

**Sitting with your Problems: Exploring the Relationship between Sedentary Behaviour and  
Creativity in University Students**

**Bachelor Thesis**

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June 28, 2022

## Abstract

**Background:** University students spend an increasing amount of time sitting. Prolonged sitting is assumed to be negatively linked to creative thinking skills, such as divergent thinking. Divergent thinking is crucial for students to solve problems effectively and to succeed in university. Therefore, this thesis aims to investigate the relationship between sedentary behaviour and divergent thinking in university students.

**Method:** A cross-sectional study was conducted to explore the relationship between sedentary behaviour (mentally active and mentally passive) and divergent thinking. This was executed by means of an online survey. The survey included multiple questionnaires but for this thesis, only the PAST-U (Past-Day Adults' Sedentary Time-University) and the AUT (Alternative Usage Task) were evaluated. 82 participants (67% women, 83% between 18-25 years old) have filled out the questionnaire. To investigate the relationship between sedentary behaviour and divergent thinking, correlational analyses and one moderation analysis, with gender as the moderator, were performed.

**Results & Conclusion:** Contrary to expectations, the analyses did not confirm any significant correlations between sedentary behaviour and divergent thinking among university students. Gender was not found to significantly moderate this relationship. Therefore, the time students spend sitting the day before does not affect their performance on the creativity test the following day.

*Keywords:* sedentary time, creativity, divergent thinking, mental well-being, university students, cross-sectional study

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## 1. Introduction

“Methinks that the moment my legs begin to move, my thoughts begin to flow, as if I had given vent to the stream at the lower end and consequently new fountains flowed into it at the upper.”

-Henry David Thoreau (1851)

We spend a large part of our lives sitting, be it watching TV, working with a laptop, driving the car or with a book in our hands. There are several reasons for this. On the one hand, ongoing technological progress has helped people become more comfortable. Necessities of daily life, such as groceries, medicines or even books can be ordered home easily and in the shortest possible time. On the other hand, socioecological changes, such as the transformation of the working landscape, has resulted in more sedentary occupations being created. In addition to technological progress, and changes in the labour market, the COVID-19 pandemic has also greatly changed people's lives and contributed to a more passive lifestyle. Offices stood empty for months and people got used to remote working. Universities have had to close their doors for the long term, and face-to-face teaching has become online teaching. This automatically resulted in university students staying at home more often and spending more time sitting (Bertrand et al., 2021; Romero-Blanco et al., 2020). Pre Covid-19, university students spent on average 8.3h per day sitting. While during Covid-19, the daily sitting time increased to 11h among university students (Bertrand et al., 2021). Given that university students have already shown themselves to be a vulnerable group in terms of prolonged sitting before the pandemic, this is even more worrisome. Studies have not only found prolonged sitting to be linked to several detrimental health consequences, that are physical such as cardiovascular diseases and type 2 diabetes (Bailey et al., 2019) and psychological in nature, such as depression, anxiety, and poorer

motivation (Hallgren et al., 2019). Moreover, it seems that prolonged sitting is associated with lower creativity (Luteijn, 2021). Creativity is not only a prerequisite for academic success, it also fosters a healthy psychological functioning (Kuncel et al., 2004; Luteijn et al., 2021). Therefore, this paper aims to explore the relationship between sedentary behaviour and creativity among university students by means of a cross-sectional study.

### **1.1. Sedentary Behaviour**

Sedentary behaviour (SB) is defined as “any waking behaviour characterized by an energy expenditure of  $\leq 1.5$  metabolic equivalents while in a sitting or reclining posture” (Tremblay et al. 2017, p. 5). One metabolic equivalent (MET) is defined as the energy expended while sitting at rest, or the standard of 3.5ml of oxygen per kilogram of body weight per minute (Tremblay et al., 2017). Sitting can take place in various contexts, which is illustrated by the Ecological Model of Sedentary Behaviour by Owen et al. (2011). The authors identified four main sedentary behaviour domains, which are: Domestic (e.g. sitting while cooking), occupation (e.g. sitting in school), leisure time (e.g. sitting in the cinema or in the football stadium), and transportation (e.g. driving a car). Furthermore, literature distinguishes between sedentary behaviour and physical inactivity, which must not be equated (Biddle et al., 2019). Physical inactivity refers to insufficient physical activity or exercise according to WHO 2020 guidelines, which in turn negatively affects one’s health (Biddle et al., 2019). In other words, a person can at the same time sit a lot (for e.g. due to their occupation) and also be physically inactive (for e.g. not engaging in sport activities).

The daily sitting time varies greatly, depending on whether people from low-income or high-income countries are surveyed. According to a recent paper of Mclaughlin et al. (2020),

adults from higher-income countries reported sitting times that were double that of adults from low-income countries (4.9 vs. 2.7h daily). This is largely linked to the occupations held in these countries, which influence daily sitting behaviour considerably. University students are an important part of the young adult population in most of the higher-income countries, as they make up over 35% (Dragoescu, 2013). The Special Eurobarometer, conducted by the European Union in 2018, found that the populations most at risk for intensive sedentary behaviour are managers, other white-collar workers, and students. The proportion that spends more than 8.5h daily sitting, is 17% among students (Special Eurobarometer, 2018). In comparison, 12% of all respondents, independent of their occupation and age, indicated that they sit more than 8.5 hours per day. However, university students seem to be a particular vulnerable group. Compared to young adults of the same age, they spend much more time sitting (Bertrand et al., 2021). Moreover, the Covid-19 pandemic led to an increase in the hours university students spent sitting. Most countries adopted movement restrictions, which meant that students could no longer go to many public places, such as gyms, cinemas, or restaurants. In addition, university facilities had to close, which required students to get used to virtual learning environments. These policies directly impacted student's sedentary behaviour as they sat three hours longer than prior to the pandemic (Bertrand et al., 2021). Romero-Blanco and colleagues (2020) also found an increase in sedentary behaviour of two hours on average, among Spanish university students during the COVID-19 pandemic.

There is growing evidence for a positive relationship between increased sedentary behaviour and negative health consequences (Owen et al., 2011). On the one hand, prolonged sitting is linked to serious physical health consequences, such as type 2 diabetes (Lee, 2014; Bailey et al., 2019; Scandiffio & Janssen, 2021), cardiovascular diseases (Bailey et al., 2019;

Hallgren et al., 2020), various types of cancer (Lynch et al., 2018; Lee, 2019; Biller et al., 2021), metabolic syndrome (Edwardson et al., 2012; Bae et al., 2018; ), and all-cause mortality (Patterson et al., 2018; Stamatakis et al., 2019). On the other hand, intensive sitting is related to mental health consequences, such as anxiety and depression (Hallgren et al., 2020; Chandrasekaran & Ganesan, 2021).

Interestingly, research indicates that not only the contexts (Owen et al., 2011) but also the type of activities in which people sit (Kikuchi et al., 2014; Hallgren et al., 2020) can affect their mental well-being. Hallgren et al. (2020) for example found mentally passive sedentary behaviours to increase the risk of depression, and mentally active sedentary behaviours to protect against the onset of it. Based on those findings, Hallgren et al. (2020) developed a framework for assessing sedentary behaviours across three living contexts: occupation, leisure, and transport, while distinguishing between passive and mentally active sedentary behaviours. Occupational behaviours are generally considered to be mentally active because most assignments at work or university require people to focus. In the leisure domain, passive sedentary behaviours include for example watching TV, movies, or YouTube or listening to music while sitting or lying. Mentally active sedentary behaviours during leisure are for example reading, playing games which require problem solving, active use of social media or sitting and talking to other people. During transport, passive sedentary behaviours consist of sitting as a passenger while commuting to/from work in a car, train or bus, but only if no mentally active tasks, such as reading on the bus, are performed at the same time. Mentally active sedentary behaviours, during transport, comprise of sitting and driving a motor vehicle, sitting and reading, using a computer or using social media.

