

**Exploring the relationship between social anxiety and sedentary leisure time in  
university students: A moderating effect of extraversion?**

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## Abstract

**Background:** Both sedentary behaviour and anxiety have severe consequences on an individual's mental and physical well-being. Young adults, especially university students, have previously shown heightened sedentary behaviour and anxiety levels. While sedentary behaviour has been linked to overall anxiety multiple times, minimal research is available on social anxiety with sedentary behaviour. Different personality traits have been linked to both social anxiety and sedentary time. Thus, this study investigated the relationship between social anxiety, sedentary leisure time, and a possible moderation by extraversion.

**Method:** A cross-sectional study was conducted with 104 university students (66.4% females, 82.7% between ages 18-25). Participants filled out a modified version of the Past-U, the Liebowitz Social Anxiety Scale, and the Eysenck Personality Questionnaire–Brief Version, which only contained the items to measure extraversion. Linear regression and moderation models were used to analyse the data.

**Results:** A non-significant relationship between social anxiety and sedentary leisure time was found. At the same time, a significant positive relationship between social anxiety and sedentary leisure screen time was observed ( $\beta = .207, p = .035$ ). Extraversion did not moderate the relationship between social anxiety and sedentary leisure time.

**Discussion:** The significant positive relationship between social anxiety and sedentary leisure screen time, while social anxiety and total sedentary leisure time were unrelated, raises questions about underlying factors. Future research may investigate possible influences on the association between social anxiety and screen time. However, the sample's high sedentary leisure and social anxiety levels are alarming and might risk university students' mental and physical health.

*Keywords:* sedentary behaviour, social anxiety, anxiety, leisure time, screen time, extraversion, university students, cross-sectional study, moderation, linear regression

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## **Exploring the relationship between social anxiety and sedentary leisure time in university students: A moderating effect of extraversion?**

Almost one-third of the population is affected by a mental disorder during their lifetime (Kessler et al., 2005). These mental disorders are significant contributors to the global burden of disease, accounting for 32% of all years lived with disability and 13% of disability-adjusted life years (Vigo et al., 2016). Familiar mental disorders, such as depression and anxiety, have risen among younger generations compared to previous generations (Patalay & Gage, 2019). Additionally, a meta-regression indicates that sedentary behaviour has increased over the last ten years, especially among university students (Castro et al., 2020). A large body of research shows that various psychiatric disorders, including depression and anxiety, seem to be associated with harmful health behaviours like a more inadequate diet, sleep issues, and low physical activity levels (Firth et al., 2019). Therefore, it is not surprising that research regarding sedentary behaviour is rapidly growing (Salmon et al., 2011; Tremblay et al., 2017; Tremblay et al., 2010), which is resulting in increasing evidence of a relationship between sedentary behaviour and negative health indicators or outcomes (Katzmarzyk et al., 2009; Stamatakis et al., 2011). Nevertheless, research concerning specific types of anxiety and different types of sedentary behaviour, like screen-based sedentary behaviour, is still lacking. Thus, this study investigates the relationship between social anxiety and various types of sedentary behaviour.

### **Sedentary behaviour**

Sedentary behaviour is defined as “any waking behaviour characterised by an energy expenditure  $\leq 1.5$  metabolic equivalents (METs), while in a sitting, reclining, or lying posture” (Tremblay et al., 2017, p. 9). METs describe a human's energy consumption concerning a specific activity (Jetté et al., 1990). A MET under 1.5 is relatively low, implying that sedentary behaviour is not physically exhausting (Tremblay et al., 2017). Typical

examples of sedentary behaviour include sitting at work, in transit, television viewing, computer use, reading, and video gaming (Walsh et al., 2015). Therefore, it is different from physical inactivity, which is generally too little exercise according to WHO guidelines (Bey & Hamilton, 2003; Owen et al., 2008; Owen et al., 2010). It is possible to meet the recommendations regarding physical activity and still experience negative health consequences, such as an increased risk of cardiovascular disease mortality, due to too much sitting (Owen et al., 2010). For example, a quick workout in the evening does little to compensate for a whole day of sitting in class or at work.

The different sedentary behaviours can be divided into further subcategories. Hallgren & Dunstan, et al. (2020) split sedentary behaviour into mentally active and passive, while various other authors distinguished between occupational and non-occupational sitting (Lee & Kim, 2018; Owen et al., 2011; Smith et al., 2016). Again, others differentiated screen-based sedentary behaviour, like television viewing and being on social media (Must & Tybor, 2005). The various activities of individuals while being sedentary have been indicated to have different effects on an individual's mental health (Hallgren, Nguyen, et al., 2020). Keeping the distinctions in mind, screen-based leisure activities are one of the most prevalent forms of sedentary behaviour (Australian Bureau of Statistics, 2013; Clark et al., 2009). Recently, screen-based sedentary behaviour increased even more due to the ongoing Covid-19 pandemic and its effects on daily routines and social isolation (Margaritis et al., 2020; Vanderloo et al., 2020).

Research indicates that many students show higher levels of sedentary behaviour than the general population of young adults. Many spend, on average, 6-8 hours each day engaging in screen-based sedentary behaviour alone (Bauman et al., 2017; Khan et al., 2019). A reason for the heightened levels of both total and screen-based sedentary time might be due to the type of activities of university students, such as attending lectures or studying that often

involve long periods of sitting (Castro et al., 2020), which results in an average of 8.3 hours of self-reported sedentary time each day (Mussi et al., 2017). Sitting time is an issue because a threshold between 6 and 8 hours of total sitting time per day was identified, above which the mortality risk is increased (Chau et al., 2013; Patterson et al., 2018).

Sedentary behaviour has been repeatedly associated with various health risks. Research shows that heightened sedentary behaviour is associated with poorer cognitive function, physical activity levels, and health-related quality of life (Iannotti et al., 2009; Miller, 2010; Saunders et al., 2020; Syväoja et al., 2014; Teychenne et al., 2010). Concerning the physical consequences of too much sitting, evidence suggests that sedentary behaviour is a risk factor for premature death and several chronic diseases, like metabolic syndrome, type 2 diabetes, and cardiovascular disease (Biswas et al., 2015; Patterson et al., 2018; Wilmot et al., 2012). Sedentary behaviour also impacts mental well-being, including a higher risk of anxiety and depression (Teychenne et al., 2015; Zhai et al., 2015). In particular, increased social media, television, or computer use are associated with poorer mental health outcomes (Boers et al., 2019; Keles et al., 2019; Liu et al., 2015; Sanders et al., 2019).

### **Social Anxiety**

Anxiety is the most prevalent mental health problem (Kessler et al., 2009), with a 12-month prevalence of 18% among a sample of over 9000 respondents (Kessler et al., 2005). The highest burden of experiencing anxiety lies in females and males, between 15 and 34 (Baxter et al., 2014). Teychenne et al. (2015, p. 2) defined anxiety as an “excessive and persistent (yet often unrealistic) worry which can inhibit one’s ability to carry out activities of daily living”. Anxiety is commonly described as a complex response and a momentary state that varies in intensity and changes over time. However, anxiety can also refer to a personality trait or a disorder (Spielberger & Cattell, 1966). Various types of anxiety were identified, the most common type being social anxiety (Stein & Stein, 2008), with a lifetime prevalence of 12.1%

(Ruscio et al., 2007). During the Covid-19 pandemic, social anxiety increased further and therefore became an even more persistent issue (Zheng et al., 2020).

Social anxiety has been defined by Ferrand et al. (2009) as cited in Abdollahi & Talib (2014) as “persistent fears of one or more social situations in which the person is exposed to others and expects to be scrutinised”. This fear can be marked to such an extent that individuals avoid most interpersonal encounters (Stein, 1996). Individuals who experience social anxiety generally must deal with it their whole life, as the onset is typical during childhood and early adolescence (Chavira & Stein, 2005), and continues into adulthood (Cairney et al., 2007). Individuals only reveal issues with social anxiety when asked explicitly (Roy-Byrne & Stein, 2005). Cox et al. (2005) support this argument by finding that about 50% of adults diagnosed later in life did not report excessive shyness during their childhood. Social anxiety and its associated suffering have often been underestimated as a shared experience (Turk et al., 2008).

