To exercise or not to exercise?

Exploring the effects of stress on the implicit and explicit processes behind the intention to exercise

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Abstract

This research delves into the question of why some people enjoy exercise and engage in it regularly, while others barely engage in any physical activity despite the well-known consequences. It is crucial to investigate the underlying psychological factors that influence exercise intentions using the Theory of Planned Behaviour (TPB) and Affective Reflective Theory (ART). Specifically, the core affective experience calmness-tension and stress are explored as they may play a significant role in moderate and vigorous exercise intentions.

In total, 81 participants completed the questionnaire, consisting of questions about moderate and vigorous exercise intention, the Affective Exercise Experiences (AFFEXX) questionnaire, the Perceived Stress Scale (PSS) and a Single Category Implicit Association Test (SC-IAT). Spearman's rank correlation and moderation analysis were used to investigate the relationships between the variables.

The analysis showed no significant correlation between the explicitly and the implicitly measured core affective experience calmness-tension (r (79) = .01, p = .94). However, the AFFEXX core affective experience calmness-tension showed a significant positive correlation with both moderate (r (79) = .34, p = .002) and vigorous exercise intention (r (79) = .38, p < .001). Additionally, stress showed a negative moderation effect in this relationship (ß = -0.01, t(77) = -2.49, p = .015).

Hence, the relationship between the core affective experience calmness-tension and vigorous exercise intention is significant and weakened when stress levels are high, underlining the importance of reducing stress levels when creating exercise intention interventions.

Key terms: physical activity, TPB, ART, AFFEXX, SC-IAT, core affective exercise experience calmness-tension, stress, PSS, moderate exercise intention, vigorous exercise intention

Introduction

Only 44% of the Dutch population meets the national exercise guidelines (*Cijfers en Feiten Sport en Bewewegen*, n.d.), despite the well-known consequences of exercising too little. As people age, the amount of time they spend exercising decreases, and a clear increase in sedentary behaviour is observed. This might be due to a general dislike towards exercise, insufficient awareness, or time constraints (*Cijfers en Feiten Sport en Bewegen*, n.d.). To maintain a healthy lifestyle, adults aged 18 to 64 should try to minimise sedentary behaviour and practice at least 150 to 300 minutes of moderate-intensity or 75 to 150 minutes of vigorous-intensity aerobic physical activity per week. Regular physical exercise helps to maintain healthy body weight, contributes to one's mental health and helps fight certain diseases such as cardiovascular disease and cancer (World Health Organisation, 2022). Engaging in enough physical activity shapes our daily functioning and affects long-term mental and physical health outcomes (Deslandes et al., 2009; Penedo & Dahn, 2005). Hence, the question is: why do people not want to initiate exercise when they are inactive, given the extreme health-related consequences? This research aims to focus on different ways this question can be assessed and explores the effect of stress on exercise intention.

Theoretical Framework

The answer to this question can be found in the underlying cognitions that play a role in exercise motivation, outlined in the Theory of Planned Behaviour (TPB) by Ajzen (1991). Central to the TPB is a behavioural intention, which directly affects the behaviour itself. Therefore, the stronger the intention, the more likely the behaviour will be performed. In turn, behavioural intention is influenced by attitudes, subjective norms, and one's perceived behavioural control (Ajzen, 1991). A study by Zhang et al. (2023) shows an accurate prediction of adherence to the general 24-hour movement guidelines by using the TPB constructs on a sample of Chinese college students. Additionally, Budden & Sagarin (2007)

found that perceived behavioural control and attitudes towards exercise were able to predict the intention to exercise and a meta-analysis of Hagger et al. (2002) found self-efficacy, perceived behavioural control and attitudes to be the most important aspects of forming exercise intentions. In order to increase physical activity intentions, the attitudes towards physical activity need to be targeted by interventions. However, TPB is used to explain human behaviour by looking at cognition; a reflection on the TPB by Ajzen (2011) concludes that next to the TPB, emotions and affect should be considered to fully understand the direct and indirect processes behind the intention to exercise.

A theory that focuses on affect and emotions is the Affective-Reflective Theory (ART). This theory focuses on the psychological processes and decisions an individual makes to exercise or not to exercise (Brand & Ekkekakis, 2018). The ART distinguishes between affective and reflective processes. Affective processes, or type 1 processes, involve immediate emotional responses to exercise, they require minimal cognitive effort because they are automatic, implicit processes. Type 2 processes are reflective and evaluative, they are much slower since they include cognitive evaluations and conscious attitudes towards physical activity. Therefore, the ART aims to predict behaviour in situations where people either remain in a state of physical inactivity or initiate action. It focuses on a broader psychological context from the perspective of this dual-process theory and looks at the deep roots of behaviour, together with both anticipated and momentary affect, instead of only focusing on the cognitive and conscious aspects of it (Brand & Ekkekakis, 2018; Ekkekakis et al., 2021).

