

**Exploring the Impact of Student Sedentary Leisure Time on Mood: Moderating Role of  
Openness to Experience via Experience Sampling Methods**

Bachelor Thesis

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## Abstract

**Objective:** Increased prolonged sedentary behaviour (SB) is associated with significant (mental) health risks. Given that university students sit more than the general adult population, examining the influence of increasing Sedentary Time (ST) on mood is more relevant than ever. As a result, the current study sought to investigate the association between sedentary leisure time and state mood, as well as the possible moderation effect of the personality trait of openness to experience in university students.

**Methods:** An Experience Sampling Method (ESM) study was carried out over two weeks with 25 university students ( $M = 21.68$ ,  $SD = 2.61$ , 56% men). Participants were given three daily surveys on the research application m-Path that assessed sedentary leisure time, and state mood. Trait openness to experience was assessed at baseline. Linear mixed models were used to investigate the relationship between sedentary leisure time, state mood, and openness.

**Results:** There was no significant main effect of total sedentary leisure time on negative affect, [ $B = -0.001$ ,  $SE = 0.001$ ,  $p = .573$ ]. There was, however, a significant main effect of total sedentary leisure time on positive affect, [ $B = -0.002$ ,  $SE = 0.001$ ,  $p = .002$ ].

Additionally, openness to experience was found to be a non-significant moderator in this relationship,  $p = .766$ .

**Conclusion:** Sedentary leisure time among university students had no direct association with negative affect, but was significantly associated with lower positive affect. Openness to experience was found not to mitigate this relationship implying that the association between sedentary leisure time and mood is relatively stable across the openness spectrum. While some students may use sedentary leisure time as a coping strategy, it is not the best approach for improving their overall mood.

**Keywords:** Sedentary Behaviour, context, leisure time, depression, openness to experience, Experience Sampling Methods

## **Exploring the Impact of Student Sedentary Leisure Time on Mood: Moderating Role of Openness to Experience via Experience Sampling Methods**

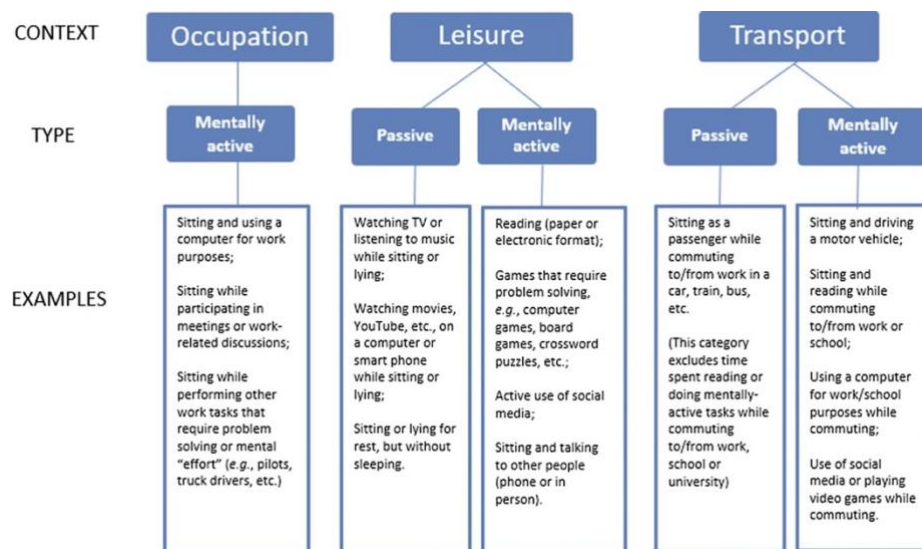
People often assume that the solution to physical tiredness is sitting or lying down, but sitting too much can be harmful. Sedentary behavior, or prolonged sitting, is associated with health risks. Extended periods of sedentary time are linked to a higher risk of several health problems, including type 2 diabetes, cardiovascular disease, hypertension, dyslipidaemia, and obesity (Park et al., 2020). Research indicates that even with adequate physical activity, prolonged sitting can adversely affect health, emphasizing the importance of reducing sedentary time to mitigate these risks (Park et al., 2020). Sedentary behaviour, particularly intellectually passive activities such as watching television and sitting, has been linked to an increased risk of depression due to lower social connections and physical activity levels (Park et al., 2020). Trembley et al. (2017) defined sedentary behaviour (SB) as: “any waking behavior characterized by an energy expenditure  $\leq 1.5$  metabolic equivalents (METs) while in a sitting or reclining posture”. Sedentary time (ST) is the amount of time spent engaging in any type of SB, which is commonly assessed in hours per day (Trembley et al., 2017). Some of the more typical SBs are commuting (e.g. driving a car), reading, sitting at school or work, or screen-related activities including gaming, mobile use, television viewing, and computer use (Owen et al., 2011).

Hallgren et al. (2020) created a framework to evaluate SBs across different life contexts: Occupation, Leisure, and Transportation. Sedentary activities within each environment, except occupation, are categorised into two types: 1) primarily mentally passive behaviors and 2) those requiring significant mental engagement, meaning mentally active. Behaviors are categorized based on the cognitive engagement involved in the activity. One category is mentally active sedentary behavior, which encompasses tasks in work settings that demand focus. This can also encompass activities like using computers, reading, or

playing video games. Conversely, mentally passive sedentary behavior involves activities like watching TV, listening, or talking while seated, typically occurring during free time and leisure activities. The distinction between passive and mentally engaging activities is important as mentally passive behaviours might increase the likelihood of depression whereas mentally stimulating activities could help reduce the risk of developing depression (Schuch et al., 2016).

**Figure 1**

*Framework Discerning Between Mentally Active and Passive Task Within the Three Contexts of SB.*



*Note.* From Passive Versus Mentally Active Sedentary Behaviors and Depression, Hallgren, M., Dunstan, D. W., & Owen, N, (2020), *Exercise and Sport Sciences Reviews*, 48(1), 20–27  
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The recent COVID-19 pandemic had a significant influence on university students' ST, getting an average of eleven hours a day throughout the pandemic (Bertrand et al., 2021). Moulin et al. (2021) found that university students have much greater levels of sedentary time than other demographic groups globally. Moreover, recent studies have begun to delve into the connection between sedentary behavior and mental health, specifically focusing on

depression as both a potential contributor to and a result of sedentary behaviours (Walker et al., 2015; Huang et al., 2020). However, understanding the distinct impacts of mentally active versus passive sedentary behaviours and their effects on mental health outcomes, notably depression, remains an ongoing challenge (Hallgren et al., 2018). This highlights the need for exploration of various types of sedentary behaviour within specific behavioural contexts and their potential impact on mental health and mental well-being.

To appropriately analyse possible links between sedentary behaviours and mental well-being and mental health, the research could consider both the environment in which these behaviours occur (such as occupation, transportation, or leisure activities) and the precise type of sedentary activity being examined (mentally passive and mentally active) (Hallgren et al., 2020). Building on Hallgren et al.'s (2020) call for a more nuanced understanding of sedentary behaviour, this study focuses on sedentary leisure time, which is a domain where people have more autonomy and control over their activities. According to one study, there is a clear connection between excessive sedentary leisure time and an elevated risk of depression, suggesting that the mental passivity of such activities may lead to low mood states (Hallgren et al., 2020). Conversely, mentally active sedentary leisure activities like reading or strategic gaming may provide cognitive stimulation that mitigates negative mood effects (Kandola et al., 2020). While we have some understanding of this topic there is still a lack of research on how sedentary leisure activities can impact mental wellbeing and mental health.

