UiT The Arctic University of Norway

Department of Psychology, Faculty of Health Sciences

Social Jetlag and its Relation to Procrastination:

The Possible Moderating Role of Daytime Fatigue and Affect

Klaus Svartdal Færevaag

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Supervisor: Professor Oddgeir Friborg

Foreword

This project was the end of a long and tough journey as a student. And even though you would expect the master's thesis to be the toughest task of them all, this thesis has been the most enjoyable process during my time as a student. A big reason for this has been the great help from my supervisor, so a big thank you goes out to Professor Oddgeir Friborg for extensive help and inspiration during the whole process; it was truly a joy to work with you.

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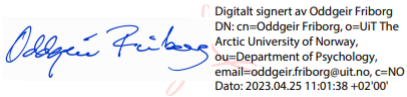
Lastly, I would like to send a big thank you to Tuva, for your constant enthusiasm and support. You have always believed in me and encouraged me to do my best when I doubted myself, and for that, I am extremely grateful.



Klaus Svartdal Færevaag

Master student

Professor Oddgeir Friborg

Supervisor

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Sammendrag

Hensikten med denne studien var å utforske sammenhengen mellom Social Jetlag (SJL) og prokrastinering blant studenter. SJL kan oppstå når vår indre, biologiske klokke er forsinket sammenlignet med vår sosiale klokke (knyttet til sosiale forpliktelser som jobb, skole), noe som forårsaker en opphopning av søvnunderskudd i løpet av uken. Dette kan predikere flere negative atferder hos studenter, som for eksempel prokrastinering. Siden affekt og tretthet på dagtid også har vist seg å påvirke selvregulering - en sentral komponent i prokrastinering - kan de ha en modererende effekt på forholdet mellom prokrastinering og SJL. Et bekvemmelighetsutvalg av studenter (N = 830) svarte på en nettbasert undersøkelse om SJL, prokrastinering, dagtretthet, og affekt. SJL var svært utbredt, og gjennomsnittlig SJL var ca. 1t25min. Assosiasjonen mellom SJL og akademisk prokrastinering var imidlertid lav (r =.09), og sammenhengen var ikke signifikant moderert av affektive humørstilstander eller nivå av tretthet. Mens SJL og prokrastinering kan være utbredt blant studenter, er den enkle assosiasjonen mellom SJL og prokrastinering svak. Det virker heller ikke som tretthet på dagtid og affektive tilstander er gode representanter for selvregulerende komponenter som er relevante for utsettelse i denne kontekst. Nivået av SJL i studentpopulasjonen er likevel høyt, og fremtidige studier må undersøke ytterligere hva implikasjonene av dette kan være for deres akademiske arbeid og generelle helse.

Nøkkelord: Social Jetlag, prokrastinering, søvn, affekt, tretthet

Abstract

This study aimed to assess the relationship between Social Jetlag (SJL) and procrastination among university students. SJL may occur when our biological circadian sleep clock is delayed as compared to our social clock (e.g., getting up early for work), causing an accumulation of sleep debt during the week. This may predict several maladaptive behaviors for students, such as procrastination. Since affect and daytime fatigue also has been shown to negatively impact self-regulation, which is a vital component of procrastination, they may have a moderator effect on the relationship between procrastination and SJL. A convenience sample of students (N = 830) responded to an online questionnaire about SJL, academic and trait procrastination, daytime fatigue, and affect. SJL was widespread, and the mean SJL was approx. 1h25min. However, the simple associations between SJL and academic procrastination were low (r =.09), and both relationships were not significantly moderated by affective mood states or daytime fatigue levels. While SJL and procrastination may be prevalent among students, the simple association between SJL and procrastination is weak. It seems also that daytime fatigue and affective states are not good representatives of self-regulatory components relevant to procrastination in this context. The level of SJL in the student population is nevertheless pronounced, and future studies need to further explore the implications SJL has for their academic work and general health.

Keywords: Social Jetlag, procrastination, sleep, affect, fatigue

Social Jetlag and its Relation to Procrastination:

The Possible Moderating Role of Daytime Fatigue and Affect

Sleep is one of the most important aspects of our lives. We spend on average 1/3 of our lives asleep, but several studies reveal that people struggle to meet the recommended dose of nightly rest (e.g., Abrahams, 2015; Lund et al., 2010). Poor sleep has been linked to several negative outcomes, such as increased illness (Lund et al., 2010), negative mood (e.g., Pilcher & Huffcutt, 1996), higher stress levels (Lund et al., 2010), poorer reaction times, higher blood pressure (Patrick et al., 2017), and an increased risk of heart failure (Laugsand et al., 2014).

It is therefore concerning that the modern human sleeps between one and two hours less than we did 100 years ago (Roenneberg, 2013). One possible reason for this is due to external social obligations (e.g., work, school) that require us to get up early, causing an accumulation of sleep debt during the week. To compensate for this deficiency, most people sleep more during the weekend to catch up (Roenneberg et al., 2019). This can leave us feeling unrested and tired in the coming days, even though the intention was to catch up on lost sleep and finally feel rested. In the literature, this is often referred to as Social Jetlag (SJL; Roenneberg et al., 2003), defined as the difference in time between the midpoint of sleep on workdays and free days (MSF – MSW). The term was initially used to describe how people in the working population shifted their sleep schedule when having days off from work, but recent studies reveal that university students might also be affected by this sleeping pattern. Almost 80% of university students struggle with SJL (e.g., Komada et al., 2018) and studies show that increased SJL is related to, for example, lower academic performance and higher daytime fatigue (Haraszti et al., 2014: Tamura et al., 2022).

Indeed, the Students' Health and Well-being Report (Studentenes Helse- og Trivelsundersøkelse, SHoT) reveals that 48% of students struggle with daytime fatigue (Sivertsen & Johansen, 2022). Students are an important asset for the future of our world,

investing years of their youth to pursue dreams and take up important positions in vocational life and the society around them. However, students may struggle more than meets the eye. About one in four Norwegian students end up leaving university before finishing their degree, and only 30% of those who drop out end up finishing some degree later (SSB, 2022a). Moreover, students report having mental issues, stress, and issues related to sleeping, and only 42% of Norwegian students report having a good quality of life (Sivertsen & Johansen, 2022).

There also seems to be a relationship between daytime fatigue and poor self-regulation (Owens et al., 2016), and self-regulation is a core component of procrastination (i.e., chronic irrational delay; Steel, 2007). Indeed, studies show that there is a strong relationship (r = .64) between daytime fatigue and procrastination among students (Steel et al., 2018). Prior studies also show that negative affect can predict future procrastination tendencies (Pollack & Herres, 2020), as negative affect also is related to lowered self-regulation (Liu et al., 2020). Up to 95% of students report procrastinating to some degree (Steel, 2007), which is unfortunate, as procrastination is related to many negative outcomes, such as lower academic performance and poor health (Tice & Baumeister, 1997).

Identifying possible reasons why students feel fatigued and cannot self-regulate effectively to get schoolwork done, is therefore important. The present study will address these issues by looking into how SJL is related to procrastination in students. In an online questionnaire, the prevalence of SJL and procrastination and the relationship between the two were examined. As indices of self-regulatory capacity, daytime fatigue and affective states were included as possible moderating factors that may alter the relationship between SJL and procrastination. Lastly, since both age and gender differences have been identified in SJL and procrastination respectively (Randler et al., 2019; Steel & Ferrari, 2013), both will be

included as covariates in the model. Before presenting the results, the current status of sleep, SJL, and procrastination among students will be examined.

Why Do We Sleep?

When we sleep, several processes crucial for normal daily functioning take place. One of the most important processes highly relevant for students is the consolidation of memories following a day of learning. Memory consolidation refers to our ability to store and make sense of the things we experience when awake. This may improve not only the amount of memories retained but also the strength of memory representations (Diekelmann & Born, 2010; Sejnowski & Destexhe, 2000). As a result, new associations can be produced as our brain re-organizes the input it has received during the day, making it easier to produce new insights and ideas (Diekelmann & Born, 2010). Moreover, not sleeping is detrimental to learning, as studies show that subjects who sleep between test sessions produce far greater improvements compared to groups not allowed to sleep (e.g., Stickgold et al., 2000; Fischer et al., 2002).

Our sleep can be categorized into *non-rapid eye movement* (NREM) and *rapid eye movement* (REM) sleep. NREM is further divided into stages 1, 2, and 3, with higher numbers indicating deeper levels of sleep and slower brainwaves (Chokroversty, 2010). NREM sleep is typically associated with low psychological activity, while REM sleep is typically associated with dreaming (Carskadon & Dement, 2005). The normal pattern of sleep during the night is a progression in stages of deeper sleep, followed by a period of REM sleep. Then repeating cycles of REM and NREM sleep occurs throughout the night, each cycle approximately 90 minutes in length (Carskadon & Dement, 2005). REM sleep was considered paramount for memory consolidation for a long time, but newer research reveals that NREM sleep might be more important than previously thought (Ackermann & Rasch, 2014). This is one of the reasons why sleep duration is important, as we can complete multiple cycles of

REM and NREM sleep, which helps in maintaining normal human functioning during the day.

The World Health Organization (WHO) recommends that adults get 7-9 hours of sleep every night (Hirshkowitz et al., 2015). However, 25% of students report less than 6.5 hours of sleep, and as many as 60% of students can be categorized as poor sleepers (Lund et al., 2010). As mentioned earlier, the negative health effects of sleep deprivation are well documented. For students, a higher prevalence of negative mood (Pilcher & Huffcutt, 1996), difficulty with learning and memory (Walker, 2008), poor self-regulation (Dorrian et al., 2019), and a higher susceptibility for illness (Lund et al., 2010) is especially problematic for their academic success. One culprit for why students struggle to get enough sleep is that classes often start early in the morning. A study by Yeo and colleagues (2023) shows that these early classes can impair students' capabilities in the long term, as an increase in early morning classes was related to lower academic performance.

Even though sleep duration is important, new research tells us that sleep quality is just as essential. Sleep quality can be seen as a measure of how much each of the hours spent asleep help you get energized and ready for a new day (Pilcher et al., 1997). This can be influenced by for example 1) the number of times you wake up during sleep, 2) how long it takes for you to fall asleep, 3) the number of hours spent asleep, and 4) subjective assessment of how rested you feel the next day (Buysse et al., 1989). While noises, bright light, or health issues that wake you up during the night can lower your sleep quality, an irregular sleep schedule can also lead to lowered sleep quality, through misalignment of our circadian rhythm (Caruso, 2014). Studies on shift workers show how bad sleep quality can become when exposed to an irregular sleep schedule for a prolonged amount of time (e.g., McDowall et al., 2017). For example, medical professionals who work 24-hour shifts report less empathy for patients and have an increase in medical errors of 36% (Abrams, 2015). For students, lower

sleep quality has been linked to several negative consequences, for example, higher daytime fatigue (Pilcher et al., 1997) and lower academic performance (Gilbert & Weaver, 2010).