Social anxiety is among the top ten chronic mental and physical diseases in terms of its effective outcomes like days lost at work (Alonso et al., 2004). Therefore, the effects are not solely subjective distress but also impact one's health-related quality of life (Saarni et al., 2007), relevant to society and the public health sector (Stein, 1991). During the Covid-19 lockdown levels of anxiety increased and the quality of life decreased, especially in adolescence and young adults (Ravens-Sieberer et al., 2020; Xiong et al., 2020). Individuals who experience social anxiety suffer from various consequences. They tend to be shy when meeting others, keep back in group settings and withdraw from unfamiliar social environments. In the interaction with others, they might show evident discomfort (not making eye contact, blushing) but constantly experience intense physical or emotional symptoms (heart racing, sweating, fear, trembling). Individuals with social anxiety tend to show low self-esteem and high self-criticism (Cox et al., 2004). Often, depressive symptoms co-occur



(Vythilingum et al., 2002), which Beesdo et al. (2007) showed in a 10-year prospective longitudinal and family study. These mental, physical, and social consequences justify the extended need for research on social anxiety, which further reduces the attached stigma and encourages those affected by social anxiety.

### **Social Anxiety and sedentary behaviour**

An association between sedentary behaviour and anxiety in the general population was established through previous research. High levels of sedentary behaviour are related to higher levels of anxiety symptoms (Stanczykiewicz et al., 2019) and increase the risk of developing anxiety disorders (Primack et al., 2009; Sanchez-Villegas et al., 2008). Additionally, the two meta-analyses of Allen et al. (2019) and Teychenne et al. (2015) demonstrated a moderate substantiation for a positive association between these two variables. The relationship between anxiety and sedentary behaviour was also established in university students (Lee & Kim, 2018). Anxiety might contribute to a heightened sedentary lifestyle, which creates a vicious cycle where both variables constantly influence each other (Mendes et al., 2021; Schuch et al., 2020).

Previous research debated the direction of the relationship between anxiety and sedentary behaviour. A few studies suggested that sedentary behaviour and anxiety are related (Allen et al., 2019; Lee & Kim, 2018; Primack et al., 2009; Sanchez-Villegas et al., 2008; Stanczykiewicz et al., 2019; Teychenne et al., 2015). However, anxiety was repeatedly associated with predicting heightened sedentary behaviours. Anxious individuals tend to be more passive, resulting in an increased likelihood of engaging in sedentary leisure activities such as television watching and computer use to escape unpleasant feelings (Potts & Sanchez, 1994; Stubbs et al., 2017). The study by de Wit et al. (2011) found evidence for a predictive relationship between anxiety and screen-based sedentary behaviour (TV watching).

Therefore, it is reasonable to expect that individuals with heightened anxiety levels may spend more time being sedentary.

There is limited evidence concerning different types of sedentary behaviour and specific forms of anxiety. Generally, leisure-time computer use, and television watching were related to mental disorders (de Wit et al., 2011). The study by Teychenne & Hinkley (2016) showed that screen-based sedentary behaviours, such as overall screen time and computer/handheld device use, were predicted by anxiety symptoms. It is expected that leisure time television watching, and computer use are linked to mental disorders because these sedentary behaviours are generally related to little face-to-face social interaction (Kubey & Csikszentmihalyi, 2013). However, still little is known about which specific type of anxiety is associated with increased sedentary time due to studies focusing on general anxiety.

The research on the relationship between social anxiety and sedentary behaviour is limited. The study by Abdollahi & Talib (2014) concluded that social anxiety significantly predicts sedentary behaviour. Still, their research only focused on obese university students and excluded those who were under-or normal weight. Nevertheless, the nature of social anxiety leads to the assumption that this relationship might also exist without bringing the variable weight into play. Additional exploration is needed to explore this research gap.

### **Extraversion**

Personality traits emerged as one possible explanation of who might be at risk for sedentary behaviour (Allen et al., 2017; Wilson & Dishman, 2015). Personality traits are characteristic patterns of thinking, feeling, and behaving (Allen et al., 2017). Therefore, they can be seen as a stable factor influencing positive and negative behaviour patterns (McCrae et al., 2000). Previous research suggested that more research is needed on the effect of personality on the relationship between anxiety and sedentary behaviour (Lee & Kim, 2018).

Scientific research indicates that the relationships between personality traits and sedentary behaviour are complex (Hearon & Harrison, 2020). A Danish study found that sedentary leisure time positively correlates with neuroticism and negatively with openness, conscientiousness, and extraversion (Ebstrup et al., 2013). Additionally, an Australian study found that total screen time is positively correlated with higher levels of introversion (Allen et al., 2015). Contrastingly, a meta-analysis by Allen et al. (2017) concluded that extraversion seemed unrelated to sedentary behaviour. Additionally, socially anxious individuals scored lower on an extraversion scale than non-anxious individuals (Bienvenu et al., 2004; Naragon-Gainey et al., 2009). Previous research found mixed results on the association of extraversion with sedentary behaviour. Thus, more insight is needed into the influence of extraversion on sedentary behaviour.

Different definitions are available for extraversion. Watson and Clark (1997) investigated the available theoretical views on extraversion and concluded that generally, extroverts are viewed as happy, confident, energetic, active, and enthusiastic. Extraversion exists on a continuum with introversion, where different behaviours and attitudes are expressed (APA, 2022). Extraverts show lower arousal levels, thus increasing their need to seek out stimulating environments and excitement to compensate for the under-stimulation, which may result in less sedentary behaviour. Contrastingly, introverts show higher resting levels of arousal, thus motivating them to stay away from situations that provide overstimulation. Therefore, introverts engage in reserved behaviours to maintain elevated arousal levels (Walker, 2020). Thus, investigating the concept of extraversion to both social anxiety and sedentary behaviour might offer additional insight.

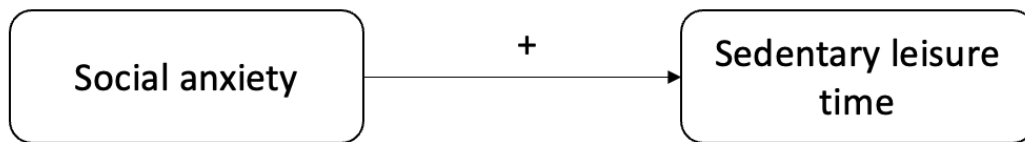
## Present study

The available research on social anxiety is limited. Additionally, there is a lack of research on the connection between social anxiety concerning sedentary behaviour and leisure sedentary behaviour. This study will investigate the concepts of social anxiety and leisure sedentary behaviour to narrow the existing research gap. Additionally, extraversion has been linked to sedentary behaviour (Allen et al., 2015; Ebstrup et al., 2013) and social anxiety (Bienvenu et al., 2004; Naragon-Gainey et al., 2009). But these studies did not investigate the three concepts together. Still, the literature suggests that extraversion might influence the association between social anxiety and leisure sedentary behaviour. A large body of research identifies university students as significantly affected by anxiety (Patalay & Gage, 2019) and sedentary behaviour (Castro et al., 2020; Mussi et al., 2017; Kubey & Csikszentmihalyi, 2013; Teychenne et al., 2015). Consequently, the target group for this research are university students.