Depression is an important mental health disorder and is characterised by difficulty in everyday functioning and is frequently comorbid with physical health concerns. Depression among students is becoming more widespread, affecting their mood and overall well-being. To further comprehend this issue, depression is frequently examined in terms of mood, which comprises both positive affect (PA), which encompasses emotions of enthusiasm and joy, and

negative affect (NA), which includes feelings of sadness and distress (Brans et al., 2013). Examining these affective states allows research to obtain a better understanding of students' emotional experiences. For this study, it should be clarified that depression is operationalised through mood, specifically focusing on negative affect. Depression varies in severity, ranging from brief mood changes to severe, recurrent episodes that require long-term therapy (Stringaris, 2017). Longitudinal studies have found that passive ST is associated with heightened levels of depression and that substituting passive ST with light or moderate-to-vigorous physical exercise lowers the risk of depression (Huang et al., 2020; Schuch et al., 2016). The distinction between passive and cognitively active SBs in depression research has recently been proposed and investigated as it can help understand the relationship between SB and depression (Hoare et al., 2016). The contrast between passive and mentally active SBs can be likened to the difference between passive and active learning in educational studies on university students, where active learning methods are often found to be more effective in attaining knowledge (Hallgren et al., 2018). Individuals experiencing depression are less physically active and more sedentary than those who are not (Schuch et al., 2016). Comprehensive studies showed that, compared with nondepressed controls, persons with depression spent on average less time in total physical activity and moderate-to-vigorous activity, and had considerably prolonged SBs (Huang et al., 2020; Schuch et al., 2016). Additionally, prolonged engagement in passive sedentary activities correlates with premature mortality, indicating a higher mortality rate at younger ages than expected for the general population (Hallgren et al., 2020; Walker et al., 2015).

Given the potential association between sedentary leisure time and depression, investigating potential moderators of this relationship becomes crucial. In this study, the focus is on the personality trait of openness to experience. Openness to experience relates to a person's tendency for creative thinking, curiosity, and openness to novel experiences

(Chmielewski et al., 2014). Individuals who are high in openness appreciate and are more sensitive to emotional experiences, causing them to experience emotions more deeply, which can lead to frustration, uncertainty, and trouble with emotion regulation (McCrae, 2007). It has been found that this increased sensitivity has been related to greater levels of anxiety and depression, with research indicating that women who are more receptive to feelings have higher rates of anxiety and mood disorders (McCrae, 2007). Individuals with high levels of openness may be more likely to engage in mentally stimulating sedentary leisure activities, such as reading or problem-solving, which could mitigate the negative impact of sedentary behaviour on mental health (Wilson & Dishman, 2015). Those exhibiting low levels of openness, on the other hand, may be more inclined to engage in passive sedentary leisure activities such as excessive TV viewing, which may increase depressed symptoms (Wilson & Dishman, 2015). Researchers conducted a comprehensive examination of 33 previous researches, which found positive associations between physical exercise, conscientiousness, and extraversion while indicating an adverse link with neuroticism. According to this review, agreeableness and openness, on the other hand, showed no significant relationship, neither positive nor negative, with physical activity (Hearon & Harrison, 2020). A few studies have found that individuals high in openness to experience tend to have a positive relationship with sedentary leisure activities, indicating that they may engage in various leisure activities, both physically demanding and sedentary behaviours (Sutin et al., 2016; Wilson & Dishman, 2015). In contrast, another source proposes a negative association between openness and sedentary leisure behavior, implying that those scoring high in openness might engage less in sedentary activities (Allen et al., 2017). While research has shed light on the links between some personality qualities and sedentary leisure time, such as conscientiousness and extraversion, *the purpose of openness as a moderator remains ambiguous.*

Previous studies on SBs have faced methodological challenges, often relying on cross-sectional designs that can only identify associations, not causations, with depression. Zhai et al. (2015) noted in their meta-analysis that while pooled data indicated a significant link, many individual studies found no relationship. Consequently, researchers have stressed the need for new methods to examine additional influencing factors (Zhai et al., 2015; Hallgren et al., 2020). Traditional longitudinal approaches give some insight, but studies have demonstrated that the Experience Sampling Method (ESM) is superior in capturing real-time data and comprehending the dynamic links between sedentary behaviours and mood (Myin-Germeys et al., 2018; Snippe et al., 2016). To address these limitations, the current study employs the Experience Sampling Method.

ESM in the context of SBs entails prompting individuals at various times during the day to report on their present sedentary behaviours, thoughts, feelings, and environmental surroundings via mobile devices or other electronic methods (Myin-Germeys et al., 2009). ESM in SB research can give important insights into the temporal dynamics of SB, including patterns of SB throughout the day, variables affecting SB, and the impact of SB on psychological and physical well-being (Myin-Germeys et al., 2009). This methodology enables researchers to collect real-time data on sedentary behaviour patterns, including duration, frequency, and contextual aspects including location and social environment. ESM empowers researchers to address the issue of bias in retrospective memory and explore fluctuations over time and their connections, thereby enhancing the study of behavioral aspects of mental health problems with a focus on context (Myin-Germeys et al., 2018).

In light of previous research emphasising the nature of SB and its possible associations with mental health outcomes, the purpose of this study is to look at the relationship between mood, SB, and the personality trait openness to experience. The present research gaps focus on the effect of sedentary leisure time on sedentary behaviour as well as



the potential moderation effect of the personality trait openness to experience. This research deficit is especially important for university students, who are the target group of this study. Having that said, this study's first research question is: To what extent are daily total sedentary leisure time and negative affect associated over time in university students? Based on the research question it is hypothesized that *(H1) total sedentary leisure time is positively related to negative affect*. The second research question is: To what extent does the trait openness to experience moderate the relationship between total sedentary leisure time and negative affect over time? In line with the findings of Wilson and Dishman (2015), it is hypothesised that *(H2) individuals high in openness experience lower levels of total sedentary leisure time and in turn lower levels of negative affect*.

## **Methods**

### **Design**

This research project involved a collaboration among five undergraduate students. All of the research questions based on the study are interested in sedentary time and have their own specific factors to analyse; in this case, the variables under investigation are *total sedentary leisure time, mood, and openness to experience*. As a result, during data collection, the experience sampling study contained multiple questionnaires, each pertaining to a distinct area of their research.

On the first day of the assessment, participants received a baseline questionnaire that collected demographic information and several trait assessments. In this case trait that was assessed in the baseline questionnaire was the trait of openness to experience. Over the next 14 days, individuals were given a morning questionnaire at 10:00 that measured their total sedentary time for the previous day (see Appendix B). Furthermore, a momentary measure was used to assess sedentary time, its context and type, as well as the state mood of the previous 30-minute period. Following that, two further surveys were planned during the day,

one at 15:00 and another at 20:00, challenging participants to recollect their sedentary time, context and kind, and related mood within a 30-minute period.