A reason why students struggle to get to bed early enough to get a good night's sleep before early morning classes are partly because of their *chronotype*. Chronotype refers to our time preference for going to sleep and waking up in the absence of external pressure or time cues (e.g., alarm clock) (Roenneberg et al., 2019). Chronotypes can vary from being early chronotypes (eager to get to bed early and wake up early), all the way to late chronotypes (eager to stay up late and get up late). Most people in the general population are an intermediate type, meaning something in between early and late chronotype. Chronotype is at its latest during the late teens, but it takes a long time to reverse the trend (Fischer et al., 2017). Due to the young age of students, most students are therefore more skewed towards being late chronotypes (Enright & Refinetti, 2017). A consequence of this is that most students are not able to get to bed early, except for the earliest of chronotypes (Roenneberg et al., 2019). The trend is quite strong, as people with later chronotypes accumulate much more sleep debt during the week than both intermediate and early chronotypes do (Roenneberg et al., 2007) due to delayed bedtimes. For students, being a late chronotype has been associated with lower academic performance compared to earlier chronotypes (Enright & Refinetti, 2017). Moreover, being a late chronotype can be a risk factor for health issues, such as higher levels of depression (Levandovski et al., 2011) and an increased risk of type 2 diabetes (Vetter et al., 2015) compared to earlier chronotypes.

As we age, our chronotype changes slightly. As mentioned, chronotype is at its latest in the late teens, and the reverse effect occurs at around year 40 for most individuals (Fischer et al., 2017). From baseline, however, our chronotype is closely related to genetic and environmental factors. These genetic factors are often related to our *Biological Clock*, which is responsible to regulate everything from behavior to metabolism (Roenneberg et al., 2019).

This clock is trying to keep up with our internal 24-hour cycles, our circadian rhythm, which is regulated by *zeitgebers*. The most normal zeitgebers are sunrise and sunset, and studies of people exposed to irregular sunlight exposure during the year (like living above the arctic circle) show that it is related to negative outcomes, such as poor sleep (Arendt, 2012). This internal clock is tied to several processes that are crucial throughout the day, such as shutting off melatonin production and secreting cortisol to wake us up (Cajochen et al., 2010). However, due to the demands of our modern society, the Biological Clock struggles to keep up due to how rapidly our *Social Clock* is changing, which can have adverse effects.

The Social Clock refers to people showing up on time for scheduled social interactions, for example, school and work (Roenneberg et al., 2019). This Social Clock is closely related to the *Sun Clock,* which has existed since the dawn of time and is in tune with daily sunrise and sunsets. Roenneberg and colleagues (2019) explain how the Sun Clock once used to be more in line with our Social Clock, but since the introduction of the different time zones throughout the world at the beginning of the 19th century, our Social Clock has been misaligned with the Sun Clock. This change means that biological processes (mostly our circadian rhythm) cannot keep up with the sudden changes in our Social Clock, leaving room for issues related to not being able to get up at sunrise and going to bed at sunset (Roenneberg et al., 2019). This is problematic as the misalignment of our circadian rhythm has been linked with several negative outcomes, such as an increase in metabolic disorders (Feng et al., 2012). We are not all doomed however, as research also tells us that our Biological Clock is a system that adapts to the environment (Roenneberg et al., 2004), but the system might just need more time than we can give it to adapt. Misalignment of the circadian rhythm can occur in several ways, such as through travel jetlag (Bin et al., 2019), but also when our social obligations interfere with our internal, preferred sleep-wake schedule.

Social Jetlag

As discussed earlier, most people, except for early chronotypes who have little trouble getting up early, accumulate sleep debt during the week. People then try to make up for the lack of sleep by sleeping in on the weekend, resulting in Social Jetlag (SJL; Roenneberg et al., 2003). The differences in sleep schedules between work and free days are usually differentiated by the use of an alarm clock, as most people struggle to get up early enough for work and school without external help (Roenneberg et al., 2019). SJL is problematic, similar to travel jetlag, as it disrupts our circadian rhythm (Wittman et al., 2006). It is at the same time different from travel jetlag, as our zeitgebers are not disrupted by changes in the light-dark cycles that are common when experiencing travel jetlag, making SJL more similar to the disruption of circadian rhythm that shift- and nighttime workers experience (Roenneberg et al., 2019).

Similar to what we see in chronotypes, SJL peaks at ≈3h in adolescence, and gradually decrease as we get older (Randler et al., 2019; Roenneberg et al., 2019). For university students, the mean SJL seems to be ≈1h30min (Chang & Jang, 2019), but some younger samples have reported SJL to be over 2h on average (Lee & Yang, 2023), which is considerably more SJL than recorded in the general population of ≈1h (Brandao et al., 2021). It has been proposed that SJL peaks during adolescence due to how school times are not in tune with the lateness of chronotypes during this age (Randler et al., 2019), leaving these individuals at a major disadvantage to fight against their natural sleep-wake cycle.

An issue, however, is that traditional calculations of SJL have not accounted for the sleep debt that individuals accumulate during the week, and so it is difficult to determine if the negative consequences of SJL reported in the literature are because of this misalignment, or because of sleep deficit (Silva et al., 2016). However, new calculations accounting for this sleep deficit have been developed, called “sleep corrected SJL” (SJLsc; Jankowski, 2017). Some studies have already started to adopt this new calculation and therefore control for sleep

debt, and results so far seem to be that sleep-corrected SJL is still related to negative outcomes (e.g., de Medeiros Lopes et al., 2022). When accounting for sleep debt that people experience during the week, SJLsc seems to be significantly lower than normal SJL at ≈1h20min (de Medeiros Lopes et al., 2022).

To illustrate how easy it is to accumulate SJL; when we choose to go to sleep, when we wake up, and the duration of our sleep can all influence how much SJL one has. For example, an individual that usually goes to bed at noon and gets up at 6 O'clock accumulates sleep debt during the week, due to less-than-optimal sleep duration each day. If then during the weekend they were to go to bed at the same time that they usually do but sleep in until 10 O'clock, this individual will have an SJL-score of 2h. Many other combinations of later bedtimes and longer sleep duration during the weekend will therefore increase SJL, showing how easy it is to surpass 2 hours of SJL, the threshold of SJL considered as where negative health effects are especially prevalent (e.g., Rutters et al., 2014).

Consequences of SJL

A review of the possible negative health outcomes with SJL showed that, among many other outcomes, there was an increase in aggression, mood disorders, cardiometabolic risk, and substance abuse associated with SJL, as well as a decrease in work performance (Beauvalet et al., 2017). SJL ≥2h has also been associated with more depression (Levandovski et al., 2011) and excessive daytime sleepiness (Sasawaki et al., 2022). Not only is SJL related to sleep deficit during the week, but SJL is also related to lower sleep quality (Sűdy et al., 2019). This means that people who struggle with getting enough sleep due to SJL, also compromise their sleep quality (e.g., Sasawaki et al., 2022). It is therefore understandable that people with SJL report higher daytime fatigue (e.g., Tamura et al., 2022), sleepiness (e.g., Choi et al., 2019; Sasawaki et al., 2022), lower academic performance among students (Haraszti et al., 2014: Tamura et al., 2022), and lower well-being (Fischer et al., 2022).

McGowan and colleagues (2016) also showed how SJL was linked with increased impulsivity and symptoms of ADHD, tying into our interest in self-regulation in this thesis. Indeed, Wang and Hu (2016) explored how SJL can help predict poor self-regulation and found that later chronotype was related to poor self-regulation, especially when also struggling with SJL. Moreover, a study by Kühnel and colleagues (2016) shows that SJL can impair self-regulatory capacity, in that people tend to procrastinate more, i.e., delay tasks when suffering from both low sleep quality and SJL.

Procrastination

Everyone puts off doing something from time to time. However, a crucial aspect that discerns smart delay and procrastination, is that procrastination is irrational (Steel, 2007). People know that something needs to be done, but choose not to, even though they know that they will have to deal with the consequences later. It is therefore important to highlight that while procrastination is maladaptive, being able to prioritize some tasks ahead of others is far from maladaptive and can be seen as an important part of functioning in the complex world we live in (e.g., Patterson et al., 2011). From this, the landmark meta-analysis of Steel (2007) produced what we can say is the most recognized definition of procrastination: "...to procrastinate is to voluntarily delay an intended course of action despite expecting to be worse off for the delay" (Steel, 2007, p. 66).

It is hypothesized that people procrastinate to avoid aversive tasks and do something else instead, to feel better in the short term (Sirois & Pychyl, 2013). A central part of procrastination is therefore that people are aware of the practical consequences that they will suffer in the future, and therefore also suffer psychological consequences from their behavior (Ferrari et al., 1995). This is perhaps the reason why there are substantial differences in objectively measuring procrastination and self-report measures, as described by Steel and colleagues (2001). They argue that self-report measures of procrastination are based on

internal assessments, which can be substantially influenced by anxiety, low self-esteem, depression, and negative affect (Steel et al., 2001). This is an important distinction, in that we must be aware that it is not necessarily only procrastination behavior that is measured using self-reported procrastination scales, but some mix of behavioral measures and psychological distress.

Another central dimension of procrastination is that it is a kind of chronic self-regulatory failure (Sirois et al., 2015). Self-regulation can be described as how we adjust ourselves toward goal attainment in the future (Baumeister & Heatherton, 1996), and Tice and Baumeister (1997) argue that the depletion of self-regulatory resources is the key to predicting if someone procrastinates or not. Studies have shown how self-regulation is negatively related to procrastination as a part of the personality trait conscientiousness (Steel, 2007). Conscientiousness is related to high self-discipline and low impulsiveness, and low conscientiousness has multiple times been seen as central for predicting procrastination tendencies (e.g., Schouwenburg, 2004; Steel & Klingsieck, 2016). Along the same line, Przepiórka and colleagues (2019) showed that low self-control was related to an increase in procrastination tendencies. Along the same line, self-discipline was negatively correlated (r = -.78) with procrastination (Steel & Klingsieck, 2016), showing how important it is for students to acquire good self-discipline to combat procrastination tendencies. Other more or less stable traits like chronotype can also predict procrastination. For example, studies show that being a late chronotype is positively related to an increase in procrastination tendency (e.g., Przepiórka et al., 2019), and the effect is further mediated by neuroticism (Hess et al., 2000).

Another core component of procrastination is that there is some sort of delay present. However, Svartdal and colleagues (2020b) describe that the term “delay” has been misinterpreted in the past, and a consequence of this is that much of the literature and the

accompanied scales used to measure procrastination and delay have only focused on onset delay, i.e., the initiation of delaying a task. This has meant that too little focus has been given to delay that can happen during the whole process before a goal is met (Svartdal et al., 2020b). Such delay can manifest itself in behavior that disrupts the completion of goals, such as through self-handicapping (Ferrari & Tice, 2000), i.e., adding obstacles to hinder ourselves in completing tasks.