Physical Activity

The ART and the TPB are useful theories when investigating exercise intention. According to Ekkekakis et al. (2021) and Schinkoeth & Brand (2020), individuals seek pleasure and avoid displeasure. People who have had a negative experience when exercising vigorously will steer clear of vigorous activity in the future. This is considered a negative core

affective valence, which provides the first step towards a reflective type 2 process (Schinkoeth & Brand, 2020). Understanding an individual's core affective valence towards physical activity can create a more positive attitude to make exercise more pleasurable. An individual assesses their capability to perform a behaviour in advance and weighs the costs and benefits against each other, which influences a person's motivation to exercise, similar to the TPB and the ART. These core affective experiences are divided into three core affective experiences: pleasure versus displeasure, energy versus tiredness and calmness versus tension (Ekkekakis et al., 2021).

Stress

The core affective experience calmness versus tension is most suitable to explore further in this research since an individual will experience calmness when no stress is present and tension when there is. Physical activity and stress are related to each other reciprocally even though this relationship is usually not approached as being bi-directional (Stults-Kolehmainen & Sinha, 2013). The term stress can be used for situations that are considered uncontrollable, long-lasting or repetitive, physically demanding and emotionally draining (McEwen, 2007). Additionally, the individual sees the stressor as threatening and feels unable to cope with it (Stults-Kolehmainen & Sinha, 2013). A sample of college students showed that students who took part in vigorous physical activity had less stress and thus, overall better mental health (Zhai et al., 2021; VanKim & Nelson, 2013). People with high stress levels are more likely to fall ill, eat a high-fat diet and exercise less frequently. Hence, if an open attitude towards implementing exercise in a daily routine is adopted, physical activity could moderate the negative effects stress has on an individual, and it is used as an effective coping strategy for stress (Stults-Kolehmainen & Sinha, 2013).

Furthermore, when looking at the relationship between exercise and stress it is important to look at the influence of context and mental state of an individual because stress

and exercise affect everybody differently. Some individuals might feel calm when exercising or feel good afterwards, while others might feel tense and stressed about having to exercise. Consequently, the amount of calmness or tension an individual perceives directly influences their intentions to exercise (Ekkekakis et al., 2021).

Explicit and Implicit Measurements

Insights into the relationship between the intention to engage in physical activity and the amount of stress a person perceives can be gained through the use of explicit and implicit measurements. The Affective Exercise Experiences (AFFEXX) questionnaire is an explicit measure of exercise behaviour and consists of questions concerning explicit recollections of past exercise behaviours. It uses three sectors of bipolar valenced dimensions that are either considered to be unpleasantly or pleasantly valenced concerning exercise experiences. These are divided into three core affective experiences (Ekkekakis et al., 2021), out of which this research focuses on the core affective experience calmness-tension from the AFFEXX questionnaire.

Next to measuring explicit processes, it is valuable to combine it with the measurement of implicit processes. Implicit associations affect our behavioural urges and therefore play a big role in initiating exercise because the positive and negative associations that are constantly created are unconsciously affecting our present behaviour (Brand & Ekkekakis, 2018). To investigate the automatic associations between exercise and positive and negative stimuli, an Implicit Association Test (IAT) or Single Category Implicit Association Test (SC-IAT) can be used (Schinkoeth & Brand, 2020). The IAT measures unconscious biases by using a rapid classification task between two opposing stimuli (Chevance et al., 2019). When concentrating on the intention to exercise and the moderating role of stress in this relationship, the corresponding IAT to explore would be based on the core affective experience calmness-tension from the AFFEXX questionnaire here as well. For instance,

participants must classify words associated with calmness and words associated with tension to either exercise or sedentary behaviour. Their reaction times provide insights into their underlying attitudes that are not measurable with an explicit measurement.

This research is approached with a combination of implicit and explicit measurements influencing the intention to exercise, by using the AFFEXX and the IAT. The AFFEXX is an explicit self-report measure and the IAT measures implicit attitudes; where the IAT can provide valuable insights into intentions and possible biases, the AFFEXX might be able to predict future behaviours more accurately. This research aims to connect implicit and explicit measurements to uncover exercise attitudes beyond conscious awareness and combine those with conscious ones. The ultimate goal is to create a holistic view of the levels of the driving factors behind exercise intention.