## 1.2. Creativity

Creativity is commonly defined as generating ideas that are new (i.e. original, unexpected), and appropriate (i.e. useful, adaptive concerning task constraints; Oppezzo & Schwartz, 2014). Being creative is not limited to certain prototypical areas (such as arts or music), rather individuals can act creatively in almost all areas of life. Creativity can manifest itself, for example, in reprocessing painful emotions, trying new learning methods for an exam preparation or trying new culinary dishes in the kitchen (Forgeard, 2015). It is a quality that is present in all people to varying degrees (Acar et al., 2021). Creativity encompasses two cognitive processes, namely divergent and convergent thinking (Guilford, 1967). *Divergent thinking* is defined as a style of thinking, in which as many ideas as possible are created. This happens in a context, where more than one solution is correct (Colzato et al., 2013). A well-known example of this technique is Brainstorming. *Convergent thinking* is a style of thinking, in which only one solution to a problem is correct.

Creativity comes with many positive benefits which directly affect an individual' private as well as professional life. On the one hand, creativity is positively linked to a healthy psychological functioning (Garfield et al., 1969; King & Pope, 1999; Acar et al., 2021). There are several reasons, which let us assume a positive impact of creativity on mental health. Research recognizes the importance of affective processes and creativity (King & Pope, 1999; Forgeard, 2015). Creative individuals tend to be open towards new experiences and also towards their own inner life (King & Pope, 1999). This in turn enables them to explore their emotions and to express them in a positive way, through an enjoyable activity for example (Forgeard, 2015). Acar et al. (2021) found evidence for this and identified a significant positive relationship between creativity and well-being as a result of their meta-analysis study. Acar and colleagues



present two interpretive approaches (a) Either creative people have a higher well-being or (b) Those with higher well-being tend to be more creative. The authors argue that creative people might have better coping mechanisms for unpleasant situations, which in turn can enhance a positive mood and improve well-being. Hence, the way creative people process their emotions might help them in overcoming personal challenges. Further empirical evidence, which demonstrates positive effects of creativity on mental health, comes from Garfield et al. (1969), who conducted a study with American undergraduate college students and found a positive correlation between creativity and mental health. They attribute this to the fact that creative individuals are more self-confident, independent, and self-accepting. Khosravani and Gilani (2007) also investigated the relationship between creativity and mental health among college students. Their results are in line with previous research, as they found a significant negative relationship between creativity and different facets of mental health, namely anxiety, depression, self-esteem, and perceived stress. In other words, creative students were less anxious and less depressed. The subjects also experienced less stress and had a higher self-esteem.

On the other hand, creativity positively influences the work-and academic performance of students (Kuncel et al., 2004; Mourges et al., 2016; Luteijn et al., 2021). Creativity contributes to student's academic performance on two levels: on the subjective (creativity as part of the act of learning) and on the intersubjective (learning as a creative act) level (Gajda & Beghetto, 2017). On the interpersonal level, creativity boosts students' ability to develop new and personally meaningful ideas, insights, and understandings within the respective academic context (Gajda & Beghetto, 2017). On the intersubjective level, students can contribute to the learning of others by sharing their innovative ideas and academically valuable interpretations with their fellow students (Gajda & Beghetto, 2017). Several studies confirm the positive effect of creativity on

academic achievement and complement that creativity can also enhance students' motivation (Struther et al., 1996; Fodor & Carver, 2000; Naderi et al., 2009). Struther et al. (1996) for example conducted a study with 313 female and male psychology students who rated their last academic performance as unsatisfactory. The authors examined the relationship between those students' attributions (stable vs. unstable), action control (action focus vs. rumination focus), creativity (high vs. low), and their academic achievement and motivation. Interestingly, those students who made unstable contributions for poor academic performances and who were highly creative and action oriented, were buffered from performance deficits. In contrast, students who made unstable attributions and who were high in creativity and rumination-oriented, were not able to improve their performance. Moreover, students who made stable attributions and were low in creativity were less motivated than students who were in the same condition but with high creativity. These findings illustrate that students who possess certain traits, such as creativity, can protect themselves from the adverse effects of failed exams and inherit a higher motivation (Struther et al., 1996). In another study, Fodor & Carver (2000) examined undergraduate students in engineering and science. Here, too, the researchers found positive correlations between achievement motivation (striving to perform well) and creativity and between power motivation (striving to impress others) and creativity. To sum, creativity can contribute to a healthy state of mind as well as to greater productivity and success in academic life.

### **1.3. The Relationship between Sedentary Behaviour and Creativity**

One area, that received little research interest, is the relationship between sedentary behaviour and creativity. To this point, research has mainly focused on either examining (1) the interaction between physical activity or sedentary behaviour on cognition (e.g., Steinberg et al.,

2015; Falck et al., 2017; Chandrasekaran & Ganesan, 2021) or less frequently on examining b) the interaction between physical activity and creativity (e.g., Blanchette et al., 2005; Colzato et al., 2013; Oppezzo & Schwartz, 2014; Zhou et al., 2017).

There are several biological mechanisms which might explain the negative relationship between prolonged sitting and creativity. Research found prolonged sitting to be associated with a decline in cognitive functioning, which is a core element of creative thinking (Murali & Händel, 2021; Oppezzo & Schwartz, 2014). Prolonged sitting decreases cognitive functioning by: (1) influencing cerebral and peripheral vascular functions (Chandrasekaran & Ganesan, 2021). Poor cerebral blood flow may reduce oxygen supply to the brain and thereby disrupt neuronal metabolism, and damage cells which leads to an impairment in learning and working memory. Moreover, prolonged sitting is assumed to (2) influence respiratory functions (Chandrasekaran & Ganesan, 2021). It has been found that sitting for more than one hour leads to a slack and bent-over posture, which in turn causes fatigue in various muscle groups. This induced fatigue can reduce lung volume and capacity which decreases a continuous oxygen supply to the brain. Besides, prolonged sitting might (3) affect hormonal function (Chandrasekaran & Ganesan, 2021). Prolonged sitting is assumed to increase the stress hormone cortisol, which leads to fatigue. This fatigue is negatively linked to executive cognitive functions, such as episodic memory, inhibition and updating.

To sum, research clearly establishes a negative link between prolonged sitting and various form of cognitive functions. Biological mechanisms might explain these relationships. Yet, the relationship between sedentary behaviour and creativity, for which optimal cognitive functioning is necessary, remains unclear. In particular, given that creativity can bring many

benefits for students, such as increasing their well-being and improving academic performance, it is indispensable to further investigate the relationship between sitting behaviour and creativity.

#### **1.4. Introducing the Moderator Variable: Gender**

Both creativity and sedentary behaviour are two complex constructs, which are influenced by many factors, such as sociodemographics (Massimiliano, 2015; Jago et al.; Rouse & Biddle; 2010), personality (King & Pope, 1999), intelligence (Sternberg, 1985), and social environment (Shaw et al., 2017) amongst other things. The line of research that analyzes gender differences with regards to sedentary behaviour and creativity is particularly interesting.

Research identified significant gender differences in sedentary time. Jago et al. (2005) conducted a study with young adolescents and found boys to be less sedentary and more physically active than girls. Rouse and Biddle (2010) analyzed sedentary behaviour and physical activity in university students. They also found significant gender effects but only for particular sitting behaviours, which were sitting and talking, computer game playing, and studying. According to the authors, women spend significantly more time sitting and talking than men. Male students spend significantly more time studying than females, and males spend more time playing computer games than females.

Gender is not only associated with sedentary behaviour, but also with creativity. Furnham & Niderstrom (2010) for example identified a moderate but significant effect of gender on creativity. They found men to be more creative than women, which however they based on their sample. Their sample consisted mainly of successful businesspeople, hence the authors believed that women have to be more talented than men to get to the top in this area. Shubina & Kulakli (2019) also demonstrated a significant gender difference in creativity among students. Their

study finds Males to be more creative than females. However, there are also studies which suggest the opposite, namely females being more creative than males (Baer & Kaufman, 2008; Ülger & Morsünbül, 2016).

To sum, there is mixed evidence for both the relationship between gender and sedentary behaviour, and the relationship between gender and creativity. Nonetheless, research agrees that gender clearly correlates with both sedentary time and creativity, which is why gender is introduced as a moderator in the present study.

### **1.5. The Current Study**

To conclude, university students are both a high-risk group in terms of prolonged sitting and also in need of creativity to maintain a healthy state of mind while effectively meeting academic challenges. This raises the need to analyze the relationship between students' sedentary behaviour and creativity in more detail. Moreover, understanding the relationship better, will enable future researchers to develop effective interventions to improve students' creativity in order to contribute to their mental well-being. This study aims to fill this gap in research by means of a cross-sectional study, which is guided by the following research questions and hypotheses:

RQ: To what extent are sedentary time and divergent thinking related among university students?