There are also nuances in the measurement of procrastination, as delaying day-to-day tasks differ from, for example, delay of academic tasks. Such differences can for example be seen in how scales measuring academic procrastination, such as the Academic Procrastination Scale (APS), better predict GPA (Grade Point Average) in students compared to other scales that measure procrastination in general (McCloskey, 2011). It might therefore be smart to include multiple measures of procrastination in any given questionnaire, as you can measure different constructs within the realm of procrastination. This is especially true for measurement in a student sample, as procrastination can manifest itself in not just delay of academic tasks, but also in the delay of other important tasks in the day-to-day. Other scales, such as the Irrational Procrastination Scale, also better predict people's quality of life (Svartdal, 2017), and can be a useful addition when designing a questionnaire.

While most students procrastinate, some group differences have been found. From a global sample (N = 16413), Steel and Ferrari (2013) found that, among many variables, there were significant differences in levels of procrastination between gender and age, as younger people tended to procrastinate more, and men tended to procrastinate more than women. As a result, young men seem to struggle the most with procrastination, highlighted as a possible culprit to why the overwhelming majority of students at university are women (Steel & Ferrari, 2013). It has also been proposed that the reason why we see fewer men graduating from university is partly that young men possibly lack the self-regulatory skills to finish a

degree (Steel & Ferrari, 2013). Even though it has been known for decades that students struggle with poor self-discipline and poor self-regulation, it has been explored that universities structure the semester in a way that facilitates delaying tasks. For example, deadlines for academic tasks are often months away and tasks given out early in the semesters are not in line with how experienced the students are at the topics (Svartdal et al., 2020a; Paden & Stell, 1997).

Consequences of Procrastination

One of the consequences of procrastinating is that you are left with less time to complete tasks. This is accompanied by increased stress (Tice & Baumeister, 1997; Sirois et al., 2003), more anxiety, and lower energy levels (Steel et al., 2018). A possible outcome for all these relationships is that an increase in procrastination tendencies has for example been linked with procrastinators getting ill more often and having worse academic performance compared to people who procrastinate less (Tice & Baumeister, 1997; Beswick et al., 1988), as well as poorer health (Tice & Baumeister, 1997) and lower quality of life (Botnmark et al., 2014). Procrastinating students also delay getting treatment when they are ill (Sirois et al., 2003), which could further worsen their situation.

There also seems to be a relationship between mood regulation and procrastination tendencies. Distracting ourselves from aversive, boring tasks is a great way to lift our mood and spirit in the short term, but with detrimental long-term effects (Sirois & Pychyl, 2013). Moreover, studies show that experiencing negative affect can predict procrastination the following day (Pollack & Herres, 2020), showing how interconnected mood and procrastination tendencies are.

Procrastination as a Consequence of SJL

Diving deeper, it seems that there is also a relationship between how well we sleep and the tendency to procrastinate. For example, Sirois and colleagues (2015) showed that

procrastination was related to feeling unrested, and a second study showed that procrastination may compromise sleep quality. Li and colleagues (2020) found that an increase in procrastination was related to more SJL, shorter sleep duration, and increased daytime sleepiness in a sample of young students. Przepiórka and colleagues (2019) found that sleep problems and procrastination had a reciprocal relationship, where increases in procrastination could predict sleep problems, and vice versa. Moreover, in a diary study, Kühnel and colleagues (2016) showed how employees procrastinated less on days when they slept better and even showed that SJL predicted more procrastination when sleep quality was low.

Something that can increase SJL, is delaying bedtime during the week. Bedtime procrastination, a term for delaying the time you intend to fall asleep without external reasons to do so (Kroese et al., 2014), is related to being a late chronotype (Kadzikowska-Wrzosek, 2018; Pu et al., 2022) and insufficient sleep (Kroese et al., 2014). Bedtime procrastination seems to be mostly related to poor self-regulation (Kadzikowska-Wrzosek, 2018; Kroese et al., 2014), and delaying sleep onset with screen usage at night is, not surprisingly, related to SJL (Hena & Garby, 2020). A study on adolescents showed that bedtime procrastination was related to a later bedtime and shorter sleep duration on school nights, accompanied by higher daytime fatigue and higher scores on both anxiety and depression scores (Pu et al., 2022).

A common theme among procrastinators seems to be a lack of emotion regulatory strategies (e.g., Sirois & Pychyl, 2013), a commonality they share with people with greater levels of SJL (Sun et al., 2017). Along the same line, Liu and colleagues (2020) showed that negative affect was both related to lower self-regulation and that negative affect also had a mediating role in the relationship between sleep quality and self-regulation. Another commonality is that being a late chronotype seems to be related to both an increase in SJL (Tavernier et al., 2015) and related to greater levels of procrastination (Hess et al., 2000;

Przepiórka et al., 2019). Digdon and Howell (2008) also support the findings that being a late chronotype is related to a greater tendency to procrastinate, accompanied by poorer self-regulation overall. Kühnel and colleagues (2016) argue that the depletion of self-regulatory capacity must be closely related to SJL, due to how SJL impairs both sleep quantity and quality. The authors add that differences between individuals with varying degrees of SJL could be the reason why some people struggle more to self-regulate at work (Kühnel et al., 2016), showing that SJL could impede self-regulatory capacity.

The Current Thesis

The present study aimed to address how prevalent SJL is in a university student sample, and how it is related to procrastination. As discussed, ≥2h of SJL has been categorized as a critical value where most negative health outcomes start to foster. Therefore, using a one-way ANOVA, we explored how a varying degree of SJL (<0h, <1h, 1-2h, and ≥2h) could predict procrastination tendencies among our student sample. Previous research has indicated a weak, but significant relationship between SJL and procrastination (e.g., Li et al., 2020). However, few studies measure SJL as suggested by Jankowski (2017). In the present study we, therefore, added the newer, sleep-corrected formula of SJL (SJLsc), which may give new insights into how SJL is related to procrastination.

As discussed, another limitation of previous studies is the use of only one measure of procrastination. This may be especially problematic in the student population, as it is possible that academic procrastination would relate differently to SJL compared to general procrastination. This limitation is addressed in the current study by including measures of both general and academic procrastination.

Although previous research has indicated a weak relationship between procrastination and SJL, this relationship might be affected by other factors that decrease self-regulation. At least one study has shown that other factors can alter the relationship, such as when people

who struggle with SJL also struggle with low sleep quality (Kühnel et al., 2016). Hence, we tested factors that may moderate the procrastination-SJL relationship through lowered self-regulation. such as negative affect and daytime fatigue. As both factors affect self-regulation negatively (Liu et al., 2020; Owens et al., 2016), it is possible that they also will moderate the procrastination-SJL relationships.

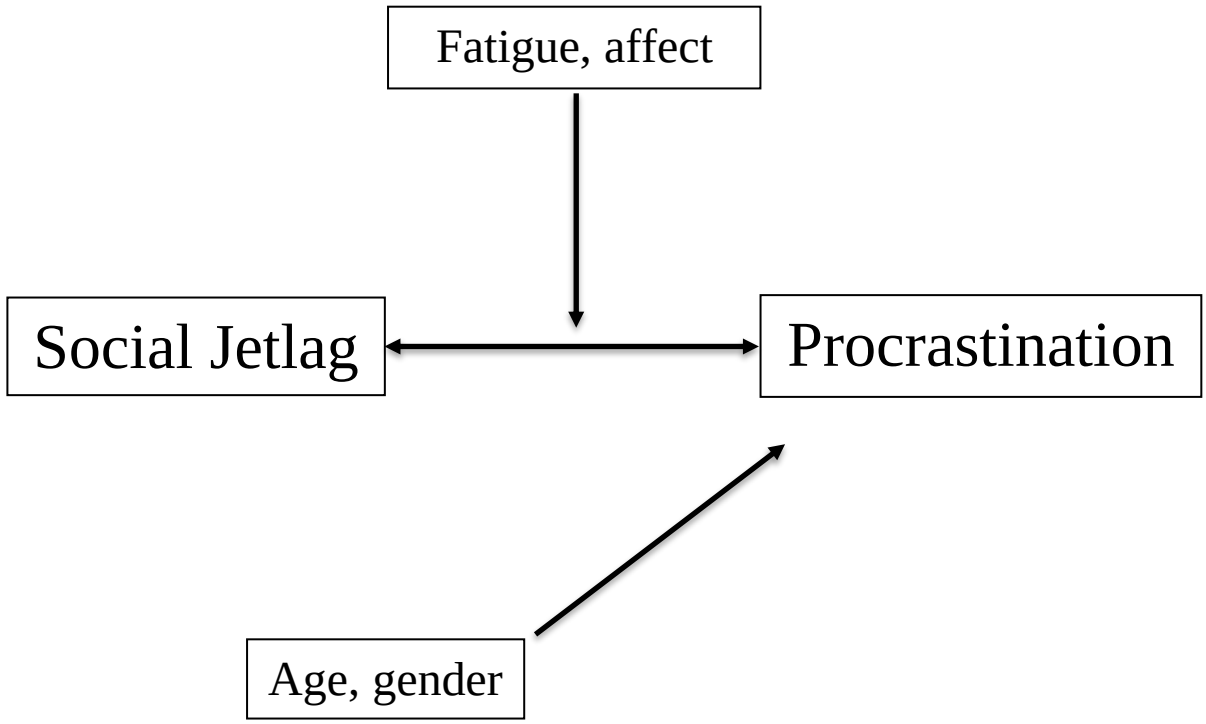
Finally, as discussed earlier, both gender and age differences can be found in SJL and procrastination. Therefore, we investigated whether or not gender and/or age could influence the relationships.

To our best knowledge, no prior studies have addressed these possible moderating effects and the influence of age and gender on the relationship between SJL and procrastination. These questions were examined in a multiple regression analysis model that considers the joint contribution of SJL and self-regulatory indicators on procrastination, adjusted for covariates (Figure 1). Specific hypotheses for our current study are as follows:

- **H1** SJL and SJLsc will correlate positively with scores on both academic (APS) and trait (IPS) procrastination.
- **H2** Students exceeding high levels of SJL (≥2h) will have significantly higher procrastination scores compared to students with SJL <2h.
- **H3** Negative affect will be a moderator for the effect of SJL on procrastination, i.e., higher levels of negative affect will strengthen the association between SJL and procrastination.
- **H4** Daytime fatigue will be a moderator for the effect of SJL on procrastination, i.e., higher levels of daytime fatigue will strengthen the association.

Figure 1

Model for SJL and procrastination, with possible moderators and covariates



Methods

Sample and Ethics

Participants were recruited on 19th-25th October 2022 through www.Qualtrics.com, using e-mail and social media channels (e.g., Facebook) to reach out to relevant students. Participation was anonymous and voluntary. Participants were given a consent form describing broadly what the study was about and were told that they could withdraw from the questionnaire at any time with no negative consequences for them. At the end of the questionnaire, participants were given the option to be enrolled in a raffle to possibly win one of three gift cards with a value of 500 NOK each. The project received ethics approval from the ethics board at the Faculty of Psychology, UiT the Arctic University of Norway.

