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# Cycling under the influence

## Who and why?

Juni 2019







Kunnskap for en bedre verden

## Cycling under the influence

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Bygg- og miljøteknikk

Innlevert: Juni 2019

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## Forord

Dette er en masteroppgave skrevet våren 2019 ved institutt for bygg- og miljøteknikk ved Norges teknisk-naturvitenskapelige universitet(NTNU) i Trondheim. Oppgaven er del av emnet *TBA4945 - Transport, masteroppgave*. Dette er det avsluttende emnet for fagretningen transport på den gjennomgående sivilingeniørutdanning *Bygg- og miljøteknikk*, og utgjør 30 studiepoeng.

Opgaven er skrevet som en utvidet forskningsartikkel og er med det noe mer konsis enn en tradisjonell masteroppgave, men fyldigere enn en forskningsartikkel. Oppgaven inneholder også en noe utvidet beskrivelse av forskningsmetodene som vedlegg, samt hele spørreundersøkelsen og notater fra intervjuer. Oppgaven er i sin helhet skrevet på engelsk, men har et sammendrag på norsk. Arbeidet ble presentert på Nordic Traffic Safety Academy(NTSA) i Helsingfors 7. mai 2019.

Jeg ønsker å rette en takk til de som har bidratt til oppgaven. Først og fremst takk til min hovedveileder Trude Tørset og mine biveiledere Petr Pokorny og Gunnhild Beate Antonsen Svaboe ved NTNU for god hjelp og veiledning gjennom hele prosessen. Jeg vil også rette en takk til Statens Vegvesen og Marianne Stølan Rostoft, for hjelpsomme kommentarer i slutfasen samt støtte til reisen til Helsingfors. Videre rettes en takk til Syklistenes Landsforening og Ung i Trafikken for hjelp med distribusjon av spørreundersøkelse.

Trondheim, 4. juni 2019



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Mathias Vestgård

## Sammendrag

Med et økende fokus på både miljø- og helseproblematikk, har sykling for alvor blitt satt på agendaen som et miljøvennlig og sunt fremkomstmiddel i Norge. Mange positive effekter kan komme som følge av en økning i sykkelbruk, men det kan også ha noen negative konsekvenser. Flere syklistene vil redusere antallet biler på veien og ha en helsefrembringende effekt på syklistene, men en økning i antallet syklistene kan også føre til en økning i sykkelulykker og utrygg adferd relatert til sykling. Et eksempel på en slik adferd er sykling under alkoholpåvirkning(SUA). Sykkelen kan for mange være et billig og praktisk alternativ for å komme seg hjem fra klubber, barer eller venner etter å ha drukket alkohol. Lite er kjent om alkoholbruk og sykling i Norge, og dette studiet tar derfor for seg SUA i Norge. Målet var å finne ut hvor utbredt SUA er i Norge, hvilke holdninger man har til SUA i Norge og hva som legges til grunn når en person tar valget om å sykle under alkoholpåvirkning.

Datainnsamling ble gjort gjennom tre komplementære metoder: først ble uformelle fokusgruppeintervjuer i naturlig forekommende grupper på puber og barer gjort for å få en tidlig indikasjon på utbredelse av og grunner til SUA. Deretter, delvis basert på resultatene fra fokusgruppeintervjuene, ble et nettbasert spørreskjema laget. Dette ble gjort for å få en sterkere indikasjon på utbredelsen av SUA blant befolkningen, samt for å avdekke holdninger og grunner til SUA fra et bredere utvalg av respondenter. Til slutt ble fokuserte intervjuer gjennomført over to kvelder i et område med et stort utvalg barer og restauranter i Trondheim. Her ble mennesker som enten parkerte eller hentet en sykkel, intervjuet for å ytterligere avdekke grunner til SUA og hvilke vurderinger som gjøres rett før eller etter SUA.

Resultater viste at SUA er et utbredt fenomen i Norge, hvor 82,6%(537 respondenter) av totalt 650 gyldige svar fra spørreundersøkelsen hadde syklet under alkoholpåvirkning minst en gang i løpet av livet. Av disse 537 respondentene, hadde 59,9%(322 respondenter) gjort det en eller flere ganger i løpet av det siste året. Syklistene som sykler etter å ha konsumert alkohol er oftere menn, yngre enn 30 år og boende i store norske byer(>50 000 innbyggere). Holdningene er generelt tillatende til sykling under et lavt nivå av alkoholpåvirkning, men holdningene blir raskt mer negative til SUA når alkoholpåvirkningsnivået øker. Tillatende holdninger, det å ha venner som sykler under alkoholpåvirkning og det å ha venner/familie som synes det er OK at en selv sykler etter å ha drukket alkohol, øker muligheten for at en person har gjort det i løpet av det siste året. Blant de vanligste grunnene til SUA, finnes sykkel- og alkoholvaner, hvor hyppigere sykling og hyppigere alkoholinntak assosieres med mer SUA. Fint vær, distanser egnet for sykling, og at det å sykle er en hyggelig/fin aktivitet er også fremtredende grunner til SUA. Studiet avdekket også at mange har lite kunnskap om lovverket tilknyttet SUA, og det ble også avdekket noen problemer og usikkerheter knyttet til det nåværende lovverket. Siden SUA er utbredt i Norge, er det nødvendig med mer data om temaet, spesielt tilknyttet skader og ulykker som forekommer ved et lavt alkoholpåvirkningsnivå, for å kunne si om dette utgjør en trafikksikkerhetsrisiko.

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## Abstract

Environmental awareness and an increased focus on health have put cycling on the agenda as a healthy and sustainable transport mode. While there are undoubtedly a lot of positive benefits stemming from a shift from car use to bike use, an increase in the number of bicyclists on the road might also have some negative impacts. More cyclists might reduce the number of cars on the road and give health benefits to the cyclists, but an increase in bike use might also lead to more cycling related accidents and an increase in unsafe cycling habits. One such cycling habit is cycling under the influence of alcohol(CUI). For many, the bike can serve as a practical and cheap alternative of getting home from bars, clubs or friends after one or many drinks. Little is known about alcohol consumption in combination with cycling in Norway. This study tried to understand some of the mechanisms behind CUI in Norway; the goal was to find out how prevalent CUI is in Norway, what the attitudes towards CUI in Norway are and what reasons there are for a person to ride a bike under the influence of alcohol.

Data was collected in three complementing ways: First, informal focus group interviews in naturally occurring groups at pubs, bars and similar gave insights from stories and discussions among friends. Second, an online questionnaire gave more detailed information from a bigger part of the population and a broader category of questions. Third, focused interviews at nighttime on weekends and popular days to go out with persons about to park or leave on a bike, enabled the possibility of gaining information from cyclists influenced by alcohol to understand the considerations done when CUI actually happened.

CUI can be seen as prevalent in Norway. Of 650 respondents in an online questionnaire, 82,6%(537 respondents) had done it some time during their life. Of these 537, 59,9%(322 respondents) had done it sometime the past year. These are more often male, young adults(20-39 years) and living in big Norwegian cities(>50 000 inhabitants). Attitudes are generally permissive towards a low level of alcohol influence, they become increasingly negative towards cycling under higher levels of influence. Permissive attitudes, having friends who also CUI and having family/friends who accept that a person does it, increase the possibility of doing it. Both higher cycling and drinking frequencies were associated with more CUI the last year. Typical reasons to ride a bike under the influence include nice weather, distances suitable for cycling and that riding a bike is enjoyable. The study uncovered a low knowledge of rules and regulations among the population. The law is quite vague, and possible problems related to enforcement of it was discovered. As CUI is prevalent in Norway, more data is needed on CUI related accidents, especially concerning riding a bike under a low level of influence.

## 1 Introduction

### 1.1 Background

The recent focus on environmental and health related issues has caused a need for transport modes that are both environmentally friendly and healthy. This has paved the way for the use of bicycles as a mean of transport in everyday life. The Norwegian government has set a goal for the distribution of the expected growth in personal transport, called the zero growth goal. The zero growth goal states that the future increase in personal transport in urban areas should be accommodated by public transport, walking and cycling (Samferdselsdepartementet, 2017). To be able to reach this goal, cities throughout the country are trying to increase the share of commuting cyclists through awareness campaigns and new bike-friendly infrastructure. Many of the biggest cities even have specific strategies for this purpose, such as Oslo Kommune (2014), Miljøpakken (2014) in Trondheim and Bergen Kommune (2009). With the bike being a healthy and relatively quick way of getting around, a likely result of the increased focus on cycling is an increased number of bike-users in traffic. Adding electrical bikes that generate higher speeds and less sweat in to the mix, cycling becomes even more attractive. An increase can be expected both for commuting and recreational purposes.

While the increase of bike use undoubtedly has a lot of benefits, such as a reduction of cars in traffic and improved health, the increase can have certain negative impacts as well. An increase in bike use might lead to an increase in severely injured and killed cyclists. There are also indications towards a big under-reporting of cycling accidents, especially accidents where only the cyclist is involved (Vegdirektoratet and Statens Vegvesen, 2018). Another negative impact might be an increase in unsafe riding habits, and one such unsafe riding habit is cycling under the influence of alcohol (CUI). Alcohol's effects on cognitive and physical abilities have been widely studied. In studies related to car use, reaction and recognition time seem to be prolonged with the intake of alcohol (Maylor and Rabbitt, 1993; Tzambazis and Stough, 2000). This is also likely to occur when CUI. The working memory, vigilance for and inhibition of response to rare events and information processing also seem to be deteriorated after alcohol consumption (Dry et al., 2012). All of the abilities mentioned above can be important when manoeuvring any vehicle in traffic.

Høyen (2017) points out in a report concerning cycling safety that mixing alcohol and cycling increases the risk of being involved in an accident. Deterioration of riding skills can occur and increase the accident risk. Hartung et al. (2015) did an experimental study, where participants were asked to ride a test course sober, then repeat it after consuming increasing amounts of alcohol. Deterioration of riding skills happened even after low amounts of alcohol, and generally worsened with an increasing level of blood alcohol concentration (BAC). However, some of the test subjects performed better with a BAC level of more than 0,16% compared to what others performed sober.

Accident characteristics are also affected when riding a bike under the influence of alcohol; Andersson and Bunketorp (2002); Airaksinen et al. (2018); Orsi et al. (2014) all found that the share of cyclists sustaining head injuries was significantly higher among those with positive BAC levels compared to sober cyclists, and that single accidents were more common among intoxicated cyclists than sober cyclists. Single accidents are accidents where only the cyclist is involved. CUI might be an unsafe riding habit in itself, but often seems to be combined with additional unsafe riding habits and situations as well, such as riding without a safety helmet and riding at nighttime in the dark (Andersson and Bunketorp, 2002; Twisk and Reurings, 2013; Crocker et al., 2010). This can increase the accident risk, and might also explain the accident characteristics mentioned above. Høyen (2017) also points out that the use of helmet seems to have a greater positive effect on intoxicated cyclists due to the accident characteristics mentioned earlier.

## 1.2 Previous research

Several studies on the prevalence of CUI and attitudes towards it, have been identified in the research literature. In Germany, Hagemeister and Kronmaier (2017) investigated CUI in contrast to driving under the influence of alcohol (DUI) through an online questionnaire. The results show that CUI is more common than DUI, and that if a person drinks more often or uses a vehicle (both for bike and car) more often, it is more likely that the person will use the vehicle after alcohol consumption. CUI was also perceived as less dangerous than DUI by the respondents. Also in Germany, Huemer (2018) used the theory of planned behaviour (TPB) as a framework, creating an online questionnaire to uncover factors influencing the prevalence of CUI. With one part covering respondents habits, and the other part covering 9 groups of predictors assumed to influence the choice of CUI, a third of the respondents stated that they had ridden a bike under the influence the previous week. More alcohol consumption and more bike use was found to increase the possibility for a person to use a bike under the influence in this study as well. In general, a permissive attitude towards CUI was found.

In the Netherlands, Verster et al. (2009) conducted a survey among students. 690 of 800 respondents stated that they went out for drinks on average 1,6 times a week. Of the 690 students, 64,5% stated that they often or always took the bike back home. de Waard et al. (2016) did short

interviews and breathalyser tests at nighttime in Groningen (city with big student population) and The Hague (city with low student population). In The Hague, 50,8% of all cyclists tested had a positive BAC level, while the share was 67,6% in Groningen. Whether the cyclist was a student or not did not significantly affect if the cyclist had a positive BAC level. The share of cyclists with a positive BAC level increased steadily throughout the night and until the morning. 39% of the cyclists knew the Dutch laws concerning CUI, while 61% did not.

In an analysis of data from The Korea National Health and Nutrition Examination, Hwang et al. (2017) looked at respondents that were 19 years or older and rode a bike. 12,1% of these had experienced CUI sometime during their life. Groups who were more likely to have experience with CUI were male, lived in urban areas, drank alcohol and had less education. A higher age also increased the probability for a person to have had experience with CUI. It should be noted that people not drinking alcohol were also included in the study, and this might be part of the reason for a reduced share compared to studies presented from Germany and the Netherlands.

In Sweden, a different approach was taken by Warner et al. (2017). In a multidisciplinary report on CUI, part of the data collection was done through in-depth interviews. 34 participants (19 female, 15 male) who rode a bike and drank alcohol more or less regularly (not necessarily combined), answered questions related to CUI. 29 of them had ridden a bike under the influence of alcohol before. Benefits of doing so, were said to be that it was "practical, free, safe, nice and better than taking the car". Risks were identified as "impaired ability, danger to oneself, danger to others". Of factors that could prevent people from riding a bike under the influence of alcohol, the informants said: "cycling-unfriendly infrastructure such as traffic, parenting and experience such as previous accident involvement" (Warner et al., 2017, p. 11).

Most of the studies presented show a rather lenient attitude towards CUI and it seems to be quite prevalent. Risks related to CUI seem to be neglected by the ones doing it. It should be pointed out that the majority of the studies are based on online questionnaires, surveys and interviews, and therefore rely on self-reported data. CUI can be a sensitive topic, and respondents/informants might feel an urge to answer in a more socially acceptable way, causing a bias. However, the results consistency strengthen the results validity. Furthermore, the high number of informants stating that they had in fact ridden a bike under the influence of alcohol in the face-to-face interviews in Warner et al. (2017), strengthen the belief that such a bias does not occur to a particular degree, at least for the European studies.

### 1.3 CUI in Norway

In Norway, only some data on cycling and alcohol can be found. In a report studying fatal bike accidents between 2005 and 2012, Krekling et al. (2014) found drugs or alcohol to be a part of the reason in 13 (18%) of 71 accidents studied. In 9 of these accidents, the cyclist was the one under the influence, and in the remaining 4 a car driver under the influence was involved. In the report, it is pointed out that the actual number is likely to be higher, because the police does not always check for alcohol or drugs, if there is no question of criminal liability related to the accident. This might be the case for single accidents, where the cyclist is the only person involved. In Oslo, Melhuus et al. (2015) did a study on cyclist accident data from the emergency room in Oslo from 2014. Of 1647 patients from within the city of Oslo, 162 (9,7%) reported being influenced by alcohol or other drugs. An interesting result was that when looking only at the 53 city bike users who reported to the hospital, the share was 17,5%. Although the system is closed between midnight and 6 o'clock in the morning, people might use city bikes more often to go to clubs, bars and similar, and find some other transport mode back home. Then, there is no need to lock up a personal bike in the city at nighttime. In a study related to traffic safety for cyclists, Høye (2017) points out that cyclist under the influence of alcohol have a greater accident risk, and that the use of a safety helmet has a greater positive effect on intoxicated cyclists due to the

common characteristics of CUI related accidents.

The legislation concerning CUI in Norway is somewhat vague. CUI is not strictly illegal, and there is no defined limit of BAC where it turns illegal. In chapter IV. "Driver of vehicles etc.", § 21 of the Norwegian law for traffic, it is stated that "no driver should use or try to use any vehicle when she/he is not in a condition fit to do so in a safe manner, whether this is due to alcohol or any intoxicating or sedating substance, or due to illness or tiredness, or due to any other circumstances" (Vegtrafikkloven, 1965, § 21, Samferdselsdepartementet (1965), translated by the author). A vehicle here, means any device (motorized and non-motorized) meant for transportation on land that is not based on rails (Vegtrafikkloven, 1965, § 2, Samferdselsdepartementet (1965)). Overall in Europe, the legislation varies greatly. In the Northern parts, such as the UK, Ireland and the other Scandinavian countries, the legislation is similar with no distinct BAC limit. In the Czech republic, Slovakia and Estonia, there is a zero tolerance, with the same low BAC limit as for driving a car. In Austria, the BAC limit is 0,08%, while in Germany, the limit of absolute unfitness to ride a bike is as high as 0,16% (EuroVelo). The Netherlands has a limit of 0,05% (de Waard et al., 2016).