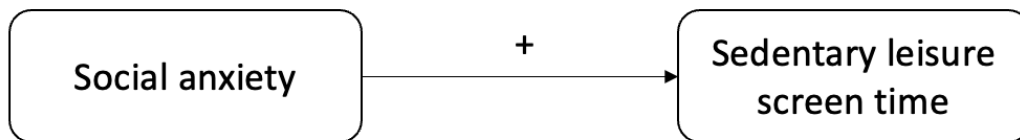
This study investigates the relationship between social anxiety and specific sedentary behaviours. The first research question is: *What is the relationship between social anxiety and leisure sedentary behaviour in university students?* Social anxiety is expected to predict sedentary leisure time (*H1a*) (Figure 1). Apart from total sedentary leisure time, it is also expected that social anxiety predicts sedentary leisure screen-time (*H1b*) (Figure 2). The second research question is: *What is the effect of extraversion on the relationship between social anxiety and leisure sedentary behaviour?* It is expected that extraversion moderates the relationship between social anxiety and leisure sedentary time (*H2*) (Figure 3).

**Figure 1**

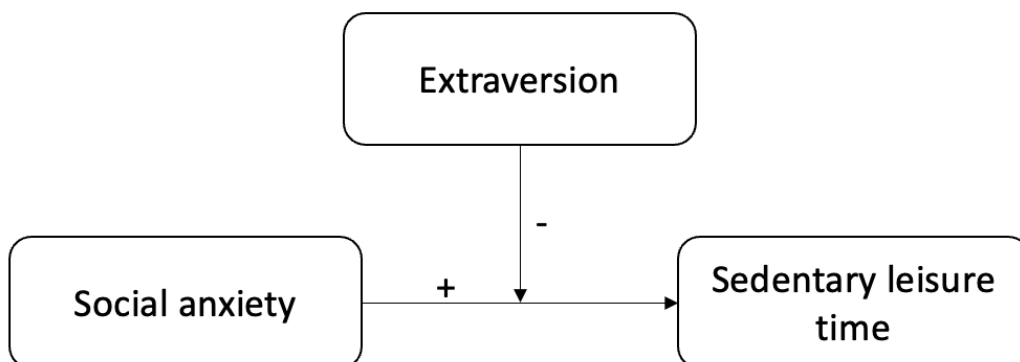
*The expected effect of social anxiety on sedentary leisure time*

**Figure 2**

*The expected effect of social anxiety on sedentary leisure screen time*

**Figure 3**

*The expected effect of extraversion on the relationship between social anxiety and sedentary leisure time*



## **Methods**

### **Design**

This study used a quantitative cross-sectional study design; therefore, the dependent and independent variables were measured once. The used survey included one measurement of sedentary behaviour and seven individual scales about different mental health and well-being concepts; thus, questionnaires irrelevant to this paper were included. The study began on 06.04.2022 and was conducted over 46 days. Ethical approval was granted by the Ethics Committee of the University of Twente (Case number: 220299).

### **Participants**

The study used a convenience sampling method due to the accessibility and reduced time effort, (Bornstein et al., 2013). Participants were recruited through the Test Subject Pool BMS (Sona) system of the University of Twente. Subjects were compensated with 0.25 Sona points. Additionally, the researchers used social networks for recruitment. Inclusion criteria were met if participants were enrolled at a university or a university for applied sciences, were at least 18 years old and had sufficient proficiency in English. Participants also needed access to the internet. Participation in this study was entirely voluntary, and withdrawing was possible at any moment without justification.

### **Procedure**

The survey was created using Qualtrics and was provided on the Sona platform of the University of Twente. Additionally, participants who did not have access to that platform got sent a link that would take them to the Qualtrics survey. After obtaining access, participants could freely decide if they wanted to take part in the study or not by clicking on the provided link. Before the participants answered any questions, the researcher provided information about informed consent. Participants were informed about the purpose, their rights, the risks

of the study and the duration (Appendix A). After participants gave their consent, demographic information was collected. The main questionnaires were presented in a randomized order. After completing the questions, the researchers thanked the participants for their participation. The time it took to complete the questionnaire was around 30 minutes.

## **Materials**

### ***Demographic Variables***

The demographic variables were gender (female, male, non-binary/ third gender), age (18-25, 26-30, 31-40, 41-50, 51 years or older), study programme and nationality (Dutch, German, other).

### ***Sedentary Time Measurement***

This study used a modified version of the Past-day Adult's Sedentary Time-University (PAST-U) questionnaire to measure the self-reported sedentary time of participants. The original PAST-U consists of 9 items that ask how many minutes participants spent sitting during different activities the past day; contexts include work, study, transport, reading, watching television, using the computer, socialising and others (Clark et al., 2016). According to Clark et al. (2016), the PAST-U questionnaire has shown acceptable validity compared to device-based measures of sedentary time ( $r = .58$ , 95% CI [0.32–0.76]). Reliability was also established as acceptable (ICC = .50, 95% CI [0.39-0.7]).

The modified version used in this study consisted of 14 items. Items were added to obtain more information on participants' screen time (Appendix B). The items for travelling, driving, TV watching, computer use (e.g., video gaming), social media use, social interaction via screens, reading online, other screen use, reading books, eating, and socialising were combined to obtain the total leisure sedentary time. The variables TV watching, computer

use, social media use, social interaction via screens, reading online and other screen use were combined to get the total sedentary leisure screen time.

### ***Social Anxiety Measurement***

The Liebowitz Social Anxiety Scale (LSAS) was used to measure the social anxiety levels of subjects (Appendix C). It contains 24 items that are divided into two subscales. One addresses social interaction (11 items), and one addresses performance (13 items). Fear and avoidance are rated on a 4-point Likert-type scale during the past week, where “none/never” (0) and “severe/ usually” (3). A total score was calculated by combining the fear and avoidance scores for each item, indicating participants' degree of social anxiety (Heimberg et al., 1999).

For the whole scale, participants could obtain scores between 0 and 144. A score of 54 and under indicates no social anxiety, 55-65 moderate levels, 65-80 marked, 80-95 severe and 95 and above very severe social anxiety (Al-Sharbati et al., 2012; Herbelin, 2005). The convergent validity was previously found to be highly significant ( $p < .001$ ). Concerning its reliability, all LSAS scores' alpha coefficients were in the excellent range (subscales between .81 and .92; whole .96) (Heimberg et al., 1999). Cronbach's alpha in the present study was .94.

### ***Extraversion***

The Eysenck Personality Questionnaire–Brief Version (EPQ-BV) consists of 24 items, 12 for extraversion and 12 for neuroticism. Because extraversion was of interest, only that subscale was included in this study (Appendix D). The items were measured using a 5-point Likert scale ranging from “not at all” (0) to “extremely” (5) (Sato, 2005). The items “Do you tend to keep in the background on social occasions?” and “Are you mostly quiet when you are with other people?” used reverse coding. The final scale is composed of adding all the items together; therefore, the scores could range between 12 and 60.



The study of Sato (2005) showed a Cronbach's Alpha of .92 and test-retest reliability of .92. The Cronbach's alpha in this study was .94. Sato (2005) determined the concurrent validity by comparing the items of this scale to the corresponding ones in the original EPQR-S. It was found that the items are highly correlated (.89). Lastly, factor analysis was conducted, proving that all 12 items intended to measure extraversion did indeed measure it. All corresponding factor loadings were 0.60 or above (Sato, 2005).

### **Data analysis**

Data was analysed using SPSS (version 27). Before starting the data analysis, the obtained data was prepared. The exclusion of participants from the dataset followed two guidelines. First, students that did not give their consent were removed. Additionally, respondents that did not fill out the specific scales needed for this analysis were excluded. For the items of sedentary time, missing values were assumed to indicate that this activity did not apply to this participant; therefore, those missing values were replaced with a 0.

Respondents that indicated unrealistic sedentary leisure (screen) time were excluded from the data analysis. The cut-off point for each variable was set at >20hr. The data was checked for normal distribution. Frequency distributions were created for the demographic variables, and for the sedentary behaviour, social anxiety, and extraversion measurements, the *M* and *SD* were calculated.

Both *H1a* and *H1b* were examined using simple linear regression analyses with social anxiety as the independent variable. For *H1a*, the dependent variable is sedentary leisure time. Furthermore, for *H1b*, the dependent variable is sedentary leisure screen time. For *H2*, the SPSS macro-PROCESS by Hayes was used to test if extraversion moderates the relationship between social anxiety and leisure sedentary behaviour. A significance level of  $p < .05$  was used for all analyses.