The sample originally consisted of 1161 respondents. Students who reported that they had worked night- and/or shiftwork in the last two months were excluded, due to how sleep

recorded from these participants will skew data significantly (Juda et al., 2013). The final number of respondents was 830 (66% women). The mean age of participants was 24.10 years, with participants being students of all study areas of UiT the Arctic University of Norway.

Materials and Procedures

Social Jetlag (SJL)

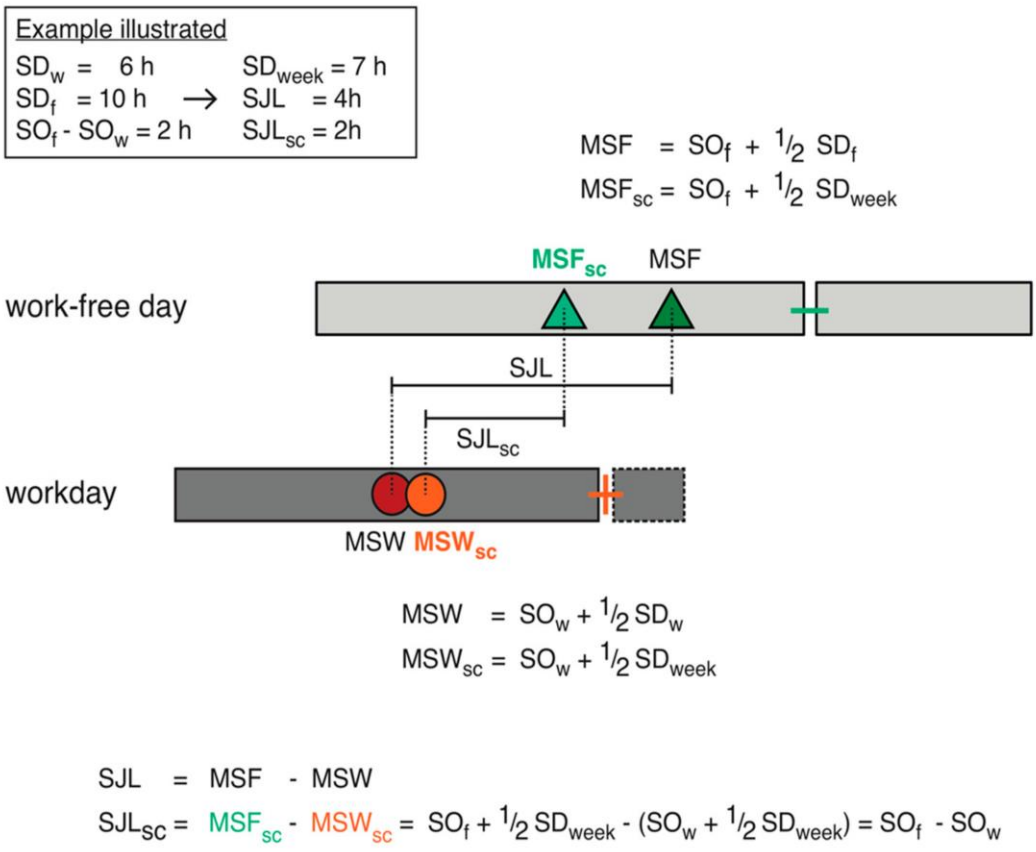
SJL was calculated through self-reported sleep data. Participants were asked to report when they usually go to bed at night and when they get up in the morning. Self-reported measures correlate highly with wrist actigraphy, and the method is regarded as a reliable and valid way of measuring sleep onset and offset (Santisteban et al., 2018). From this, we can calculate SJL from the midpoint of sleep on the weekend versus the midpoint of sleep on weekdays (MSF - MSW), in line with Roenneberg and colleagues (2003). However, this calculation does not consider the accumulated sleep debt people experience during the week, which might be a major confounder. A second measure of SJL will therefore also be used, where sleep measures will be adjusted for sleep debt (see Figure 2), following Jankowski (2017). We opt to use both measures of SJL, as we will be able to compare our results to previous findings, while also providing new insights using the sleep-corrected formula.

A fellow student reported that questions about bedtime were poorly worded in the Norwegian translation of bedtimes and could easily be misinterpreted by participants. Computing the difference in responses to questions 1) “going to bed” and 2) “getting ready to sleep” revealed that 55% of participants had indeed misinterpreted the questions and reported that they “got ready to sleep” before they “went to bed”, leaving us with data that was difficult to interpret. Three ways forward were discussed: 1) remove all misinterpreted responses, 2) use multiple imputation to guestimate both variables, or 3) simply switch the order of these two variables. The latter was chosen because the first implied a drastic loss of power and the second had problems with identifying sufficiently good predictors for the

imputation model. Following the third choice, differences between new sleep data versus original sleep data show that the new, corrected sleep data is more similar to that of earlier studies (e.g., de Medeiros Lopes et al., 2022): Sleep duration during the week (new; 7.54h, SD = 1.22, old; 8.38h, SD = 1.26) and during the weekend (new; 8.64h, SD = 1.37, old; 9.37h, SD = 1.44). This will however be discussed as a possible limitation of this study later on.

Figure 2

Calculation of SJLsc, from Jankowski (2017)



Chronotype

Chronotype was measured by the Munich ChronoType Questionnaire (MCTQ; Roenneberg et al., 2003). This questionnaire is widely used by Norwegian healthcare professionals, and a translated version was used since our participants were Norwegian students, a version that has shown good psychometric properties (Johnsen et al., 2012).

Participants who reported using an alarm clock on the weekend were also excluded from the computation of chronotype (N = 534), in line with Roenneberg and colleagues (2015), as using an alarm clock during the weekend does not reflect sleeping patterns in line with individuals' Biological Clock. Originally, the midpoint of sleep during weekends (MSF) was used as a basis for the calculation of chronotype, but recent studies show that the accumulation of sleep debt during the week needs to be considered (MSF_{SC}; Roenneberg et al., 2015) when individuals sleep longer on weekends compared to the week. This is the measure of chronotype that will be used in our study for participants whose sleep duration is longer on weekends than on weekdays. For participants with ≤sleep on free days versus weekdays, MSF will be used as a measure of chronotype. Items score raw scores in local time format, with questions like "When do you go to bed at night". Cronbach's alpha, $\alpha = .751$ for the MCTQ.

Sleep Quality

Sleep quality will be measured with the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI combines seven components of sleep quality: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The combined score of all components yields a sum score, where higher scores equal worse sleep quality. A Norwegian-translated version will be used for ease of participants, a version that has shown good psychometric properties in the past (Pallesen et al., 2005). Items were scored on a Likert scale from 1 (Not during the past month) to 4 (Three or more times per week), with questions like "During the past month, how often have you had trouble sleeping because you... ...cannot breathe properly", $\alpha = .776$.

Procrastination

Since students can delay academic and daily tasks, procrastination will be measured with the Academic Procrastination Scale (APS; McCloskey, 2011; Yockey, 2016) and the

Irrational Procrastination Scale (IPS; Steel, 2010). Both scales have been translated to Norwegian for the ease of participants, with the Norwegian version of APS (Svartdal et al., 2022) and IPS (Svartdal, 2017) showing good psychometric properties. Scoring for APS was made from 1 (disagree) to 5 (agree) on questions like “I put off projects until the last minute”, $\alpha = 0.896$. Scoring for IPS was made on a Likert scale from 1 (disagree) to 5 (agree) on questions like “My life would be better if I did some activities or tasks earlier”, $\alpha = .902$.

Positive and Negative Affect

Affect was measured with the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). This scale measures both positive and negative affect as two separate factors, meaning that we can isolate negative affect in our analysis. A Norwegian-translated version will be used for ease of participants. PANAS has been translated in the past, showing good psychometric properties (Burge & Matthiesen, 2004). Items score on a Likert scale from 1 (Very slightly or not at all) to 5 (extremely), on questions like “Indicate the extent you have felt this way over the past week: Interested”. $\alpha = .861$ for positive affect and $\alpha = .870$ for negative affect.

Daytime Fatigue

Daytime fatigue was measured with the Chalder Fatigue Scale (Chalder et al., 1993). A translated Norwegian version was used for the ease of participants, a version that showed good psychometric properties (Loge et al., 1998). Scoring was made on a Likert scale ranging from 1 (less than usual) to 4 (a lot more than usual) on questions like “Are you lacking in energy?”. $\alpha = .899$.

Statistical Analysis

All statistical analyses were performed in IBM SPSS Statistics 29. Our first hypothesis (**H1**) was tested with a simple correlation analysis done through SPSS. **H2** was analyzed by comparing ≥2 hours of SJL to <2h, using ANOVA. **H3** and **H4** were tested through two

regression analyses that include the moderator variables for negative affect (negative PANAS variables) and daytime fatigue (Chalder Fatigue Scale), respectively. In case of possible covariates for the relationships, data will be adjusted for age and gender during analysis.

The regression models were performed in blocks. SJL was added alone in the first block, showing the unadjusted association with procrastination. In block two, using centered interaction terms, the interaction terms were added (either SJL x Negative Affect or SJL x Fatigue). In the third step, final adjustments were made to the model by adding covariates (age, gender). The adjusted R-square index, ranging from 0-1, was used to assess the variance explained by the model in each block.

Results

The sample originally consisted of 1161 responses. Due to not finishing all questions, and/or participating in shift- and/or nighttime work, the final total N = 830.

Descriptive Statistics and Correlations

Table 1 shows the descriptive data and correlations of our sample. N = 830, except for chronotype, where participants who use an alarm clock to wake them up during the weekend were excluded (N = 534). The mean age of our sample was 24.10 years (SD = 4.39), 66% were women, 30% were men, and 1.2% were others/not disclosed.

The average sleep duration during the school week was 7.54h (SD = 1.22), equivalent to 7h32min. The average sleep duration during the weekend was 8.64h (SD = 1.37), equivalent to 8h38min. The mean SJL was ≈1.43h (equivalent to 1h25min), SD = 1.05. A small percentage of 4.2% of participants had negative SJL, 37.2% had SJL between 0h and 1h, 39.1% had SJL between 1h and 2h, and 23.7% reached problematic levels of SJL (≥2h). Accounting for the accumulation of sleep debt, SJLsc was ≈0.97h (equivalent to 58.2 minutes), SD = 0.99. Here, only 8.1% had ≥2h of SJLsc, while 26.8% had SJLsc scores between 1h and 2h, and 65.1% had ≤1h of SJLsc.

The mean chronotype (MSFsc) was 4.63h past midnight (equivalent to 4:37 AM). Further on, chronotype was categorized following Fischer and colleagues (2017): Early chronotypes < 0330h, intermediate types 0330h to 0530h, and late types > 0530h. This places our mean chronotype in the intermediate type (60.8%), while 12.2% can be categorized as early chronotypes and 27.0% as late chronotypes.