From this, it is evident that the legislation is somewhat difficult to understand properly in contrast to the legislation for car drivers. That it is not directly illegal to ride a bike under the influence of alcohol is illustrated by an interview in a news article by the Norwegian Broadcasting Corporation (NRK). The Leader of the mobile police unit in Rogaland, Norway, explains the law, saying that it is not directly illegal to ride a bike under the influence of alcohol, but if you cause problems while doing so, you can be charged (Laugaland and Pedersen, 2014). A different example illustrating the difficulties of actually understanding the law, can be found on Trygg Trafikk's website. Trygg Trafikk is an organisation working on traffic safety in Norway, and in a note on laws and regulations for cyclists, it is written "Since the bike is a vehicle, it is also forbidden to ride a bicycle while under the influence." (Trygg Trafikk, translated by the author). As pointed out earlier, the law does not forbid riding a bike under the influence of neither drugs nor alcohol, it is only forbidden if the driver of the vehicle or cyclist is in a condition where this can not be done in a safe manner. Whether this means no amount of drugs/alcohol or some amount, vary from person to person. When an organisation working solely on traffic safety can misinterpret the law, it can also be done by regular citizens, and the vagueness of the law can have an impact on the prevalence and attitudes towards CUI.

In order to get further insights on recorded cases and actual enforcement, Trøndelag police district was contacted by the author of this master thesis. Mail correspondence with a police superintendent revealed that data on the number of cases related to CUI was difficult to obtain from the police database because of the way the police recorded the data. The police superintendent also wrote that very few cases actually end up with the police. Further, the superintendent noted that the police perform controls of cyclists, but these controls are not directed towards possible alcohol or drug use among the cyclists. For the most part, there are no specific actions taken or controls done towards seeing if a cyclist is under the influence or not. If a cyclist is involved in an accident and there are signs pointing towards CUI, then a control of BAC level or other substances will be done. Other than this, it was also mentioned that if a cyclist obviously violates §3 of the Norwegian law for traffic, the cyclist will be controlled by the police. What is crucial here, is how an eventual witness or the police officer perceives the particular situation. §3 of the Norwegian law for traffic says that "Everyone must travel safely and be attentive and cautious so that no danger can occur and so that other traffic is not unnecessarily hindered or disturbed" (Vegtrafikkloven, 1965, § 3, Samferdselsdepartementet (1965), translated by the author).

To further get insights on various accidents in Trondheim, including CUI related accidents, the emergency room in Trondheim was contacted by a group of students including the author of this thesis, but such data could not be obtained.

## 1.4 Objective

As shown, there is little knowledge on CUI in Norway. Accident databases from hospitals and police lack information, and the number of unrecorded accidents is likely to be high. With this little knowledge on CUI in Norway, the objective of this research is to explore CUI in Norway. The mentioned probable increase of cyclists in the traffic, makes it important to understand the populations attitudes to what can be regarded as potentially unsafe riding behaviour. This can in turn help to direct eventual measures to promote safe cycling habits. Therefore, the following research questions have been investigated:

1. How prevalent is CUI in Norway?
2. What are the attitudes towards cycling under the influence of alcohol in Norway, and which socio-demographic groups find using a bike after alcohol consumption most acceptable?
3. If a person is riding a bike under the influence of alcohol; what are the main reasons to do so, and at what level of influence do people find it acceptable?

To help answer questions 2 and 3, several hypotheses have been tested:

- Among the ones who have experience with CUI, there is a significantly higher proportion of CUI last year among students(H1), younger age groups (<30 years)(H2) and people living in big Norwegian cities (more than 50 000 inhabitants)(H3) than for the rest of the sample.
- Students (H4), younger age groups (<30 years)(H5) and people living in big Norwegian cities (more than 50 000 inhabitants)(H6) have a more permissive attitude towards CUI than the rest of the sample.
- There is a linear trend between CUI last year and drinking (H7) and cycling (H8) habits (higher frequency of cycling/drinking associated with more CUI last year)
- There is a linear trend between CUI last year and having friends who CUI (friends who also CUI, associated with more CUI last year)(H9).
- There is a linear trend between CUI last year and having friends (H10) and family (H11) accepting that you CUI (higher acceptance, associated with more CUI last year)
- There is a linear trend between CUI last year and perceived level of safety (higher level of safe riding, associated with more CUI last year)(H12).

Gaining knowledge on the proposed research questions can be useful in several ways. With an indication on the prevalence of CUI, this can later on be combined with detailed accident studies, and thus uncover if CUI is a traffic safety issue in Norway. Knowing the demographic groups that more often cycle under the influence and have a permissive attitude towards it, enable the possibility of taking measures such as awareness campaigns more effectively, if CUI is found to be a problem. Knowing attitudes towards, prevalence of and reasons for CUI will also help to determine if the current law is effective or if there is a need for a change of legislation.

## 2 Method

Data collection was done through three complementary methods; focus group interviews (FGIs), an online questionnaire and short one-on-one focused interviews (FIs), making the research a combination of qualitative and quantitative methods, known as a mixed-method approach. Clark and Ivankova (2017) identifies one of the main strengths with a mixed method approach as the ability of qualitative and quantitative methods to offset each others strengths and weaknesses. Further explaining this, Clark and Ivankova (2017) points out that quantitative methods have the strength of being able to generalise its results, but the results are likely to lack detail on the given topic.

By combining quantitative and qualitative methods, part of this issue can be overcome, and this is also the main reason for combining these methods. Each of the methods were selected for specific purposes in order to get a more complete picture of the topic, partly in detail while also being able to draw some general conclusions.

## 2.1 Main framework

For the research design, the Theory of Planned Behaviour (TPB) was used as a main framework, especially for the creation of the online questionnaire. TPB is a theory seeking to describe factors influencing human behaviour. In TPB, Ajzen (1991) divides mechanisms behind human intention, and eventually behaviour, into three predictors. A person's intention is affected by the attitude towards the behaviour, the subjective norm and the perceived behavioural control.

To illustrate the relevance for CUI; if a cyclist has a permissive attitude towards CUI (attitude towards the behaviour), all the cyclist's friends also find it acceptable (subjective norm) and the cyclist feels like she/he has sufficient control on the bike to ride safely after a certain amount of alcohol (perceived behavioural control), it is more likely that this cyclist has intentions to ride a bike after alcohol consumption, and further it will be more likely that the cyclist actually will ride a bike after alcohol consumption. Although in a somewhat extended form, TPB has been used together with other supplementary predictors in several studies related to transport (Donald et al., 2014; Lois et al., 2015; Bird et al., 2018) and even CUI, like in Huemer (2018). The recent use of the theory, illustrates that it is relevant for such purposes. Using an extended version of it, one can more easily get answers to certain questions to be looked at, and/or investigate if other predictors also play a key role in certain behaviour.

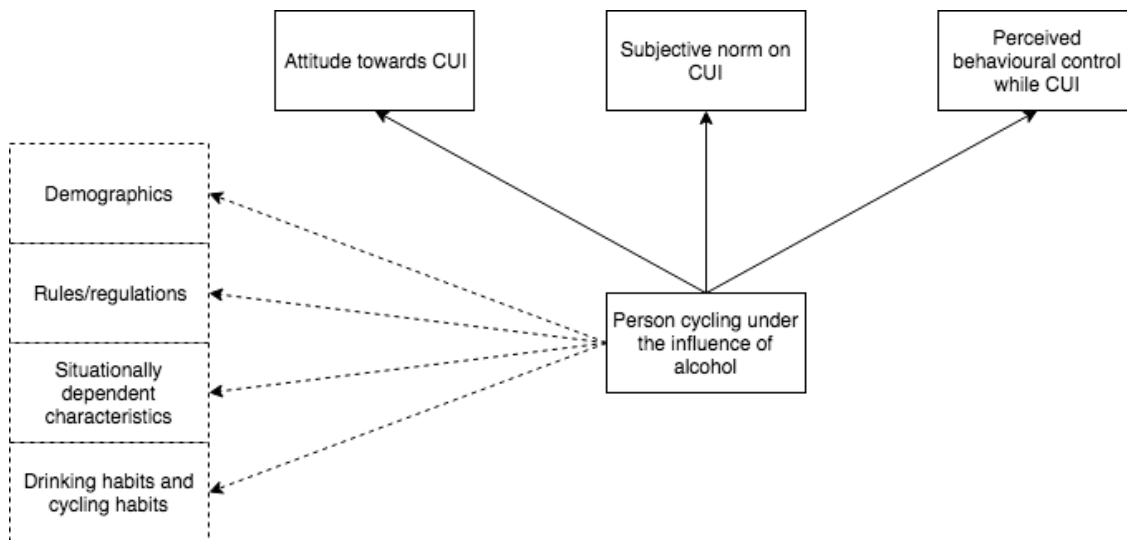


Figure 1: Research model

In addition to the three predictors from TPB, four others were included in this study, as shown in figure 1. Demographics were assumed to play a role in a person's behaviour: for instance younger individuals might take more risk than older individuals, while older individuals might have more experience. Knowledge of rules and regulations were also thought to affect the actions of an individual. If a certain action like CUI has strict laws and potential punishment, there might be an increasing possibility that the individual will refrain from doing the action. Therefore, if the person is aware of the law, this might affect the actions. Situationally dependent characteristics

are a group of characteristics related to the situation's time and place, for instance the distance home, weather conditions or presence of other transport modes. A person can prefer to take a bus, but if no other option is available, the person might choose the bike. Lastly, habits were also assumed to increase the possibility of having a certain behaviour. If a person more often both ride bikes and drink alcohol, the probability of encountering a situation where the two can be combined will increase, and thus the possibility of riding a bike under the influence is more likely.

For the qualitative collection methods, the collection and analysis process was inspired by the stepwise-deductive inductive method (SDI) (Tjora, 2017a). Tjora (2017a) explains the method as 7 steps going from data generation and raw data to concepts and theory by coding the raw data and grouping these codes. Since the data collection methods and their belonging data were "short" versions of traditional qualitative methods, SDI has been used in a more concise way. The first 4 steps were done individually for the FGIs and FIs. Then the codes and grouping categories have been combined, and the last 2 steps, concept development and theory, have been done with all results present.

## 2.2 The influence scale

Studies on CUI have often asked about alcohol consumption in terms of the number of alcoholic units consumed, like in Huemer (2018); Hagemester and Kronmaier (2017). While this can be useful to estimate BAC levels, there are uncertainties related to what a unit is and body weight of the respondents. Different BAC levels also have different impacts on people. Another way to investigate level of alcohol consumption, can be done in a more empirical manner.

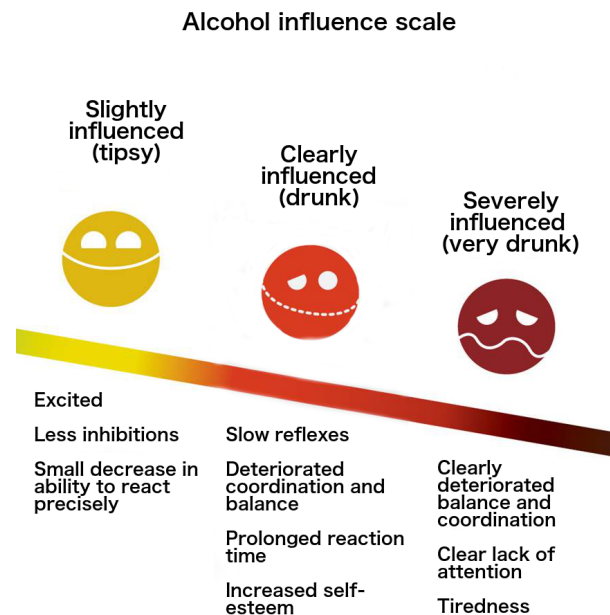


Figure 2: The influence scale, an edited version of the scale from Helsedirektoratet (2015)

A scale from Helsedirektoratet (2015) has been edited, and recognisable signs of alcohol influence have been adapted to be more suitable for this specific research. The edited scale looks at alcohol related effects on a person connected to balance, reaction and other abilities influencing



the ability to ride a bike. As shown in figure 2, some expected signs for the different levels of intoxication are explained, and they are assumed to be familiar to people with a regular level of alcohol consumption. This scale has been used to ask participants questions connected to alcohol consumption, for instance to see respondents attitude towards CUI at different levels of alcohol influence. The reasoning behind this choice was that the effects shown in this scale was more relatable for respondents compared to the effects after varying numbers of drinks consumed.

### 2.3 Ethical aspects

For the FGIs and FIs, some ethical concerns are raised. As pointed out by Levang et al. (2017) in a study done under similar circumstances, participants recruited spontaneously have limited time to reflect upon their participation. The topic might be a bit sensitive to some, but measures were taken to inform informants and ensure their privacy. Before each interview, it was explained that no identifiable information would be collected or stored, and only written notes would be taken. Their anonymity was also ensured. Information about the study and its main purposes was also given beforehand, and therefore informed consent was preserved. Informants could also leave the interview at any time or refuse to answer any questions.

Many of the informants were also likely to have consumed alcohol prior to participating. This was also the case in Levang et al. (2017), and their principle of interrupting an interview if the informant was visibly influenced by alcohol, was also followed in this research. If a potential informant was visibly influenced before being approached, any approach towards that person would not be done. This was done to ensure that the influence of alcohol did not affect the answers or consent to an extent that could raise further ethical concerns. Another measure taken to avoid interviewing severely influenced people, was to do all the interviews before 22:00 at night time. In this way, people going out would have had less time to consume a big amount of alcohol, reducing the probability of becoming very drunk.

### 2.4 Focus group interviews

FGIs enabled data collection from several informants at the same time. FGIs were chosen as a data collection method to give an early indication on prevalence of, attitudes towards and reasons for CUI through a less restricted form of conversation. Naturally occurring groups were chosen because they could possibly reveal information that could otherwise not be obtained (Brown, 2015), and friends and acquaintances could be more likely to call each other out on untruthful responses (Kitzinger, 1995). The results were used as input for the online questionnaire. The interviews were mostly semi-structured, with 5 main questions to be asked. Informants were also motivated to tell stories or describe scenarios where they had decided to CUI or not.

The interviews were carried out in a somewhat unconventional and informal way, with the groups being small (3-5 informants) and the interviews short (5 questions, approx. 10 minutes). Small groups of people already sitting together around a table in bars and pubs were asked to participate in a short focus group interview on the spot. The reasoning behind this, was that the group probably already knew each other, and therefore the discussions would flow more easily and without restraints. Another important aspect was that recruiting informants was assumed to be easier because it could be done on the spot.

In a very condensed manner, the FGIs were structured after the three stages of an interview; warm-up, reflection and round-up, as described in Tjora (2017b). Two questions concerning cycling/alcohol habits and whether or not an informant had ridden a bike under the influence of alcohol served as a warm-up. The reflection part consisted of two questions related to reasons for people to CUI and whether or not informants found CUI to be acceptable. The last question was related to knowledge on legislation, and worked as some sort of round-up, where there was less

need for reflection. If informants did not know the legislation, they could be informed of it in this stage, before the interview ended.

The sample was intended to be varied, both in terms of age and gender on a total basis, but also when it came to the composition of the groups and in what type of places they were recruited. This was to get a representative selection of the population, and also to get different group dynamics. All types of bars were eligible: ranging from student bars to cocktail bars and craft beer bars. The nature of the places was intentionally varied. This was to ensure varied groups of informants. Student bars were identified as a place to find students and craft beer bars/cocktail bars as places to find an older part of the population. The places were also selected on a somewhat subjective estimation of popularity, to make sure that there were many groups to choose from in each location.

#### **2.4.1 Informants**

A total of 23 informants in 6 different groups participated in the FGIs. They were conducted between the 25th of January 2019 and the 14th of February 2019. All interviews were done between 18:00 and 21:00 at night in various locations in the city of Trondheim. 12 of the informants were male and 11 were female. Informants ages were only roughly estimated to make sure there was a variation in age among the informants. The estimated ages varied from the early 20's to late 50's. None of the informants were estimated to be older than 60 years purely based on appearance, and as a result the oldest age groups might have been underrepresented in the FGIs. Other than that, the groups were varied, with both all male and all female groups, as well as mixed groups and one group with a broader age span. None of the informants were visibly influenced by alcohol.