The ESM data were obtained using the research platform m-Path. The study employed a time-contingent variant of ESM rather than an event-contingent design. To elaborate, researchers may ask the participants to report how they feel at specific moments, either randomly throughout the day or at predetermined intervals. For example, they may require participants to report on their mood and activities every few hours, regardless of what they are doing. The data was collected between the 8<sup>th</sup> and 23<sup>rd</sup> of April 2024. This study was approved by the Ethics Committee of the University of Twente (request number 240234).

### **Participants**

The study focused solely on full-time university students, as they were the primary target group for the research. Participants having vocations other than full-time students were purposefully excluded from the study. Inclusion requirements included being 18 years or older, having a competent comprehension of the English language, and having access to a smartphone with an Android or iOS operating system for m-Path.

Participants were recruited mostly by convenience sampling, with five researchers participating in data collection. In other cases, snowball sampling was used, with volunteers/participants reaching out to their contacts to join the research. Furthermore, recruiting was done through the University of Twente's SONA system, which allowed participating students to gain the SONA points required for graduation. Other volunteers, however, received no reward for their engagement. The study intended to collect a sample size of 30 participants, which is thought to give appropriate reliability for ESM investigations (Conner & Lehman, 2012). Furthermore, a recent study indicated that the median sample size for ESM investigations was around 19 individuals (van Berkel et al., 2018).

## Materials

### *Baseline Questionnaires*

**Demographics.** Four questions were utilized to collect demographic information from the participants. They were inquired about their age, gender, nationality, and current occupation. Regarding age, participants were prompted to provide their age numerically. Gender inquiry offered four choices: 'Female', 'Male', 'Other', and 'Prefer not to say'. Nationality options included 'Dutch', 'German', and 'Other'. For current occupation, participants could select from five options: 'HBO Student', 'Bachelor Student', 'Fachhochschule Student', 'Master Student', and 'Other'. Participants who chose the 'Other' option for occupation were excluded from the study, as it specifically targeted higher education students.

**Trait openness to experience.** This study utilised the Big Five Inventory-2 short form (BFI-2-S) which is a questionnaire used to evaluate personality traits, encompassing the Big Five domains (Soto & John, 2017). The BFI-2-S scale exhibited low internal consistency reliabilities, averaging around .61 across samples with a range of .39 to .79, reflecting reduced internal consistency (Soto & John, 2017). In line with the findings of Soto and John (2017) Cronbach's alpha for the scale in this study was calculated to be  $\alpha = .552$ , indicating poor internal consistency.

The six items measuring openness to experience were selected from the questionnaire. The questionnaire prompts the participants with the sentence "*I am someone who...*". The participants subsequently indicate on a 5-point Likert scale the extent to which they associate with the items. The items were "*Is fascinated by art, music, or literature*", "*Has little interest in abstract ideas*"(R), "*Is original, comes up with new ideas*", "*Has few artistic interests*"(R), "*Is complex, a deep thinker*", "*Has little creativity*"(R). 'R' denotes reverse-keyed items, which are questions that are framed opposite from others. Items like being

fascinated by art, music, or literature, being original and creative, and coming up with new ideas, are positively associated with open-mindedness, indicating an inclination towards exploration and unconventional thinking. Conversely, having little interest in abstract ideas is negatively linked to open-mindedness, suggesting a preference for practical and concrete thinking over abstract concepts (Soto & John, 2017). In order to score the final construct, the scoring of the openness to experience trait in the BFI-2-S involves summing responses to its items, where higher scores reflect greater openness characterized by creativity, intellectual curiosity, and a willingness to explore new experiences and ideas (Soto & John, 2017).

### ***Repeated Questionnaires***

**Sedentary Time.** Sedentary time was measured using the 'Past-day Adults' Sedentary Time-University' (PAST-U) questionnaire, which includes nine items depicting various sedentary scenarios (Clark et al., 2016). The PAST-U's nine-item format allows for more accurate assessments than single-item surveys (Prince et al., 2020). (Clark et al., 2016). Respondents recall their sitting time from the previous day in specific situations like studying, working, commuting, and other activities. Sedentary time can be assessed per context or as a total across all items.

Studies validating measures of SB in adults have either examined single-item estimates or used multiple items to create composite scores. Among these measures, the PAST and PAST-U questionnaires showed the strongest validity (PAST:  $r = 0.57$ , 95% CI [0.39–0.71]; PAST-U:  $r = 0.63$ , 95% CI [0.44–0.76]) compared to total sedentary behavior derived from activPAL data (Clark et al., 2016). Consequently, it can be concluded that the PAST-U questionnaire exhibits acceptable criterion validity (ICC = 0.64; mean difference = 0.08 hours, SD = 2.04 hours) when compared to objective accelerometer measurements, rendering it suitable for the current study (Clark et al., 2016).

To adapt the PAST-U to the current study and reduce participant burden while keeping as many psychometric features as feasible, the phrasing of most items was simplified and optimised to match the shorter surveys required for the ESM design, two pairs of questions were combined into two individual items (see Appendix C). The pair related to TV and computer usage, were consolidated into a question about sitting or lying down time during screen-based activities like TV watching, internet use, and gaming, including leisurely pursuits like social media and online shopping: “How long were you sitting or lying down while watching TV, internet-use or playing video games yesterday? (Include activities that were not for studying/working purposes, like social media, online shopping, etc.)”.

**Mood.** Mood was evaluated using a self-report questionnaire based on a two-factor model that assesses mood through negative affect (NA) and positive affect (PA) dimensions. The International Positive and Negative Affect Schedule Short Form (I-PANAS-SF), a condensed version of the original PANAS by a study was employed for this study (Watson et al., 1988). This shortened questionnaire maintains the PA and NA subscales but reduces the number of items from ten to five per scale (see Appendix D).

To tailor the I-PANAS-SF to the current study and lessen the load on participants with three daily surveys, the number of questions per component was lowered from five to three. Items with the greatest factor loadings were chosen to preserve as many of the psychometric qualities as possible. The PA factor included the elements 'attentive', 'determined', and 'active', whereas the NA factor included the items 'nervous', 'anxious', and 'upset'. The questions were changed to focus on affective states over the last 30 minutes, making them more relevant to the present sedentary experience: "Over the past 30 minutes, to what extent did you feel...?" Items with the greatest factor loadings were chosen based on their performance in the pilot test and how well they fit with the context of sedentary behaviour. In the end, the items "attentive" and "active" for PA, with factor loadings of .77 and .74

respectively, and the items "afraid" and "upset" for NA, with factor loadings of .75 and .68 respectively, were selected for the final measurement. Additionally, in this sample, the customized items showed satisfactory internal consistency, with Cronbach's alpha scores of .62 for the PA scale and .75 for the NA scale.

### **Procedure**

The aforementioned specified measures were programmed into m-Path and pilot-tested for four days. Upon completion of the pilot test, the study was made available on the University of Twente SONA System and disseminated to participants through email, text messages, QR codes on flyers, or an alternate code (2yr88). Subsequently, participants were provided with a welcoming message and an introductory overview. Instructions were given to participants on how to install the m-Path app, sign in to the study, and ensure that their app notifications were enabled. Following that, participants were asked to provide informed consent (see Appendix A). If participants did not provide consent, the trial stopped, and no data was preserved. If participants indicated their active consent, the data collection began immediately. Demographic questions were answered initially and were not repeated in subsequent measurements. Over the following 13 days, participants were surveyed three times daily. Surveys were randomly administered within the morning (10:00-12:00), afternoon (15:00-17:00) and evening (20:00-22:00) time intervals. Participants were notified at regular intervals to complete surveys, receiving reminders every 60 minutes within the specified time window. To maintain precise measurements, each survey had a validity period of 120 minutes. If unanswered, surveys were treated as missing data. The schedule aimed to reduce routine influences on mood measurements. In other words, the timetable was designed to reduce factors that could impact or distort mood assessments.