Mean academic procrastination (APS) was 2.95 (SD = 1.13). Mean trait procrastination (IPS) was 3.13 (SD = .96), which is consistent with earlier findings (Botnmark et al., 2014).

A significant correlation was found between SJL and APS, $r = .09$, $p = 0.008$ and there was a significant relationship between SJL and IPS, $r = .10$, $p = 0.006$. There was also a significant relationship between SJLsc and APS, $r = .07$, $p = .036$, however, no significant relationship was found between SJLsc and IPS, $r = .05$, $p = .12$. This partly supports our H1, in that there would be significant correlations between SJL and procrastination tendencies.

A strong positive correlation was found between SJL and SJLsc, $r = .78$, $p < .001$, showing that they indeed are similar, but that there are some differences between the two. Notably, there was a significant negative correlation between SJL and age, $r = -.20$, $p < .001$, and there was a similar negative correlation between SJLsc and age, $r = -.12$, $p < .001$. There was a significant positive correlation between SJL and chronotype, $r = .58$, $p < .001$, indicating worse SJL with later chronotypes, as confirmed by earlier findings. No significant correlations were found between SJL and sleep quality (PSQI), even though earlier studies have shown that SJL can be detrimental to sleep quality (e.g., Südy et al., 2019). SJL did not correlate significantly with daytime fatigue, but when accounting for sleep debt, there was a significant negative correlation between SJLsc and daytime fatigue, $r = -.07$, $p < .05$. Significant correlations were not found between daytime fatigue and chronotype, which is not in line with earlier findings (e.g., Fárková et al., 2021). There was however a positive

correlation between chronotype and sleep quality (PSQI), $r = .19$, $p < .001$, which is similar to earlier findings (Wittman et al., 2006).

Table 1

Means (M), standard deviations (SD), and correlations for our sample (N = 830)

	M	*SD*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*
1. SJL	1.43	1.05										
2. SJLsc	.88	1.01	.78**									
3. Chronotype	4.63	1.29	.58**	.61**								
4. IPS	3.15	.93	.10*	.05	.22**							
5. APS	2.95	1.12	.09*	.07*	.22**	.78**						
6. PANAS-	2.39	.61	-.02	-.06	.02	.18**	.10*					
7. PANAS+	2.91	.73	-.07*	.01	-.17**	-.40**	-.29**	-.05				
8. Chalder	2.47	.55	.01	-.07*	.08	.36**	.28**	.44**	-.44**			
9. PSQI	7.54	3.67	.04	-.06	.19**	.27**	.24**	.34**	-.38**	.54**		
10. Age	24.10	4.39	-.20**	-.12**	-.18**	-.06	-.06	-.01	.03	-.01	.05	
11. Gender	1.33	.50	-.06	-.01	-.18**	.03	.02	-.15**	.06	-.14*	-.03	.05

Note. Social Jetlag (SJL and SJLsc) and Chronotype (MSFsc) are hours relative to midnight (24:00h). N = 534 for Chronotype due to exclusion criteria. Procrastination (IPS and APS), and PANAS were measured on a 5-point Likert scale. Chalder scores were measured on a 4-point Likert scale. PSQI is a sum of composites, with higher scores equaling worse sleep quality. Gender is coded as 1) female, 2) male, 3) other/do not want to say.

*$p < .05$. **$p < .001$

Group Differences

A one-way ANOVA was used to test differences in procrastination levels across groups of SJL, with grouping <1h, ≥1 and <2h, and ≥2h of SJL. Earlier studies have shown that ≥2h of SJL is related to problematic health outcomes (Levandovski et al., 2011; Sasawaki et al., 2022), and identifying whether this holds up in this study is therefore of interest. The one-way ANOVA revealed significant differences between groups for APS and IPS between

at least two of the groups: APS: F(2,827) = 3,01, p = .05 and IPS: F(2,827) = 3,31, p = .04. Tukey's HSD Test for multiple comparisons found that the mean value of APS and IPS was significantly different between groups <1h and ≥2h of SJL for APS (p = .04, 95% C.I. = [-.48, -.01]) and IPS (p = .03, 95% C.I. = [-.41, -.02]). There was no significant difference between <1h and ≥1 & <2h, and no significant difference between <2h and ≥2h of SJL (p > .05). Since there are known gender and age differences for procrastination (e.g., Steel & Ferrari, 2013) and known age differences in SJL (e.g., Randler et al., 2019), controlling for these are of interest. Running an ANCOVA reveals that there were no differences in SJL between groups of both APS and IPS when gender and age are controlled for (p > .05). Further on, no differences between groups of procrastination were found when correcting for sleep debt, SJLsc (p > .05). However, this partly confirms our H2, in that there were significantly increased tendencies to procrastinate with SJL levels of ≥2h when compared to <1h of SJL. When controlling for age and gender, however, no differences can be detected between groups.

Regression Model

A series of regression analyses were used to test our H3 and H4, the results of which are described in Table 2. The results of the regression indicated that SJL explained 0.8% of the variance of academic procrastination, APS (R^2 = .08, F(1,828) = 7.05, p = .008). SJL predicted 0.8% of the variance for general procrastination, IPS (R^2 = .08, F(1,828) = 7.75, p = .006). After adjusting for sleep debt, SJLsc still accounted for some variance of APS (R^2 = .073, F(1,828) = 4.43, p = .036). SJLsc did not significantly predict IPS (R^2 = .00, F(1,828) = 2.38, p = .12). When controlling for age however, SJL did not significantly predict APS (R^2 = .007, F(2,710) = 2.56, p = .078). Similar results were found for SJLsc and APS (p >.05), SJL and IPS (p >.05), and SJLsc and IPS (p >.05)

Table 2

Regression results for academic procrastination (N = 830)

Predictor	ΔR^2	*B*	*SE*	*β*	*t*	*p*
Block 1	.008					
(Constant)		2.808	.065		43.018	<.001
SJL		.098	.037	.092	2.655	.008
Block 2	.001					
(Constant)		3.143	.255		12.315	<.001
SJL		.067	.042	.061	1.608	.108
SJL x Negative affect		-.026	.040	-.023	-.652	.514
SJL x Fatigue		.020	.040	.017	.496	.620
Block 3	.003					
(Constant)		3.138	.256		12.258	<.001
SJL		.068	.042	.062	1.621	.105
SJL x Negative affect		-.011	.044	-.009	-.246	.805
SJL x Fatigue		.019	.043	.017	.440	.660
Age		-.012	.010	-.047	-1.229	.219
Gender		.024	.083	.011	.289	.772

Note. B = unstandardized coefficient; SE = standard error; β = standard coefficient

To test our H3, a regression analysis including negative affect (PANAS) as a moderator for the relationship between SJL and procrastination (APS and IPS) was conducted. The results from the regression indicated that SJL and negative affect predicted 1.2% of the variance of APS (R^2 = .01, F(2,827) = 3.73, *p* = .024). However, the moderation effect of negative affect on the relationship between SJL and APS was not significant, β = -.02, *p* = .51. SJL and negative affect explained 1% of the variance for IPS, without reaching statistical significance (R^2 = .010, F(2,827) = 2.50, *p* = .083). Moreover, the moderation effect of negative affect on the relationship between SJL and IPS was not significant, β = -.03, *p* = .49. Similar results were found using SJLsc in the model (*p* >.05). These results do not support our H3.

To test our H4, a regression analysis including daytime fatigue (Chalder Fatigue Scale) as a moderator for the relationship between SJL and procrastination (APS and IPS) was conducted. The results from the regression indicated that SJL and Chalder predicted 1% of the variance of APS (R^2 = .01, F(2,827) = 3.64, p = .027). Similar to our earlier testing, however, the moderation effect of daytime fatigue on the relationship between SJL and APS was not significant, β = .02, p = .62. SJL and daytime fatigue again explained 1% of the variance of IPS (R^2 = .010, F(2,827) = 4.08, p = .02), but the moderation effect of negative affect on the relationship between SJL and IPS was not significant, β = -.02, p = .52. Similar null results were found when accounting for sleep debt, SJLsc (p >.05). These results do not support our H4.

Discussion

The present thesis follows previous studies exploring the prevalence of SJL, as well as the relationships between SJL and procrastination. SJL in our student sample was widespread, and a substantial amount of the sample reached 1h-2h (39.1%) and ≥2h (23.7%) of SJL. Supporting our first hypothesis, we found a significant relationship between SJL and academic procrastination, as well as a significant relationship between SJL and general procrastination. Notably, the inclusion of the new calculation of SJL, SJLsc, improves our findings in that we still found a significant relationship with academic procrastination when sleep debt was accounted for. The inclusion of both SJL and SJLsc could prove beneficial, as we are able to compare our results to previous studies, as well as provide new evidence to support that SJLsc could be problematic. Similarly, including measures of both academic and general procrastination could be advantageous, given the dual roles students have in society.

However, when age and gender were controlled for, the model showed no significant associations between SJL and procrastination. Along the same line, when including possible moderators that are known to deplete people of self-regulatory capacity, the regression model

was not improved. This was unexpected as a hypothesis was that factors indicating depletion of people's self-regulatory capacity should impact the relationship between SJL and procrastination. The rather low relationship between SJL and procrastination could indicate that SJL is less relevant to address to improve students' tendency to procrastinate, even when self-regulatory capacity is reduced.

We also found group differences in the degree of SJL and its relation to procrastination tendencies, the same critical value of ≥2h of SJL that has been identified in earlier studies (e.g., Levandovski et al., 2011; Rutters et al., 2014). This is especially true in our case for differences between ≥2h of SJL and <1h ($p < .05$), with significantly higher levels of procrastination between these groups, in support of our hypothesis. This difference between groups did however not appear when accounting for sleep debt (SJLsc), but what this means is unclear. It could be that since the means between SJL and SJLsc (≈1h25min vs ≈58min) are quite different, the same critical value of ≥2h does not apply for SJLsc. It is perhaps then important for future studies to create new critical values for SJLsc to see if the same negative outcomes can be found above a certain degree of SJL when sleep debt is controlled for. It could also be that self-regulatory capacity is largely dictated by the accumulation of sleep debt, which the original SJL computation includes. It is however only speculation, as we are dealing with weak correlations between variables. Previous findings do reveal that sleep deprivation is related to lower self-regulation (Dorrian et al., 2019), so future studies also need to examine SJLsc and its relationship with health outcomes in more detail, to see if SJLsc is negative for health. For example, Kayaba and colleagues (2018) found no relationship between daytime sleepiness and SJLsc, which is not in line with our finding that daytime fatigue was negatively related to SJLsc ($r = -.07$, $p < .05$). This finding could be because of the large number of participants (N = 830), which makes it easier to find significant, but small correlations.