## **2.5 Online questionnaire**

To increase the number of respondents and to be able to reach out to a bigger part of the country, an online questionnaire was chosen as the second method of the data collection. This data collection method has previously been used for similar purposes, such as in Huemer (2018) and Hagemeister and Kronmaier (2017).

To make the questionnaire in this study as good as possible, the creation process went on for more than a month, using results from the focus group interviews as input. Several tests of the questionnaire itself on friends were done, as well as helpful discussion sessions with supervisors and fellow students. Through this process, many questions were left out or improved, and what started as a survey with more than 40 questions, ended up at 32 questions, with one question being optional. Any possible privacy and ethical issues were resolved by making sure that no information about the respondents devices, IP addresses or any other digital information were collected by the software used.

The questionnaire had an incentive in form of a chance to win 6 scratchcards to increase the number of responses. Respondents who wanted to participate in the contest had to send a text message to a phone number with a keyword given after the survey was finished, separating contest entries from the responses and making it impossible to match respondents identities with the answers. A winner of the contest was drawn and contacted on April the 4th.

The online questionnaire itself had questions grouped in the same 7 predictors shown in figure 1. Respondents had to answer to some demographic details, their alcohol and cycling habits, their attitude towards CUI and how well they handled a bike while CUI at different influence levels, what their friends/family thought about them CUI and whether or not they knew the legislation. They also had to answer to reasons to CUI and if they would take the bike in a given scenario depending on distance and presence of public transport. Factors mentioned as important for people to ride or not to ride under the influence of alcohol during the focus groups, were included in

various forms in the questionnaire. Questions were answered in various ways, ranging from ordinal frequencies for habits, yes/no-answers to questions related to rule knowledge and competitive alternatives and a Likert scale(1=agree to 5=disagree, 3=neither agree nor disagree) for questions related to attitude, perceived behavioural control and subjective norm.

Using a Likert scale introduces certain problems for the analysis. Sometimes, the Likert scale is treated as an interval scale. This has been criticised, because it is hard to argue that the numeric intervals between the steps of the scale are correct and can be given a numerical value. Thus, mean and standard deviations cannot be used (Jamieson, 2004). To overcome the issues related to the Likert scale data, non-parametric tests looking at the mean rank and median have been used instead, and the Likert scale data has been treated strictly as ordinal throughout analysis.

Questback Essentials was the selected tool for creating the questionnaire. It was chosen because a free student licence could be obtained through a university agreement, enabling all features and an unlimited number of responses. The survey was distributed through several channels; an online forum for cyclists called Terrenngsykkelforum, personal accounts on Facebook and a Facebook page called "JEG HAR INGEN VENNER Å MISTE - IKKE KJØR I FYLLA!" (meaning "I have no friends to lose - don't drink and drive!"). An interest organisation for cyclists, Syklistenes Landsforening, published an article and a post on Facebook about the study with a link to the survey on their website. With these locations, everyday cyclists, people concerned with traffic safety and people from different parts of the country could be reached. The survey was online from the 27th of February until the 15th of March 2019.

### 2.5.1 Respondents

655 responses were obtained through the online survey. 738 began the survey, but 83 people did not complete it. A bit of data cleaning to remove contradictory answers, was needed. Contradictory answers involved people expressing a negative attitude towards CUI in a low influence level, but positive attitude towards CUI in a high influence level. Such answers could indicate that the questions were not understood properly, or that respondents just answered randomly. After the data cleaning, the final data set contained 650 respondents. Regarding gender, there were 40,3% female, 59,4% male, while 0,3% did not want to specify.

The sample age/gender distribution is shown in figure 3. Respondents ages ranged from 17 to 85 years (mean=38,16, SD=13,09). Naturally the youngest age group, 10-19 years, is smaller for the sample, since the population data used contains all people older than 10 years, while the lowest age was 17 from the survey respondents. The older age groups are somewhat underrepresented in the sample. The age group 20-29 is the biggest in the sample. Looking at the sample distribution, the most certain conclusions can be made on age groups from 20 to 59 years. As shown in table 1, employment and especially student shares are higher in the sample compared to the general population, and in these groups the most certain conclusions can be made.

<b>Employment status</b>	<b>Sample</b>	<b>Population</b>
Student	21,1%	5,5%
Employed	71,7%	67,6%
Unemployed	0,8%	3,5%
Disabled	2,6%	9,8%
Pensioner	2,2%	15,1%

Table 1: Employment status (data from Statistisk Sentralbyrå (2019b, 2018a, 2019c, 2018b))

94% of the respondents responded that they use a bike at least a few times a year. In a series

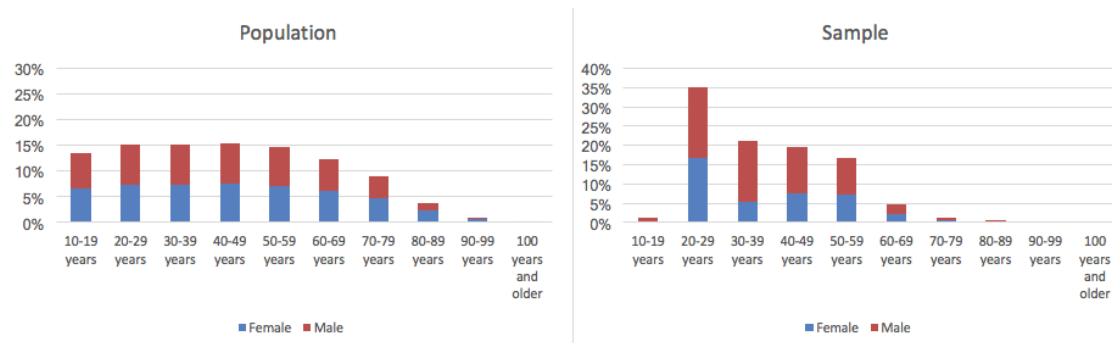


Figure 3: Age/gender distributions (population data from Statistisk Sentralbyrå (2019a))

of studies on bike use in different regions in Norway, the share of people who had ridden a bike the last year ranged from 57% to 65% (Tretvik, 2015, 2018, 2016; Kummeneje and Tretvik, 2015). It should be noted that in Tretvik (2015), pensioners and age groups above 60 years were identified as having a clearly lower share of people having used the bike at least once last year. In all these reports, people older than 60 years made up at least 23% of the sample, compared to only 6,1% in this survey. A result of this is probably an increased share of cyclists in the survey sample. However, the share of cyclists is still likely to be higher in the sample than in the population. 94,6% of the respondents stated that they drank alcohol at least once a year. Comparable numbers from the population, indicates a share of 83% in 2017 Folkehelseinstituttet (2018). Again, it should be noted that the share is lower among the older age groups in the population, and might explain the high share of people who drink alcohol. With regards to CUI, people drinking alcohol and riding a bike are the most relevant to study.

The share of respondents living in a city bigger than 50 000 is 60,9% in the sample, while for the population it is 40,4% (calculated using numbers from Thorsnæs (2018)). To conclude, the sample will be representative for people in the age from 20 to 59 years who rides bikes at least once a year and drink alcohol at least once a year. The sample can not give certain conclusions alone on groups like pensioners, disabled, unemployed and the oldest age groups. Conclusions can be more certain on differences between people living in big cities and not, because the number of respondents in both these groups are high.

## 2.6 Focused interviews

Rather than using lengthy in-depth interviews, a less time-consuming approach called focused interviews was used in this study. Tjora (2017c) explains that such an approach could be suitable in situations where the informant has encountered or been directly involved in the particular situation being studied and when the informant's experiences and observations are the ones to be questioned.

The focused interviews were done with people about to park or leave on a bike around popular nightlife areas in Trondheim at nighttime. The idea was to get insights from people who ride bikes under the influence of alcohol right after or before it happens. This could lead to different answers than what was uncovered through the FGIs and the online questionnaire. The method enabled getting the reflections being made while the activity actually took place. These interviews would also supplement the findings from the questionnaire and focus groups. Analyses of the FGIs and questionnaire were already done, and any unclear aspects were emphasised in the focused interviews. An aspect that needed further investigation was the role of influence level, and a question related to how drunk a person would be before not taking the bike this was included. The interviews were kept short to avoid the loss of focus from informants.

7 questions were asked, and they were a combination of short and open answer questions. The interview guide also used the principles of dividing the interview into warm-up, reflection and round-up (Tjora, 2017b). The warm-up consisted of three questions related to age, employment status and whether or not the informant had consumed any alcohol prior to the interview. The reflection part was also made up of three questions; one on whether or not the informant found CUI OK, one on tolerated influence level to ride under and one related to specific reasons for why the informant brought the bike. The round up question concerned knowledge on legislation.

As a sign of recognition and to build trust, a t-shirt with a clearly visible university logo was used during the interviews. The interviews were all held in a sunny area filled with different bars and good possibilities for bike parking. The interviews were done on days with warm and sunny weather.

### 2.6.1 Informants

A total of 8 informants were interviewed over the course of two days; Friday the 26th of April between 20:00 and 22:00 and Saturday the 27th of April between 18:00 and 19:00. Of the 8 informants, 4 were female and 4 were male. All but one 22 year old female student, were employed. The age of the participants ranged from 22 to 55 years.

## 3 Results and analysis

### 3.1 Focus group interviews

All 23 informants stated that they drank alcohol. 11 of the informants (5 male and 6 female) stated that they rode a bike at least once a year. 18 of the informants stated that they had sometime during their life ridden a bike under the influence of alcohol.

When asked about whether or not CUI was acceptable, everyone agreed that it was acceptable, at least up to a certain level of intoxication and depending on what situation and location you are in. One person pointed out that when living in a city you know well, you might adapt and select a safer route when riding under the influence of alcohol. Knowing the city well, one might use streets with less traffic and separate cycling infrastructure. Almost all of the groups came to a similar conclusion; that up to a certain level of intoxication CUI is OK. It was also pointed out that you are more of a danger to yourself than others. However, one interesting quote on this question came in the very first group: "If a car driver accidentally kills a cyclist under the influence of alcohol, and it was the cyclists fault, this would probably affect the car driver in a negative way psychologically". This illustrates that although a cyclist under the influence might not be a great physical danger to others, there is still a psychological factor present. This was also mentioned during interviews in Warner et al. (2017). Also, if the car driver tries to avoid the cyclist from the mentioned quote, the driver could very well crash and hurt himself/herself and possibly others.

From the discussions, codes could be generated and categorised, following SDI. Table 2 shows these categorised codes. One group of codes identified, was safety. Several aspects were mentioned both for and against CUI here; that the bike is safer than the car, only the rider is affected and that using the bike makes it less scary in darker areas were reasons for CUI. Contradictory to the statement that only the rider is affected, is the risk of harming others psychologically. A fear of falling was another reason against CUI. Habits were brought in to the picture, because one informant said that he/she had never encountered any situations where CUI was an option. This was because of habitual use of other transport modes(walking and PT).

Other codes were linked to situational characteristics. Distance was the code identified most often, and it was mentioned as a reason both for and against CUI. A lack of other options, speed, freedom and that cycling is free were other factors mentioned and placed in this category. Given the circumstances, it was also mentioned that taking the bike could be practical. It could also depend on the infrastructure; highly trafficked roads could mean that people would not use the bike. If one just happened to have the bike present, this was also mentioned as a reason to CUI, removing the need to lock it up overnight. Weather(rain and unpredictable weather) was mentioned as a factor against CUI, and also depends on the situation. That taking the bike gives you freedom was mentioned twice. It can be argued that having freedom is practical. For instance, it is practical to not have to follow bus schedules to go home. Therefore, freedom might be seen as part of something being practical, and they should be seen in relation to each other.

	Safety	Habits	Situational characteristics
<b>Reasons to CUI</b>	Only rider is affected(2) Safer than car(1) Less scary in dark areas(1)		Distance(6) Lack of other options(3) Just brought the bike(2) Free(2) Freedom(2) Speed(2) Practical(1)
<b>Reasons not to CUI</b>	Fear of falling(1) Psychological harm on others(1)	Habitual use of other modes(1)	Weather(1) Distance(1)

Table 2: Categorised codes on reasons to/not to CUI

When asked whether or not CUI was OK, all groups found CUI to be OK, at least to some extent. The codes generated are shown in table 3. Four groups said that CUI is OK depending on the level of influence, where a lower level of influence meant that it was more acceptable to ride a bike. However, there were no discussions concerning what influence levels that were accepted. One group said it should be up to the individual to decide whether or not it is OK, and that it depends on the persons control, or ability to ride safely, in the given moment. Control is of course linked with influence level, but not solely, since some people might ride more safely than others while still being more influenced by alcohol. One group also brought up the role of infrastructure, where routes with little traffic and/or bike paths were identified as suitable for riding a bike after consuming alcohol.

	Control	Situational characteristics	Other
<b>Is CUI acceptable?</b>	Depends on influence level(4) Depends on control(1)	Depends on infrastructure(1)	Up to the individual(1)

Table 3: Categorised codes on CUI acceptance

When asked about what the law says concerning CUI in Norway, very few people knew it. Most groups had a discussion on it, and ended up concluding that it probably was similar to the law for DUI, but with a higher BAC limit. Only one person actually knew the law more or less correctly. The lack of knowledge concerning the law can very well be a reason for the permissive attitudes expressed by close to all participants of the focus groups.

To summarise the results from the focus groups, there was a high share of the informants who had ridden bikes under the influence of alcohol sometime during their life. The most important codes identified from the focus groups were distance, lack of other options, the influence level and freedom/practicality. In general, a permissive attitude towards CUI was observed in the focus groups, both among the ones with and without experience of CUI, and age did not seem to play a part either. Lastly, very few of the informants actually knew the law concerning CUI.

### 3.2 Online questionnaire

82,6% (537 respondents) of the 650 respondents had sometime during their lifetime ridden under the influence of alcohol, while 14,6% said they had not and the remaining 2,8% could not remember. Of the 537 that had ridden a bike while under the influence before, 47,8% had done it some time during the last year, 8,9% the last month and 3,2% the last week, amounting to 59,9% that had done it sometime the past year. This means that 49,5% (322 respondents) of all respondents had done it sometime the past year. The share of cyclists who had ridden under the influence last week and month would probably be higher if the survey was conducted during the summer months.

Table 4 and 5 show the share of respondents from the whole sample in different demographic groups who have CUI sometime during their life and the share of people who has CUI the last year. There are visible differences, for instance that males, students, employed and people living in big cities have a higher share in both tables. Educational level also affected whether or not a person had ridden under the influence. The ones who had finished a university/college degree, high school and vocational high school all had high shares of CUI sometime during their life. CUI last year was especially common among the ones who had finished high school and university/college. It is interesting to see that fewer of the ones under 30 have ridden a bike under the influence of alcohol sometime during their life than the three next age groups, but this somewhat evens out when looking at CUI the last year. A reason might be that people in this group have lived shorter, and therefore have had fewer opportunities to ride under the influence. It should also be noted that there were much more male respondents in the age group 30-39 years, as previously shown in figure 3. Due to the high share of CUI and CUI last year among males, this is likely to have increased the share of CUI and CUI last year for this particular age group.

Share of CUI within different groups							
Gender	Male				Female		
		88,9%				73,3%	
Employment status	Student	Employed	Unemployed	Home maker	Disabled	Pensioner	Other
	82,5%	85,2%	40%	0%	70,6%	50%	60%
Educational level	Middle school		High school	Vocational high school		University/college	
	56,3%		74,7%	75,4%		87,2%	
City size	Less than 1000 inh.		1000-10000 inh.	10000-50000 inh.	50000-100000 inh.	More than 100000 inh.	
	80%		63,4%	78,8%	80,6%	90,4%	
Age group	Under 30	30-39	40-49	50-59	60-69	70-79	80-89
	76,4%	90,5%	89%	86,2%	70%	50%	0%

Table 4: Share of CUI in demographic groups

Share of CUI last year within different groups							
Gender	Male				Female		
		57,8%				37,4%	
Employment status	Student	Employed	Unemployed	Home maker	Disabled	Pensioner	Other
	52,6%	51,3%	20%	0%	23,5%	14,3%	40%
Educational level	Middle school		High school	Vocational high school		University/college	
	25%		42,5%	29,8%		55,5%	
City size	Less than 1000 inh.		1000-10000 inh.	10000-50000 inh.	50000-100000 inh.	More than 100000 inh.	
	40%		29%	37%	43,1%	63%	
Age group	Under 30	30-39	40-49	50-59	60-69	70-79	80-89
	49,8%	61,3%	50,4%	41,3%	36,7%	0%	0%

Table 5: Share of CUI last year in demographic groups

Concerning knowledge on rules and regulations on CUI, 47,7% (310 respondents) of all respondents said they knew them, while 25,8% and 26,5% said they did not know them or were unsure accordingly. Of the 310 respondents who said they knew them, 41,6% answered the correct option. This means that only 19,8% of all respondents said they knew the law and also were able to identify what it says as well.