## Data Analysis

The data from each produced questionnaire was exported from m-Path to Excel. Participants with a response rate below 50% were excluded from the dataset, which is a standard practice in ESM studies (Connor & Lehman, 2012; Kang, 2013). Additionally, if discrepancies were detected in the sitting time variable, such as participants reporting sitting time in hours instead of minutes, the data was adjusted accordingly. Subsequently, the dataset was imported into IBM SPSS Statistics 29 for statistical analysis.

To aid interpretation, ST data would remain in minutes. A measurement point variable was established, and the day variable was adjusted to reflect one day prior. Following this step, the variables needed for additional analyses were computed in a long format suitable for further examination. All constructs and scales were computed as per usual instructions. Instances where participants were not sitting during the measurement were treated as missing data for the context variables. Additionally, the sum scores for the PA and NA scales were computed from the specific items of the I-PANAS-SF. To measure the variable state mood, the NA scale score was subtracted from the PA scale score, providing a momentary assessment of the participants' mood within a 30-minute timeframe.

Linear Mixed Models (LMMs) were selected as the statistical model for this study due to their capability of within-subject correlations and variability across measurement occasions. This makes them valuable for longitudinal or repeated measures studies where standard regression approaches may be insufficient due to violated assumptions and hierarchical data structures. LMM does this by computing Estimated Marginal Means (EMMs). This allows missing values and time-varying factors to be accounted for (Krueger & Tian, 2004). The approach was applied by designating time points as repeated measurements and individual participants as subject variables. The autoregressive covariance

structure AR (1) was used in the LMMs to accommodate for the assumption that the strength of correlation of data within individuals decreases over time.

LMMs were utilized to explore the direct association addressed in the first research question, as well as the interaction term relevant to the second research question. In all models, mood was designated as the dependent variable, with sedentary leisure time and openness included as covariates as appropriate for each model. All estimates were unstandardized, and a significance level of .05 was used. Additionally, between-person and within-person scores for sedentary leisure time were computed and incorporated into the LMMs, facilitating the examination of both between-person and within-person effects (Curran & Bauer, 2011). Between-person scores measure differences between persons, whereas within-person scores reflect changes within the same person over time or under different settings.

## **Results**

### **Descriptive Statistics**

#### ***Participants***

The initial sample comprised 41 individuals. However, 16 participants were excluded from the analysis due to response rates falling below 50%, following the criteria established by previous studies (Connor & Lehman, 2012; Kang, 2013). This resulted in a final sample size of  $N=25$ , yielding an overall average response rate of 79.8%, and producing 824 observations that underscore the breadth and depth of the analyses. The age of the participants ranged from 18 to 29 years ( $M = 21.68$ ,  $SD = 2.61$ ). Among the participants, 24 were enrolled in university programs, while one was affiliated with another institution of higher education (see Table 1).



**Table 1***Sample sociodemographic characteristics (N=25)*

Characteristics	<i>n</i>	%
<b>Gender</b>		
Male	14	56
Female	11	44
<b>Nationality</b>		
German	14	56
Dutch	7	28
Other	4	16
<b>Occupation</b>		
Enrolled at a university	24	96
Enrolled at another higher education institution	1	4

***Sedentary Time and Context***

The average sedentary time recorded for participants in this study was 10.76 hours per day ( $SD=5.27$ ). Importantly, this sample mean is similar to the initial validation research of the PAST-U, where the mean sedentary time of students was 10.72 hours (Clark et al., 2016). Additionally, the mean sedentary leisure time was 209.93 minutes (3.48 hours) per day ( $SD=123.76$ ). The variation indicates that the daily sedentary leisure times ranged greatly around the average. Throughout the day, participants were asked to report on numerous environmental contexts during sedentary periods. Students spent 55.7% of their time in the context of leisure. Furthermore, 18.9% of students reported not being seated.

***Mood***

The average mood level in this sample was 1.82 ( $SD = 2.36$ ). This number was calculated by subtracting the NA state's sum score ( $M = 3.14$ ,  $SD = 1.56$ ) from the PA state's sum score ( $M = 4.96$ ,  $SD = 1.88$ ). The final mood levels varied from -8 to 8. Overall, the

mood in this group was quite near to the scale's centre of 0, suggesting neither a notably positive nor negative mood.

### ***Openness to Experience***

The sample's average openness to experience level was 19.19 (SD = 1.83). The openness levels differed among subjects, with higher scores suggesting greater openness. Participants' openness scores ranged from 15 to 23, indicating that they were typically moderate to highly open to new experiences.

## **Variation of Sedentary Leisure Time and Mood**

### ***Mean Sedentary Leisure Time and Mood per Participant***

Average sedentary leisure time varied across participants. Mean sedentary leisure time ranged from 108.4 minutes (Participant 21) to 332.6 (Participant 1). This indicates substantial variability in the amount of time individuals engage in sedentary leisure activities (SD=123.76). Similarly, average mood scores varied considerably across participants (SD=2.36), ranging from -0.51 (Participant 23) to 3.47 (Participant 1)(see Figure 2). For example, Participants 1, 4, 8, and 13 all had significantly higher average mood scores than the overall mean, while Participants 3, 22, and 23 had significantly lower average mood scores.

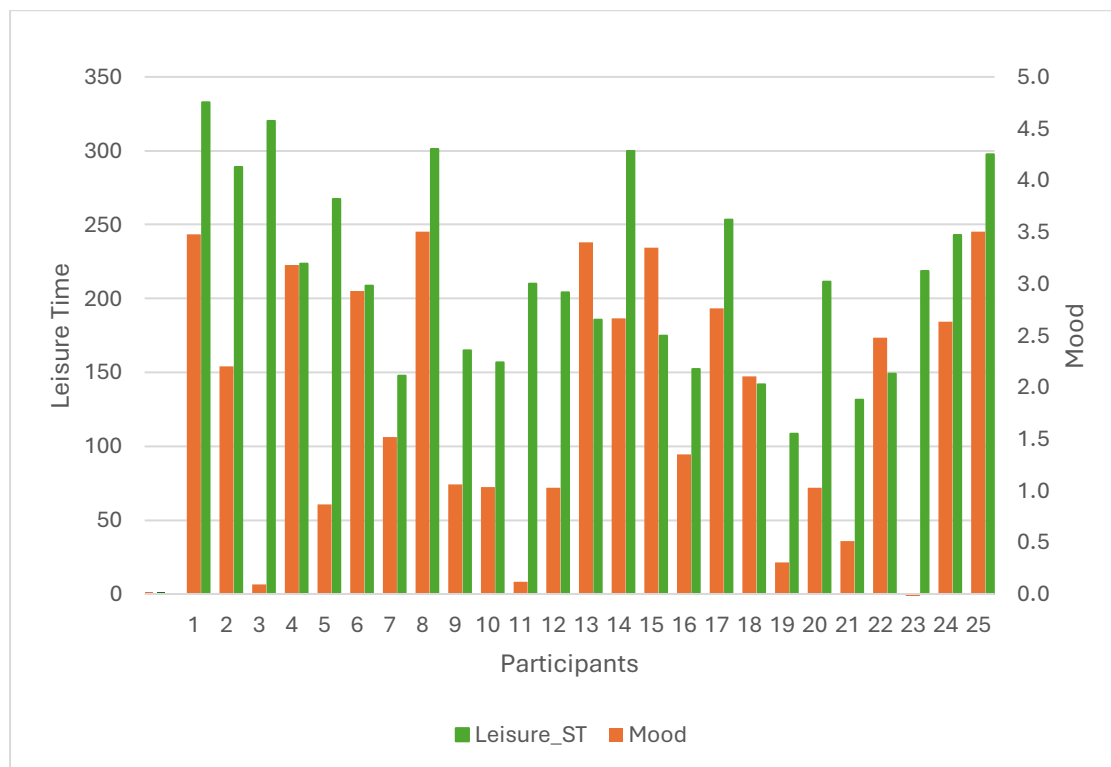
There are some potential trends between leisure time and mood but only in specific participants. For some participants, there seems to be a positive relationship between leisure time and mood (e.g., Participants 1, 8, 17). This suggests that for these individuals, more leisure time may be associated with a better mood. For others, there appears to be a negative or no relationship (e.g., Participants 4, 10, 14). This implies that for these individuals, leisure time might not be a significant factor in their overall mood. Some people with high leisure time tend to have a good mood (e.g. Participant 1), whereas others have a worse mood (e.g.