H1: A higher total sedentary time is associated with lower levels of divergent thinking among university students.

H2: A higher amount of mentally active sedentary time is associated with higher levels of divergent thinking among university students.

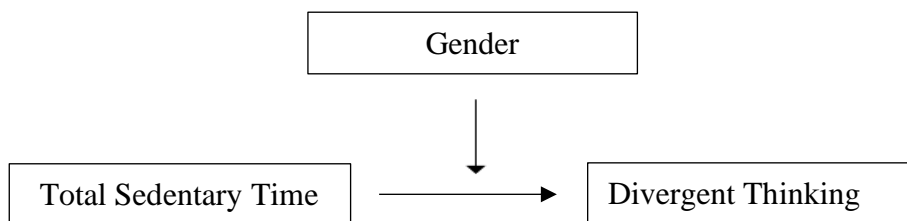
H3: A higher amount of mentally passive sedentary time is associated with lower levels of divergent thinking among university students.

RQ: To what extent does gender moderate the relationship between total sedentary time and divergent thinking among university students?

H4: Gender moderates the relationship between total sedentary time and divergent thinking (see Figure 1).

### Figure 1

*A Schematic Overview of the Moderation Effect of Gender*



## 2. Methods

### 2.1. Research Design

This paper presents the analysis of data obtained through a cross-sectional study. For this purpose, an online survey was created with the web-based software Qualtrics. The survey was distributed on the test subject pool system SONA. The online survey was part of a larger study on sedentary behaviour and included multiple questionnaires. For this thesis, only the questionnaire on sedentary behaviour and the creativity tasks are of interest. Other elements included in this survey were stress, neuroticism, extraversion, anxiety, sleep, and positive and

negative affect (see Appendix D.) Participants took an average of 30 minutes to fully complete the survey. The data collection took place in the period from 06. April 2022 until 11. May 2022. The study was granted ethical approval by the BMS Ethics Committee (request number 220299).

## **2.2. Participants**

Participants were selected by means of convenience-sampling, which means they were selected based on availability and willingness to take part in the study. Furthermore, an a-priori sample size analysis was conducted via G\*Power version 3.1.9.6 to determine the sample size needed for the moderation analysis ( $\alpha = .05$ , power = .90, effect size = .20, 3 predictors). This yielded a required sample size of 75. Recruitment was done in-person and via diverse social media platforms (WhatsApp, Facebook, Instagram, and LinkedIn or SONA). The subjects participated on a voluntary basis and received no compensation for the participation. Psychology and communication science students of the University of Twente received 0.25 SONA credits for participation. To ensure privacy, no personal data such as names or other personal identifiers have been stored. Participants were included if they were over 18 years old, university- or higher education students and proficient in English language.

## **2.3. Procedure**

At the beginning of the study, participants were informed in an introduction about the content of the study, the aim, and the approximate duration of participation. In case of any questions or comments, they were also given the contact details of the researchers. Afterwards, the participants were presented the informed consent, which they had to actively agree to, in order to access the questionnaires. The first block of questions consisted of sociodemographic characteristics. The second block of question was dedicated to sedentary behaviour. The

subsequent questionnaires were presented in a randomized sequence. This was done against the backdrop that the survey, due to the inclusion of questionnaires on many different topics, was relatively long. Randomization was intended to prevent people from answering only the first questionnaires and thus leaving the last questionnaires unanswered. Moreover, two attention checks were built into the questionnaire to filter out careless respondents. One example for this was the following question: *“To check whether you answer the questions attentively, please click yes”*.

## **2.4. Materials**

### **Sedentary Behaviour**

Sedentary Behaviour was assessed by means of a modified Past-Day Adults' Sedentary Time-University (PAST-U) questionnaire. This self-report questionnaire is based on the original PAST questionnaire but has been adapted to university students (Clark et al., 2016). The questionnaire asks about sedentary time spend the day before in the following specific contexts: studying, working, transportation, television viewing, computer/electronic device use, reading, eating, socializing, and other purposes. Clark et al. (2016) have demonstrated that the PAST-U has acceptable levels of validity (.64) when compared to sedentary time measured with the accelerometer activePAL. Total sedentary time was computed by adding up all the measurements of the PAST-U items.

Since the original PAST-U does not distinguish between mentally active and passive sedentary time, and two of the hypotheses are based on this distinction, it was necessary to adapt the questionnaire slightly. This was done based on the classification of sedentary behaviours by Hallgren et al., (2020). For instance, question four on sedentary time during transportation had to



be adjusted. The initial question was as follows: *“Thinking again of yesterday, please estimate the total time that you spent sitting, travelling from one place to another. Please include sitting and waiting for transport. Do not include any time you were standing up while travelling or waiting”*. Sedentary time was considered to be mentally passive, when the participant was only a passenger, and as mentally active, when the participant was driving the motor vehicle. Hence, the adjusted question(s) were as follows: *“Thinking again of yesterday, please estimate the total time that you spent sitting, travelling from one place to another only as a passenger/while you were the driver. Please include sitting and waiting for transport. Do not include any time you were standing up while travelling or waiting”*. For a comprehensive version of the categorized PAST-U items, see Table 1 below. In total, the adjusted PAST-U consisted of 12 questions. For a comprehensive overview, including all changes, see Appendix B. Mentally active sedentary time was computed by adding up eight measurements, and mentally passive sedentary time by adding up four.

**Table 1**

*Revised PAST-U Items Categorized into Mentally Active and Mentally Passive Sedentary Time*

Mentally active	Mentally passive
Sitting for study	Sitting for eating
Sitting for work	Sitting for television/streaming/YouTube watching
Sitting for transport as a driver	Sitting for transport as a passenger
Sitting and engaging with other people directly via social media	Sitting and scrolling through social media
Sitting for reading on a smartphone	
Sitting for reading a paper-based book	
Sitting and socializing with friends	
Sitting for playing computer or video games	

### **Divergent Thinking**

**Divergent Thinking** was measured through Guilford's Alternative Usage Task (AUT), which is a standard test for measuring divergent thinking. The test was initially developed by J.P. Guilford in 1960 and is still a widely used tool among researchers to measure divergent thinking. In the AUT, participants are presented common objects for which they are asked to come up with as many non-obvious uses as possible, within a given time frame. Successful performance on this test depends on the cognitive flexibility of the participant, meaning the ability to think outside existing categories (Opezzo & Schwartz, 2014). The AUT has proven to be reasonably valid and reliable (Runco & Acar, 2012; Opezzo & Schwartz, 2014). So far, there is no agreement

among scholars on how many stimuli should be presented to participants, in order to obtain reliable results (Silvia et al., 2008). Research varies greatly in this regard. Some studies present only one stimulus (Silvia & Phillips, 2004), while others present three (Opezzo & Schwartz, 2014), or even fourteen stimuli (Murali & Händel, 2022) to the participants. In this study, the participants were given two stimuli, “brick”, and “paperclip”, for which they had to find as many alternative uses as possible, within three minutes. Moreover, it was intended to choose two stimuli from different domains, which were neither visually similar nor similar in their original function. In this case the stimuli were related to the construction and workplace environment. This was done to ensure that diverse responses from the participants could be elicited. Examples for alternative uses for “brick” are: using it as a diving aid, using it as a weapon or using it as a holder for fireworks. Further examples for the stimuli “paperclip” are: creating earrings out of it, or to pick a lock, just to name a few.