## Results

### Sample description

In total, 141 students participated in the study. Thirty-five participants needed to be excluded because they did not fill out the three required questionnaires for this analysis. Two respondents were excluded from the dataset due to a screen time >20 hr. The final sample consisted of 104 participants, which exceeded the proposed sample size by the G\*power analysis of  $n= 89$  for all analyses (Appendix E and F). From the final sample 69 individuals identified as female (66.4%) and 35 as male (33.6%). 82.7% of the sample were between the age of 18 and 25. Moreover, 73% of respondents had German nationality, and most were psychology students (42.3%) (Table 1).

**Table 1***Characteristics of the sample (N = 104)*

Variable		<i>n</i>	%
Age	18-25 years	86	82.7
	26-30 years	16	15.4
	31-40 years	2	1.9
Gender	Female	69	66.4
	Male	35	33.6
Nationality	Dutch	11	10.6
	German	76	73
	Other <sup>a</sup>	17	16.4
Study programme	Psychology	44	42.3
	Communication Science	10	9.6
	Law	5	4.8
	Other <sup>b</sup>	45	43.3

*Note.* <sup>a</sup> American, Belgian, British, Bulgarian, French, Iranian, Israeli, Korean, Lithuanian, Polish, Romanian, Turkish, Ukrainian, and Vietnamese.

<sup>b</sup> Includes, inter alia, Anglistics, Architecture, Business Administration, Computer Science, Education, Engineering, International Management, Public Health, and Sport Management.

### **Descriptive statistics**

The Kolmogorov-Smirnov test was used to test for normal distribution. For the social anxiety scale, the normality assumption was met ( $D(106) = .07, p = .200$ ), as well as linearity (Appendix G), and homoscedasticity (Appendix H). These assumptions were also met for the sedentary leisure screen time ( $D(104) = .08, p = .090$ ; Appendix I; Appendix J) and sedentary leisure time variables ( $D(99) = .06, p = .200$ ; Appendix K; Appendix L). For the extraversion

scale the normality assumption was not confirmed ( $D(106) = .09, p = .037$ ). However, the related Q-Q plots indicate linearity (Appendix M) and the residual plot showed homoscedasticity (Appendix N). To again test the normality assumption the Durbin-Watson test was used, which indicated normality (1.835). Therefore, all variables meet the required assumptions. Five participants were excluded from the sedentary leisure time analyses because their sedentary leisure times were  $>20$  hr.

**Table 2**

*Descriptive statistics of the scale's sedentary behaviour in hours, social anxiety, and extraversion*

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Leisure time (hours)	99	9.3	3.4	3	19.8
Screen time (hours)	104	5.6	3	.42	18.3
Social Anxiety (Scale 0-144)	104	50.6	22.4	6	105
Extraversion (Scale 12-60)	104	36.7	10.3	13	57

The descriptive statistics of the sedentary behaviour, social anxiety and extraversion scales can be seen in Table 2. The mean sedentary leisure screen time was 5.6 hours ( $SD = 3$ ),

indicating that participants spend almost six hours of their leisure time in front of a screen, nearly a quarter of their whole day. The mean sedentary leisure time was 9.3 hours ( $SD = 3.4$ ), indicating that participants spent 60% of their leisure time in front of screens. The sample had a mean social anxiety score of 50.6 ( $SD = 22.4$ ), indicating that the mean was in the lower half of the scale. Still, 45.3% of students show scores that could indicate a social anxiety disorder. On the extraversion scale, the sample had a mean of 36.7 ( $SD = 10.3$ ), indicating that the mean is in the upper half of the scale.

### **Linear regression analysis**

Two linear regression analyses were conducted to test the hypotheses related to the first research question (*What is the relationship between social anxiety and leisure sedentary behaviour in university students?*). For *H1a* (*Social anxiety predicts sedentary leisure time*), social anxiety was set as the predictor and sedentary leisure time as the outcome variable. The overall regression was not statistically significant ( $R^2 = .031$ ,  $F(1,97) = 3.14$ ,  $p = .079$ ). It was found that social anxiety did not significantly predict sedentary leisure time ( $\beta = .177$ ,  $p = .079$ ). Therefore, *H1a* needs to be rejected.

For *H1b* (*Social anxiety predicts sedentary leisure screen-time*), social anxiety was again set as the predictor and sedentary leisure screen-time as the outcome. The overall regression was statistically significant ( $R^2 = .043$ ,  $F(1,102) = 4.55$ ,  $p = .035$ ). Social anxiety significantly predicted sedentary leisure screen time ( $\beta = .207$ ,  $p = .035$ ). Consequently, *H1b* can be accepted.

### Moderation analysis

To test  $H2$ , related to the second research question (*What is the effect of extraversion on the relationship between social anxiety and leisure sedentary behaviour?*), a moderation analysis was conducted. The overall model was not significant ( $R^2 = .4$ ,  $F(3, 95) = 1.32$ ,  $p = .272$ ). The individual effects can be seen in Table 3. The effect of social anxiety was shown as non-significant ( $B = -0.026$ ,  $p = .691$ ); therefore, it is not connected to leisure sedentary time. The effect of extraversion was also tested and showed non-significant results ( $B = -0.072$ ,  $p = .477$ ). Thus, extraversion is not fit to predict sedentary leisure time. Following, the moderation effect was also not significant ( $B = 0.002$ ,  $p = .375$ ). Hence, it can be assumed that extraversion has no moderating effect. Consequently,  $H2$  needs to be rejected.

**Table 3**

*Moderation analysis for the interaction effect of extraversion on the relationship between social anxiety and leisure sedentary time*

	B	SE	<i>t</i>	<i>p</i>	95% CI	
					LL	UL
Constant	10.51	4.13	2.54	.013	2.31	18.72
Social anxiety	-0.026	0.07	-0.4	.691	-.156	.104
Extraversi on	-.072	.1	-.71	.477	-.27	.13
Interaction	.002	.002	.89	.375	-.002	.005

## Discussion

This study aimed to investigate the relationship between social anxiety and leisure sedentary (screen) time; furthermore, a possible moderating effect of extraversion on this relationship was explored. Regarding the first research question, conflicting answers have been found. On the one hand, social anxiety did not predict sedentary leisure time, but on the other hand, social anxiety did significantly predict sedentary leisure screen time. Therefore, no clear answer has been found. For the second research question, no moderating effect of extraversion was observed.

A non-significant relationship between social anxiety and sedentary leisure time was found in this study. This finding goes against the formulated predictions that were based on the sparse existing research. It was assumed that social anxiety predicts sedentary leisure time due to an established relationship between anxiety and sedentary behaviour in general (de Wit et al., 2011; Teychenne et al., 2015). Additionally, the assumption was based on the indication that socially anxious individuals tend to withdraw from new experiences and avoid face-to-face social interaction (Cox et al., 2004), which results in more engagement in sedentary leisure behaviours (Potts & Sanchez, 1994; Stubbs et al., 2017).

However, previous studies investigated anxiety and sedentary behaviour in general. Additionally, the present study examined a university student sample, which might explain these different findings. Also, the study by Abdollahi & Talib (2014) that found an association between social anxiety and sedentary behaviour used a different subsample of the student population, namely obese students, and measured sedentary behaviour via another questionnaire. The current social situation (Covid-19) could have influenced this study's findings. It might be that students were not sedentary in their leisure time because they were socially anxious but because they did not have a choice. Additionally, in this study participants spent quite some time sitting while socialising during their leisure time, which

questions the influence of social anxiety on participants behaviour. It might be that people are socially anxious but do not actively avoid specific situations like socialising, therefore no effect was found. Regardless, this study was the first to investigate a potential relationship between social anxiety and sedentary leisure time and found no support for this association.