Generalizability of Findings

Regardless of whether sleep debt is included in the calculation of SJL, given the results produced from our study and the literature that precedes it, SJL most probably negatively influences other student-related activities and students' health. The Students' Health and Well-being Report (SHoT) tells us that almost 50% of students struggle with daytime fatigue and only 41% of students report of good quality of life. SJL could be one of the reasons why students feel this way despite the weak correlation with procrastination, as multiple studies show that SJL is negatively related to lower well-being (e.g., Fischer et al., 2020) and higher daytime fatigue (e.g., Tamura et al., 2022). Given the negative outcomes related to prominent SJL (See Beauvalet et al., 2017 for a review), reducing SJL in the student population must be seen as a priority. Information needs to be given to students about the possible negative outcomes related to shifting sleep schedules between weeks and weekends so that students can know that minimizing SJL could improve their daily functioning. Given that earlier studies have shown that age plays a role in the amount of SJL people experience (e.g., Randler et al., 2019), perhaps concentrating advice to younger students entering the university is a relevant path, such as including advice on how to sleep better as a part of any introductory course.

In line with Wittman and colleagues (2006) however, there is perhaps also a need for societal changes to combat the issues related to SJL, given that simply not sleeping in on the weekend to catch up on lost sleep is related to even worse outcomes (Åkerstedt et al., 2019). Since only a minority of people in the general population are early chronotypes (Roenneberg et al., 2019), it is perhaps not too farfetched to propose that the onset of work- and school is extended to better accommodate most people in society. Studies have already shown that programs that help people extend their sleep help reduce SJL, depressive symptoms, and daytime fatigue (Furihata et al., 2023), thus indicating that small changes may make a big

impact. Several studies have also shown that flexible school starts could improve the sleep of younger students (e.g., Winnebeck et al., 2016), and flexible work times reduce stress and result in fewer sick days in the working population (e.g., Halpern, 2005). This shows that there are alternatives to the traditional rigid school- and work schedules that could improve people's lives.

Such non-rigid school schedules could especially benefit those who struggle the most with early morning classes, such as evening chronotypes. A recent study by Jankowski and colleagues (2023) showed that early chronotypes perform better than evening chronotypes on intelligence tests. Moreover, when the tests were done later in the day, there was no difference between chronotypes on test scores (Jankowski et al., 2023). No wonder later chronotypes are associated with lower academic performance, as they are forced to both learn and perform tests/exams at a time of the day when their performance is far from optimal. Since very few people are true early chronotypes, and their performance is not decreased when tests are done later in the day, the evidence is quite convincing in favor of moving school times to better accommodate the "sore losers" of society, namely the evening chronotypes. Moving exam times are also something to consider, as early chronotypes perform better than their later counterparts when exams are placed early in the day (var der Vinne et al., 2015).

Strengths and Limitations

The strengths of our study are that we managed to recruit over 1100 responses to our questionnaire, which greatly increased the statistical power and partly also the generalizability of our findings. A large number of participants perhaps reflects a keen interest from students in participating in studies that explore topics that are relevant to their daily lives, such as studies on sleep and/or procrastination. Given our geographical position as a university above the arctic circle, we are also able to produce new insights into how SJL interferes with normal functioning in environments that are not optimal for our circadian rhythm. Earlier studies

have shown that living above the arctic circle is related to poorer sleep (Arendt, 2012), but given our results, SJL seems to not be significantly different from data collected from other student samples that are located further south (e.g., de Medeiros Lopes et al., 2022). Another strength is that using both traditional measures of SJL (MSF - MSW) and the alternative, sleep-corrected formula SJLsc (SOf - SOw) gives great insight into how Social Jetlag may interfere with normal daily functioning for students. At the same time, using both measures make it possible to a) compare our results to earlier results that have used the traditional calculation of SJL, and b) accompany new research in figuring out how problematic SJL is when sleep debt has been removed from the equation.

One issue that we faced during our study, was that it was pointed out by a fellow student that questions about “going to bed” and “getting ready to sleep” was poorly worded in Norwegian and could easily be misinterpreted by participants. A quick check of results showed that 55% of participants had indeed misinterpreted these questions wrongly, where “getting ready to sleep” was perhaps misinterpreted as the ritual people have before going to bed (e.g., brushing teeth), instead of turning off the lights and preparing for sleep onset. This meant that all sleep data was impossible to interpret and needed to be fixed. However, a simple recoding of answers in the correct order fixed the issue. Comparing sleep times between before and after recoding reveal that the change was more in line with sleep times of previous studies done on students (e.g., de Medeiros Lopes et al., 2022), and so the new data is perhaps more “correct” than before. This is a limitation, however, as we are unsure of the actual correct sleep times of participants, which is not a good thing. Future studies in Norwegian (or other languages that could encounter this issue during translation) should therefore be aware of this issue and translate questions about bedtime in a way that is less confusing for participants.

Since students who partake in shift- and nighttime work were excluded from the analysis, we only have results based on students who do not attend such work, which is not optimal. What we could have done is to include such workers and give them a different scale tailored to account for the differences in work hours they experience (Juda et al., 2013). The percentage of students who also partake in shift- and nighttime work at our university is unknown and would perhaps be an interesting group of students to investigate further in the future. Some research has been done on students who also work part-time as shift- or nighttime workers. In general, they struggle even more with sleep deprivation and daytime fatigue than other students (e.g., Ferreira & Martino, 2012).

Significant correlations were not found between daytime fatigue (Chalder) and chronotype, which is not in line with previous findings (Fárková et al., 2021). Questions in the Chalder Fatigue Scale are scored on a scale from “less than usual” to “a lot more than usual”, which could lead to participants not feeling like they are any more fatigued than usual, but still be fatigued. Perhaps using a different scale, like the Fatigue Severity Scale (FSS) or the Pediatric Daytime Sleepiness Scale (PDSS) would be wise in the future, like in Fárková and colleagues (2021) or Sasawaki and colleagues (2022). We also did not find any effect of negative affect or daytime fatigue as moderators between SJL and procrastination. This could partly be because of how there was no significant relationship between Chalder or negative affect and SJL in the first place, and that again, using different scales to measure daytime fatigue or negative mood could yield a better result. It could also be because of the cross-sectional design chosen for this study, as such a design is not perfect to measure the variables chosen. A cross-sectional design is also not optimal as finding moderator effects has been proven difficult with such a design (Siemsen et al., 2010).

Future Studies

Using a different design, such as a diary, could therefore prove to be useful in the future to see if high levels of SJL over a longer period would make students more susceptible to procrastination. Further, it could also be useful to see if SJL over a longer period makes students more vulnerable if they struggle with accompanied high levels of daytime fatigue, and/or negative affect. Even though our study did not find that self-regulatory capacity was impeded when either suffering from daytime fatigue or excessive negative affect, earlier studies have indicated a relationship between these factors and an increase in procrastination tendencies (e.g., Steel et al., 2018; Pollack & Herres, 2020), and changing the study design might better uncover these relationships.

A knowledge gap that needs further investigation, is that very little research has been done on the relationship between school dropout rates, SJL, and chronotype. Given the strong relationship between SJL, evening chronotype, and poorer academic performance, it would not be farfetched to assume that those individuals who struggle the most with SJL and are of later chronotypes also are the majority of individuals who end up leaving school before finishing a degree. As mentioned earlier, one in four students drop out of university, but some individuals do not even get that far. In Norway, another one in five end up leaving High School (SSB, 2022b), and it could be because school times are not in tune with their biology since both SJL peaks and chronotype is at its latest during adolescence.

So far, a few studies have shown that SJLsc is indeed negative for health, such as its relationship to obesity (Karadag & Yilmaz, 2021) and behavioral problems (Chen et al., 2022) in children and adolescents, but more studies need to be done to see the whole picture. If it turns out that SJLsc is negative for health, studies also need to assess critical values that can be used in further research, like the ≥2h critical values for normal calculations of SJL. Identifying such critical values can be of great use to healthcare professionals and politicians,

who can then produce proper guidelines to combat the issues related to SJL when sleep debt is accounted for.

Conclusion

People sleep up to two hours less than they used to 100 years ago (Roenneberg, 2013), and younger people especially struggle the most to adapt to the societal demands of modern society (Randler et al., 2019). It is estimated that up to 95% of students procrastinate (Steel, 2007), and more and more research reveals that there is a relationship between SJL and procrastination tendencies (e.g., Kühnel et al., 2016). SJL is related to many negative health outcomes and can leave students with less self-regulatory capacity to get schoolwork done on time, further worsening both academic outcomes and health in general.

This thesis examined the relationship between SJL and procrastination among university students. Only a few studies have explored this relationship in student samples, and most have used procrastination measures that only measure general procrastination tendencies and are not focused on the delay of academic tasks. Given the dual role students have in society, including both general, irrational delay (IPS) and delay of academic tasks (APS) could be beneficial in this context. Also including the updated calculation of SJL, SJLsc, could be advantageous to see if the negative outcomes related to SJL are still prominent when sleep debt is accounted for.

The mean SJL in our study was about 1h25min in our sample, similar to other student samples from the past (e.g., de Medeiros Lopes et al., 2022). To deal with these issues, it is proposed that younger students need to learn what good sleep hygiene looks like and that structuring your week in a certain way can lead to better outcomes in the future. It is also proposed that perhaps the individual is not to blame, in line with Roenneberg and colleagues (2019), and that flexible work- and school starts (e.g., Winnebeck et al., 2016; Halpern et al., 2005) are perhaps necessary to better people’s health in the future. Our study confirms the

relationship between SJL and procrastination, and Jankowski's (2017) addition of accounting for sleep debt (SJLsc) also allows us to show that even when sleep debt is accounted for, the relationship between SJL and procrastination is still significant. However, controlling for age rendered the effect non-significant for both SJL and SJLsc. This could mean that in our context, the rather low relationship between SJL and procrastination could indicate that SJL is less relevant to address to improve students' tendency to procrastinate. However, future studies with a more longitudinal design could reveal if prominent SJL over a longer period could increase procrastination among students, especially if accompanied by factors that are known to deplete people of self-regulatory capacity.