The participant’s responses on the AUT were scored along three sub-categories (Colzato et al., 2013 or Dippo & Krudowitz, 2013), which are: (1) Fluency, (2) Originality, and (3) Flexibility. Fluency refers to the total number of given responses per participant. To obtain this score, all of a participant's responses are added together. In this study, only adequate responses were included (Reiter-Palmon et al., 2019). Responses were considered inadequate if they were (1) repetitive (a repetition of a previously given use), (2) implausible (given the objects characteristics, e.g., using a brick as jewelry), or (3) a non-use (e.g. throwing the brick into the sea) (Murali & Händel, 2022). Originality considers how unusual the ideas are, which is mirrored by the relative frequency of each idea. For this, responses were first scored on a 5-point Likert scale, ranging from 1 - “very obvious”, 2 - “somewhat obvious,” 3 - “expected,” 4 - “somewhat expected,” and to 5 - “unexpected”. Afterwards, the originality score was divided by

the fluency score, to achieve an average originality score (Dippo & Krudowitz, 2013). Flexibility refers to the numbers of different categories used. To achieve this score, responses were first generalized into a single keyword that would encompass similar answers. This was done because participants often described the same use for a stimuli, but used different words to do so. Hence, responses for the stimuli *paperclip* such as “opening a lock of a door”, “key” and “pick a lock” were summarized under the generic key word “lock”. The same procedure was applied to the second stimulus *brick*. Responses for the stimuli such as “throw at someone” and “self-defense” were summarized under the key word *weapon*. Second, the key terms were further simplified into generalized functions that contain many key terms. For the first stimuli *paperclip*, keywords such as “lock” and “smartphone” were summarized under the function of “puncturing through something”. After the three sub-scores for fluency, flexibility, and originality were calculated, the results were combined into a final score for each participant. This was done by adding up all three subcomponents. To obtain a total score for divergent thinking, the average scores for the two items “paperclip” and “brick” were calculated and then added together.

### **Sociodemographic Variables**

Sociodemographic characteristics collected from respondents were gender (female, male, non-binary), age, and nationality. Moreover, participants were asked to fill in their current study program.

### **2.5. Data Analysis**

The statistical analyses were performed using IBM SPSS (version 28). First, the dataset was cleaned and prepared for subsequent analyses. This included excluding participants, who prematurely discontinued either the PAST-U or the AUT, from the dataset. All the main

variables were tested for normality. This was assessed by visually inspecting the Q-Q plots (see Figures A-C in Appendix E), and also by statistical testing, using the Shapiro-Wilk-Test. According to the Shapiro-Wilk-Test, all variables were normally distributed, except for total sedentary time, which was:  $D(82) = 0.96, p = .019$ . After checking the Q-Q plot for total sedentary time, it became apparent that five outliers caused the p-value to be only slightly too small. Therefore, this variable was also treated as normally distributed. The main variables were further tested for linearity, as this is a requirement for Pearson correlations. This was visually assessed via scatterplots (see Figures D-F in Appendix F). The scatterplots indicated no violations of this condition. However, the relationships between the variables seem to be rather weak. Descriptive analyses were carried out to obtain frequencies, means, and standard deviations of the sociodemographic variables, sedentary time, and divergent thinking. To test the first three hypotheses, Pearson correlation analyses between sedentary time variables and divergent thinking were performed. In order to test the fourth hypothesis, a moderation analysis was conducted using the PROCESS 4.1 macro for SPSS (Hayes, REF). This was done by calculating a linear regression with divergent thinking as the outcome variable (DV), total sedentary time as the predictor variable (IV), and gender as the moderator variable. Further, bootstrapping was applied, with a number of 5000 bootstrap samples. Significances were tested by means of 95% confidence intervals.

### **3. Results**

#### **3.1. Descriptives**

This cross-sectional study started with 127 participants, of which 45 had to be excluded. Among them were 17 participants who indicated unrealistic sitting times that were above 20hours, and 28 who did not fill in the AUT. Afterwards, the dataset included 82 participants, of

which 55 (67.1%) were women. The sample size analysis yielded a required sample size of 75, with 82 participants this requirement was met. Most participants (82.9%,  $n = 68$ ) were aged between 18-25 years. Out of the 82 participants, 60 (73.2%) were German, and 40 (48.7%) studied psychology (see Table 2).

**Table 2**

*Sociodemographic Characteristics of Participants at Baseline and Study Program (N = 82)*

Baseline characteristics		
	n	%
<b>Gender</b>		
Female	55	67.1
Male	27	32.9
<b>Age</b>		
18-25	68	82.9
26-30	14	17.1
<b>Nationality</b>		
German	60	73.2
Dutch	11	13.4
Other	11	13.4
<b>Study Program</b>		
Psychology	40	48.8
Communication Science	8	9.7
Engineering	5	6.1
Other	29	35.4

*Note.* Other study programs stated were Linguistics, Archeology, Architecture, Computer Science, Business Administration, Political Science, Educational Science, Technology, Cultural Science, Economics, Law, Management Studies, Social Science, Sustainable Energy Technologies.

## Sedentary Time

Table 3 below illustrates the sedentary behaviour of the sample. University students sat on average 12.7 hours the previous day ( $SD = 3.3$ ). Of these, they spent on average 7.8 hours mentally active ( $SD = 3.1$ ), and 4.9 hours mentally passive ( $SD = 2.0$ ). The activities that participants engaged in for the longest average time included, studying ( $M = 3.0$ ), watching TV ( $M = 2.0$ ), and socializing ( $M = 1.3$ ).

**Table 3**

*Sedentary Time in Minutes (and Hours) and Divergent Thinking.*

Variable	<i>M</i>	<i>SD</i>	Min	Max
<b>Sedentary Time</b>				
Mentally Passive	293.3 (4.9h)	122.0 (2.0h)	55 (0.9h)	570 (9.5h)
Mentally Active	465.6 (7.8h)	187.1 (3.1h)	160 (2.7h)	945 (15.7h)
Total	767.8 (12.7h)	199.3 (3.3h)	425 (7.1h)	1194 (19.9h)
<b>Divergent Thinking</b>				
Fluency	4.3	2.2	0	10
Originality	2.3	0.9	0	4.2
Flexibility	3.9	2.0	0	9.5
Total	10.3	4.6	0	22.7

## Divergent Thinking

The mean fluency score for divergent thinking was 4.3 ( $SD = 2.2$ ), meaning that on average participants would list 4 alternative uses for paperclip and brick. The mean originality score was 2.3 ( $SD = 0.9$ ). The mean flexibility score was 3.9 ( $SD = 2.0$ ). Flexibility refers to the number of different categories that the participants used. Hence, the lower this score, the poorer the participant's ability to think flexibly.

### 3.2. Evaluating the Hypotheses

#### **H1 A higher total sitting time is associated with lower levels of divergent thinking among university students**

To test the first hypothesis, a Pearson correlation analysis was run with the variables total sedentary time and total divergent thinking score. The result was not significant  $r(80) = .03, p = .769$ . Hence, this hypothesis is rejected.

#### **H2 Mentally active sedentary time is associated with higher levels of divergent thinking among university students**

To test the second hypothesis, a Pearson correlation analysis was run with the variables mentally active sedentary time and total divergent thinking score. The result was not significant  $r(80) = .13, p = .234$ . Therefore, this hypothesis is rejected.

#### **H3 Mentally passive sedentary time is associated with lower levels of divergent thinking among university students**

To test the third hypothesis, a Pearson correlation analysis with the variables mentally passive sedentary time and total divergent thinking score was performed. The result was not significant  $r(80) = -.16, p = .151$ . Accordingly, this hypothesis is rejected.



**Table 4**  
*Pearson Correlations between Sedentary Time and Divergent Thinking*

Variable	Divergent Thinking
	Total
Sedentary Time	
1. Mentally Passive	-.16
2. Mentally Active	.13
3. Total	.03

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . \*\*\* $p < .001$ .

#### **H4 Gender moderates the relationship between total sedentary time and divergent thinking**

To test the fourth hypothesis, a moderation analyses was carried out. The overall model was not significant,  $F(3, 78) = .035, p = .991, R^2 = .001$ . Further, the results show that gender did not significantly moderate the effect between total sedentary time and divergent thinking,  $F(1, 78) = .001, p = .903, 95\% \text{ CI } [-0.020, 0.022]$ . Hence, this hypothesis is rejected.

**Table 5**  
*Moderation Analysis: Total Sedentary Time and Gender for Divergent Thinking*

Variable	Estimate	SE	t	p	95% CI	
					LL	UL
Intercept	21.047	14.795	1.423	.159	-8.408	50.502
Total ST	-.0007	.018	-.041	.968	-.037	.035
Gender	-.868	8.333	-.104	.917	-17.458	15.722
Total ST*	.001	.010	.902	.903	-.020	.022
Gender						

*Note.* Abbreviations: ST = sedentary time, Estimate = coefficient, SE = standard error, t = t-statistic, p = p-value, CI = confidence interval; LL = lower limit, UL = upper limit.