Table 6 shows three questions from the questionnaire and its responses. They are related to attitude towards CUI and perceived ability to ride safely varying with alcohol influence level, and a perception of at which influence level one starts to pose a danger to others. Respondents attitudes towards CUI and perceived ability to ride safely vary similarly, and the shares are more or less the same for the different influence levels. The pattern from the attitude and perceived control can also partly be seen in the responses to when one poses a danger to others, where the majority thinks one starts to pose a danger to others when being clearly influenced by alcohol. The results from table 6 seem to indicate that the majority accepts CUI when slightly influenced of alcohol, while the same cannot be said for the two higher levels of influence.

Cycling when being ... by alcohol is OK.						
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree	Total
Slightly influenced	45,2%	27,2%	6,0%	11,8%	9,7%	100%
Obviously influenced	4,5%	13,7%	8,9%	24,6%	48,3%	100%
Severely influenced	0,8%	1,7%	3,2%	10,0%	84,3%	100%

I ride safely when I'm ... (by alcohol)						
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree	Total
Sober	80,3%	13,6%	2,2%	3,0%	0,9%	100%
Slightly influenced	41,0%	35,2%	7,3%	10,2%	6,3%	100%
Obviously influenced	5,0%	13,4%	10,1%	27,6%	43,9%	100%
Severely influenced	1,5%	1,1%	3,5%	10,4%	83,4%	100%

When do you think one starts to pose a danger to others when riding a bike under the influence of alcohol?					
Slightly influenced	Obviously influenced	Severely influenced	Never	Don't know	Total
26,6%	55,8%	13,2%	1,8%	2,5%	100%

Table 6: Attitudes towards CUI, perceived control and safety concern

Table 7 shows reasons for CUI. The 537 respondents who previously had done CUI, had to agree/disagree to possible reasons to CUI. That cycling had no cost, was practical and fast were identified as possible reasons from the FGIs. From the survey responses, it is clear that many respondents find cycling a practical and fast way of getting home after alcohol consumption, while it having no costs does not seem to be such an influential factor.

Reasons to CUI	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree	Total
No cost	41,0%	19,6%	14,3%	6,0%	19,2%	100%
Practical	63,3%	22,5%	6,0%	2,2%	6,0%	100%
Fast	57,5%	21,6%	10,4%	4,5%	6,0%	100%

Table 7: Reasons for CUI

Respondents who both drank alcohol and rode bikes were asked whether or not they would take the bike or a different mean of transport in a given scenario. The scenario was always the same: *they were a given distance away from home, they were slightly influenced by alcohol, the weather was warm and dry and they could lock their bikes at the place they were.* Questions were related to walking versus cycling and bus versus cycling. The first part of table 8 shows how distance affects the choice of biking against walking. With the distance being 1 km, 35,5% would take the bike, while 46,7% would take the bike if the distance was 3 km. When the distance was 3 km, as much as 14,3% would neither walk nor take the bike, and a fair assumption could be that at this distance, some people start preferring motorised transport (bus, taxi etc.). The last part



of table 8 shows that only 26,2% would take the bike if it was 5 km away from home. The share was reduced 12,8% if there was a free bus. These results show the distance's role in whether or not a person would take the bike. With shorter distances ( $\leq 1km$ ) more people would walk, while for longer distances ( $\geq 5km$ ) more people would take the bus. In a middle segment, people are more likely to take the bike. Ticket price also is a factor, as seen by the decrease in people who would choose the bike when the free bus was available.

Would you walk instead of taking the bike if it was about ... from where you were to your home?					
	Yes	No	Neither take a bike nor walk	Don't know	Total
1 km	56,7%	35,5%	1,6%	6,2%	100%
3 km	30,3%	46,7%	14,3%	8,6%	100%

Would you take the bus if it was about 5 km from where you were to your home if there was ... going?					
	Yes	No	Neither take a bike nor bus	Don't know	Total
a bus	57,9%	26,2%	5,9%	10,0%	100%
a free bus	78,1%	12,8%	1,7%	7,4%	100%

Table 8: Cycling vs. other transport modes

Although not one of the hypotheses, CUI and CUI last year among the ones who have done CUI before have been tested against gender to see if it affects whether or not a person has done it. A chi-square test of homogeneity was used with significance level  $\alpha = 0,05$ . 343 of 386 males (88,9%) had done CUI before, and 192 of 262 (73,3%) females had done CUI before. Gender proved to be a significant factor of whether or not a person had done CUI ( $p < 0,001$ ,  $\phi = 0,201$ ), where males were more likely to have ridden under influence. Of the ones who had previously CUI before, 120 of 343(65,0%) males and 98 of 192 (51,0%) females had done it the previous year. Again, gender proved to be significant ( $p = 0,002$ ,  $\phi = 0,137$ ), where males were more likely to have ridden under influence the last year. Because of the big difference in total share of male and female respondents and the effect it had on CUI and CUI last year, weights were used for gender when testing the hypotheses. The ones who did not want to answer the gender question have simply been given a weight of 1, while the male/female-weights were calculated before each test, due to a different number of responses eligible for some of the tests.

H1-H3 concerned seeing if there was a significantly higher proportion of CUI last year among students (H1), younger age groups (<30 years)(H2) and people living in cities with more than 50 000 inhabitants (H3) compared to the rest of the sample who had previously ridden under the influence. Here, the variables were dichotomous for both the independent groups and the dependent variable of CUI last year, and a chi-square test of homogeneity was suitable for the purpose. All tests were performed in a similar manner. CUI last year was created as a binomial variable (1=CUI done last year, 0=CUI longer than a year ago). Each of the relevant groups (students, younger than 30 years, people living in big cities), were tested against the rest of the sample not fitting the particular group description. A significance level,  $\alpha = 0,05$ , was used. In this sample, 63,9% were male, while 35,8% were female, and they were weighted 0,78 and 1,39 accordingly. Only people who had done CUI at least once in their life, were tested here.

Table 9 shows the results of the tests of hypotheses H1-H3. The proportion in the table shows the share of people who have done CUI the last year within the specific group. The null hypothesis(H0) was that the particular group had an equal proportion of people who had been CUI the last year to the rest who had done CUI before. If  $p < 0,05$ , H0 was rejected. H2 and H3 could be confirmed at a significant level, while in the case of H1, the null hypotheses could not be rejected. Whether or not a person was under 30 years or not or lived in a city with more inhabitants than 50 000, had a significant effect on whether or not a person had been CUI the previous year. The effect size,  $\phi$ , showed that 19,6% of the variability between people living in the big cities and the rest of the sample, was accounted for by the fact that a person lived in a big city or not, while it was 12,1% for over/under 30 years. If a person was was a student, it gave higher proportions of

CUI within the last year than for the rest of the sample. The effect was not significant, but it was very close.

<b>Hx: Significantly higher proportion of CUI last year in the group than for the rest of the sample</b>						
<b>H0: Group X has an equal proportion of CUI last year as the rest of the sample</b>						
	<b>H1</b>		<b>H2</b>		<b>H3</b>	
	<b>Students</b>	<b>Rest of sample</b>	<b>&lt;30years</b>	<b>Rest of sample</b>	<b>≥50 000 inh.</b>	<b>Rest of sample</b>
N	119	418	189	347	352	185
CUI last year	78	234	125	186	230	81
Proportion	0,66	0,56	0,66	0,54	0,65	0,44
<b>Difference in proportion</b>	0,1		0,12		0,21	
<b>p(2-sided)</b>	0,062		<b>0,005*</b>		<b>&lt; 0,001*</b>	
<b>Effect size, <math>\phi</math></b>	0,081		0,121		0,207	

Table 9: H1-H3

H4-H6 concerned seeing if students (H4), younger age groups (<30 years)(H5) and people living in cities with more than 50 000 inhabitants (H6) had a more permissive attitude towards CUI than the rest of the full sample. They were tested using the Mann-Whitney U-test (with  $\alpha = 0,05$ ,  $CI = 95\%$ ), because the dependent variable (attitude towards CUI) was ordinal and not dichotomous. Respondents attitudes towards CUI were divided in three categories, depending on the level of alcohol influence. In the questionnaire, all respondents had expressed their attitude towards CUI when slightly, clearly and severely influenced by alcohol, and therefore all of the different levels had to be examined separately. Respondents had to answer if they agreed or not to the statement "I find CUI OK when being slightly/clearly/severely influenced by alcohol" in the form of a 5 point Likert scale (from 1=agree to 5=disagree). Agreeing to the statement was seen as having a more permissive attitude. For the Mann-Whitney U test, weights are not taken into account when done in SPSS, and were therefore not used for this test.

Table 10 shows the results of the tests of hypotheses H4-H6. If H0 was rejected, the mean rank was used to determine if the attitude was more permissive or not. A lower mean rank, meant a more permissive attitude towards CUI. For H4, a statistically significant difference could only be found for attitudes towards CUI when clearly influenced by alcohol. Students had a more permissive attitude towards CUI when clearly influenced than the rest of the sample as shown in the upper part of table 10. Since only attitudes for one of the levels had a significant result, the general hypotheses of H4 could not be confirmed. For H5, a statistically significant difference could be found for all levels of alcohol influence. People under 30 years had statistically significant lower mean ranks for all three influence level with the numbers found in the middle part of table 10, leading to the conclusion that people under 30 had a more permissive attitude towards CUI than the rest of the sample. For H6, people living in big cities had more permissive attitudes towards CUI when slightly and clearly influenced by alcohol at a statistically significant level. This was not the case when severely influenced as shown in table 10. Thus, the general hypotheses H6 could not be confirmed.

To summarise, students had a more permissive attitude towards CUI than the rest when clearly influenced, young people had a more permissive attitude than the rest at all influence levels, while people living in big cities had a more permissive attitude towards CUI when slightly and clearly influenced by alcohol. Of the results that were not statistically significant, some were quite close, and for all groups tested here, a more permissive, but not necessarily statistically significant, attitude could be seen.

<b>H4: Students have a more permissive attitude towards CUI than the rest of the sample</b>						
<b>H0: The distribution of attitudes towards CUI is equal for students as for rest of the sample</b>						
	Slightly influenced by alcohol		Obviously influenced by alcohol		Severely influenced by alcohol	
	Students	All other emp. statuses	Students	All other emp. statuses	Students	All other emp. statuses
N	137	513	137	513	137	513
Mean Rank	303,85	331,28	281,93	337,14	308,47	330,05
Mann-Whitney U	31175,000		29171,000		32807,000	
Z	-1,615		-3,280		-1,890	
p(2-sided)	0,106		<b>0,001*</b>		0,059	

<b>H5: Young people(&lt;30 years) have a more permissive attitude towards CUI than the rest of the sample</b>						
<b>H0: The distribution of attitudes towards CUI is equal for people under 30 years as for rest of the sample</b>						
	Slightly influenced by alcohol		Obviously influenced by alcohol		Severely influenced by alcohol	
	<30 years	≥30 years	<30 years	≥30 years	<30 years	≥30 years
N	237	413	237	413	237	413
Mean Rank	306,07	336,65	288,24	346,88	307,55	335,80
Mann-Whitney U	44335,500		40111,000		44685,500	
Z	-2,125		-4,110		-2,921	
p(2-sided)	<b>0,034*</b>		<b>&lt; 0,001*</b>		<b>0,003*</b>	

<b>H6: People living in big cities(number of inh. ≥ 50 000) have a more permissive attitude towards CUI than the rest of the sample</b>						
<b>H0: The distribution of attitudes towards CUI is equal for people living in big cities as for rest of the sample</b>						
	Slightly influenced by alcohol		Obviously influenced by alcohol		Severely influenced by alcohol	
	≥ 50 000	<50 000	≥ 50 000	<50 000	≥ 50 000	<50 000
N	396	254	396	254	396	254
Mean Rank	303,27	360,15	306,55	355,04	318,52	336,39
Mann-Whitney U	41490,500		42788,500		47526,500	
Z	-4,006		-3,446		-1,873	
p(2-sided)	<b>&lt; 0,001*</b>		<b>0,001*</b>		0,061	

Table 10: H4-H6

H7-H12 were about testing if there was a linear trend between CUI last year, and various characteristics. Higher frequency of drinking (H7) and cycling (H8), having friends who also CUI (H9), having friends (H10) and family (H11) who accept that you CUI, and having a higher level of perceived control (H12) were all assumed to be connected to more CUI last year. These hypotheses were about testing if there existed a relationship between an ordinal, independent variable and a dichotomous, dependent variable. In H7 and H8, the ordinal variable was in the form "Several times a week", "Few times a month" to "Few times a year", while for the rest they were all in the form of the previously mentioned likert scale. The dichotomous variable was CUI last year. These tests were only done with people who both drank alcohol and rode bikes, because the others were not likely to encounter a situation where CUI would happen. Respondents who answered "I don't know" to questions related to H9-H11 were not included either. The hypotheses were tested using the Cochran-Armitage test of trend ( $\alpha = 0,05$ ) to test if a linear correlation between the independent, ordinal variable and the dependent, dichotomous variable could be observed. For H7, H8 and H9 there were 61,7% male and 37,9% female, and they were weighted 0,81 and 1,32 accordingly. H10 had 65% male and 34,5% female and was weighted 0,77 and 1,45. H11 had 62,2% male and 37,4% female and was weighted 0,80 and 1,34. H12 had 64,4% male and 35,1% female and was weighted 0,78 and 1,42.

As shown in table 11, the Cochran-Armitage test of trend showed a statistically significant linear trend,  $p < 0,001$ , for all hypotheses H7-H11. For H7 and H8, a higher frequency of both drinking and cycling, is clearly associated with a higher proportion of CUI the last year. For H9, a higher level of agreement to having friends who CUI was clearly associated with a higher proportion CUI the last year. It is harder to establish if a persons family (H10) or friends (H11) find it OK for a person to ride under the influence is associated with a higher proportion of CUI the last year, but it seems to be the case from the numbers shown in table 11. Therefore, if a person either has friends who also ride under the influence of alcohol, friends/family who find it acceptable, or drink/cycle more often, it is more likely that that person has ridden a bike under the influence of alcohol the last year.

<b>H7: There is a linear trend between CUI last year and drinking habits (higher drinking freq. associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and drinking habits</b>					
Habitual drinking					
	Several times/week	Few times/month		Few times/year	
N (who have done CUI last year)	124 of 177	171 of 301		15 of 104	
% CUI last year within frequency	70.1%	56.8%		14.4%	
Score	72,220				
p	< 0,001*				
<b>H8: There is a linear trend between CUI last year and cycling habits (higher cycling freq. associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and cycling habits</b>					
Habitual cycling					
	Several times/week	Few times/month		Few times/year	
N (who have done CUI last year)	265 of 399	30 of 117		15 of 66	
% CUI last year within frequency	66.4%	25.6%		22.7%	
Score	76,948				
p	< 0,001*				
<b>H9: There is a linear trend between CUI last year and having friends who CUI (friends who also CUI, associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and confirmation of having friends who CUI</b>					
My friends also ride bikes under the influence of alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	172 of 203	81 of 162	15 of 49	4 of 14	2 of 31
% of group done CUI last year	84.7%	50%	30.6%	28.6%	6.5%
Score	108,007				
p	< 0,001*				
<b>H10: There is a linear trend between CUI last year and having friends accepting that you CUI (higher acceptance, associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and having friends who find it acceptable that you CUI</b>					
My friends find it OK for me to ride a bike while being slightly influenced by alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	200 of 264	54 of 109	19 of 34	5 of 15	5 of 11
% of group done CUI last year	75.8%	49.5%	55.9%	33.3%	45.5%
Score	25,884				
p	< 0,001*				
<b>H11: There is a linear trend between CUI last year and having family accepting that you CUI (higher acceptance, associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and having family who find it acceptable that you CUI</b>					
My family find it OK for me to ride a bike while being slightly influenced by alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	108 of 146	63 of 102	33 of 46	28 of 50	40 of 88
% of group done CUI last year	74%	61.8%	71.7%	56%	45.5%
Score	18,183				
p	< 0,001*				

Table 11: H7-H11

H12 had to be tested individually for all three influence levels asked, and if a significant result was obtained for all three levels and the trend was as expected, H12 could be confirmed. All were found to have a possible linear trend, but higher perceived control was only clearly connected to more CUI the last year for being slightly influenced by alcohol, as shown in table 12. The linear curve would be much flatter for the two last influence levels. This also makes sense, when looking at what influence level most people found CUI to be OK in. That people believe they can handle the bike when being slightly influenced by alcohol is associated with more CUI the last year, but it is more difficult to conclude for the two higher influence levels.

