du tränat (inkludera även träning i form av träningscykling) eller utfört någon annan form av fysisk aktivitet (exempelvis promenerat) under 2019?

Aldrig	1 gång i månaden eller mer sällan	2-4 gånger i månaden	2-3 gånger i veckan	4 gånger i veckan eller mer
☐	☐	☐	☐	☐

Appendix H – Example of statements in Sensation Seeking Scale V

1. A. I like “wild” uninhibited parties

   B. I prefer quiet parties with good conversation

2. A. There are some movies I enjoy seeing a second or even a third time

   B. I can’t stand watching a movie that I’ve seen before

3. A. I often wish I could be a mountain climber

   B. I can’t understand people who risk their necks climbing mountains

4. A. I dislike all body odors

   B. I like some for the earthly body smells

5. A. I get bored seeing the same old faces

   B. I like to comfortable familiarity of everyday friends