#### 4. Discussion

This study aimed at exploring the relationship between sedentary behaviour (mentally active/passive, and total) and divergent thinking (expressed among the dimensions of fluency, originality, and flexibility) in university students. Overall, the results do not provide any evidence for a relationship between sedentary behaviour and divergent thinking. Gender does not seem to have a moderating effect on this relationship.

In comparison to previous studies, this sample was more sedentary. Students sat on average 12.7h ( $SD = 3.3$ ) the previous day. Bertrand et al. (2021) found university students to sit on average 8.3h prior to the COVID-19 pandemic, and 11h during the pandemic. Romero-Blanco et al. (2020) reported daily sedentary times of students that were on average 6.88h prior to the COVID-19 pandemic, and 8.89h during the pandemic. The students in this sample spend most of their time while sitting studying ( $M = 3.0h$ ), watching TV/DVDs/Videos-on-Demand ( $M = 2.0h$ ), and socializing ( $M = 1.3h$ ). The high values for sitting and studying might be attributed to the fact that the survey was conducted in the middle of the semester and many students were preparing for exams or writing their theses. Overall, these results are in line with the findings by Rouse & Biddle (2010) who identified the same predominant activities among students. They found studying to be the most common activity ( $M = 4.6h$ ), then watching TV ( $M = 1.3h$ ), followed by sitting and talking ( $M = 1.2h$ ). The total sitting time, among students in this sample, was slightly higher for men 13.3h ( $SD = 3.2$ ) than for women 12.5h ( $SD = 3.4$ ) for women. Romero Blanco et al. (2020) also identified higher sedentary times among men 9.1h ( $SD = 3.2$ ), than for women 8.7h (3.1).

In comparison to previous studies, this sample was less creative. The mean scores of this sample were as follows: fluency was 4.2 ( $SD = 2.2$ ), originality was 2.3 ( $SD = 0.9$ ), and

flexibility was 3.9 ( $SD = 2.0$ ). Oppezzo & Schwartz (2021) conducted a within-subject research design with undergraduate psychology students ( $N = 48$ ). Participants received three words and had four minutes to generate as many alternative uses as possible. The mean fluency score was 6 for the sitting condition. In other words, participants in their study generated two more words on average, than participants in the present study. Oppezzo & Schwartz also assessed originality and flexibility, but evaluated the scores differently. Hence these measurements cannot be compared with the ones of this study. Murali & Händel (2021) also conducted a within-subject research design with undergraduate psychology students ( $N = 20$ ). Participants received 7 words and had three minutes to come up with alternative uses for each word. In the sitting condition, the mean fluency score was 12.7 ( $SD = 5.3$ ), and the mean flexibility score was 6.5 ( $SD = 2.1$ ). To sum, all the studies cited above found mean scores for fluency and flexibility, that were considerably higher than the ones found in this study. However, a comparison of experiments with cross-sectional studies, as the present study is, should be treated with considerable caution.

Surprisingly, no evidence was found for the first hypothesis, which assumed that a higher total daily sitting time is associated with lower levels of divergent thinking among university students. This result is in contrast to previous research, who found college students to exhibit better divergent thinking when standing up, than when either lying or sitting (Oppezzo & Schwartz, 2014; Zhou et al., 2017). However, in the present study only sedentary behaviour and no physical activity was asked from the participants. Prolonged sitting and physical activity, such as exercising, can occur in parallel (Biddle et al., 2019). Several studies have shown that physical activity and exercise positively impact divergent thinking (Colzato et al., 2013; Luteijn et al., 2021). In other words, it could be that students in this sample sit a lot, but are at the same time strongly physically active. Therefore, their physical activity could counterbalance potential

negative effects of prolonged sitting on divergent thinking. Hence, the non-significant results in this study might be explained by the fact that physical activity of the participants was not queried and might have served as a buffer. Moreover, it should be stated again that research conducted on the subject so far has been exclusively experimental. This also means that participants were deliberately assigned into conditions in which they either sat, stood, or moved before, or while, taking the creativity test. In other words, the experiments aimed at comparing an in-the-moment change in behaviour with an in-the-moment change in divergent thinking. The present study aimed at comparing sedentary behaviour one day prior with an in-the-moment-change in divergent thinking. The time difference might explain why the present study found no significant effects of sitting on divergent thinking, but the experiments did. Furthermore, in the present study, it is unknown in which bodily state the participants did the creativity task. Participants could have been lying in bed, sitting at their desk or standing while filling in the survey. The body position is proven to influence arousal which in turn impacts cognition and performance on creativity tasks (Colzato et al., 2013). Therefore, unawareness of this fact should be taken into account when considering the results.

Interestingly, the second hypothesis which stated that mentally active sedentary time is associated with higher levels of divergent thinking among university students, could not be accepted. Likewise, the third hypothesis which assumed that mentally passive sedentary time is associated with lower levels of divergent thinking among university students, had to be rejected as well. To date, no research has been conducted on mentally active and passive sedentary behaviour and divergent thinking. However, previous studies found that sitting while watching TV, which is considered to be mentally passive, is linked to poorer cognition (Falck et al., 2017; Hamer & Stamatakis, 2014). In the same study, sitting while using the internet or reading, two

mentally active behaviours, were found to be linked to better cognitive function. An explanation for the fact that no significant proof for the two hypotheses was found, might be that divergent thinking is not only influenced by the type of sedentary behaviour, but also by several other variables. Both the personality structure and the level of intelligence have an impact on divergent thinking (Gajda et al., 2017). Thus, individuals who are high on personality traits related to confidence traits, independence traits, and openness, tend to be more creative (Batey & Furnham, 2006). Neither personality traits, nor intelligence have been assessed in the present study. It should also be noted that divergent thinking is only one facet of creativity. Creativity is a complex construct, which also encompasses convergent thinking. Convergent thinking is usually assessed using the RAT (Random Association Task). However, it would have been beyond the scope of this paper to examine this cognitive process as well.

Surprisingly, no evidence was found for the fourth hypothesis, which stated that gender moderates the relationship between total sedentary time and divergent thinking. One reason for this could be that the majority of the sample consisted of women (55 women, and only 27 men). Possibly there were not enough men in the sample to prove such an effect. However, this result is not completely detached from existing literature. Previous research suggests an association between gender and specific types of sedentary behaviours, but is not in agreement about this. Rouse & Biddle (2010) for e.g., found that gender moderates only particular sedentary behaviours (Rouse & Biddle, 2010). Since there were hardly any men in this sample, such an effect might not have become visible.

#### 4.1. Strengths and Limitations

The main strength of this study is its unique character. It is the first study to investigate the relationship between sedentary behaviour and creativity in university students in a cross-sectional study. This study is novel in two aspects: first, it makes use of the new conceptualisation of sedentary time (mentally passive and active sedentary time) and secondly, it bridges to the important skill of divergent thinking. Nevertheless, this study also has several limitations, which need to be addressed. The first limitation concerns the characteristics of the sample. Both the quality and the quantity of the sample were not ideal. Of the 82 participants in the study, only 27 were male. This is particularly inconvenient since one of the hypotheses aimed to explore the moderating effect of gender. The fact that mainly women participated in the study can be explained by the predominance of women in social sciences such as psychology and communication science. This condition is merely reflected by this sample. However, a sample which is imbalanced in terms of gender, may affect the results and the representativeness for the student population as a whole.

The second limitation relates to the sample size. The eventual sample size was relatively small, with 82 participants. It did meet the required sample size of at least 75 participants. However, many participants had to be excluded while preparing the dataset. Of the 127 participants who initially took part in the survey, 45 had to be excluded. Among them were 17 participants who reported sitting times that were above 20hours. This indicates that some participants did not fully understand the PAST-U. Additionally, 28 participants had to be removed because they did not fill in the AUT. Since the survey consisted of multiple questionnaires from a total of five undergraduate students, it may well be that the participants were unwilling to spend so much time on it. This suggests that the length of the survey could

have had a negative impact on their motivation to continue until the end. Against the backdrop of this limitation, a randomization of the questionnaires was therefore introduced. However, if the AUT always appeared rather at the end of the survey, it might be that many participants got lost because of this.