<b>H12: There is a linear trend between CUI last year and perceived level of safety (higher level of safe riding, associated with more CUI last year)</b>					
<b>H0: There is no linear trend between CUI last year and perceived behavioural control</b>					
I ride safely when being slightly influenced by alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	137 of 176	100 of 151	13 of 26	22 of 44	5 of 17
% of group done CUI last year	77.8%	66.2%	50%	50%	29.4%
Score	27,836				
p	< 0,001*				
I ride safely when being obviously influenced by alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	17 of 22	54 of 62	27 of 37	95 of 129	84 of 163
% of group done CUI last year	77.3%	87.1%	73.0%	73.6%	51.5%
Score	25,191				
p	< 0,001*				
I ride safely when being severely influenced by alcohol					
	Agree	Partly agree	Neither agree nor disagree	Partly disagree	Disagree
N (who have done CUI last year)	5 of 7	5 of 5	10 of 14	41 of 50	217 of 339
% of group done CUI last year	71.4%	100.0%	71.4%	82%	64%
Score	5,392				
p	0,020*				

Table 12: H12

To summarise, a more permissive attitude, increased perceived behavioural control and a liberal

subjective norm from TPB seem to be linked with whether or not a person has been CUI the last year. The same can be said for increased habitual drinking and cycling. Distance also influence what type of transport mode one will use. Bike usage is connected to distances between walkable distances and distances where motorised transport is preferred, and this seems to be the case for cycling trips done under the influence as well. Young people have a more permissive attitude towards CUI than the rest, while living in a city with more than 50 000 inhabitants was linked with an increased share of CUI last year. People agree to having ridden a bike under the influence because it is practical and fast, while less agree on it being free as a reason. There is a high share of respondents who have ridden under the influence, and the attitudes towards CUI are rather permissive when slightly influenced by alcohol.

### 3.3 Focused interviews

All but one of the informants stated that they had consumed alcohol and were about to ride their bike home from the bar area. The informant who had not consumed alcohol prior to being interviewed, was arriving at the bar area and stated that she was probably drinking alcohol later on. She also planned on riding the bike back. The age span from the interviews coincide quite well with the results in table 4 and 5 from the online questionnaire; the share of CUI last year was biggest for the age groups younger than 59 years, and seemingly decreasing for the oldest age groups, the same for CUI in general. None of the informants stated that they were older than 55 years, with two being 50 or older, one person being 43, two being in the age group 30-39 years and three being 29 years or younger. Concerning knowledge on rules and regulations, only 2 informants were able to recollect what the law says, while 3 informants thought the law was the same as for DUI.

In the focused interviews, the informants had to express whether or not they thought CUI was acceptable. Grouped codes generated from these responses can be found in table 13. Five informants expressed that it was a matter of how influenced by alcohol a person was. One informant answered that it should be up to the individual to decide if it is OK or not. Another informant said that he was unsure if CUI was OK, but at least it was better than DUI. One informant could not make up his mind on whether it was OK or not, and said: "I am not sure if I find it OK actually. I have done it a lot though, and still do it".

	<b>Control</b>	<b>Safety</b>	<b>Other</b>
<b>Is CUI acceptable?</b>	Depends on influence level(5)	Better than DUI(1)	Up to the individual(1) Unsure(1)

Table 13: Categorized codes on CUI acceptance

Informants also had to express how influenced they had to be before deciding not to ride a bike. Five informants said they would not ride a bike when being clearly influenced. One person said he would not ride when walking straight along a line started to become a problem, but sometimes he still did it while being quite drunk anyway. Another informant would consider riding when clearly influenced, but not while being severely influenced by alcohol. The informant who could not make up his mind on whether CUI was OK or not, stated that the influence level alone not necessarily was the only factor for deciding to ride or not. He expressed that how well he felt he could control the bike was more important. If he felt good, he would ride, if not he would walk. This resonates with perceived behavioural control from TPB.

Table 14 shows the grouped codes generated from a question concerning reasons why informants used the bike on the day they were interviewed. Habitual use of the bike was brought up the most times as a reason to bring the bike. Many situational characteristics were brought up as reasons to bring the bike, some similar to the ones identified in the focus groups and some new ones. Just having the bike, for instance from doing something different earlier that day,

was identified twice. One informant went for a drink after work, and already had the bike at work. Another informant had brought the bike to a lunch in a park before deciding to have a drink. The weather was especially nice on both interview days, and this was mentioned as a reason twice. As for the focus groups, speed and distance were also identified here. As reflected upon earlier, the distance was here explained as too long to walk, while taking a bus might take approximately the same amount of time. One informant stated that in such a case, the weather would impact whether or not he would take the bike. Rain meant bus, while sun meant riding a bike. Two new codes were also identified as situational characteristics; light conditions and that cycling is enjoyable. An informant said that she would not ride the bike if it was too dark outside, while another said that riding a bike is enjoyable, and this was also part of the reason why she brought the bike. One informant said that he chose the bike specifically for the purpose of this trip. He was going for a drink after work, and chose to take the bike to work because of this.

	<b>Habits</b>	<b>Situational characteristics</b>	<b>Purpose of trip</b>
<b>Reasons to bring bike</b>	Habitual use of bike(3)	Just brought the bike(2) Weather(2) Speed(2) Distance(2) Light conditions(1) Enjoyable(1)	Drinking(1)

Table 14: Categorized codes on reasons to bring the bike

Only one of the informants used a helmet. This indicates little knowledge on the most common injuries sustained in CUI related accidents. The informant expressed that the reason for using the helmet, was encountering patients with injuries from CUI as she was working as an ergo therapist. Another informant said he was a police officer, and that he found the legislation unclear and difficult to actually enforce. This illustrates the vagueness and potential problems related to the current legislation.

To summarise the findings from the focused interviews, habitual use of the bike was identified the most as a reason to take the bike after alcohol consumption. Weather, speed, distance and that the bike just happened to be the selected transport mode of the day are also factors affecting whether or not a person will ride under the influence. A permissive attitude towards CUI has also been seen in the focused interviews, but this attitude changes with influence level; people find CUI acceptable at a low level of alcohol influence, but not so much at a higher level of alcohol influence. Generally, there seems to be little knowledge on the legislation, and risks connected to being caught by the police are not being considered. The risk of falling does not seem to be considered that much either, at least when it comes to riding under a low level of alcohol influence. Most people felt comfortable during the interviews, and it seems like the phenomenon of CUI in practice is a socially acceptable one.

## 4 Discussion and conclusion

The first research question asked about general prevalence of CUI in Norway. As an answer, CUI is arguably a prevalent phenomenon in Norway, at least among the population younger than 60 years. In this study, more than 8 out of 10 stated that they have ridden a bike under the influence of alcohol sometime in their life in an online questionnaire. Approximately half of all respondents had done it sometime during the last year, indicating that this is also happening relatively often. The relatively high prevalence found in Norway is comparable to the high prevalence found in other European countries, like in Warner et al. (2017); Huemer (2018); Verster et al. (2009); de Waard et al. (2016); Hagemester and Kronmaier (2017). Compared to results from Hwang et al. (2017), CUI is much more prevalent in Norway than in South Korea, where

approximately 1 in 10 had done it the previous year. A reason for the differences seen between the European countries and South Korea, might very well be due to cultural differences.

The second research question concerned attitudes towards CUI in general and among demographic groups in Norway. Partly explaining the observed prevalence of CUI in Norway, and answering the second research question, the attitudes towards CUI seem to be rather permissive, at least towards cycling when being slightly influenced by alcohol. 7 out of 10 agreed or partly agreed that cycling while being slightly influenced is OK, but only 2 out of 10 agreed or partly agreed that riding a bike when being clearly influenced is OK. When being severely influenced, attitudes were even more dismissive; only 3 out of 100 agreed or partly agreed that it was OK. The shift from permissive to dismissive attitudes happens quite abruptly, when going from a low to medium and high influence levels. Answering which demographic groups that find CUI most acceptable, people younger than 30 seem to have a more permissive attitude towards CUI than the rest. There are indications pointing towards the same for inhabitants in cities with more than 50000 inhabitants, at least for the two lowest influence levels. The generally permissive attitudes seen from the online questionnaire are supported by findings from both the FIs and FGIs. When asked whether or not CUI was OK, it was stated that it depends on the level on alcohol influence four times in the FGIs and five times in the FIs, making it the most common response to that question. Further investigating this in the FIs, five respondents stated that they would ride when slightly influenced, but not clearly influenced. Huemer (2018) found permissive attitudes for cycling after one small glass of beer, and this fits well with the attitudes seen here towards the lowest influence level. There are also some demographic characteristics that have a higher prevalence of CUI the last year among those who in general have ridden a bike under the influence before; both if a person is younger than 30 years and if a person lives in a city with more than 50 000 inhabitants are connected with a higher share of CUI the last year among those who have done it before, supporting the mentioned permissive attitudes in these groups. In general, young adults (20-39 years) seem to do it more often than the older parts of the population. Males were also found to be more likely to have ridden a bike under the influence than females. Supporting these findings, in de Waard et al. (2016), more males than females had a positive BAC level of the cyclists tested, and in Hwang et al. (2017) males and people living in urban areas were more likely to have experience with CUI.

An interesting observation from the focused interviews, was that three participants were 29 years or younger, two informants were 30-39 years, one was 40-49 years, while the last two were 50-59 years of age. From what was observed, there was no visible tendency towards any specific age group below 60 years, and this might differ from the questionnaire results. However, it should be noted that at the time when the interviews were held it was still quite early in the evening/night. A fair assumption would be that there is an increasing number of younger people later on in the night. The number of informants was also quite low, being only 8.

The first part of the third research question concerned reasons for people to CUI. It might be the most difficult question to answer, and what has been uncovered through this study, is that there are a lot of different reasons and factors explaining whether or not a person will ride a bike under the influence of alcohol. The reasons can roughly be divided in two, where on the one side you have factors that subconsciously affects the person. Such factors include demographics, attitudes towards CUI, and the subjective norm. For instance, it is very unlikely that someone would say that their age was the reason for him/her to take the bike. On the other hand, there are factors that are present through knowledge, by choice and preference, such as knowledge on rules and regulations, habits, perceived control and situationally dependent characteristics.

From the online questionnaire, many respondents agreed to cycling being a "practical" and fast mode of transport after alcohol consumption. Distance and presence of public transport also affected whether or not a respondent would take the bike. The term practical was not much used in the FGIs or FIs, and a reason for this might be the possible varied interpretations of

the term. Practical can be seen as high flexibility, low legal consequences, freedom and many other explanations. In hindsight, this term should have been rephrased or explained further in the questionnaire. Many of the reasons given, can not be seen only in relation to CUI, but must also be seen as reasons to cycle in general. Habitual use, weather conditions, speed, biking being enjoyable and distance are such factors. Factors that can be more directly linked with CUI include lack of other options (often because of less PT at night time), cycling being less scary in dark areas (than walking), CUI being safer than DUI, that the cyclist is the only one affected and that the bike gives you the freedom to leave whenever you want. These factors were mentioned much more seldom than the ones related to cycling in general. Reasons to CUI found during this study corresponds well with findings from Warner et al. (2017); cycling is practical, free, nice/enjoyable and better than taking the car.

Perceived level of control for different alcohol influence levels varied in a similar manner as attitudes towards CUI; it was high for the lowest influence level, but low for the two higher influence levels. Of the ones who had ridden under the influence before, around 8 out of 10 agreed or partly agreed that they rode safely when being slightly influenced by alcohol. This was also the case in Huemer (2018), where most respondents felt they had strong cycling abilities after 0,3L of beer, OK cycling abilities after 1L of beer and rather weak cycling abilities after 2L of beer.

Linear correlations between perceived behavioural control at different influence levels and CUI last year could be found. Higher perceived behavioural control when being slightly influenced by alcohol, was clearly associated with more CUI last year. For the two highest influence levels, the trend was not as visible. This can indicate that people in general tend to ride a bike when being slightly influenced by alcohol, but not at higher influence levels. Such a theory is supported by the attitudes shown in all three methods.

Distance was the most common reason mentioned by informants from the FGIs and FIs combined. It seems to be some sort of distance in between a distance suitable for walking and a distance suitable for public transport/motorised vehicles, where people tend to use the bike. As a possible illustration on such a distance, Tretvik (2018) found the average distance of cycling trips in the Eastern parts of Norway to be 5,8 km. This distance is an average of all types of trips, from long recreational trips for exercising purposes, to fairly long commuting trips and short service trips like shopping trips. Therefore, a fair assumption is that the average distance would be a bit shorter when the purpose is to go for a drink; for instance, from the online questionnaire 35,5% would take the bike if it was 1 km and 46,7% would take the bike if it was 3 km, while 26,2% would take the bike if it was 5 km to home when being slightly influenced by alcohol. That distance is a factor influencing the choice of taking the bike, can also explain why a higher prevalence of CUI is seen in the big cities; usually in big cities, there is a bigger, more varied offer of services within a smaller radius, meaning more possible destinations within a distance suitable for cycling.

Habitual cycling must also be seen as a reason for people to ride under the influence of alcohol. Results from the online questionnaire indicated that both habitual cycling and habitual drinking are connected with an increased possibility of CUI last year. That habitual cycling is part of the reason to choose the bike after consuming alcohol, was also mentioned during the FIs. 3 of the informants who were about to ride under the influence said that they took the bike because that was the transport mode they generally used. Both Hagemeister and Kronmaier (2017) and Huemer (2018) also found that if a person drinks more often and/or uses the bike more often, this is connected with more CUI.

Results from the online questionnaire also indicated that having friends who also CUI, and having friends and family who find it OK for a person to ride a bike under the influence is also connected with higher shares of CUI the last year. This illustrates that the subjective norm from TPB, takes part in forming whether or not a person will CUI. The subjective norm was also quite permissive for being slightly influenced and riding a bike. More respondents thought their friends



would accept them riding a bike while being slightly influenced than their family, but many respondents either agreed or partly agreed to both statements. Huemer (2018) found similar results; respondents family and friends would not find riding after 0,3 L of beer very condemnable, but somewhat condemnable after 1 L of beer.

The last part of the third research question involved finding an influence level where people found CUI to be acceptable. Using the influence scale, it became clear that a low or slight level of influence level was accepted. This was found in results from all three methods. From the online survey, 7 out of 10 agreed or partly agreed that cycling while being slightly influenced is OK, while this decreased substantially with an increasing influence level. In the FIs, five of the informants would ride only when being slightly influenced, while one informant would not ride when being severely influenced and one informant would consider riding when being severely influenced. One informant stated that the influence level alone not was enough to decide; the perceived level of control in the given moment would be more important. This is something that will also be connected to the amount of alcohol consumed. Self-esteem might be increased with alcohol intake, giving a higher perceived level of control, and thus a higher accepted level of influence.

The mixed-methods approach has helped to create a better understanding around CUI in Norway. CUI seems to be rather prevalent in Norway, and the attitudes are permissive, at least towards a low level of influence. People under 30 years and people living in cities with more than 50 000 inh. are doing it more often than the rest of the sample, and their attitudes are also more permissive. From the focus group interviews and focused interviews, it is evident that the choice of riding a bike on occasions where alcohol will be consumed is heavily linked with various situational characteristics and other factors relevant for cycling in general. Distance, weather and habitual cycling were among the most mentioned reasons to take the bike in the FGI and FI. This was also evident from the online questionnaire, where distance and availability of public transport affected whether or not respondents would use a bike. From the online questionnaire, it was further confirmed that cycling habits had an impact on whether or not a person had ridden under the influence. More cycling in general, meant more CUI. Results from the questionnaire seem to prove that the theory of planned behaviour created by Ajzen (1991) has some validity, and partly can be used to explain why people ride under the influence. The research model created, seem to highlight important aspects connected to the choice of CUI.