Current Research

Up until now, there has been limited research on the interconnection of these concepts in academic literature. Therefore, when combining the dilemma of the bidirectionality of the relationship between stress and exercise intention and the theoretical framework, the question is whether the core affective experience calmness-tension can explain the implicit and explicit relationship towards the intention to exercise of an individual and whether stress levels might have a moderating effect in this relationship. Ultimately, the goal would be to transform negative associations towards physical activity into a positive one to lower the threshold to start exercising. This could be especially important for those who experience stress, which can be moderated by being more physically active. By incorporating and exploring implicit emotions, underlying psychological driving forces can be uncovered that play a role in exercise intention and how stress relates to it.

This framework has led to three research questions (RQ) that will be investigated further this research paper as well as the corresponding hypotheses (H).

RQ1: To what extent do implicit and explicitly measured core affective exercise experiences correlate for the construct of calmness-tension?

H1: There is a significant positive relationship between the core affective experience calmness-tension measured by the AFFEXX questionnaire and the implicit attitude towards exercise measured by the SC-IAT (see Figure 1).

RQ2: To what extent is the core affective experience calmness-tension positively associated with the intention to engage in moderate and vigorous physical activity?

H2: There is a bivariate correlation between the core affective experience calmness-tension and exercise intention. This would suggest that individuals who feel calmer are more likely to have the intention to exercise both moderately and vigorously when compared to individuals who experience higher levels of tension (see Figure 2).

RQ3: To what extent are stress levels moderating the association between the core affective experience calmness-tension and the intention for vigorous physical activity?

H3: Stress levels moderate the relationship between the core affective experience calmness-tension and vigorous exercise intention. The relationship is stronger for those individuals who have lower stress levels and weaker for those with higher stress levels (see Figure 3).

Figure 1

Theoretical model of hypothesis 1

Figure 2

Theoretical model of hypothesis 2

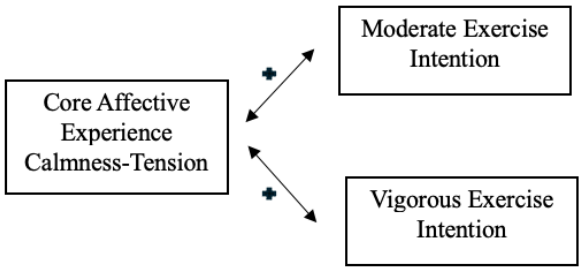
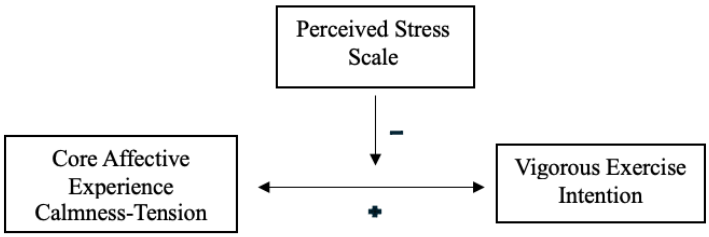


Figure 3

Theoretical model of hypothesis 3



Methods

Design

To test the hypotheses, a quantitative cross-sectional survey design was used. The survey was conducted online and could be completed at any time of day at any place. It was used to compare the AFFEXX and the SC-IAT, explore the relationship between the core affective experience calmness-tension, moderate and vigorous exercise intention and investigate the effect of stress on the relationship between the core affective experience calmness-tension and vigorous exercise intention.

Participants

Only individuals aged 18 years and older who understood sufficient English could participate in the questionnaire to be able to completely understand the SC-IAT. For the

sampling procedure, a convenience sampling method and snowball sampling were used. Participants were approached by posting the survey on SONA systems in return for SONA points and by spreading the questionnaire through the social media channels Instagram, WhatsApp and LinkedIn.

Materials

The questionnaire was a self-report measure, and participants could access the survey from their laptop, tablet or smartphone. They could access the link through SONA systems or complete the questionnaire without acquiring SONA points. The questionnaire started with a short introduction about the research topic. After this, the participant was asked to fill in an informed consent form (see Appendix B), after which the survey commenced.

The following parts of the questionnaire have been used for this research: questions about social demographics and exercise background, physical exercise intention both for moderate and vigorous activity, part of the AFFEXX questionnaire to measure the core affective appraisal calmness-tension, the Perceived Stress Scale that measures the amount of stress an individual has perceived during the past month, and a Single Category Implicit Association Test measuring the core affective experience calmness-tension (see Appendix C for the complete questionnaire).