The third limitation considers the evaluation of the AUT, which is very subjective and thus difficult to replicate by other researchers. For instance, the item *brick* is an object used in its original application to build houses or walls. Several participants gave answers such as “build a building”, or “build a wall”. Those answers were not considered an alternative use in this study, which is why they were omitted from further data analyses. However, it is ultimately up to the researcher to decide when an answer is valid, as there are no fixed evaluation criteria. On another note, the AUT does not take into account the feasibility of the participant’s ideas (Kudrowitz & Dippo, 2013). Meaning, if a participants gave the answer “use paperclip as a compass”, the feasibility of this idea was not investigated. However, as described in the data analysis section, responses that were either repetitive or implausible, were excluded from further analysis.

#### **4.2. Future Research**

Future studies should address the limitations of this study and analyze the relationship between sedentary behaviour and divergent thinking in greater depth. This study is a cross-sectional study, meaning that no statements about causal relationships can be made. Therefore, it is recommended for future research to choose a different study design. An experiment would be conceivable, yet this would change the complete set-up of the study. Researchers could conduct an experiment with male and female students. For example, students could first spend 20 minutes sitting or standing and then complete a creativity test. Another possibility would be for students

to complete the creativity test while sitting or standing. Such a study set up would allow the researchers to make causal inferences. Moreover, such an experiment would eliminate the problem of participants giving false information about their sitting duration. In addition, it would be possible for participants to ask the experimenter questions if they do not understand the creativity test for instance. In the course of this, pre-tests can also be conducted.

Further improvement of the study could be achieved by counteracting the subjective evaluation of the AUT. It would be conceivable to assign the evaluation to two independent raters. This is commonly done for studies which apply the AUT (see Colzato al., 2013; Oppezzo & Schwartz, 2021). Interrater reliability can ensure that coding the items is consistent. A more holistic improvement could be attained by including other creativity tests. By using the RAT for instance, convergent thinking would be measured as well. The combination of the AUT and the RAT would help the researchers to obtain a more comprehensive view of the creativity level of the participants.

Sedentary behaviour could also be assessed differently. As already mentioned above, not all participants understood the items from the PAST-U. To avoid misreporting by participants, a more objective method of measuring sedentary behaviour may be used in future studies. One alternative approach would be to use accelerometers, such as the activPAL or ActiGraph, which measure the frequency and amplitude of the body part they are attached to (Atkin et al., 2012).

As no moderating effect of gender was observed in this study, it is advisable to additionally examine other variables as a potential moderator. Literature suggests that creativity is influenced by several factors, one of them being physical exercising (Colzato et al., 2013). In a future experiment, one more condition could be added, in which participants work out for 15 minutes prior to doing the creativity task.



### **4.3. Conclusion**

This study did not find significant evidence for a relationship between sedentary behaviours and divergent thinking in university students. Gender was also not found to be a moderating factor in this relationship. In other words, the time students spent sitting the day before, does not have an effect on their level of divergent thinking. This is rather good news, against the background that students are sitting longer and longer. Nevertheless, the descriptive analyses also indicate that this sample was less creative and more sedentary than other samples with comparable socio-demographic characteristics. Hence, more research needs to be undertaken, to further examine the relationship between sedentary behaviours and creativity among students. Only if creativity, and its underlying mechanisms, is better understood, interventions can be developed to boost it. Only by doing this, we can make sure that “our thoughts begin to flow”.

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## Appendix A

### Opening Statement and Informed Consent Prior To Participation in Survey

#### Opening Statement

Thank you very much for your interest in participating in this study on sitting behaviour. Please read the following information carefully.

We, a group of 3rd-year-psychology students, created this study as part of our Bachelor theses under the supervision of Gerko Schaap. We are interested in investigating the relationship between sitting behaviour and mental health concepts, such as anxiety, mood, and stress among university students. Sitting behaviour also includes activities in a reclining position or lying down. Examples of sitting behaviours are watching television, reading, driving, or studying while sitting.

The study will take approximately 30 minutes. You are asked to answer several questionnaires which will help us to analyse the relationship between sedentary behaviour and concepts of mental health. As a potential risk and/ or benefit, it may be that you become aware of, for instance, your stress, positive or negative mood, and how much you sit.

By taking part in this study, no personally identifiable information will be gathered, and your privacy will be ensured at any times. The results that we gather will be stored safely and are only available to the researchers and the supervisor. After we completed our theses, the data will be deleted. Your answers to the questionnaire stay completely anonymous. Participation is fully voluntary in this study. In case you participate, you can withdraw at any time without a reason or negative consequences. In case you have any questions or concerns about this study, feel free to contact the researchers.

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**Informed Consent**

Through ticking the following box, you give consent to this study, you confirm that you are at least 18 years old, enrolled at a research university or university of applied science and have sufficient use of English to answer the questionnaires. Additionally, by giving consent you indicate that you understood everything, and voluntarily agree to take part in this study.

- Yes, I do consent.
- No, I do not consent.

## **Appendix B**

### **Demographics and Adjusted PAST-U**

#### **Demographics**

What is your gender?

- Male
- Female
- Non-binary

Please indicate your age below:

- 18-25 years
- 26-30 years
- 31-40 years
- 41-50 years
- 51 years or older

What is your nationality?

- Dutch
- German
- Other

What is the name of your study program?

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#### **Adjusted Past-U**

We are going to ask you about particular activities you did yesterday while sitting down or lying down. Please note that this does not include sleeping, either in bed or if you fell asleep while doing another activity, for example watching television.

We are going to ask you about different times when you may be sitting or lying down: when studying, working, travelling, watching TV, using the computer, and doing other activities. For

each of these, only count the time this was your main activity! For example, if you watched TV and ate dinner at the same time, this might be TV or meal time, but not both.

Your answers can be given in hours and minutes. Try to report only the time you spent sitting or lying down and do not take into account the time you spent getting up for breaks (e.g. coffee, bathroom).

Please indicate the time as precisely as possible.

### **Sitting for Study**

Q1. How long were you sitting while studying yesterday? (include the time at university, during lectures, tutorials, meetings, group discussions, self-study, study from home, etc.)

Hours:

Minutes:

### **Sitting for Work**

Q2. How long were you sitting at your workplace or working from home in a paid position yesterday? (Examples: babysitting, sitting at the reception, minding a stall/shop, data entry/administrative paper work, tutoring, etc.)

Hours:

Minutes:

### **Sitting for Transport**

Q3. Thinking again of yesterday, please estimate the total time that you spent sitting to travel from one place to another **only as a passenger**. Please include sitting and waiting for transport. Do not include any time you were standing up while travelling or waiting.

Hours:

Minutes:

Q4. Thinking again of yesterday, please estimate the total time that you spent sitting to travel from one place to another **while you were the driver**? This does not include physically active driving, such as bicycling.

Hours:

Minutes:

### **Television/Streaming/YouTube Viewing**

Q5. Please estimate the total time you spent sitting or lying down to watch TV, DVDs or watch videos-on-demand, YouTube etc. on your computer/tablet/phone or other electronic devices yesterday? This includes if you watch TV in bed.

Hours:

Minutes:

### **Playing Computer or Video Games**

Q5. Please estimate the total time yesterday that you spent sitting or lying down and playing computer or video games using the computer or any other electronic devices (e.g. Xbox, Playstation, etc.).

Hours:

Minutes:

### **Social Media**

Q6. Please estimate the total time yesterday that you spent sitting or lying down and scrolling through social media (e.g. Instagram, Facebook, Twitter, TikTok, etc.).

Hours:

Minutes:

Q7. Please estimate the total time yesterday that you spent sitting or lying down while engaging with other people directly via screens (e.g. by using WhatsApp, Facebook messenger, or other messenger apps).

Hours:

Minutes:

**Sitting for reading**

Q8. Please estimate the total time yesterday that you spent sitting or lying down while reading **during your leisure time on a smartphone**, tablet or any other electronic device (e.g. reading on a kindle). Include screen-based reading in bed but do not include time spent reading for paid work or for study.

Hours:

Minutes:

Q10. Please estimate the total time yesterday that you spent sitting or lying down while **reading paper-based books during your leisure time**. Include reading in bed but do not include time spent reading for paid work or for study.