One thing that seemed to have little effect on whether or not a person would CUI, was knowledge on rules and regulations concerning CUI. Very few actually knew the law, and none of the informants in the FIs and FGIs expressed any concern regarding possible legal implications following CUI. This is illustrated by the high number of people who thought the law was as strict as for cars, but still rode a bike under the influence. Little reflection was also done by informants on the risks of CUI, this was especially visible in the FIs. Riding a bike under the influence might not only have negative impacts, some benefits might occur; a person might drink less alcohol on a given night if she/he is riding a bike home, and some possible unwanted situations happening in bus and taxi lines might also be avoided.

All in all, more information to inhabitants could be useful, so people are informed of what alcohol does to a person when riding, and what the typical accidents are. Head injuries are the most common injuries related to CUI, and a simple measure to reduce some of the risk of sustaining head injuries is to use a safety helmet. However, only one of the informants from the FIs was actually using a safety helmet, and this indicates a need for more awareness. The law concerning CUI as it is, is vague, but what might be the biggest problem related to it is that it is difficult to enforce such a law from a policing point of view. A solution could be to look at countries such as Germany and the Netherlands, with a defined BAC limit. Arguably, the BAC should be a tolerant one and higher than for cars, since the the norm in society seems to be that CUI at a low alcohol influence level is acceptable. However, there is a need to investigate CUI-related accidents more in depth to see the harm and costs of CUI in Norway before making any changes to the legislation.

## 4.1 Limitations and reflections

In hindsight, some important aspects were not studied in detail. In the open question at the end of the survey, several respondents commented on the role of infrastructure. There were no questions related to this in the questionnaire, and thus many respondents expressed that they were more likely to take the bike if the route was less trafficked and/or had separate cycling infrastructure. This was also brought up in the focus group interviews, and is an aspect that should be investigated further. However, a lot of positive feedback on the survey was given, and it seems to have uncovered many important aspects related to CUI. For instance, demographic differences were uncovered, and the survey succeeded in giving an indication on the prevalence of CUI from a relatively big number of respondents. It also gave measurable differences in important aspects, for instance related to perceived level of control and attitudes.

Also related to the online survey, the sample was not completely representative for the general population. It is likely that the sample contained respondents who drank alcohol more often and rode bikes more often than the general population. The sample did not contain many respondents from the oldest age groups either. Although this can be seen as a weakness related to making conclusions for the general population, the sample contain respondents that are more likely to have experience with CUI. This strengthens results that were specifically related to CUI, like reasons to CUI and perceived level of control.

Many questions in the questionnaire were answered using likert scale data. The interval between the response options can not be seen as equal, making analyses a bit more uncertain. The testing of H7-H12 illustrates this. Here, only possible linear correlations can be found, but this will eventually depend on the interval between the response options. This is a flaw, and the exact correlation can not be seen, but one can find correlations and see in which direction they point towards. The likert data also fails to uncover the "true" attitude of respondents, as the scale is not continuous. There are few options that could have solved this, but a possible solution is using a continuous slider bar instead of the likert scale.

The FIs were done quite early in the night due to ethical aspects explained previously. That the interviews were done so early, might also affect the results; a person riding a bike late at night might have different reasons to do so, than a person riding a bike in the evening. To illustrate possible differences; when riding late at night, a person might be more afraid of walking alone in the dark, and therefore take the bike. This is not likely to be the case when riding a bike during the evening, when it is still daylight. Daylight was mentioned as a reason to CUI from the FIs, while that riding a bike was less scary in the dark was mentioned in the FGIs. Therefore, these results might fail to uncover reasons to choose the bike after alcohol consumption late at night. However, that the interviews were done so early might increase the credibility of the answers given. This is because none of the informants were visibly influenced by alcohol, and their responses are more likely to be truthful.

All data collected in this research rely on self-reported answers. A possible limitation with such data, is that respondents and informants might answer in a more socially acceptable way. However, the high prevalence of CUI and permissive attitudes towards CUI for the low influence levels seen, partly strengthen the belief that this was not the case. If any bias occurred, it would only be for the two highest influence levels. The study also obtained similar results as previous international studies, indicating that such a bias did not occur.

Regarding the application of the different methods, there are some aspects that could have made the data collection and analyses better. Too little emphasis was put on the the analysis of the questionnaire data during the creation of the questionnaire. This lead to finding the needed

statistical analyses after the data was collected. Integrating the choice of statistical analyses in the questionnaire creation process would lead to creating questions and answers that could be optimised for each analysis. This was a challenge that was solved and the end result was not affected by this, but the analysis would be less time consuming and give easier interpretations. Another aspect concerns the FIs and FGIs; they were a bit short, and thus lacked some depth. It was somewhat necessary to keep the the interviews short due to the way informants were recruited, but also lead to shorter answers. A way to overcome this, could have been to have fewer questions, but then one might have failed to uncover some aspects of the topic. With longer interviews, it would probably also be much more difficult to recruit informants on the spot, and overall the way it was done was seen as the best option.

With better time to get an approval from the Norwegian Centre for Research Data concerning personal data, a recorder could also have been used during the interviews for more detailed transcriptions. The interviews were quite short, so this was not a big issue, but for longer interviews a recorder would be preferred.

The combination of all these methods worked in a satisfying way and gave results that could not have been obtained otherwise. A broader understanding of the topic was obtained, for instance attitudes and prevalence of a broader demographic sample, as well as more detailed and specific reasons to take the bike after alcohol consumption. Such a method can be suitable for studying other traffic safety related behaviours. Some examples could be pedestrians jaywalking or cyclists crossing at red lights. The influence scale seemed to be relatable, and is something that can be adapted and used in any study related to effects of alcohol/drug use.

Future studies could look at harmful effects of and accidents related to CUI in Norway, deterioration of riding skills and alcohol consumption, CUI during winter time and the role of infrastructure and CUI. CUI late at night should also be studied more in depth. Another interesting topic arising from this spring's sudden increase in use of electrical scooter-sharing systems in Oslo, could be to look at the use of such electrical scooters under the influence of alcohol. This study uncovered who the ones riding a bike after alcohol consumption are, and the next step could be to look at the type of bikes being used, including bike and scooter sharing systems and electrical bikes. The Norwegian Public Roads Administration will also follow up the study done by Melhuus et al. (2015) with numbers from 2019, this time also including accidents related to the use of electrical scooters. A study on electrical bikes and alcohol could also be interesting. The electrical bikes can generate higher speeds, and people might refrain from locking the more expensive electrical bikes in the city overnight. Because of this, some of the reflections and safety concerns might differ from the case with a traditional bike. A more detailed study on how the police enforce the law and actual cases and what their viewpoint on CUI is, could also be useful to clearly establish consequences of the current legislation.

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# Appendix

## A Main framework

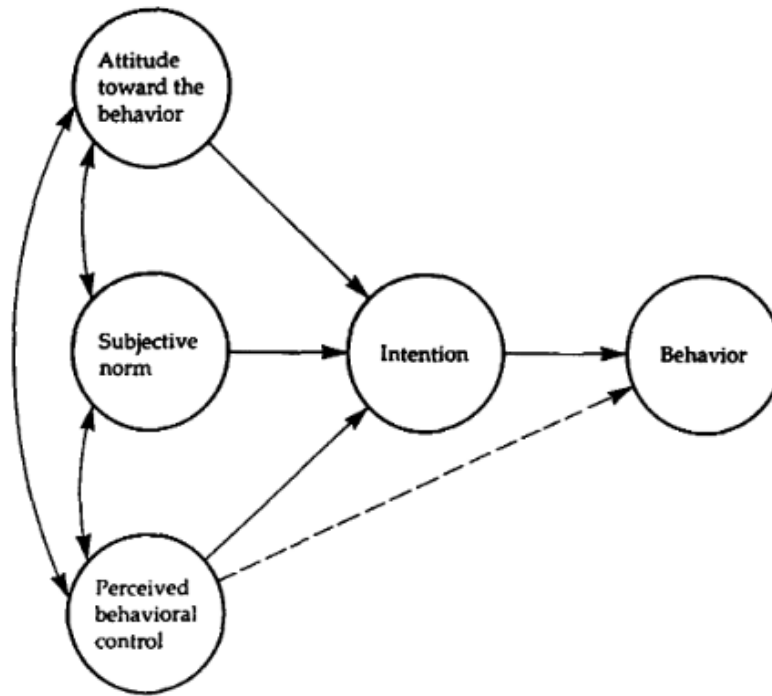


Figure A.1: The theory of planned behaviour (Ajzen, 1991)

For the research design, the Theory of Planned Behaviour (TPB) was used as a main framework, especially for the creation of the online questionnaire. TPB is a theory seeking to describe factors influencing human behaviour. In TPB, Ajzen (1991) divides mechanisms behind human intention, and eventually behaviour, into three predictors. A person's intention is affected by the attitude towards the behaviour, the subjective norm and the perceived behavioural control. An illustration of the theory is shown in figure A.1.

To demonstrate the relevance for CUI; if a cyclist has a permissive attitude towards CUI (attitude towards the behaviour), all the cyclist's friends also find it acceptable (subjective norm) and the cyclist feels like she/he has sufficient control on the bike to ride safely after a certain amount of alcohol (perceived behavioural control), it is more likely that this cyclist has intentions to ride a bike after alcohol consumption, and further it will be more likely that the cyclist actually will ride a bike after alcohol consumption. Although in a somewhat extended form, TPB has been used together with other supplementary predictors in several studies related to transport (Donald et al., 2014; Lois et al., 2015; Bird et al., 2018) and even CUI, like in Huemer (2018). The recent use of the theory, illustrates that it is relevant for such purposes. Using an extended version of it, one can more easily get answers to certain questions to be looked at, and/or investigate if other predictors also play a key role in certain behaviour.

In addition to the three predictors from TPB, four others were included in this study, as shown in figure A.2. Demographics were assumed to play a role in a person's behaviour: for instance younger individuals might take more risk than older individuals, while older individuals might



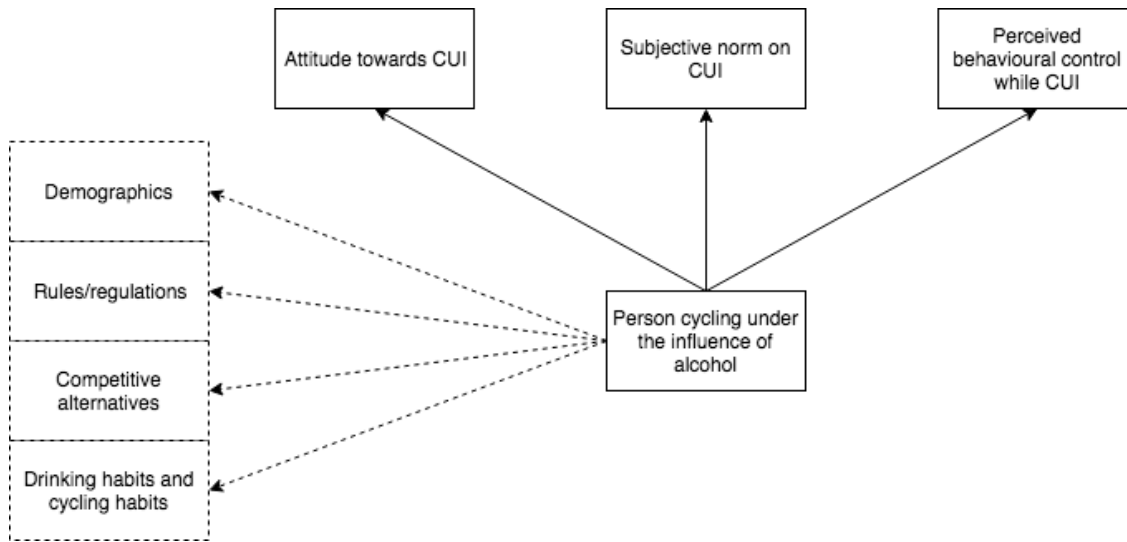


Figure A.2: Research model

have more experience. Knowledge of rules and regulations were also thought to affect the actions of an individual. If a certain action like CUI has strict laws and potential punishment, there is an increasing possibility that the individual will refrain from doing the action. Therefore, if the person is aware of the law, this might affect the actions. Situationally dependent characteristics is a group of characteristics related to the situation, for instance the distance home or presence of other transport modes. A person can prefer to take a bus, but if no other option is available, the person might choose the bike. Lastly, habits were also assumed to increase the possibility of having a certain behaviour. If a person more often both ride bikes and drink alcohol, the probability of encountering a situation where the two can be combined will increase, and thus the possibility of riding a bike under the influence is more likely.

For the qualitative collection methods, the collection and analysis process was inspired by the stepwise-deductive inductive method(SDI)(Tjora, 2017a). Tjora (2017a) explains the method as 7 steps going from data generation and raw data to concepts and theory. Between each step there is a need to ensure that the results of each step is useful and of sufficient quality, a form of testing. The 7 steps in SDI are:

1. Generation of empirical data
2. Processing of raw data
3. Coding
4. Grouping of codes
5. Concept development
6. Concepts
7. Theory

Step 1-2 concern selection and use of the data collection methods and the initial processing of the collected data.

The coding step is about generating short codes in order to reduce data volume, find the core of the data and facilitate idea generation. Grouping of codes is a thematic grouping of the codes

generated in the previous phase. The idea is to connect the groups with theory, leaving the empirical aspect of the data, and explain the results through theory. Concept development concerns developing concepts that potentially can explain the phenomenon you are looking at. Moving from concepts to theory, one seeks to eventually describe the phenomenon through some sort of rule that can be tested and used. (Tjora, 2017b)

Since the data collection methods and their belonging data were "short" versions of traditional qualitative methods, SDI has been used in a more concise way. The first 4 steps were done individually for the FGI and FI. Then the codes and grouping categories have been combined, and the last 2 steps, concept development and theory, have been done with all results present.

## B The influence scale

Other studies on CUI based on questionnaires, such as Hagemeister and Kronmaier (2017); Huemer (2018), have asked questions related to alcohol consumption in terms of the number of alcoholic units consumed. While this can be useful to estimate BAC levels, there are also big uncertainties connected to the responses and estimates from such questions. The provided answers are uncertain because respondents might have different opinions on what a unit is, how much alcohol a "normal" drink contains and respondents might have problems remembering the amount of alcohol consumed on a given night. Also, calculating BAC levels on the basis of survey responses will be uncertain due to differences in body weights and tolerance levels. The fact that people are affected to a varying degree of the same BAC level, also causes uncertainties connected to the interpretation of such estimates. Another way to investigate level of alcohol consumption, can be done through more qualitative measures. Helsedirektoratet (2015), the Norwegian Directorate of Health, created an alcohol influence scale for employees of bars, restaurants, pubs and other places serving alcohol to easier determine whether a guest was too intoxicated to be allowed to be served or not.