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Appendix

Intro

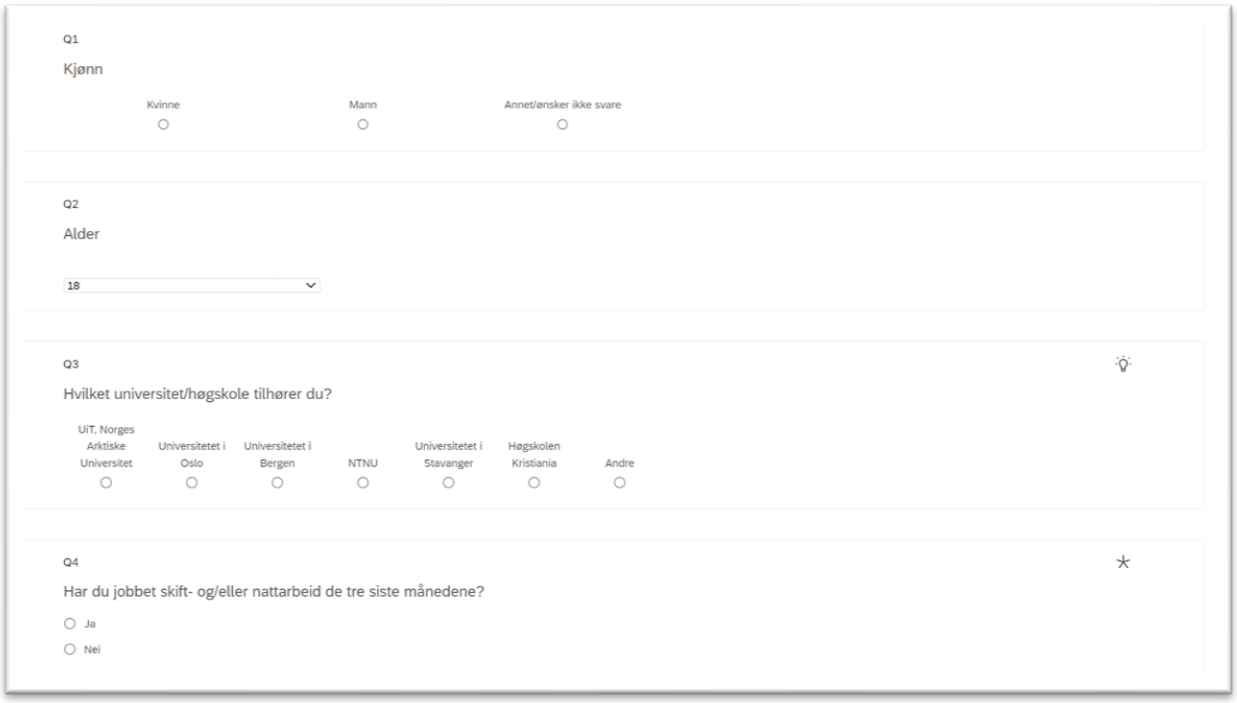
Hei og velkommen!

I dette spørreskjemaet ønsker vi å lære litt mer om hvordan søvnen din har vært den siste tiden, hvordan du har følt deg på dagtid og noen spørsmål om studievanene dine. Svar på spørsmålene så nøyaktig du kan. Det er ikke rette eller gale svar her, vi er ute etter din erfaring og dine oppfatninger. Det tar ca. 10-15 min å besvare alle spørsmålene. Hvis du har lyst, kan du til slutt få tips og triks fra Helsedirektoratet om hvordan du kan forbedre søvnen din.

Du kan også være med i trekningen av tre gavekort til en verdi av 500 kroner!

Husk at alle svar er anonyme, og kan ikke spores tilbake til deg som svarer. Du deltar frivillig og du kan når som helst trekke deg fra undersøkelsen. Dette er et prosjekt tilknyttet mastergraden til Klaus Svartdal Færevaag, med veileder professor Oddgeir Friborg ved UiT, Norges Arktiske Universitet. Prosjektet er godkjent av forskningsetisk komité ved UiT.

Takk for at du deltar! Dine svar vil bidra til kunnskap om hvordan søvn påvirker hverdagen til studenter. Trykk på pilen nede til høyre for å bli tatt med videre til undersøkelsen.



Q1

Kjønn

Kvinne | Mann | Annet/ønsker ikke svare

Q2

Alder

18

Q3

Hvilket universitet/høgskole tilhører du?

UiT, Norges Arktiske Universitet | Universitetet i Oslo | Universitetet i Bergen | NTNU | Universitetet i Stavanger | Høgskolen Kristiania | Andre

Q4 *

Har du jobbet skift- og/eller nattarbeid de tre siste månedene?

Ja

Nei

Q22

Vi starter med spørsmål om ditt vanlige søvnmønster den siste måneden. Du skal svare på hva som er mest riktig for de fleste dager og netter den siste måneden. Vennligst svar på alle spørsmål.

Q23

I løpet av den siste måneden, hvor lang tid (i minutter) har det vanligvis tatt deg å sovne om kvelden?

Mindre enn 10 minutter	10-30 minutter	30-60 minutter	Mer enn 60 minutter
○	○	○	○

Q24

I løpet av den siste måneden, hvor mange timer søvn har du faktisk fått om natten? (Dette kan være forskjellig fra hvor mange timer du oppholdt deg i sengen.)

2-3 timer	3-4 timer	4-5 timer	5-6 timer	6-7 timer	7-8 timer	8-9 timer	9 timer+
○	○	○	○	○	○	○	○

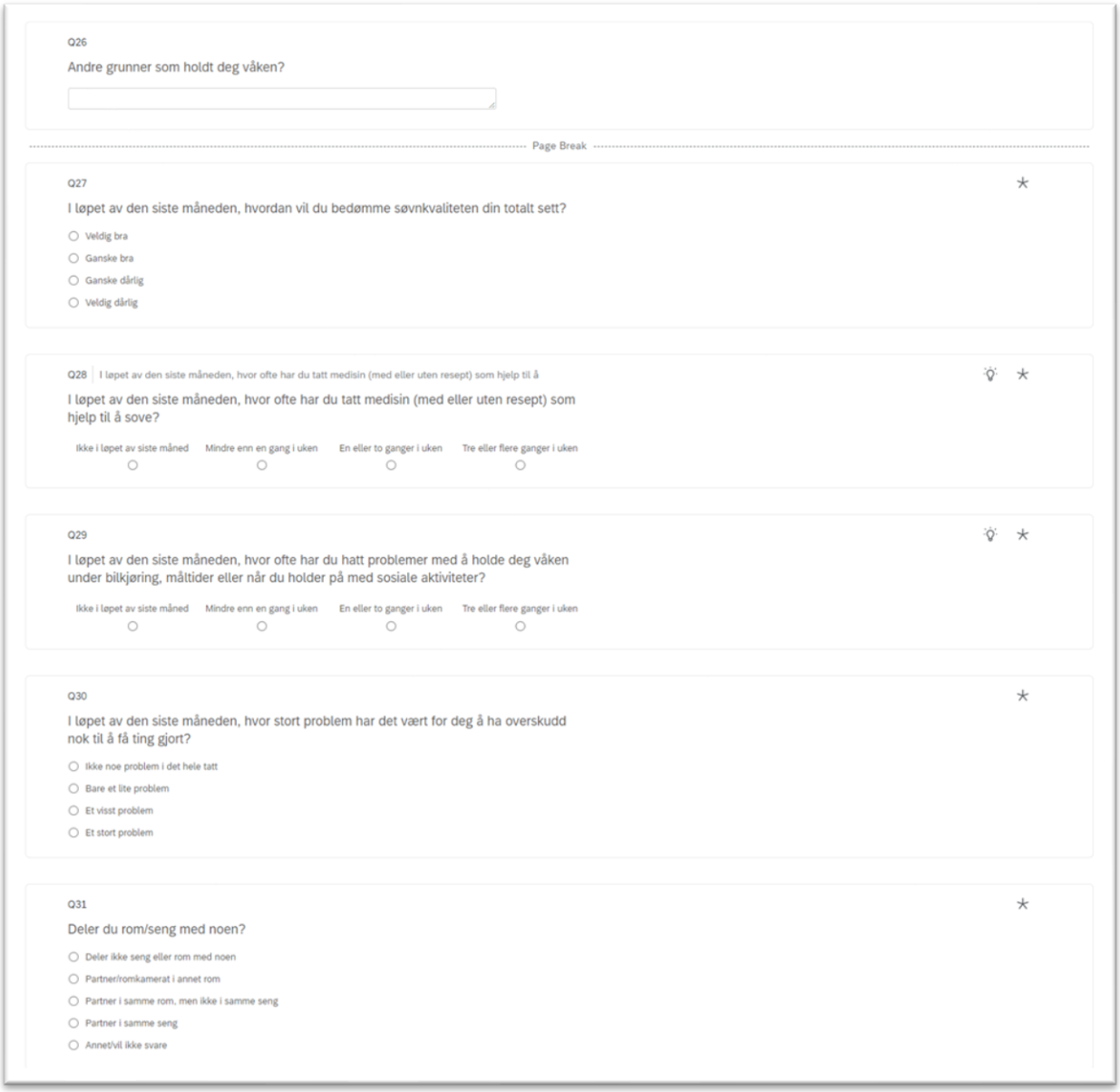
Page Break

Q25

For hvert av de følgende spørsmål, kryss av for det beste svar. Vennligst svar på alle spørsmålene.

I løpet av den siste måneden, hvor ofte har du hatt problemer med søvnen fordi du...

	Ikke i løpet av den siste måneden	Mindre enn en gang i uken	En eller to ganger i uken	Tre eller flere ganger i uken
Ikke klarer å sovne i løpet av 30 minutter	○	○	○	○
Våkner opp midt på natten eller tidlig om morgenen	○	○	○	○
Må opp for å gå på toalettet	○	○	○	○
Ikke klarer å puste ordentlig	○	○	○	○
Hoster eller snorker høyt	○	○	○	○
Føler deg for kald	○	○	○	○
Føler deg for varm	○	○	○	○
Har vonde drømmer	○	○	○	○
Har smerter	○	○	○	○
Andre grunner (beskriv under)	○	○	○	○



Q26

Andre grunner som holdt deg våken?

Page Break

Q27 *

I løpet av den siste måneden, hvordan vil du bedømme søvnkvaliteten din totalt sett?

- Veldig bra
- Ganske bra
- Ganske dårlig
- Veldig dårlig

Q28 | I løpet av den siste måneden, hvor ofte har du tatt medisin (med eller uten resept) som hjelp til å *

I løpet av den siste måneden, hvor ofte har du tatt medisin (med eller uten resept) som hjelp til å sove?

Ikke i løpet av siste måned	Mindre enn en gang i uken	En eller to ganger i uken	Tre eller flere ganger i uken
○	○	○	○

Q29 *

I løpet av den siste måneden, hvor ofte har du hatt problemer med å holde deg våken under bilkjøring, måltider eller når du holder på med sosiale aktiviteter?

Ikke i løpet av siste måned	Mindre enn en gang i uken	En eller to ganger i uken	Tre eller flere ganger i uken
○	○	○	○

Q30 *

I løpet av den siste måneden, hvor stort problem har det vært for deg å ha overskudd nok til å få ting gjort?

- Ikke noe problem i det hele tatt
- Bare et lite problem
- Et visst problem
- Et stort problem

Q31 *

Deler du rom/seng med noen?

- Deler ikke seng eller rom med noen
- Partner/romkamerat i annet rom
- Partner i samme rom, men ikke i samme seng
- Partner i samme seng
- Annet/vil ikke svare

Q6

Videre kommer spørsmål angående søvnen din i normale ukedager.
Du skal svare på hva som er mest riktig for de fleste dager og netter den siste måneden.