Hours:

Minutes:

**Sitting for eating**

Q11. Please estimate the total time yesterday that you spent sitting down for eating and drinking, including meals and snack breaks.

Hours:

Minutes:

Q12. Please estimate the total time yesterday that you spent sitting down to socialize with friends or family, regardless of location (at university, at home or in a public place).

Hours:

Minutes:

**Sitting/lying for other purposes**

Q13. We are interested in any other sitting or lying down that you may have done that you have not already told us. For example, this could include; hobbies such as doing art and craft, playing board games or for religious purposes. Again thinking of yesterday, please estimate the total time that you spent sitting or lying down NOT including the time that you have told us about in the previous answers.

Hours:

Minutes:



## **Appendix C**

### **Creativity Tasks**

#### **Guilford's Alternative Uses Task**

You have two minutes to come up with as many alternative uses for an object as possible. For example, for the object "coffee cup" you could list:

- use it as a template to draw a perfect circle
- use it upside down as a spider trap

Q1. List as many possible alternative uses as you can think of for the object "paperclip"

(Büroklammer)

Q2. List as many possible alternative uses as you can think of for the object "brick" (Ziegelstein)

## **Appendix D**

### **Other Questionnaires**

#### **Perceived Stress Scale**

The following 10 questions ask about your feelings and thoughts during the last month. Please indicate how often you felt or thought a certain way. Don't try to count up the number of times you felt a particular way; rather indicate the alternative that seems like a reasonable estimate.

0 - Never; 1 - Almost never; 2 - Sometimes; 3 - Fairly often; 4 - Very often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and stressed?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that happened that were outside of your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

### **Neuroticism**

Here are a number of characteristics that may or may not apply to you. Please select for each statement to which extent you agree or disagree with it.

1 - Disagree strongly; 2 - Disagree a little; 3 - Neither agree nor disagree; 4 - Agree a little; 5 - Agree strongly

1. I see myself as someone who...
2. Is depressed, blue
3. Is relaxed, handles stress well
4. Can be tense
5. Worries a lot
6. Is emotionally stable, not easily upset
7. Can be moody
8. Remains calm in tense situations
9. Gets nervous easily

### **Extraversion**

How well do the following questions describe your personality?

1 – Not at all; 2 – Slightly; 3 – Moderately; 4 – Very much; 5 – Extremely

1. Are you a talkative person?
2. Are you rather lively?
3. Do you enjoy meeting new people?
4. Can you usually let yourself go and enjoy yourself at a lively party?
5. Do you usually take the initiative in making new friends?
6. Can you easily get some life into a rather dull party?
7. Do you tend to keep in the background on social occasions?
8. Do you like mixing with people?
9. Do you like plenty of bustle and excitement around you?

10. Are you mostly quiet when you are with other people?

11. Do other people think of you as being very lively?

12. Can you get a party going?

### **Leibowitz Social Anxiety Scale**

Please read the items carefully. First try to indicate how much fear or anxiety you experience when you imagine that particular situation. Afterwards, please also indicate to what extent you try to actively avoid that particular situation.

0 – None; 1 – Mild; 2 – Moderate; 3 – Severe (Anxiety)

0 – Never; 1 – Occasionally; 2 – Often; 3 – Usually (Avoidance)

Anxiety

Avoidance

1. Telephoning in public
2. Participating in small groups
3. Eating in public places
4. Drinking with others in public places
5. Talking to people in authority
6. Acting, performing or giving a talk in front of an audience
7. Going to a party
8. Working while being observed

9. Writing while being observed
10. Calling someone you don't know very well
11. Talking with people you don't know very well
12. Meeting strangers
13. Urinating in a public bathroom
14. Entering a room when others are already seated
15. Being the centre of attention
16. Speaking up at a meeting
17. Taking a test
18. Expressing a disagreement or disapproval to people you don't know very well
19. Looking at people you don't know very well in the eyes
20. Giving a report to a group
21. Trying to pick someone up

22. Returning goods to a store

23. Giving a party

24. Resisting a high pressure  
salesperson

### PANAS

This scale consists of a number of words that describe feelings and emotions. Read each item and then select the answer that best matches your experience in the space next to that word. **Please indicate to what extent you have felt this way the past few weeks.** Use the following scale to record your answers.

1 – Very slightly or not at all; 2 – A little; 3 – Moderately; 4 – Quite a bit; 5 – Extremely

1. Interested
2. Distressed
3. Excited
4. Upset
5. Strong
6. Guilty
7. Scared
8. Hostile
9. Enthusiastic
10. Proud
11. Irritable
12. Alert
13. Ashamed
14. Inspired
15. Nervous

16. Determined
17. Attentive
18. Jittery
19. Active
20. Afraid

### **B-PSQI**

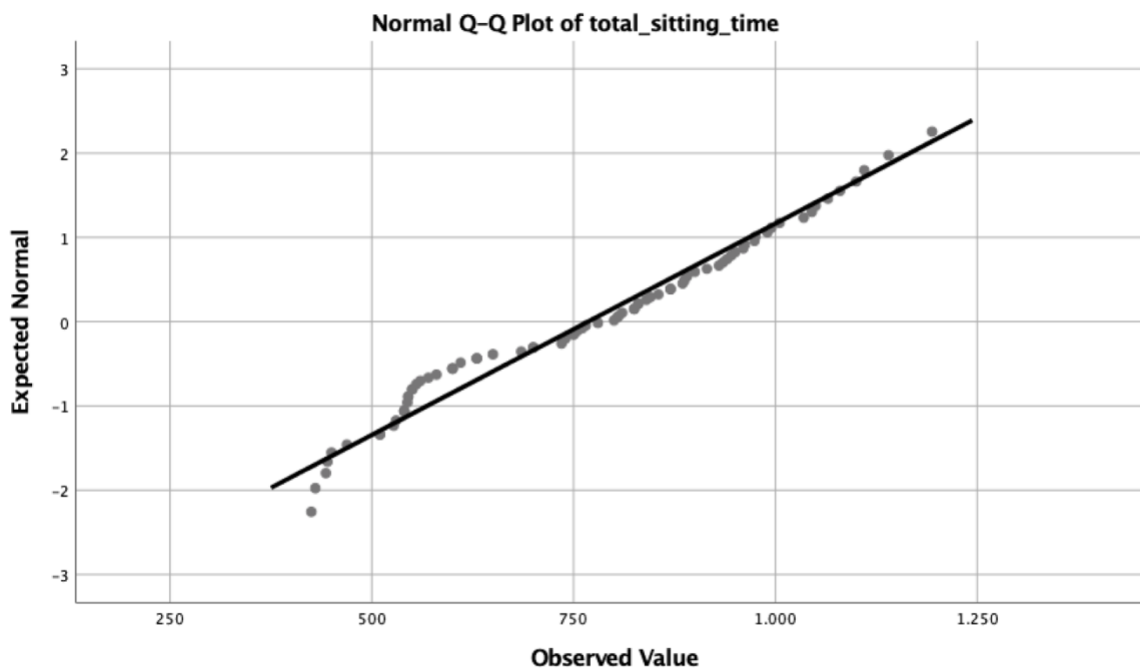
The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?
2. During the past month, when you have usually gotten up in the morning?
3. During the past month, how long (**in minutes**) has it usually taken you to fall asleep each night?
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)
5. During the past month, have you had trouble sleeping because you wake up in the middle of the night or early morning?
  - Less than once a week
  - Once or twice a week
  - Three or more times a week
6. During the past month, how would you rate your sleep quality overall?
  - Fairly good
  - Fairly bad
  - Very bad