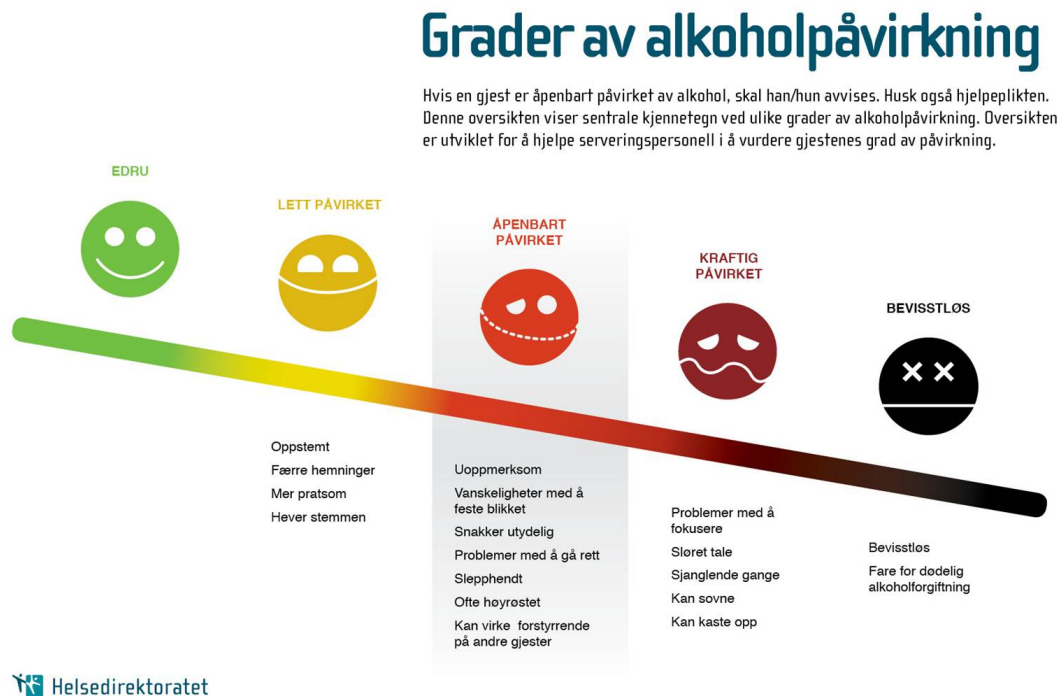


Figure B.1: The influence scale from Helsedirektoratet (2015)

As shown in figure B.1, some expected signs of recognition for the different levels of intoxication are explained. The levels and their signs of recognition are:

1. Sober (no visual signs)
2. Slightly influenced (excited, less inhibitions, more talkative, raised voice)
3. Clearly influenced (inattentive, difficulty of fixing the eyes, talks unclear, problems walking straight, problems holding on to things, often loud and disturbing)

4. Severely influenced (problems focusing, blurred speech, staggering walk, might fall asleep, might throw up)
5. Unconscious (unconscious, danger of fatal alcohol poisoning)

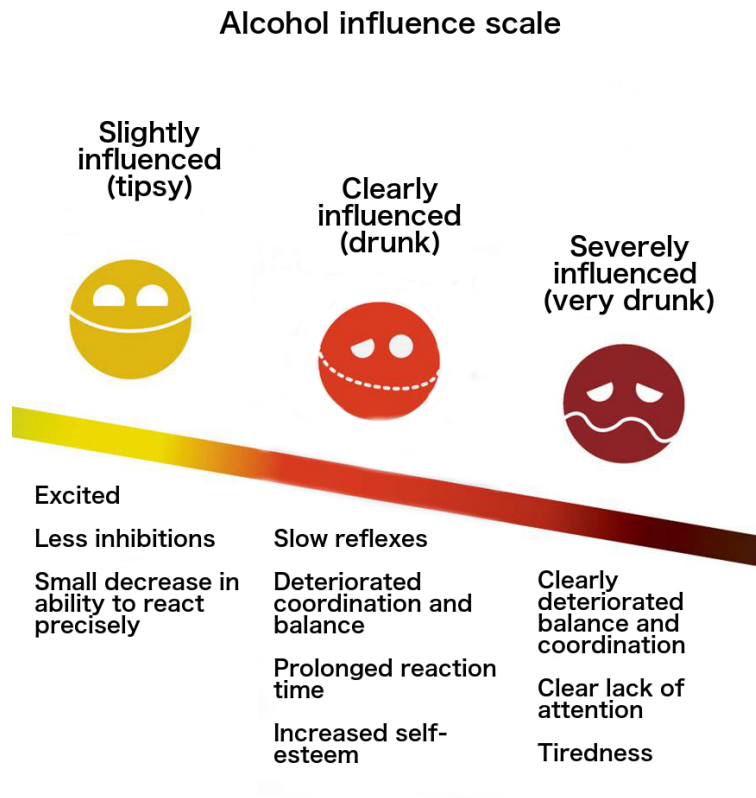


Figure B.2: The influence scale, an edited version of the scale from Helsedirektoratet (2015)

The scale from Helsedirektoratet (2015) has been edited, and the recognisable signs of alcohol influence have been adapted to be more suitable for this specific research. The edited scale looks at alcohol related changes on a person connected to balance, reaction time and other abilities influencing the ability to ride a bike, rather than changes like blurred speech or increased volume when speaking. As shown in figure B.2, some expected signs for the different levels of intoxication are explained, and they are assumed to be familiar to people with a regular level of alcohol consumption. The levels and their signs of recognition are:

1. Slightly influenced(tipsy) - excited, less inhibitions, small decrease in ability to react precisely
2. Clearly influenced(drunk) - slow reflexes, deteriorated coordination and balance, prolonged reaction time, increased self-esteem
3. Severely influenced(very drunk) - clearly deteriorated balance and concentration, clear lack of attention, tiredness

This scale has been used to ask participants questions connected to alcohol consumption. The reasoning behind this choice was that this scale was more relatable for respondents compared to the number of drinks consumed.

## C Focus group interviews

FGIs can be placed in the broad group of qualitative methods called interviews. A FGI is an effective qualitative data collection method because data can be collected from several informants at the same time. FGIs might also stimulate engagement and they can serve as environments where it is "safer" to share opinions than through regular interviews. However, there might be a need for extra moderation from the interviewer, or moderator, to ensure that participants not taking a big enough part of the conversation also express themselves. Traditionally, focus groups often last for 1 to 2 hours with groups of 6 to 12 informants. (Tjora, 2017c)

The interviews were carried out in a somewhat unconventional and informal way, with the groups being smaller (3-5 informants) and the interviews much shorter (approximately 10 minutes). Small groups of people already sitting together around a table in bars and pubs were asked to participate in a short focus group interview on the spot. The reasoning behind this, was that the group probably already knew each other, and therefore the discussions would flow more easily and without restraints. Another important aspect was that recruiting informants was assumed to be easier, because it could be done on the spot. There have been some indications showing that one can obtain information that could otherwise not be obtained, using focus groups in naturally occurring settings (Brown, 2015), although this particular purpose and setting is somewhat different. In naturally occurring focus groups, the probability for the informants to already know each other is high. In focus groups where the participants already know each other, benefits such as more natural conversations and that friends and acquaintances are more likely to call each other out on untruthful responses can occur (Kitzinger, 1995). Both were important factors when deciding on this particular type of FGIs.

FGIs were chosen as a data collection method to give an early indication on prevalence of, attitudes towards and reasons for CUI through a less restricted form of conversation. These results were used as input for the online questionnaire. The interviews were mostly semi-structured, with 5 main questions to be asked. Informants were also motivated to tell stories or describe scenarios where they had decided to CUI or not. The 5 main questions were:

1. Do you ride a bike, and do you drink alcohol?
2. Have you ever ridden a bike under the influence of alcohol before?
3. What were the reasons to ride(or not to ride) while intoxicated?
4. Do you find CUI acceptable?
5. What do you know about the legislation?

In a very condensed manner, the FGIs were structured after the three stages of an interview, warm-up, reflection and round-up, as described in Tjora (2017d). The questions concerning habits and whether or not an informant had ridden a bike under the influence of alcohol were assumed to be easy to answer. The reflection part consisted of the questions related to reasons for people to CUI and whether or not informants found CUI to be acceptable. The last question related to knowledge on legislation worked as some sort of round-up, where there was less need for reflection. If informants did not know the legislation, they could be informed of it in this stage, before the interview ended.

The sample was intended to be varied, both in terms of age and gender on a total basis, but also when it came to the composition of the groups and in what type of places they were recruited. This was to get a representative selection of the population, and also to get different group dynamics. All types of bars were eligible: ranging from student bars to cocktail bars and craft beer bars. The nature of the places were intentionally varied. This was to ensure varied groups of informants.

Student bars were identified as a place to find students and craft beer bars/cocktail bars as places to find an older part of the population. The places were also selected on a somewhat subjective estimation of popularity, to make sure that there were many groups to choose from in each location.

A typical FGI unfolded somewhat like this: After entering the bar/pub, a quick walk around the venue was done to get an overview of the different tables. The very first group selected, was selected only from convenience. Then, for all other groups, the goal was to find different group compositions and characteristics of the informants. When a suitable group with a free chair and space on the table for the notebook was identified, the group was approached. Firstly, they were asked if they had 10 to 15 minutes to spare to answer a few questions related to a research project. If they declined, an apology for the disturbance was given. If they accepted, information on the study was given, and the research questions that were to be answered at the end of the research were explained. An assurance of the informants privacy and anonymity was also given, before the 5 questions were asked in the order shown above. The first two questions were simply answered yes/no, while the rest of the questions lead to discussions. For reasons to CUI/not to CUI, this was divided in two. First the ones with experience of CUI were asked to elaborate on reasons to do it. Then, the ones that had not done it were asked to explain reasons why they had not done it. Question 4 was asked so that there could be some free flowing discussion among all respondents. The last question could be answered with a simple yes/no(if yes, also a simple explanation). The respondents could also discuss a bit before coming up with a mutual agreement, if they were unsure of the legislation. All answers were written down, and no recordings were made during the interviews. When arriving home after a round of interviews, the notes were written on a computer and further details from the interview were written down if possible.

## D Online survey

To increase the number of respondents and to be able to reach out to a bigger part of the country, an online questionnaire was chosen as the second method of the data collection. This data collection method has previously been used in relevant research, such as in Huemer (2018) and Hagemeister and Kronmaier (2017).

Creating online questionnaires is challenging. Toepoel (2017a) mentions some very important aspects when creating online surveys. Only relevant questions should be asked, the form of the answers to the questions need to be considered, the questions should be worded in an understandable way and the order of the questions should be considered. To make the questionnaire in this study as good as possible, the creation process went on for more than a month, using results from the focus group interviews as input. To ensure that the aspects mentioned above were considered, several tests of the questionnaire itself on friends were done, as well as helpful discussion sessions with supervisors and fellow students. Through this process, many questions were left out or improved, and what started as a survey with more than 40 questions, ended up at 32 questions, with one question being optional.

Toepoel (2017b) states that there are large variations in devices used by respondents to answer an online survey. Thus, the survey needed to be adapted to several kinds of devices, and was therefore tested on various screen sizes and devices for this purpose. An interface designed for people with reading difficulties was used to ensure that people with such difficulties would have less trouble answering the survey. Toepoel (2017b) also mentions the ethical aspects of online surveys, such as tracking cookies and the collection of information about the respondents and their devices. Any such privacy and ethical issues were resolved by making sure that no information about the respondents devices, IP addresses or any other digital information were collected by the software used.

The questionnaire had an incentive in form of a chance to win 6 scratchcards to increase the number of responses. Entries to such a contest needed some kind of contact information. To make sure any contest entry could not be put in combination with the survey responses, respondents who wanted to participate in the contest had to send a text message to a phone number with a keyword given after the survey was finished. This separated contest entries from the responses, making it impossible to match respondents identities with the answers. There was not any guarantee that people taking part in the contest had actually finished the survey either, further strengthening the privacy of respondents.

The online questionnaire itself had questions grouped in the same 7 predictors shown in figure A.2. Factors mentioned as important for people to ride or not to ride under the influence of alcohol during the focus groups, were included in various forms in the questionnaire. Questions were answered in various ways, ranging from ordinal frequencies for habits, yes/no-answers to questions related to rule knowledge and competitive alternatives and a Likert scale(1=agree to 5=disagree, 3=neither agree nor disagree) for questions related to attitude, perceived behavioural control and subjective norm. To gather insights on the respondents demographics, respondents had to answer questions related to their age, gender, educational level, employment status and size of the place they live. Age, employment status and city size were used in the analysis, while the other demographic details were used to say something about how representative the sample was.

Using a Likert scale introduces certain problems for the analysis. Sometimes, the Likert scale is treated as an interval scale. This has been criticised, because it is hard to argue that the numeric intervals between the steps of the scale are correct and can be given a numerical value. Thus, mean and standard deviations cannot be used (Jamieson, 2004). To overcome the issues related to the Likert scale data, non-parametric tests looking at the mean rank and median have been

used instead, and the Likert scale data has been treated strictly as ordinal throughout analysis.

## The questionnaire

	<b>Question</b>	<b>Answer</b>	<b>Category</b>
1	What is your age?	Number	Demography
2	What gender do you identify as?	Male, female, don't want to answer	Demography
3	What is your employment status?	Employment status	Demography
4	What is your highest finished education?	Educational level	Demography
5	What suits the place where you live the best?	City size	Demography
6	How often do you approximately drink alcohol?	Frequency	Habits
7	How often do you approximately ride a bike during summer?	Frequency	Habits
8	Have you ever ridden a bike under the influence of alcohol?	Yes, no, don't remember	Habits
9	When was the last time you rode a bike under the influence of alcohol?	Time interval	Habits
10	Riding a bike slightly influenced by alcohol is OK	Likert 1-5	Attitude
11	Riding a bike clearly influenced by alcohol is OK	Likert 1-5	Attitude
12	Riding a bike severely influenced by alcohol is OK	Likert 1-5	Attitude
13	When do one start to pose a danger to others while riding a bike under the influence of alcohol?	The influence scale	Perceived behavioural control
14	I ride safely when riding a bike sober	Likert 1-5	Perceived behavioural control
15	I ride safely when riding a bike slightly influenced by alcohol	Likert 1-5	Perceived behavioural control
16	I ride safely when riding a bike clearly influenced by alcohol	Likert 1-5	Perceived behavioural control
17	I ride safely when riding a bike severely influenced by alcohol	Likert 1-5	Perceived behavioural control
18	My friends find it OK for me to ride a bike when slightly influenced by alcohol	Likert 1-5, don't know	Subjective norm



19	My family find it OK for me to ride a bike when slightly influenced by alcohol	Likert 1-5, don't know	Subjective norm
20	My friends also ride under the influence of alcohol	Likert 1-5, don't know	Subjective norm
21	I know the Norwegian law concerning CUI	Yes, no, unsure	Rules/regulations
22	That cycling is free is a reason why I have ridden a bike under the influence of alcohol	Likert 1-5	Situationally dependent characteristics
23	Riding a bike home after alcohol consumption is a practical way of getting home	Likert 1-5	Situationally dependent characteristics
24	Riding a bike home after alcohol consumption is a quick way of getting home	Likert 1-5	Situationally dependent characteristics
25	It takes approximately 15 minutes to go to an event where you know you will drink alcohol. It is summer and the weather is nice; would you take the bike?	Yes, no, neither walking nor biking, don't know	Situationally dependent characteristics
26	I would walk instead of cycling after consuming alcohol if it was approximately 1 km to my home	Yes, no, neither walking nor biking, don't know	Situationally dependent characteristics
27	I would walk instead of cycling after consuming alcohol if it was approximately 3 km to my home	Yes, no, neither walking nor biking, don't know	Situationally dependent characteristics
28	I would use PT instead of cycling after consuming alcohol if there was a PT option to my home	Yes, no, neither bus nor biking, don't know	Situationally dependent characteristics
29	I would use PT instead of cycling after consuming alcohol if there was a free PT option to my home	Yes, no, neither bus nor biking, don't know	Situationally dependent characteristics
30	The Norwegian law says...	4 alternatives, one correct	Rules/regulations
31	How did you find this survey?		Other
32	Do you have any further comments related to CUI?	Open answer	Other

Table D.1: The questions used in the online questionnaire, its response form and category in the order it was presented to respondents.

The questionnaire used for the online survey, is shown in table D.1. Questions 26-29 had a scenario respondents had to use when answering. The scenario was: *You are slightly influenced by alcohol, in line with the alcohol influence scale. You are elsewhere than home. You are about to go home, you have your bike and the possibility of locking it where you are. The next 4 questions concerns this scenario.* This was done to make sure all respondents had the same information and assumptions given before answering these questions. All questions related to the influence scale had the scale presented at the beginning of each page containing such questions so the respondents did not have to remember or memorise the contents of the scale.

Some questions had routing options, and these are explained below:

- All respondents had to answer questions 1-8, 10-13, 18, 21 and 31-32.
- Question 30 was only asked to respondents that answered yes on question 21.
- If 6 and 7 were answered to be more often than never, and question 8 was answered yes, the respondent had to answer the whole questionnaire.
- If a respondent answered more often than never on 6 and 7, but no or don't remember on 8, the respondent had to answer all questions but 14-17 and 19-20.
- If a respondent said never on 6 and/or 7, but yes on 8, the respondent was asked questions 9-24.
- If a respondent said never on 6 and/or 7 and no or don't remember on 8, they only had to answer 10-13, 18 and 21.

These routing options were done to minimise time consumption for respondents, and to make sure only relevant questions were asked to each respondent. All respondents were included in the question regarding attitudes and law, to get an indication on the general attitude on CUI in the population and knowledge of the law. Questions related to perceived behavioural control had to be given only to those who had actually ridden a bike under the influence, as they were the only ones eligible to answer such questions out of experience. If a person drank alcohol and rode a bike, but had never experienced CUI, the respondent was also asked questions related to whether or not the respondent would take the bike home in given scenarios, just in case the respondent actually would have taken the bike in these scenarios. Questback Essentials was the selected tool for creating the questionnaire. It was chosen because a free student licence could be obtained through a university agreement, enabling all features and an unlimited number of responses.