Participant 6). Similarly, some people with little leisure time have low moods (e.g., Participant 23), while others have high moods (e.g., Participant 19). This shows that the relationship between leisure time and mood could be impacted by other factors.

While individual differences exist, there appears to be a minor overall tendency to improve mood with increased leisure time. This may be seen by comparing the overall heights of the bars among people. However, this tendency is not constant, and there are several exceptions.

## Figure 2

*Mean Sedentary Leisure Time and Mood Across Participants*



*Note.* Participant 23's mood level, while present (-0.51), is too small to be visually represented on this graph

### ***Individual Variation***

The variation in sedentary leisure time and mood will be further investigated by focusing on participants 1, 23, and 24 as they have the highest response rates (see Appendix E). They were selected as their consistent engagement allows the acquisition of a more comprehensive understanding of the variables under investigation (Fosnacht et al., 2017). The estimated marginal mean for mood during sedentary leisure time across all participants was 1.795 ( $SE = 0.068$ , 95% CI [1.662, 1.927]).

Firstly, participant 1 demonstrated a significantly higher average mood (EMM = 3.480, 95% CI [2.909, 4.050]) compared to the overall average. This suggests throughout the study period, participant 1 consistently reported higher levels of positive mood. There are instances where participant's 1 high leisure time corresponds with high mood (e.g., around time points 19-21), but there are also instances where high leisure time coincides with low mood (e.g., time point 41) (see Figure E1). Similarly, low sedentary leisure time is observed with both low and high moods at different time points.

Participant 23, on the other hand, exhibited the lowest average mood among all participants (EMM = -2.549, 95% CI [-3.120, -1.978]). This significant difference from the overall mean indicates a persistently lower mood. Participant 23's sedentary leisure time varies significantly across time points, for example, between timepoint 8 where it is almost 350 minutes, and timepoint 34 where it is almost 100 minutes (see Figure E2). High leisure time can be associated with greater mood (e.g., around time point 6), but it can also be associated with poorer mood (e.g., around time point 39). There are a few examples of somewhat higher or lower mood, but these changes do not appear to be related to the amount of sedentary leisure time. Similarly, low leisure time does not always predict mood. Overall, the results show a weak or inconsistent relationship between Participant 23's leisure time and mood.

Lastly, participant 24 showed a near-average mood ( $EMM = 1.855$ , 95% CI [1.284, 2.426]), with their confidence interval overlapping with the overall average. This suggests that participant 24's mood fluctuated around the average, without consistently leaning towards either extreme positive or negative affect. This could suggest a mix of positive and negative experiences throughout the study. Participant 24's sedentary leisure time varies greatly across time points. This shows that their leisure time is not evenly spread throughout time points. The mood likewise fluctuates, but less dramatically than their leisure time. While certain cases of increased leisure time are associated with better mood (for example, around time point 17), others indicate the reverse or no obvious relationship. Overall, there does not appear to be a strong, consistent association between leisure time and mood in Participant 24.

### **Linear association between Sedentary Leisure Time and Mood**

To investigate the effect of total leisure ST as well as openness to experience, on mood, LMMs were run to evaluate the hypotheses of each research question. For the first hypothesis (H1), 3 models were run.

The first model was conducted to examine the relationship between total sedentary leisure time and negative affect (**NA** mood). There was no significant main effect of total sedentary leisure time on negative affect, ( $B = -.001$ ,  $SE = .001$ ,  $F(1, 365.503) = 2.936$ ,  $p = .087$ , 95% CI [-0.002, 0.000]).

The second model was conducted to examine the relationship between total sedentary leisure time and positive affect (**PA** mood). There was a significant main effect of total sedentary leisure time on positive affect, ( $B = -.002$ ,  $SE = .001$ ,  $F(1, 354.532) = 9.463$ ,  $p = .002$ , 95% CI [-0.001, 0.001]).

Finally, the last model was conducted to examine the relationship between total sedentary leisure time and total mood. There was no significant main effect of total sedentary

leisure time on total mood, ( $B = -.001$ ,  $SE = .001$ ,  $F(1, 319) = 0.319$ ,  $p = .573$ , 95% CI [-0.001, 0.002]). Based on the results from the aforementioned models, the hypothesis (H1) is rejected.

### **Moderation Effect**

For the second hypothesis, a linear mixed model was conducted to evaluate the relationship between total sedentary leisure time, openness, and their interaction on mood.

For the interaction effect between total sedentary leisure time and openness was statistically non-significant [ $F(1, 545.57) = 0.011$ ,  $p = .915$ ]. The parameter estimate for the interaction term was  $B = 0.002$  ( $SE = 0.105$ , 95% CI [-0.205, 0.209]), suggesting that the combined effect of total sedentary leisure time and openness have a non-significant effect on overall mood. This indicates that the connection between leisure screen time and mood is not significantly different across levels of openness. Therefore the hypothesis (H2) is rejected.

In addition, the analysis revealed that the relationship between openness and total mood was non-significant [ $F(1, 397.18) = 0.088$ ,  $p = .766$ ]. The parameter for openness to experience was  $B = 0.029$  ( $SE = 0.096$ , 95% CI [-0.161, 0.218]). This suggests that fluctuations in openness levels do not significantly predict changes in overall mood and that an individual's degree of openness has no meaningful impact on their overall mood.

## **Discussion**

### **Relationship between Sedentary Leisure Time, Mood, and Openness**

Total sedentary leisure time had no significant effect on negative affect. However, it did have a significant effect on positive affect. Additionally, openness to experience did not significantly moderate the relationship between sedentary leisure time and negative affect.