Contrastingly, a significant positive relationship between social anxiety and sedentary leisure screen time was found in this study. This result is in line with the formulated prediction based on previous research that indicated that anxious individuals spend more time in front of screens during their leisure time (Potts & Sanchez, 1994; Stubbs et al., 2017). Furthermore, previous research established a positive association between anxiety and screen-based sedentary behaviours and overall screen time (de Wit et al., 2011; Rebar et al., 2014; Teychenne & Hinkley, 2016).

The association between social anxiety and sedentary leisure screen time aligns with previous research. It has been indicated that socially anxious individuals might use the internet to compensate their social fears (Shepherd & Edelman, 2005). Socially anxious individuals might view socialising via online platforms as more comfortable than face-to-face contact. Therefore, they have an increased probability of regular engagement online (Caplan, 2005; Davis, 2001; Erwin et al., 2004), primarily via social media (O'Day & Heimberg, 2021) to compensate for the lack of real-life social support (Weidman et al., 2012). This is also reflected in the findings of this study. More and more research suggest that this finding could be explained by the Fear of Missing Out (FoMO), which could indicate how social anxiety leads to problematic internet use (Wegmann et al., 2017), problematic in the sense of a possible addiction and a pathological use of social media (O'Day & Heimberg, 2021).

Nevertheless, the found regression coefficient is quite low. A higher level of social anxiety only results in a minimal increase in screen-time. Therefore, in this sample the effect of social anxiety on screen-time was observed but the effect is rather small, which might lead



to the assumption that social anxiety does not result in notable consequences on individuals' sedentary leisure screen-time. Additionally, social anxiety did not explain a lot of variance in the screen-time variable. Still, this study was the first to explicitly investigate social anxiety and sedentary leisure screen time, for which a significant positive association was found.

In this study, there was no significant interaction effect of extraversion on social anxiety and sedentary leisure time found. This was the first study to hypothesise such a moderating effect. The prediction was based on previous research that indicated that extraversion negatively correlates with sedentary leisure time (Ebstrup et al., 2013). Additionally, socially anxious people tend to be more introverted (Bienvenu et al., 2004; Naragon-Gainey et al., 2009). However, it remained unclear how these three variables are related.

Differences in the study constructions might explain contradicting findings. Ebstrup et al. (2013) used a random population sample of a Danish village and different scales for the personality and sedentary time measurement. Therefore, this interaction might not be prevalent in a university student sample. Additionally, the possible influence of other confounding variables not investigated in this study cannot be dismissed. Since this was the first study to examine a possible interaction effect between social anxiety, sedentary leisure time and extraversion, it might be the case that there is no interaction effect to be found.

### **Sample and means**

This study's average sedentary leisure time was 9.3 hours, which is quite extensive compared to previous studies that found a *total* sedentary time in students between 8.3 (Mussi et al., 2017) and 10.7 hours (Clark et al., 2016). Thus, students in this sample spent a vast amount of time sitting during their leisure time. Nevertheless, it might be that students filled out the survey on the weekend or a day off, which might explain the high amount of sedentary leisure time. Students spent a high proportion of that time in front of screens. The

average sedentary leisure screen time in this sample was 5.6 hours. This finding is in line with previous research that indicated that young adults spent, on average, 6-8 hours in front of screens (Bauman et al., 2017; Khan et al., 2019). These high numbers of sedentary leisure time are concerning due to the indicated somatic health risk increase between 6 to 8 hours of total daily sedentary time (Chau et al., 2013; Patterson et al., 2018), especially because only a part of the total sedentary time is represented in this study.

Concerning the social anxiety levels in this sample, the average was 50.4. Compared to a study by Russell & Shaw (2009), who found an average score of 34.7 in a student sample using the same scale. In their sample, around 10% of students had scores that would indicate a social anxiety disorder. Therefore, the students in this sample had relatively high social anxiety levels. Since the study of Russell & Shaw (2009) was over ten years ago, it might be that social anxiety in general increased, possibly due to the recent Covid-19 pandemic. Half of the sample for this study consisted of social science students (50.9%). It might be possible that these students show an increased awareness of experiences indicating social anxiety, possibly leading them to overreporting anxiety levels. Nevertheless, it could very well be the case that social science students have higher social anxiety levels than other students, which raises the question if there is a possible tendency of socially anxious individuals to choose to study social sciences.

### **Limitations and strengths**

This study faced some limitations but also showed some strengths. Firstly, the used questionnaires in this study to measure social anxiety (Heimberg et al., 1999) and extraversion (Sato, 2005) are valid and reliable and were commonly used in previous research. The reliability of both scales was also confirmed in this study. Additionally, this study contributed to the existing research gap by investigating social anxiety, sedentary

leisure time and extraversion together, which has not been done before according to the available information.

Nevertheless, the study also contains some limitations. Mainly, the study made use of self-report measurements. Self-reports are more likely to be affected by response biases that might affect the validity. Additionally, the effect of social desirability on the outcome needs to be considered (Oskamp & Schultz, 2005). On the same note, the accuracy of the reported sedentary times cannot be guaranteed. Due to relatively high numbers, participants might have reported certain activities twice, which resulted in the exclusion of participants. Additionally, no information about the context of the reported sedentary time was obtained. If participants were in an exam period or sick, that might alter the results. Also, students might not have been able to sit less due to certain disorders or other restrictions, which were not considered. The obtained sample did not offer a representative population since most were female German psychology students. Therefore, the found results might not hold in a different sample population.

### **Future research**

This study provided insight into the association between social anxiety, sedentary leisure time and extraversion. Still, further research is needed to validate the findings and implement the limitations. Since a significant relationship between social anxiety and sedentary leisure screen time was found, future research should focus more on these two variables and possible influences on their association, for example, the impact of FoMO on both social anxiety and screen time (Wegmann et al., 2017), or the possible influence of a weight or body image variable (Abdollahi & Talib, 2014). Exploring the causes for increased screen time in socially anxious individuals and how they spend this time online might offer additional insight. Individual's level of social anxiety might fluctuate from day to day;

therefore, a different study design might offer a more insightful explanation, for example experience sampling (Mehl et al., 2014).

Previous research also indicated a few possibilities for future research. Exploring the underlying mechanisms that might explain the relationship between anxiety disorders and sedentary behaviours could offer additional insights (de Wit et al., 2011). Concretely, future research may focus on the type/purpose of sedentary behaviour, a classification between occupational sitting and non-occupational sitting), and the general effect of personality (Lee & Kim, 2018).

## **Conclusion**

The present study aimed to analyse the association between social anxiety and leisure sedentary (screen) time and the possible effect of extraversion as a moderator. In this sample, social anxiety predicted sedentary leisure screen-time. Nevertheless, the present study could not confirm most previous findings since a non-significant association between social anxiety and sedentary leisure time was found. Thus, social anxiety might only predict a fragment of sedentary leisure time. The newly investigated interaction effect of extraversion on this relationship was not established. Future research should focus on social anxiety and screen time and possible influences on their association. This student sample's overall high sedentary leisure times indicate that university students' mental and physical health might be at risk. Additionally, the high levels of social anxiety found in this study are alarming. Hence, further research is needed to investigate causes and possible interventions for student's mental and physical well-being.

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## **Appendix**

### **Appendix A**

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.

## Appendix B

### The adapted version of the sedentary behaviour measurement

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**.

**Q77 Example:** Please indicate the **total** sitting time in the bus yesterday.

Hours: 2

Minutes: 40

Q12 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q13 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q14 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q69 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q70 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q68 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q67 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q66 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q65 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q64 Please estimate the **total** time yesterday that you spent sitting or lying down and using screens that were not described above and that were not for studying or working purposes (e.g. online shopping, etc.).

○ Hours (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q74 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q73 Please estimate the **total** time yesterday that you spent sitting down for eating and drinking, including meals and snack breaks.