Q7 *

Antall dager i uken du ikke kan velge fritt når du vil sove? (f.eks dager med skolearbeid, forelesninger, seminar, hvor du vekkes av vekkeklokke eller lignende)

1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○

Q8 *

Da går jeg til sengs klokken (Mange personer ligger våkne en stund før de sovner)

Tidligere enn 18:00

Q9 *

Jeg gjør meg klar til å sove klokken

18:00

Q10 *

Jeg trenger _____ minutter på å sovne

Mindre enn 5 minutter ○ | 5 minutter ○ | 10 minutter ○ | 15 minutter ○ | 20 minutter ○ | 25 minutter ○ | 30 minutter ○ | 45 minutter ○ | 60 minutter ○ | mer enn 60 minutter ○

Q11 *

Jeg våkner klokken

Tidligere enn 03:00

Q12 *

Jeg våkner ved hjelp av:

- Vekkeklokke
- Annen ytre påvirkning (støy, familie etc.)
- Av meg selv

Q13 *

Etter ____ minutter står jeg opp

Mindre enn 5 minutter	5 minutter	10 minutter	15 minutter	20 minutter	25 minutter	30 minutter	35 minutter	40 minutter	45 minutter	50 minutter	55 minutter	60 minutter	Mer enn 60 minutter
○	○	○	○	○	○	○	○	○	○	○	○	○	○

Page Break

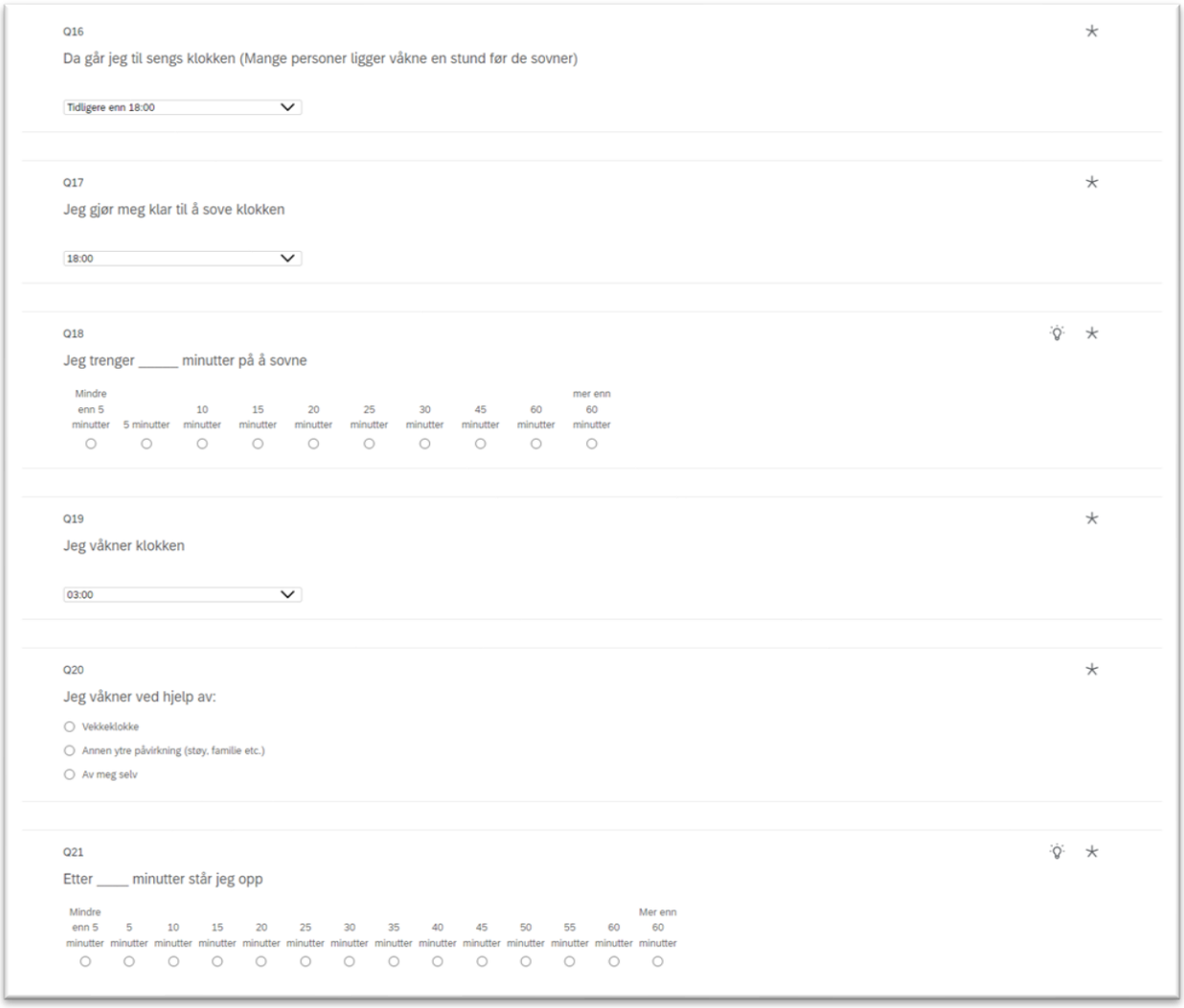
Q14

De neste spørsmål er mer rettet til når du tar deg fri fra skolearbeid, enten det er helg eller andre fridager. Du skal svare på hva som er mest riktig for de fleste dager og netter den siste måneden.

Q15 *

Antall dager i uken du fritt kan velge når du vil sove? (f.eks helg, andre fridager)

1	2	3	4	5	6	7
○	○	○	○	○	○	○



Q16 ★

Da går jeg til sengs klokken (Mange personer ligger våkne en stund før de sovner)

Tidligere enn 18:00

Q17 ★

Jeg gjør meg klar til å sove klokken

18:00

Q18 ★

Jeg trenger _____ minutter på å sovne

Mindre enn 5 minutter	5 minutter	10 minutter	15 minutter	20 minutter	25 minutter	30 minutter	45 minutter	60 minutter	mer enn 60 minutter
○	○	○	○	○	○	○	○	○	○

Q19 ★

Jeg våkner klokken

03:00

Q20 ★

Jeg våkner ved hjelp av:

- ○ Vekkeklokke
- ○ Annen ytre påvirkning (støy, familie etc.)
- ○ Av meg selv

Q21 ★

Etter ____ minutter står jeg opp

Mindre enn 5 minutter	5 minutter	10 minutter	15 minutter	20 minutter	25 minutter	30 minutter	35 minutter	40 minutter	45 minutter	50 minutter	55 minutter	60 minutter	Mer enn 60 minutter
○	○	○	○	○	○	○	○	○	○	○	○	○	○

Q37

Vi vil gjerne vite om du har følt deg sliten, svak eller mangel på overskudd den siste måneden. Hvis du har følt deg sliten lenge, ber vi om at du sammenlikner deg med hvordan du følte deg sist du var bra (sett et kryss for hver linje).

	Mindre enn vanlig	Ikke mer enn vanlig	Mer enn vanlig	Mye mer enn vanlig
Har du problemer med at du føler deg sliten?	○	○	○	○
Trenger du mer hvile?	○	○	○	○
Føler du deg søvnig eller døsig?	○	○	○	○
Har du problemer med å komme i gang med ting?	○	○	○	○
Mangler du overskudd?	○	○	○	○
Har du redusert styrke i musklene dine?	○	○	○	○
Føler du deg svak?	○	○	○	○
Har du vansker med å konsentrere deg?	○	○	○	○
Forsnakker du deg i samtaler?	○	○	○	○
Er det vanskeligere å finne det rette ordet?	○	○	○	○

Her ser du en rekke ord som beskriver ulike følelser og emosjoner. Les hvert ord og marker hvor godt ordet beskriver dine følelser de siste par ukene.

	Lite eller ikke i det hele tatt	Litt	Noe	Ganske	Svært
Interessert	○	○	○	○	○
Stresset	○	○	○	○	○
Opprørt	○	○	○	○	○
Sterk	○	○	○	○	○
Skyldig	○	○	○	○	○
Skremt	○	○	○	○	○
Fiendtlig	○	○	○	○	○
Entusiastisk	○	○	○	○	○
Stolt	○	○	○	○	○
Irritabel	○	○	○	○	○
Våken	○	○	○	○	○
Skamfull	○	○	○	○	○
Inspirert	○	○	○	○	○
Nervøs	○	○	○	○	○
Bestemt	○	○	○	○	○
Oppmerksom	○	○	○	○	○
Urolig	○	○	○	○	○
Aktiv	○	○	○	○	○
Redd	○	○	○	○	○

Q40 (APS)

Denne seksjonen spør litt om dine studievaner. Prøv å tenke tilbake hvordan vanene dine har vært siste måneden, og svar så ærlig du kan på en skala fra (uenig) til (enig).

	Uenig	Noe uenig	Nøytral	Noe enig	Enig
Jeg utsetter prosjekter til siste minutt	○	○	○	○	○
Jeg vet jeg burde jobbe med skolearbeid, men jeg gjør det ikke	○	○	○	○	○
Jeg blir distrahert av andre, mer morsomme ting når jeg skal jobbe med skolearbeid	○	○	○	○	○
"Skippertak" og jobb i siste liten er måten jeg best forbereder meg til store prøver	○	○	○	○	○
Når jeg får utdelt en oppgave, legger jeg den vanligvis til side helt til tidsfristen nesten er gått ut	○	○	○	○	○
Jeg bruker ikke mye tid på å studere pensum før slutten av semesteret	○	○	○	○	○

Q42 (IPS)

Denne seksjonen spør litt om dine studievaner. Prøv å tenke tilbake hvordan vanene dine har vært siste måneden, og svar så ærlig du kan på en skala fra (uenig) til (enig).

	Uenig	Noe uenig	Nøytral	Noe enig	Enig
Jeg utsetter ting så lenge at det går ut over velvære og effektivitet	○	○	○	○	○
Hvis det er noe jeg bør gjøre, gjør jeg det før jeg gjør andre og mindre viktige ting	○	○	○	○	○
Livet mitt ville vært bedre om jeg hadde gjort ting tidligere	○	○	○	○	○
Når jeg burde gjøre noe, gjør jeg gjerne noe annet i stedet	○	○	○	○	○
Når jeg ser tilbake på dagen, vet jeg at jeg kunne utnyttet tiden bedre	○	○	○	○	○
Jeg bruker tiden min fornuftig	○	○	○	○	○
Jeg venter med å gjøre ting mer enn hva som er fornuftig	○	○	○	○	○
Jeg utsetter ting	○	○	○	○	○
Jeg gjør alltid ting når jeg mener at de bør gjøres	○	○	○	○	○

End of Survey

Takk for at du deltok! Ønsker du å lese mer om hvordan du kan forbedre søvnen din? Her er flotte råd fra Helsedirektoratet: https://tinyurl.com/72fwkr4w

Ønsker du å delta i trekning av tre gavekort på en verdi av 500 kroner? Klikk deg videre på denne lenken, og skriv inn e-mail adresse for å være med: https://uitpsych.qualtrics.com/jfe/form/SV_e9AriduH5kPHOT4