Contrary to the initial expectation (H1), sedentary leisure time was not associated with increased negative affect. The models that looked into negative affect and total mood in relation to sedentary leisure time had a non-significant main influence. This shows that, in

our university student sample, the amount of time spent engaged in sedentary leisure activities had no direct effect on mood changes, either negatively or positively. This contrasts with previous ESM research that has reported a positive association between sedentary behaviour and depressive mood, potentially highlighting the uniqueness of leisure-related sedentary behaviour in university students (aan het Rot et al., 2012; van Os et al., 2017). Specifically, this implies that when university students participate in sedentary activities during their leisure time, the consequences on their mood may be different than sedentary activity in other situations, such as work or study. University students experience distinct stresses and daily routines than other people, such as academic stress and social challenges, which may influence how their sedentary leisure time affects their mood. While the study did not find a significant effect of sedentary leisure time on negative mood, the significant relationship with decreased positive affect suggests that prolonged sedentary activities might contribute to an overall reduction in well-being. This finding aligns with existing literature that highlights the benefits of physical activity on mental health and the potential drawbacks of a sedentary lifestyle (Hoare et al., 2016; Schuch et al., 2016). Some cases show that leisure activities can be associated with a positive mood, as seen by Participant 1, who had both high sedentary leisure time and a higher average mood. This shows that the quality of leisure activities can have a significant beneficial influence on mood.

The findings of the next model indicated no association between leisure time, openness to experience, and mood. It was initially hypothesised that openness would reduce the connection between leisure time and mood (H2) as this was in line with the research of Wilson and Dishman (2015), but the results did not support this. Instead, significant main effects of leisure time and openness on mood were found. This suggests that the relationship between sedentary leisure time and mood remains relatively consistent regardless of openness to experience. This implies that the negative impact of sedentary leisure time on positive

mood, observed in this study, is not influenced by a person's level of openness to new experiences. Even people who are more receptive to new experiences, and who are anticipated to participate in a broader range of activities, experience a comparable drop in their positive affect with more sedentary leisure time. These results contrast the findings of Hearon and Harrison (2020) who found that those who participate in more sedentary leisure activities and are more receptive to new experiences have a higher mood, regardless of the other components.

### **Strengths and Limitations**

The present study has several strengths, including the advanced use of the Experience Sampling Methodology (ESM), which is highly suited to this research area. This design allowed for accurate and detailed data collection, conducted over two weeks with three measurements per day. This approach resulted in a large, detailed dataset that captures the nuances of mood and various variables over time and during specific sedentary periods. Additionally, the study's variables were based on a new framework by Hallgren et al. (2020), which categorizes sedentary behavior into three contexts and differentiates between mentally active and passive behavior. The ESM design enabled the exploration of these contexts and mental distinctions across different times and individuals. Additionally, in this study participants reported an average sedentary time of 10.76 hours per day ( $SD = 5.27$ ). This observation is comparable with a prior study by Clark et al. (2016), who found a similar average sedentary time of 10.72 hours per day among undergraduates.

A limitation of this study that may have influenced the reliability and validity of the results is the measurement of the trait of openness to experience using the Big Five Inventory-2 Short Form (BFI-2-S) scale. Considering the restricted reliability observed in the scale, it was advisable to employ them solely within sample sizes comprising approximately 400 observations or greater (Soto & John, 2017). This issue is not unique to this study; other



studies have also encountered similar challenges with the BFI-2-S. For instance, similar reliability challenges for certain measured facets within the BFI-2-S scale have been reported by Cemalcilar et al. (2021) and Føllesdal & Soto (2022). These data suggest that attaining consistent results with this specific scale might be challenging.

### **Implications for Future Research**

Firstly, the Big Five Inventory-2 Short Form (BFI-2-S) was used to measure openness to experience, but this scale might not accurately and consistently measure this trait. Future studies could consider alternative measures that better assess openness, perhaps by using scales with more items specifically designed to measure the various facets of this personality characteristic. Secondly, using probability sampling methods in future studies would reduce selection biases associated with non-probability sampling. Probability sampling methods can reduce selection biases associated with non-probability sampling by assuring that every member of the population has a known and very little chance of being picked, resulting in a more representative sample. Furthermore, expanding the sample size beyond the small sample utilised in this study ( $N=25$ ) will give more strong statistical power and lessen the influence of outliers, hence improving the reliability and validity of study results.

### **Conclusion**

To conclude, the study found a statistically significant link between sedentary leisure time and lower positive affect (PA) in university students, but no direct association with negative affect (NA). Additionally, openness to experience did not influence the relationship between sedentary leisure time and mood, indicating that the impact of leisure time was consistent across individuals. The key takeaway is that while sedentary leisure time does not negatively impact mood, it is also not effective in enhancing positive feelings. This suggests that while some students may use sedentary leisure time as a coping strategy, it is not the best

approach for improving their overall mood. Therefore, a balanced approach to leisure activities is important for fostering well-being.

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## **Appendix A**

### **Informed Consent**

Dear participant,

We would like to thank you for taking part in our study!

This study is conducted by Roos A.S. Kruk, Paula H. Naber, Ariya Solan, Edgar G. Avanisian, and Mats O. Tebarth, and supervised by Gerko Schaap from the Department of Psychology, Health & Technology at the University of Twente.

The scope of this study is to investigate the relationship between **daily sitting time** and several variables including **mood, stress, and anxiety**. You will help us address research gaps and contribute to a growing body of evidence regarding associations between sitting time and well-being.

To participate, you need to be at least 18 years old, enrolled in a university or other higher education institution (HBO, Fachhochschule), and have proficient English language skills. Additionally, you need to be able to stand for at least 30 minutes a day and have access to and be willing to use a smartphone capable of running an app for the duration of the study.

For this study, we ask you to respond to four daily questionnaires for a duration of 14 consecutive days. On the first day of assessment, you will be asked to complete a baseline questionnaire. For the following days, you are required to respond to daily repeated questionnaires, scheduled at 10:00, 14:00, 18:00, and 21:00, each open for 2 hours. Specifically, the questionnaire at 10:00 will ask you to retrospectively report on your sitting



time from the previous day, while the remaining three questionnaires will ask you about specific conditions such as mood, stress, and anxiety. All questionnaires will be completed via the m-Path app.

There are no physical risks associated with this research project. Regarding the time period of two weeks, you may have timely constraints and not enough energy to constantly fill in the questionnaires. If any of these cases apply, you may withdraw at any given time as your participation in this study is voluntary. In the case of additional complaints, you can contact the researcher(s).

Keep in mind that in the case of early withdrawal, you will **not be granted any SONA credits**.

All personal data will be anonymised and kept confidential. The data will only be used for the purpose of this study and will be stored on researchers' devices for a period of two years.

Please do not hesitate to contact the researchers if you have any questions or concerns before, during or after your participation:

[r.a.s.kruk@student.utwente.nl](mailto:r.a.s.kruk@student.utwente.nl)

[p.h.naber@student.utwente.nl](mailto:p.h.naber@student.utwente.nl)

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Supervisor: g.schaap@utwente.nl

### **Contact Information for Questions about Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Do you agree to all of the above-mentioned statements and confirm that you consent to take part in this study and for your data to be used for future research as described?