○ Hours (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_



Q72 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

Q71 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 (1) \_\_\_\_\_

○ Minutes (2) \_\_\_\_\_

## Appendix C

### The used scale to measure social anxiety

	FEAR OR ANXIETY		AVOIDANCE	
	ANXIETY (S)	ANXIETY (P)	AVOID (S)	AVOID (P)
1. Telephoning in public (P)				
2. Participating in small groups (P)				
3. Eating in public places (P)				
4. Drinking with others in public places (P)				
5. Talking to people in authority (S)				
6. Acting, performing or giving a talk in front of an audience (P)				
7. Going to a party (S)				
8. Working while being observed (P)				
9. Writing while being observed (P)				
10. Calling someone you don't know very well (S)				
11. Talking with people you don't know very well (S)				
12. Meeting strangers (S)				
13. Urinating in a public bathroom (P)				
14. Entering a room when others are already seated (P)				
15. Being the center of attention (S)				
16. Speaking up at a meeting (P)				
17. Taking a test (P)				
18. Expressing a disagreement or disapproval to people you don't know very well (S)				
19. Looking at people you don't know very well in the eyes (S)				
20. Giving a report to a group (P)				
21. Trying to pick up someone (P)				
22. Returning goods to a store (S)				
23. Giving a party (S)				
24. Resisting a high pressure salesperson (S)				
Total Performance (P) Subscore				
Total Social Interaction (S) Subscore				
<b>TOTAL SCORE</b>				

FIG. 1. The Liebowitz Social Anxiety Scale. (From M. R. Liebowitz (1987). Social phobia. *Modern Problems in Pharmacopsychiatry* 22, 141-173. Published by S. Karger AG: Basel, Switzerland and reproduced here with the permission of the publishers.)

## Appendix D

### The used scale to measure extroversion

EPQ–BV = Eysenck Personality Questionnaire–Brief Version

5-point Likert-type scale with responses ranging from not at all (1), slightly (2), moderately (3), very much (4), to extremely (5)

Are you a talkative person?

Are you rather lively?

Do you enjoy meeting new people?

Can you usually let yourself go and enjoy yourself at a lively party?

Do you usually take the initiative in making new friends?

Can you easily get some life into a rather dull party?

Do you tend to keep in the background on social occasions?

Do you like mixing with people?

Do you like plenty of bustle and excitement around you?

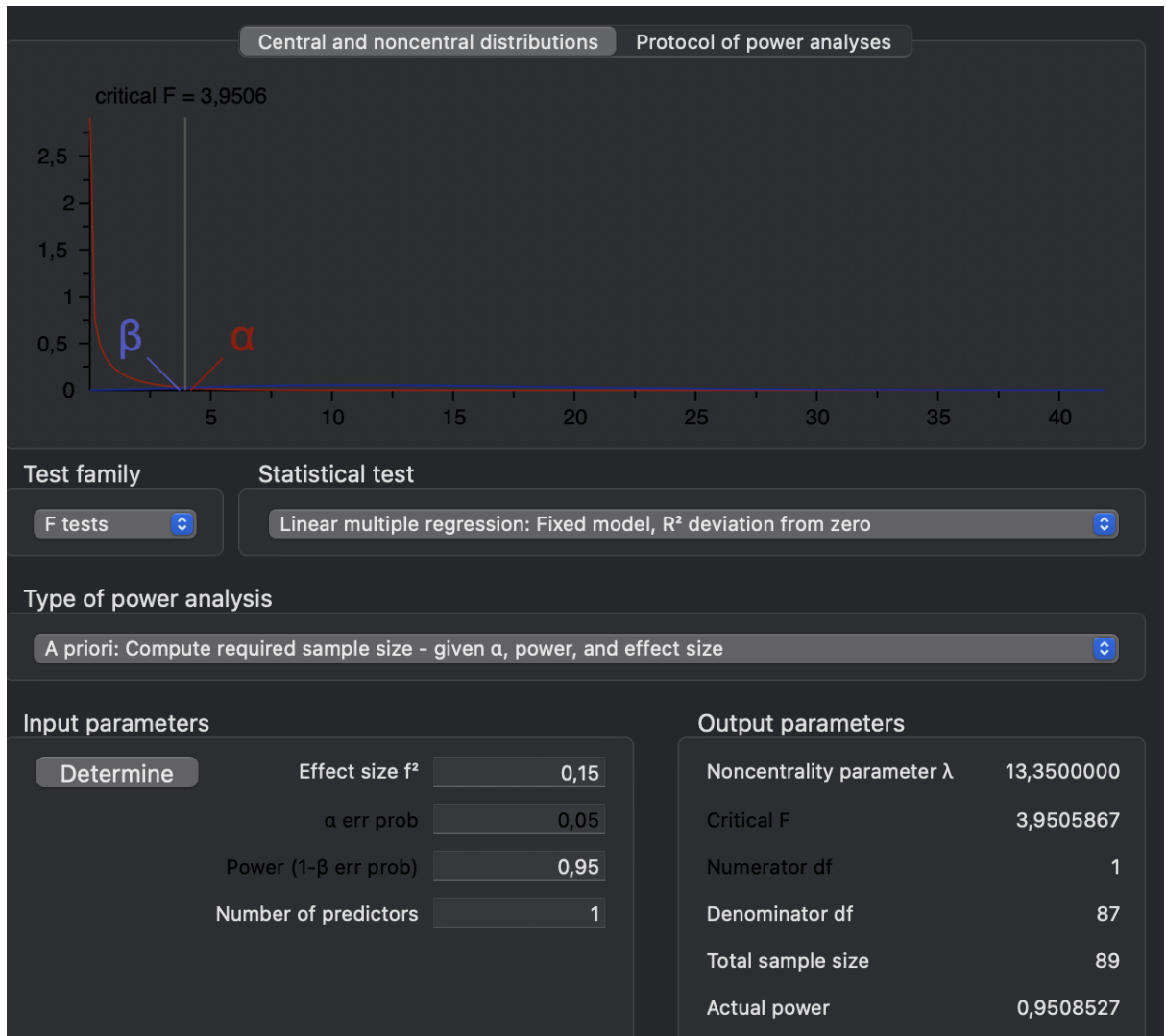
Are you mostly quiet when you are with other people?

Do other people think of you as being very lively?

Can you get a party going?