**Appendix E**  
**Normal Distribution of the Main Variables**

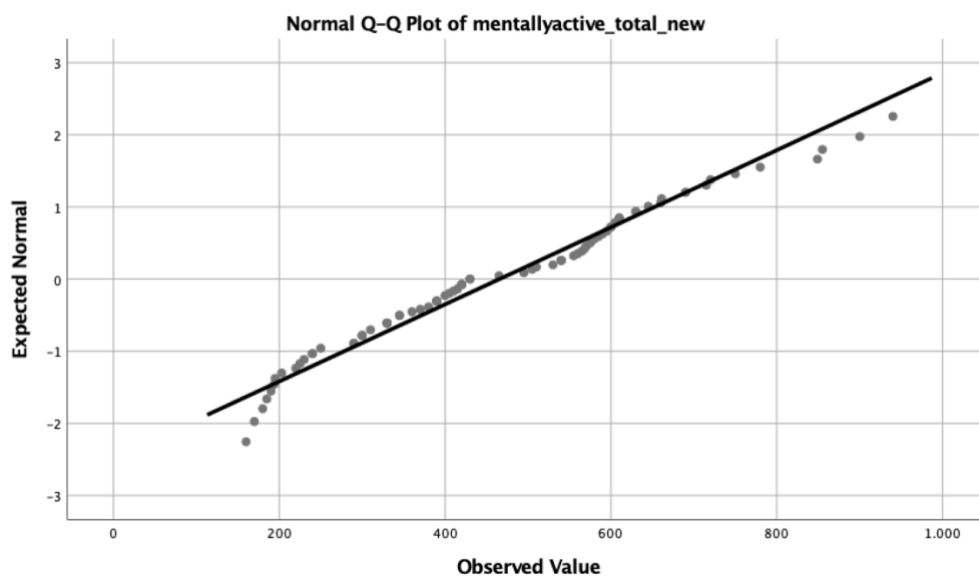
**Figure A**

*Q-Q Plot of Distribution of Total Sitting Time in Minutes*



**Figure B**

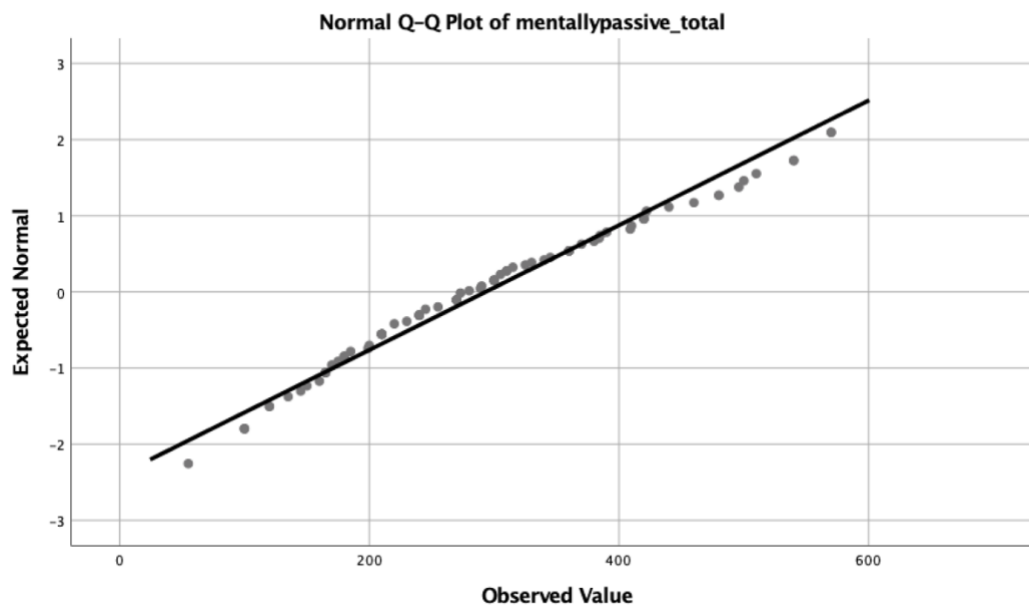
*Q-Q Plot of Distribution of Mentally Active Sitting Time in Minutes*





**Figure C**

*Q-Q Plot of Distribution of Mentally Passive Sitting Time in Minutes*

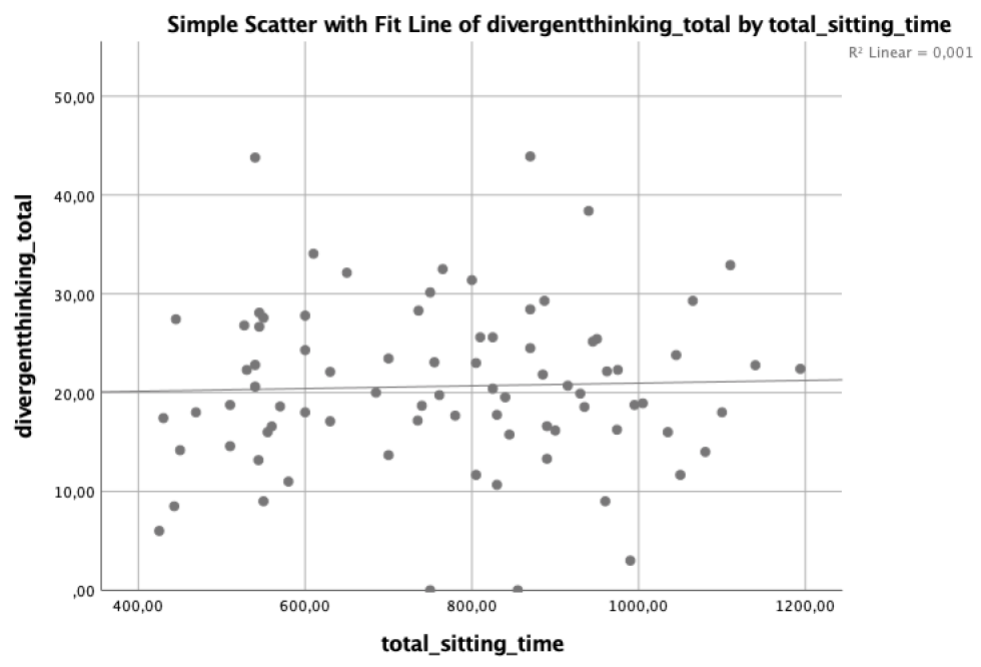


### Appendix F

#### Linearity of the Main Variables

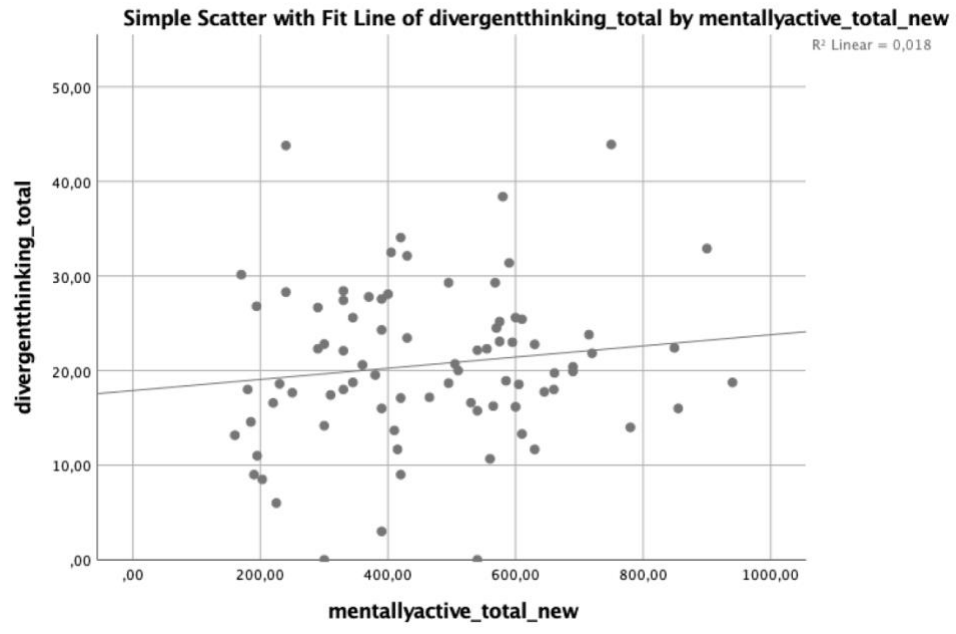
**Figure D**

*Q-Q Plot of Distribution of Total Sitting Time in Minutes and Divergent Thinking*



**Figure E**

*Q-Q Plot of Distribution of Mentally Active Sitting Time in Minutes and Divergent Thinking*



**Figure F**

*Q-Q Plot of Distribution of Mentally Passive Sitting Time in Minutes and Divergent Thinking*