Please select one of the following options:

- I agree
- I disagree

## Appendix B

### Questionnaire Schedule

	10:00-12:00	14:00-16:00	18:00-20:00	21:00-23:00
Day of signing in	Baseline Questionnaire[MT1]			
Day 1	Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 2	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 3	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 4	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 5	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 6	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 7	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 8	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 9	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States

Day 10	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 11	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 12	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 13	Total ST, Context, Type and States	Context, Type and States	Context, Type and States	Context, Type and States
Day 14	Total ST			

## Appendix C

### Adjusted PAST-U Questionnaire

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**For clarification:**

**In this survey, we are only interested in behaviour while you were sitting or lying down and being awake! Standing or other positions are not of interest here! Furthermore, sport in a seated position is also not of interest here as we are investigating sitting behaviour without physical activity!**

---

Total ST (PAST-U)	Questions	Answer options
<b>Item 1</b>	How long were you sitting while <u>studying/working yesterday</u> ? (Include the time at University, during lectures, tutorials, meetings, group discussions, study/work from home, etc.)	Numerical value
<b>Item 2</b>	How long were you sitting for <u>transportation/travelling yesterday</u> ? (Include sitting and waiting for transport. Do not include any time you were standing up while travelling or waiting.)	Numerical value
<b>Item 3</b>	How long were you sitting or lying down while <u>watching TV, internet-use or playing video games yesterday</u> ? (Include watching TV, playing video games, internet-use for activities that were not for studying or working purposes, like social media, Netflix, YouTube, online shopping, etc.)	Numerical value
<b>Item 4</b>	How long were you sitting or lying down while <u>reading</u> during your leisure time <b>yesterday</b> ? (Include reading in bed but do not include time spent reading for work or study)	Numerical value
<b>Item 5</b>	How much time did you spend sitting down for <u>eating</u> and drinking <b>yesterday</b> ?	Numerical value
<b>Item 6</b>	How much time did you spend <b>yesterday</b> sitting down to <u>socialize</u>	Numerical value

with friends or family, regardless of location?

(Include at University, at home, or in a public place, etc. Include time on the telephone)

**Item 7**

How much time did you spend **yesterday** in any other sitting or lying behaviour that you may have done but not yet told us about? (e.g., hobbies such as doing arts and crafts, playing board games, listening to music, or religious purposes)

Numerical value

**30-min ST**

**Item 1**

Over the past 30 minutes before the notification, how many minutes have you been in a sitting or reclining position?

Numerical value

**Context**

**Item 1**

Over the past 30 minutes, in which context were you in?

- 1) Leisure
- 2) Transportation
- 3) Occupation/Study

**Type**

**Item 1 (Follow-up Leisure)**

During the past 30 minutes, what activity did you spend the most time engaged in?

- Playing games like video games, board games, etc, or reading a book, newspaper, or something else.
- Actively using social media or socializing and talking with people (Phone or in person).
- Watching TV, movies, YouTube, Netflix, etc, or listening to music, or just resting in a seated or reclined position without sleeping.
- Eating and drinking while in a seated or reclined position
- Not sitting

- Item 2 (Follow-up Transportation)** During the past 30 minutes, what activity did you spend the most time engaged in?
- Sitting and driving a motor vehicle.
  - Sitting and reading or using a computer/smartphone for work/university purposes while commuting/travelling.
  - Using social media or playing video games while commuting/travelling
  - Just sitting as a passenger, or eating/drinking while commuting/travelling
  - Not sitting
- Item 3 (Follow-up Occupation/Study)** During the past 30 minutes, what activity did you spend the most time engaged in?
- Sitting and using a computer for work or study purposes.
  - Sitting while participating in a meeting, tutorial, or other work/study-related event.
  - Sitting in your work/study environment but not engaged in work or study-related tasks (e.g., socializing, eating/drinking etc).
  - Not sitting

## Appendix D

### Repeated Questionnaire Measuring Total ST (PAST-U), 30-min ST, Context/Type, and States Scheduled at 10:00

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**For clarification:**

**In this survey, we are only interested in behaviour while you were sitting or lying down and being awake! Standing or other positions are not of interest here! Furthermore, sport in a seated position is also not of interest here as we are investigating sitting behaviour without physical activity!**

---

Total ST (PAST-U)	Questions	Answer options
<b>Item 1</b>	How long were you sitting while <u>studying/working yesterday</u> ? (Include the time at University, during lectures, tutorials, meetings, group discussions, study/work from home, etc.)	Numerical value
<b>Item 2</b>	How long were you sitting for <u>transportation/travelling yesterday</u> ? (Include sitting and waiting for transport. Do not include any time you were standing up while travelling or waiting.)	Numerical value
<b>Item 3</b>	How long were you sitting or lying down while <u>watching TV, internet-use</u> or <u>playing video games yesterday</u> ? (Include watching TV, playing video games, internet-use for activities that were not for studying or working purposes, like social media, Netflix, YouTube, online shopping, etc.)	Numerical value
<b>Item 4</b>	How long were you sitting or lying down while <u>reading</u> during your leisure time <b>yesterday</b> ? (Include reading in bed but do not include time spent reading for work or study)	Numerical value
<b>Item 5</b>	How much time did you spend sitting down for <u>eating</u> and drinking <b>yesterday</b> ?	Numerical value
<b>Item 6</b>	How much time did you spend <b>yesterday</b> sitting down to <u>socialize</u>	Numerical value



with friends or family, regardless of location?

(Include at University, at home, or in a public place, etc. Include time on the telephone)

**Item 7**

How much time did you spend **yesterday** in any other sitting or lying behaviour that you may have done but not yet told us about? (e.g., hobbies such as doing arts and crafts, playing board games, listening to music, or religious purposes)

Numerical value

**30-min ST**

**Item 1**

Over the past 30 minutes before the notification, how many minutes have you been in a sitting or reclining position?

Numerical value

**Context**

**Item 1**

Over the past 30 minutes, in which context were you in?

- 4) Leisure
- 5) Transportation
- 6) Occupation/Study

**Type**

**Item 1 (Follow-up Leisure)**

During the past 30 minutes, what activity did you spend the most time engaged in?

- Playing games like video games, board games, etc, or reading a book, newspaper, or something else.
- Actively using social media or socializing and talking with people (Phone or in person).
- Watching TV, movies, YouTube, Netflix, etc, or listening to music, or just resting in a seated or reclined position without sleeping.
- Eating and drinking while in a seated or reclined position
- Not sitting

- Item 2 (Follow-up Transportation)** During the past 30 minutes, what activity did you spend the most time engaged in?
- Sitting and driving a motor vehicle.
  - Sitting and reading or using a computer/smartphone for work/university purposes while commuting/travelling.
  - Using social media or playing video games while commuting/travelling
  - Just sitting as a passenger, or eating/drinking while commuting/travelling
  - Not sitting
- Item 3 (Follow-up Occupation/Study)** During the past 30 minutes, what activity did you spend the most time engaged in?
- Sitting and using a computer for work or study purposes.
  - Sitting while participating in a meeting, tutorial, or other work/study-related event.
  - Sitting in your work/study environment but not engaged in work or study-related tasks (e.g., socializing, eating/drinking etc).
  - Not sitting

### State Stress

- Item 1** What number describes your stress over the past 30 minutes? Scale of 0 to 10, 0 being no stress and 10 being worst stress possible (11-point-likert scale)

### State Mood

- Item 1** Over the past 30 minutes, to what extent did you feel active?
- 1) Not at all
  - 2) A little
  - 3) Moderately
  - 4) Quite a bit
  - 5) Extremely
- Item 2** Over the past 30 minutes, to what extent did you feel upset?
- 1) Not at all
  - 2) A little