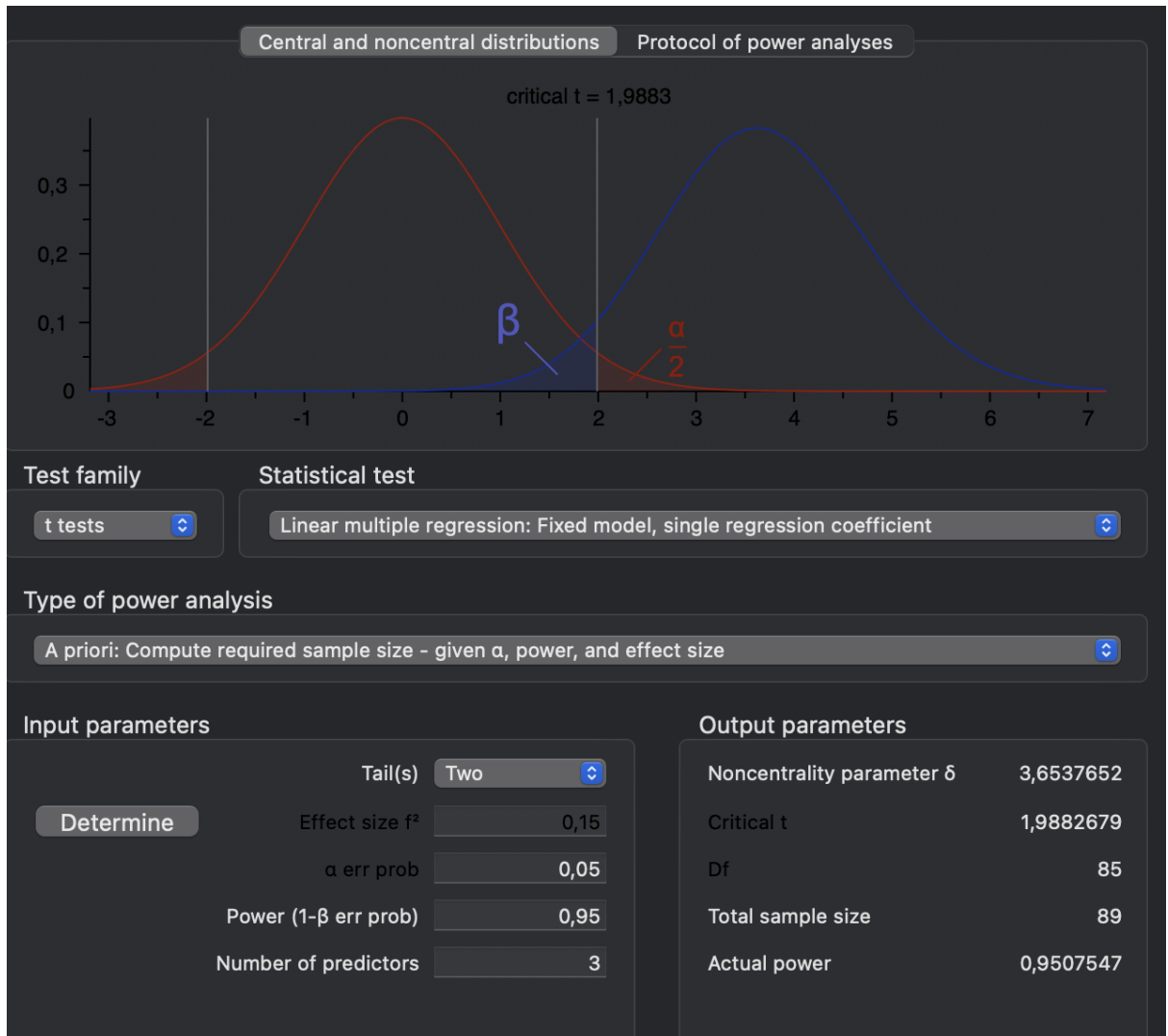
## Appendix E

### G\*power analysis for the linear regression analyses

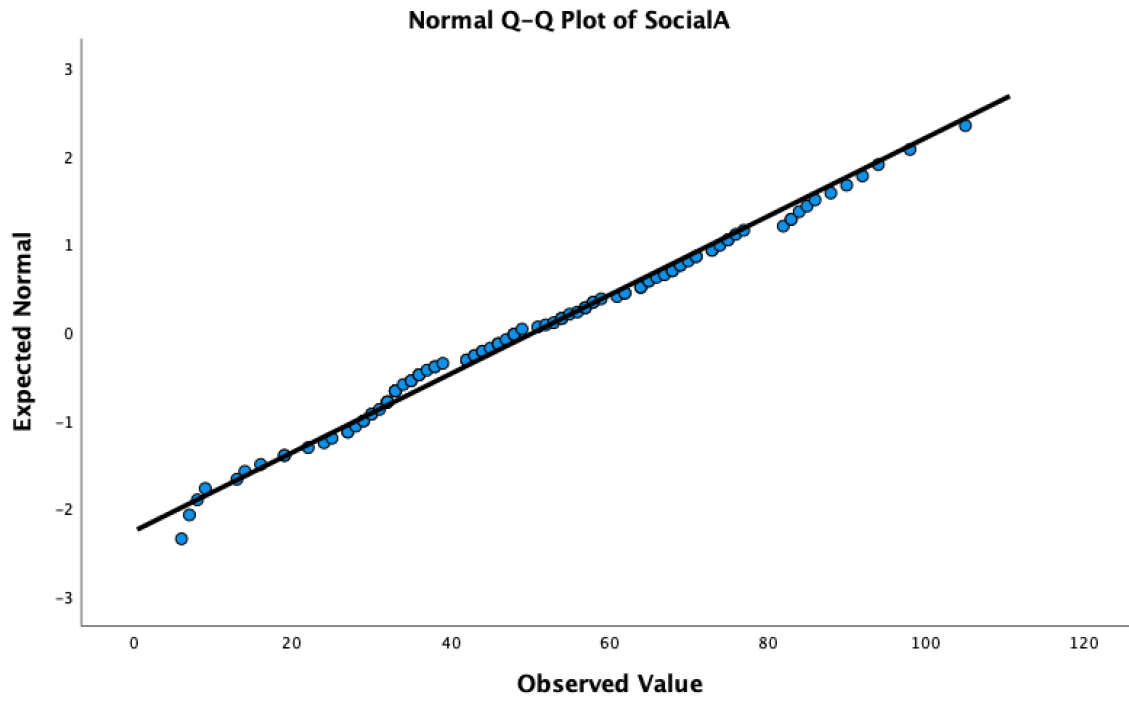


## Appendix F

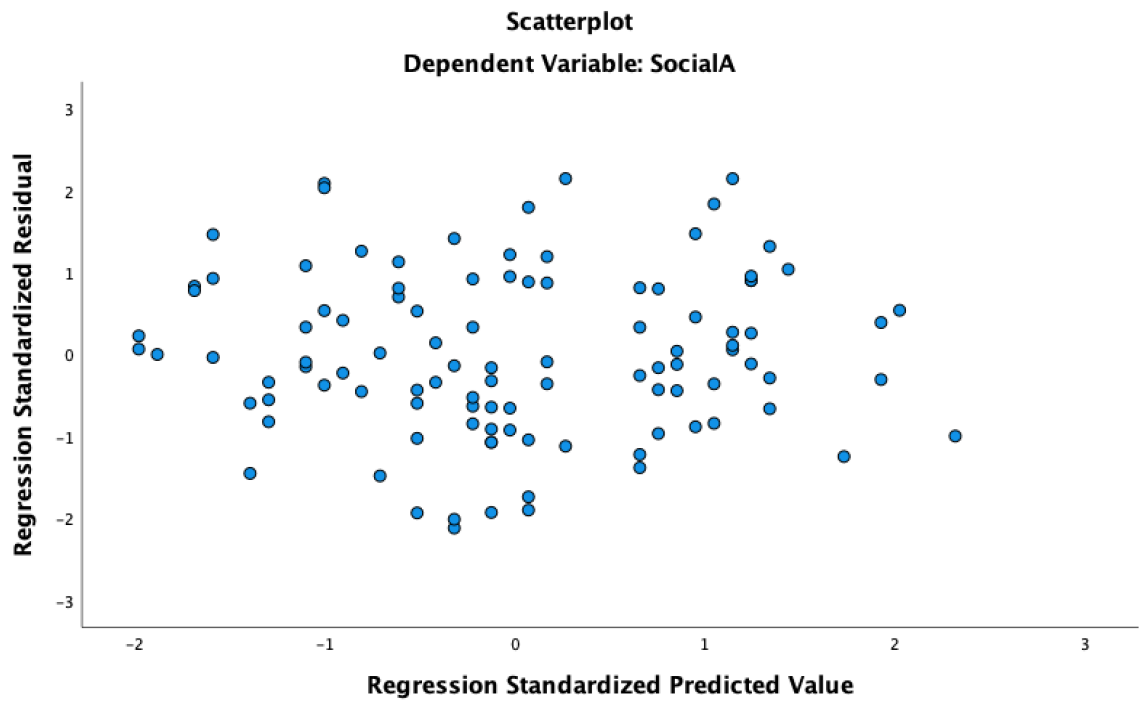
### G\*power analysis for the moderation analysis