## Distribution

The survey was distributed through several channels. Terrensykkelforum, a discussion forum for cyclists, was used to get answers from people who used bikes often, maybe especially for training and recreational purposes. The questionnaire was also shared on personal accounts on Facebook, where family and friends were encouraged to share the survey. The survey was further shared by friends of friends etc, making the distribution effective and enabling the possibility of reaching out to people with different backgrounds living in different places. The questionnaire was also shared on a Facebook page called "JEG HAR INGEN VENNER Å MISTE - IKKE KJØR I FYLLA!" (meaning "I have no friends to lose - don't drink and drive!"), which had over 300 000 likes. This page sounds like an interest group that could cause a bias, but going through acquaintances that liked the page, this seemed very unlikely. This made it possible to further increase the reach of the survey, and also to get answers from people that might be more concerned about traffic safety than from the other places the survey was published. Lastly, an interest organisation for cyclists, Syklistenes Landsforening, published an article and a post on Facebook about the study with a link to the survey on their website. This was done to reach out to cyclists with different characteristics from the ones recruited through Terrensykkelforum. The survey was online from the 27th of February until the 15th of March.

## E Focused interviews

Rather than using lengthy in-depth interviews, a less time-consuming approach called focused interviews was used in this study. Tjora (2017c) explains that focused interviews are shorter and more direct, and that they beneficially can be used when the topic is clearly defined, not too difficult and trust between informant and interviewer can be gained quickly. Tjora (2017c) also mentions that the approach is suitable in situations where the informant has encountered or been directly involved in the particular situation being studied and when the informant's experiences and observations are the ones to be questioned. Further, it is mentioned that such focused interviews can be used in spontaneous situations where the informant is recruited in an environment directly linked to the studied situation/topic. They will also save time, both for informants during the interview and for researchers when analysing the data.

The focused interviews were done with people about to park or leave on a bike around popular nightlife areas in Trondheim at nighttime. The idea was to get insights from people who ride bikes under the influence of alcohol right after or before it happens. This could lead to different answers than what was uncovered through the FGIs and the online questionnaire. The method enabled getting the reflections being made while the activity actually took place. These interviews would also supplement the findings from the questionnaire and focus groups. Analyses of the FGI's and questionnaire were already done, and any unclear aspects were emphasised in the focused interviews. The interviews were kept short to avoid the loss of focus from informants.

7 questions were asked during the FIs:

1. How old are you?
2. What is your employment status?
3. Have you had any alcohol today, and if so; how much?
4. Do you find CUI OK?
5. How drunk would you be before deciding not to take the bike?
6. Why did you take your bike today?
7. Do you know what the law says concerning CUI?

The questions were a combination of short and open answer questions. The interview guide also used the principles of dividing the interview into warm-up (questions 1-3), reflection (questions 4-6) and round-up (question 7)(Tjora, 2017d). An aspect that needed further investigation was the role of influence level, and a question related to how drunk a person would be before not taking the bike this was included.

As a sign of recognition and to build trust, a t-shirt with a clearly visible university logo was used during the interview. The interviews were all held in a sunny area filled with different bars and good possibilities for bike parking. The interviews were done on days with warm and sunny weather.

All interviews were done in the same area; an area in Trondheim with a large variety of bars and restaurants as well as parking facilities for bikes. When people were about to unlock a bike, they were approached after they had unlocked it, but before they got on. When arriving on a bike, informants were approached after they had locked their bikes. They were asked if they had 5 to 10 minutes to contribute to the data collection for a master thesis. If they declined, an apology for the disturbance was given. If they accepted, detailed information about the study was given. Anonymity was assured, and they were also told that they did not have to answer a question if

they did not want to. They could also leave the interview at any time. Then, the questions were asked in the order shown above. When finished, informants were thanked for their participation.

## F Notes from focus group interviews

### 25/1-2019 - Craft beer bar - 4 males - 30-40 years

1. **Do you ride bikes? Do you drink alcohol?**

Bikes: 3 no (not anymore), 1 yes

Alcohol: 4 yes

2. **Have you ever ridden a bike after alcohol consumption?**

3 yes, 1 no

3. **Why have you/have you not done it?**

No: because of the distance. I live too far away from any bar (**Distance**).

Yes: It depends on the situation. If you already got a bike, then it is convenient to take it home (**Just brought the bike**). It is practical in general to take the bike home after being at a bar (**Practical**), and it is free (**Free**). Often there is a lack of a proper PT option (**Lack of other options**). It has less of an impact on other people compared to driving a car (**Safer than car**).

4. **Do you think CUI is OK?**

Yes, it should be up to the individual to decide (**Up to the individual**). There should not be a set BAC limit for it. As long as the cyclist can ride somewhat straight and not lose balance, it is OK (**Depends on control**). If a car driver accidentally kills a cyclist under the influence of alcohol, and it was the cyclist's fault, this would probably affect the car driver in a negative way psychologically (**Psychological harm on others**).

5. **What do you know about the law concerning CUI?**

There is a defined BAC limit, but it is higher than compared for car driving. In any case, it is not really enforced until there is a crash.

**Other notes:** One person was kind of leading the discussion. The one that had never ridden on a bike under the influence was participating the least.

### 25/1-2019 - Student bar - 3 males, 1 female - 20-30 years

1. **Do you ride bikes? Do you drink alcohol?**

Bikes: 4 yes

Alcohol: 4 yes

2. **Have you ever ridden a bike after alcohol consumption?**

4 yes

3. **Why have you/have you not done it?**

The distance, sometimes it is too long to walk (**Distance**). It is cheap (**Free**). It only affects me (**Only rider affected**).

4. **Do you think CUI is OK?**

It is OK as long as you are not too drunk (**Depends on influence level**).

5. **What do you know about the law concerning CUI?**

Nothing

**Other notes:** They all seemed quite eager to finish the focus group rather quickly.

**29/1-2019 - Bar/pub - 2 males, 2 females - 40-50 years****1. Do you ride bikes? Do you drink alcohol?**

Bikes: 4 no

Alcohol: 4 yes

**2. Have you ever ridden a bike after alcohol consumption?**

3 yes (2 males, 1 female), 1 no(female)

**3. Why have you/have you not done it?**

Yes: I have previously lived in a rural area. Going home from dinner at friends, using the bike is easy. Longer distances (**Distance**), no bus (**Lack of other options**) and did not want pay for a taxi (**Free**).

No: I have not really encountered any situations where I needed to make a decision. I usually travel by bus or walking when I can't take the car (**Habitual use of other modes**).

**4. Do you think CUI is OK?**

Yes. Most people probably think so too. If you are too drunk, you might notice that riding a bike will not work once you try, so you leave the bike (**Depends on influence level**).

**5. What do you know about the law concerning CUI?**

One person knew the law more or less correctly.

**Other notes:** Fluid conversation. Discussion on question 4, leading to some sort of a conclusion all agreed on.

**29/1-2019 - Cocktail bar - 2 males, 1 female - 20-30 years****1. Do you ride bikes? Do you drink alcohol?**

Bikes: 2 yes (1 male, 1 female), 1 no (male)

Alcohol: 3 yes

**2. Have you ever ridden a bike after alcohol consumption?**

3 yes (the two that used to bike in general, stated that they did it quite often during the summer period).

**3. Why have you/have you not done it?**

When living in a city, distances are shorter (**Distance**), so when using the bike, it is quite fast (**Speed**). More freedom, you don't have to leave to catch a bus, or wait to leave to catch a bus (**Freedom**). It is also less scary in darker areas (**Less scary in dark areas**).

**4. Do you think CUI is OK?**

It is acceptable. In a city you know, you might choose streets with less traffic or bike paths, so it is safer. Might be worse in rural areas, that only have a single road with no bike paths (**Depends on the infrastructure**).

**5. What do you know about the law concerning CUI?**

Is there a limit, but higher than for a car?

**Other notes:** The two regular cyclists were a bit more eager to respond, and came up with the most remarks.

**6/2-2019 - Craft beer bar - 5 females - 40-60 years****1. Do you ride bikes? Do you drink alcohol?**

Bikes: 3 yes (2 said a bit), 2 no (not anymore)

Alcohol: 5 yes

**2. Have you ever ridden a bike after alcohol consumption?**

2 yes, 3 no.

**3. Why have you/have you not done it?**

Yes: I remember I did it often as a student. It was a quick way to get home (**Speed**), and as far as I can remember it always worked out fine. Of course, distance is a factor for taking the bike (**Distance**), and of course you don't have to wait in line for bus or taxi (**Freedom**). Isn't it in such queues that a lot of problems occur? Maybe everyone should just take the bike instead?

No: There is a fear of falling, hurting myself (**Fear of falling**). You also know the weather here, and how unpredictable it is. That is also a factor; sunny when leaving home, raining when you are supposed to return (**Weather**).

**4. Do you think CUI is OK?**

Acceptable until a certain level (**Depends on influence level**). As long as it does not affect others, it is only the cyclist that will be affected anyway (**Only rider affected**).

**5. What do you know about the law concerning CUI?**

Is there a similar limit as for car driving?

**Other notes:** Broader age span here than in any previous groups. Also first group were the risk of hurting oneself was mentioned as a reason not to ride under the influence.

**14/2-2019 - Pub - 3(1 male, 2 females) - 30-40 years****1. Do you ride bikes? Do you drink alcohol?**

Bikes: 1 yes (female), 2 no (both males)

Alcohol: 3 yes

**2. Have you ever ridden a bike after alcohol consumption?**

3 yes.

**3. Why have you/have you not done it?**

Going home from parties when I was younger, from friends and so on. Did it during summer vacations, pretending to be at a friend's place watching movies, but instead go to party. Don't do it so much anymore.

I used to live in a small place with fairly short distances (**Distances**) and no bus at night (**Lack of other options**).

I have done it, but can't think of any particular reason for it. Maybe just because I had brought my bike where I was going, and did not want to leave it (**Just brought the bike**).

**4. Do you think CUI is OK?**

Being in traffic while under the influence is of course dangerous. Maybe there should be a limit, like for car but it is higher. Maybe that is how it is already? I don't know, it should be OK up to some level at least. There is no problem riding a bike after 2 or even 3 beers (**Depends on influence level**).

**5. What do you know about the law concerning CUI?**

Is it what we said just now? A higher limit but similar system as for cars?

**Other notes:** Nothing special



## G Notes from focused interviews

### 26/4-2019

1. **How old are you?**  
55 (female)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (3 units)
4. **Do you think CUI is OK?**  
Influence level is important here. 3 units would be above the limit for car, but for riding a bike, I find this OK. Slightly influenced by alcohol is OK (**depends on influence level**).
5. **How drunk would you be before not riding the bike?**  
Ok when slightly influenced. Would not take the bike when obviously influenced (**obviously influenced**).
6. **Why did you take your bike today?**  
I just brought the bike with me (**just brought the bike**). Had a few drinks after work, and I usually take the bike to work (**habitual use of bike**). Some people might have left the car and brought the bike instead, if they'll have a drink. Darkness affects if I would ride the bike back home. It is fairly bright now, so its OK, but I would walk the bike if it was dark (**light conditions**).
7. **What do you know about the law concerning CUI?**  
Same as for car?  
**Other notes:** not visibly influenced by alcohol. Said she had encountered patients suffering from injuries sustained through CUI in her work, and was therefore using a helmet.

### 26/4-2019

1. **How old are you?**  
50 (male)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (3 beers and half a bottle of wine)
4. **Do you think CUI is OK?**  
I am not sure if I find it OK actually (**unsure**). I have done it a lot though, and still do it, and it has worked out fine until now.
5. **How drunk would you be before not riding the bike?**  
It is more about the feeling. Perceived control is an aspect her. How drunk you feel might be difficult to assess, but if I feel OK, I'll ride, if not I'll walk with the bike (**perceived level of control**).
6. **Why did you take your bike today?**  
Because I was going for a drink after work (**drinking**).
7. **What do you know about the law concerning CUI?**  
A bit unsure, but I guess it is not OK.  
**Other notes:** not visibly influenced by alcohol

**26/4-2019**

1. **How old are you?**  
28 (male)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (1 beer)
4. **Do you think CUI is OK?**  
I am not sure. At least I think it should be allowed to a bigger extent than what is the case for DUI (**better than DUI**).
5. **How drunk would you be before not riding the bike?**  
I have ridden a bike while slightly influenced, but I have walked the bike when obviously influenced before (**obviously influenced**).
6. **Why did you take your bike today?**  
Just because the bike is the transport mode I use in the city on the regular (**habitual use of bike**).
7. **What do you know about the law concerning CUI?**  
Possible to get a reaction, but unsure where the limit is.  
**Other notes:** not visibly influenced. Said he worked as a police officer, and he also found it hard to determine where to draw the line. Found CUI to be a difficult problem, and said this study was important.

**26/4-2019**

1. **How old are you?**  
22 (female)
2. **What is your employment status?**  
Student
3. **Have you had any alcohol today?**  
No. But I will, and I'll likely ride the bike back home. I also have ridden the bike after alcohol consumption before.
4. **Do you think CUI is OK?**  
It all depends on influence level. OK for low influence (**depends on influence level**).
5. **How drunk would you be before not riding the bike?**  
I ride only when slightly influenced. I find biking a bit scary as it is, so if I feel like I'm too drunk, I don't hesitate to walk (**obviously influenced**).
6. **Why did you take your bike today?**  
It is a quick way of getting from home to the bar – and back (**speed**). The weather also has an impact, it is so nice today (**weather**). Riding a bike can also be pleasant (**Enjoyable**). The distance also affected me taking the bike – it was too long to walk, but too short to use PT – the bike would probably be faster than the bus (**distance**).
7. **What do you know about the law concerning CUI?**  
Same as for car?  
**Other notes:** not visibly influenced.

**27/4-2019**

1. **How old are you?**  
36 (male)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (2 beers)
4. **Do you think CUI is OK?**  
Yes, after a few beers at least, but it depends how drunk you are. I follow the traffic laws, and then you won't get stopped and avoid accidents (**depends on influence level**).
5. **How drunk would you be before not riding the bike?**  
I would at least take the bike after 2-3 beers. A different case would be after drinking 6 beers, then I would probably not take the bike. I would consider it when obviously influenced, but not severely influenced (**severely influenced**).
6. **Why did you take your bike today?**  
Today the weather is beautiful (**weather**). If it was raining I would have taken a bus, and it is too long for me to walk (**distance**).
7. **What do you know about the law concerning CUI?**  
I guess it is a bit of a grey area – like if you are involved in an accident and have been drinking, it can have some legal consequences.  
**Other notes:** not visibly influenced.

**27/4-2019**

1. **How old are you?**  
29 (female)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (2 small beers)
4. **Do you think CUI is OK?**  
Well, I'm a bit unsure actually. I mean, I am about to do it now, but it depends on the amount of alcohol. I feel like the risk of falling is rather low when slightly influenced (**depends on influence level**).
5. **How drunk would you be before not riding the bike?**  
In line with what I just said, I guess it would be anywhere above slightly influenced then (**obviously influenced**).
6. **Why did you take your bike today?**  
I was already outside having a lunch in the park before I decide to come here, and therefore had the bike with me, so that's the reason why I have it now (**just brought the bike**).
7. **What do you know about the law concerning CUI?**  
I don't know it.  
**Other notes:** not visibly influenced.

**27/4-2019**

1. **How old are you?**  
32 (female)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (1 beer)
4. **Do you think CUI is OK?**  
Yes, after 1 beer it is OK. But it all depends, like, it not OK if you are too drunk (**depends on influence level**).
5. **How drunk would you be before not riding the bike?**  
I think I would not take the bike or walk with it if I was really going partying. Like, when you are more than tipsy (**obviously influenced**).
6. **Why did you take your bike today?**  
Its fast (**speed**). I live in the city, and the other alternative would be to walk. I could have walked, but today I chose the bike.
7. **What do you know about the law concerning CUI?**  
Is it the same as for car?  
**Other notes:** not visibly influenced.

**27/4-2019**

1. **How old are you?**  
43 (male)
2. **What is your employment status?**  
Employed
3. **Have you had any alcohol today?**  
Yes (4 beers)
4. **Do you think CUI is OK?**  
Yes, I believe most of us are able to decide when it is OK and not (**Up to the individual**). I do it quite a bit, and a lot of other people I know as well, and I haven't heard of any bad accidents.
5. **How drunk would you be before not riding the bike?**  
When you are so drunk that walking straight along a line starts to become a problem, you should not ride a bike either. But sometimes it still happens when you are quite drunk (**obviously-severely influenced**).
6. **Why did you take your bike today?**  
I am a regular cyclist. I ride to and from work and in general wherever I need to go within the city, so that's the reason (**habitual use of bike**).
7. **What do you know about the law concerning CUI?**  
Are there any regulations?  
**Other notes:** not visibly influenced.

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