		3) Moderately 4) Quite a bit 5) Extremely
<b>Item 3</b>	Over the past <u>30 minutes</u> , to what extent did you feel attentive?	1) Not at all 2) A little 3) Moderately 4) Quite a bit 5) Extremely
<b>Item 4</b>	Over the past <u>30 minutes</u> , to what extent did you feel afraid?	1) Not at all 2) A little 3) Moderately 4) Quite a bit 5) Extremely

### State Anxiety

<b>Item 1</b>	“How anxious did you feel over the past <u>30 minutes</u> ?”	Visual Analogue Scale (VAS), ranging from 0 “not anxious at all” to 10 “most anxious you could ever imagine”
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### Repeated Questionnaire Measuring 30-min ST, Context/Type, and States Scheduled at 15:00 and 20:00

#### **For clarification:**

**In this survey, we are only interested in behaviour while you were sitting or lying down and being awake! Standing or other positions are not of interest here! Furthermore, sport in a seated position is also not of interest here as we are investigating sitting behaviour without physical activity!**

<b>30-min ST</b>	Questions	Answer options
<b>Item 1</b>	Over the past <u>30 minutes</u> before the notification, how many minutes have you been in a sitting or reclining position?	Numerical value
<b>Context</b>		
<b>Item 1</b>	Over the past <u>30 minutes</u> , in which context were you in?	1) Leisure 2) Transportation 3) Occupation/Study
<b>Type</b>		
<b>Item 1 (Follow-up Leisure)</b>	During the past <u>30 minutes</u> , what activity did you spend the most time engaged in?	- Playing games like video games, board games, etc, or reading a book, newspaper, or something else.

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**Item 2 (Follow-up Transportation)**

During the past 30 minutes, what activity did you spend the most time engaged in?

- Actively using social media or socializing and talking with people (Phone or in person).
- Watching TV, movies, YouTube, Netflix, etc, or listening to music, or just resting in a seated or reclined position without sleeping.
- Eating and drinking while in a seated or reclined position
- Not sitting

- Sitting and driving a motor vehicle.
- Sitting and reading or using a computer/smartphone for work/university purposes while commuting/travelling.
- Using social media or playing video games while commuting/travelling
- Just sitting as a passenger, or eating/drinking while commuting/travelling
- Not sitting

**Item 3 (Follow-up Occupation/Study)**

During the past 30 minutes, what activity did you spend the most time engaged in?

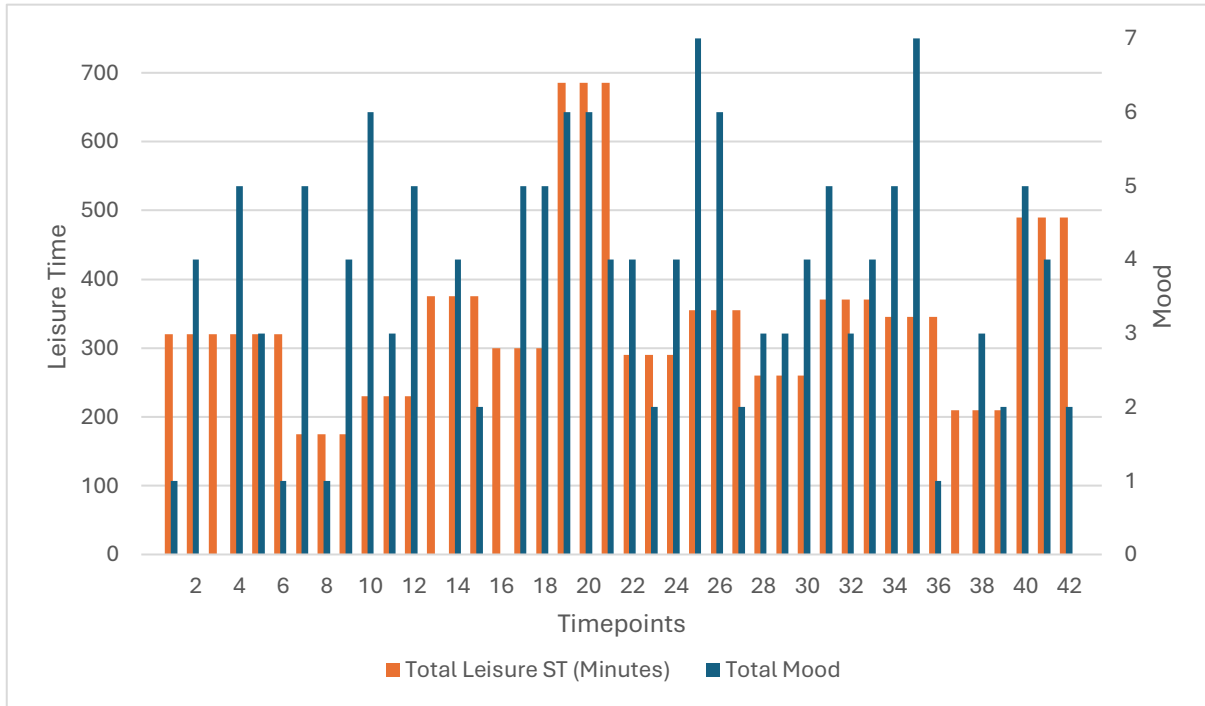
- Sitting and using a computer for work or study purposes.
- Sitting while participating in a meeting, tutorial, or other work/study-related event.
- Sitting in your work/study environment but not engaged in work or study-related tasks (e.g., socializing, eating/drinking etc).
- Not sitting

<b>Item 1</b>	What number describes your stress over the past <u>30 minutes</u> ?	Scale of 0 to 10, 0 being no stress and 10 being worst stress possible (11-point-likert scale)
<b>State Mood</b>		
<b>Item 1</b>	Over the past <u>30 minutes</u> to what extent did you feel active?	<ol style="list-style-type: none"> <li>1) Not at all</li> <li>2) A little</li> <li>3) Moderately</li> <li>4) Quite a bit</li> <li>5) Extremely</li> </ol>
<b>Item 2</b>	Over the past <u>30 minutes</u> , to what extent did you feel upset?	<ol style="list-style-type: none"> <li>1) Not at all</li> <li>2) A little</li> <li>3) Moderately</li> <li>4) Quite a bit</li> <li>5) Extremely</li> </ol>
<b>Item 3</b>	Over the past <u>30 minutes</u> , to what extent did you feel attentive?	<ol style="list-style-type: none"> <li>1) Not at all</li> <li>2) A little</li> <li>3) Moderately</li> <li>4) Quite a bit</li> <li>5) Extremely</li> </ol>
<b>Item 4</b>	Over the past <u>30 minutes</u> , to what extent did you feel afraid?	<ol style="list-style-type: none"> <li>1) Not at all</li> <li>2) A little</li> <li>3) Moderately</li> <li>4) Quite a bit</li> <li>5) Extremely</li> </ol>
<b>State Anxiety</b>		
<b>Item 1</b>	“How anxious did you feel over the past <u>30 minutes</u> ?”	Visual Analogue Scale (VAS), ranging from 0 “not anxious at all” to 10 “most anxious you could ever imagine”

### Appendix E

**Figure E1**

*Participant's 1 Mean Leisure Time and Mood Across Timepoints*



**Figure E2**

*Participant's 24 Mean Leisure Time and Mood Across Timepoints*