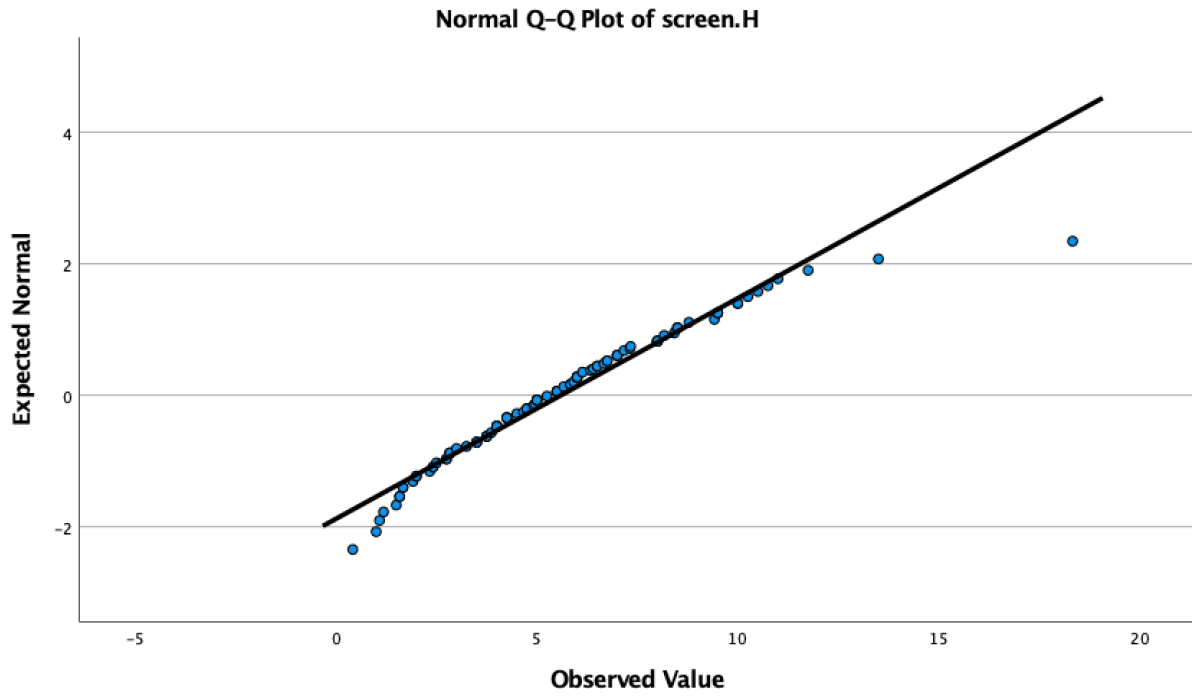
Appendix G  
Q-Q plot of the variable social anxiety



Appendix H  
Residual plot of the variable social anxiety



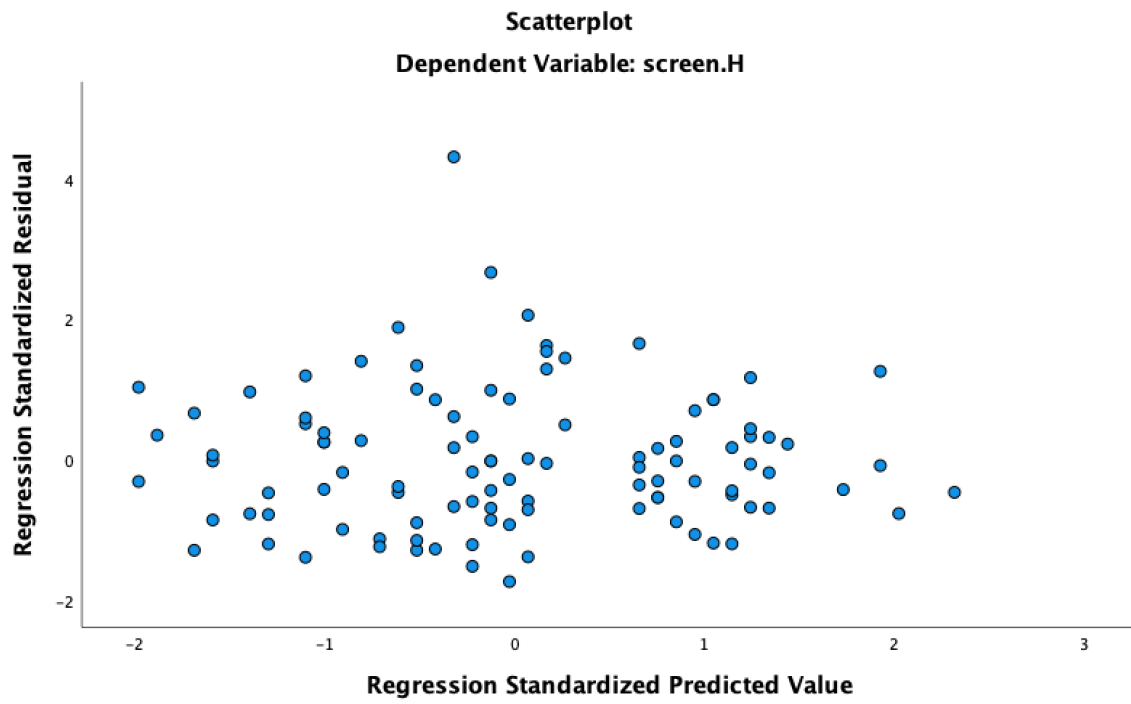
**Appendix I**  
**Q-Q plot of the variable sedentary leisure screen time**



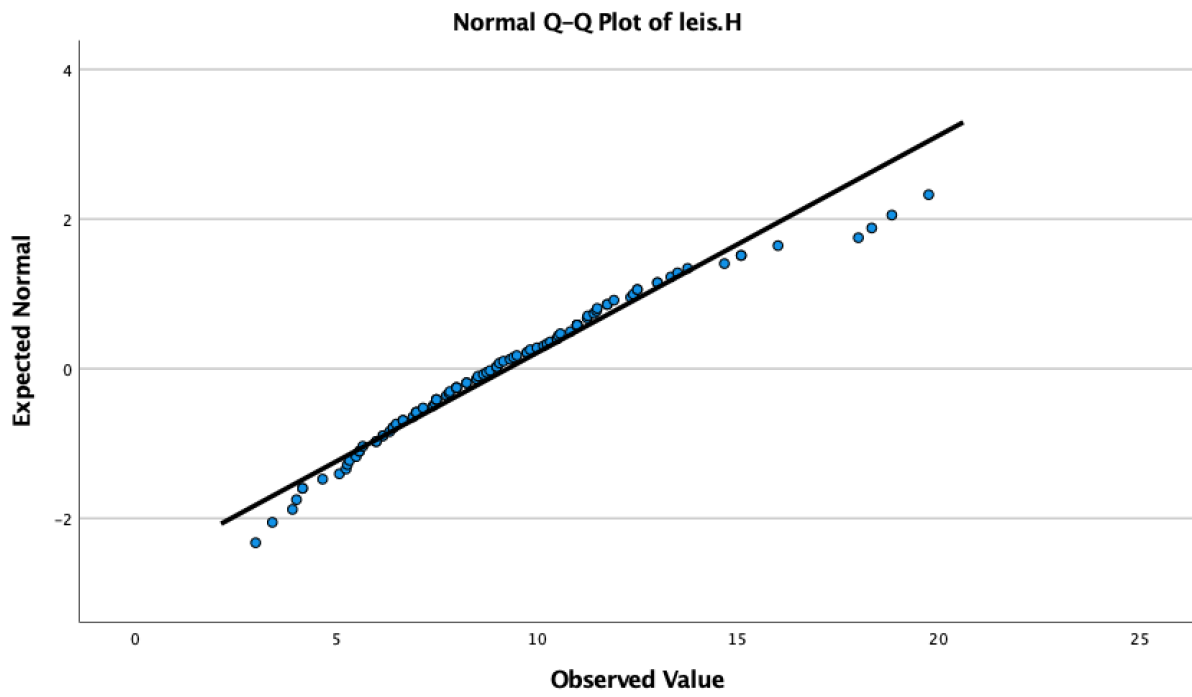


## Appendix J

## Residual plot of the variable sedentary leisure screen time



Appendix K  
Q-Q plot for the variable sedentary leisure time





Appendix M  
Q-Q plot for the variable extraversion