Moderate and Vigorous Exercise Intention

The intention to exercise was measured on two levels; the intention to exercise moderately and the intention to exercise vigorously. Moderate exercise includes walking briskly, or biking on flat terrain and is less intense than vigorous exercise. Unlike moderate exercise, vigorous exercise cannot be sustained for long periods because it is more intensive, for instance running or swimming. One of the questions was “How determined are you to engage in vigorous exercise, despite obstacles you may face?”. There were eight questions in total, four for moderate exercise intention and four for vigorous exercise intention. The data

were measured on an ordinal level and scored on a 7-point Likert scale (see Appendix D for an overview of the variables). Cronbach's alpha was used to measure the internal consistency of the items. The alpha coefficient was .91 for moderate exercise intention and .96 for vigorous exercise intention, indicating high internal consistency among the items for both variables.

Core Affective Experience Calmness-Tension

The Affective Exercise Experience (AFFEXX) questionnaire (Ekkekakis et al., 2021) measures the motivation to exercise. This questionnaire is a 36-item scale, focused on explicit beliefs and attitudes related to exercise. The internal consistency is satisfactory, and all scales had good test-retest reliability, indicating the quality of the measure. The questionnaire includes three bipolar valenced dimensions concerning exercise experiences: pleasure versus displeasure, energy versus tiredness and calmness versus tension. All core affective experience dimensions include four items. The AFFEXX questionnaire distinguishes six antecedent appraisals: liking versus disliking exercise, showing off versus shying away, empowerment versus damage, pride/honour versus shame/guilt, competence versus incompetence, and interest versus boredom. Competence versus incompetence describes four items, the rest of the antecedent appraisals include three items.

This research will focus on the four items on the core affective experience calmness-tension, of which Cronbach's alpha is considered good (α = .84). Each question contains two opposing views, such as "For me, exercise is a relaxing activity" versus "For me, exercise is a stressful activity". These were all rated on a 7-point bipolar scale with "4" being the neutral midpoint (Ekkekakis et al., 2021) and it is a continuous variable. A low score on the core affective experience calmness-tension reveals more tension when exercising. The answers to the questions are based on certain judgments and decisions an individual makes before engaging in physical activity (Ekkekakis et al., 2021).

Perceived Stress Scale

The Perceived Stress Scale (PSS) by Cohen et al. (1983) measures the degree of psychological stress over the past month. In this research, the PSS-10 was used which consists of 10 items such as “In the last month, how often have you been upset because of something that happened unexpectedly?”. The PSS-10 measures three constructs, namely perceived helplessness, perceived self-efficacy, and perceived kindness. This is rated on a 5-point Likert scale ranging from 0 (never) to 4 (very often), with a higher score indicating higher stress levels. It has overall acceptable psychometric properties (Lee, 2012). Cronbach’s alpha that is reported for the PSS is considered acceptable (α = .78). The test-retest reliability is satisfactory (>.70) in the four studies in which it was tested (Lee, 2012). However, there seems to be a gender bias; women tend to score higher on the PSS than men. Whether this is due to women perceiving generally more stress or the wording of the items remains unclear. The psychometric properties of the PSS-10 are thus considered to be acceptable for a short questionnaire that is easy to administer, and the PSS-10 is recommended above the PSS-14 and the PSS-4, which are other versions of the Perceived Stress Scale (Lee, 2012; Taylor, 2015).

Implicit Association Test Calmness-Tension

A Single Category Implicit Association Test (SC-IAT) was used to examine the implicit association between the evaluative dimension of calmness-tension and physical activity. The SC-IAT is considered to be more flexible than a regular IAT because it does not require a comparative dimension. Where the regular IAT is a measure that makes use of a dichotomy, the SC-IAT measures a single association, making it more flexible (Karpinski & Steinman, 2006). Participants can focus solely on physical activity without any potential confounding effects or far-fetched comparative dimensions (Karpinski & Steinman, 2006). The SC-IAT assessed the strength of biased association an individual might hold by

measuring reaction times of certain evaluative associations that underlie implicit attitudes (Greenwald et al., 1998). In the SC-IAT, two attributes are connected to one conceptual target instead of the usual two. Participants have access to two response keys, which are assigned to four categories that are paired in groups of two (Chevance et al., 2017). These categories are mutually exclusive and shown either with positive or negative stimuli. The task of classifying the stimuli was repeated four times, consisting of two practice blocks with 24 trials and two test blocks with 72 trials. In the first practice and test block the positive stimuli are presented together with attitude object words on one response key and the negative stimuli are presented on a separate key (see Figure 4). During the second practice and test block the attitude object words are switched to the negative stimuli response key (see Figure 5) (Schimmack, 2019; Karpinski & Steinman, 2006). This categorisation had to be done as accurately and as quickly as possible. When an individual takes too long to answer, the SoSci survey platform notifies them to respond faster.

Figure 4

Example of the SC-IAT During the First Round

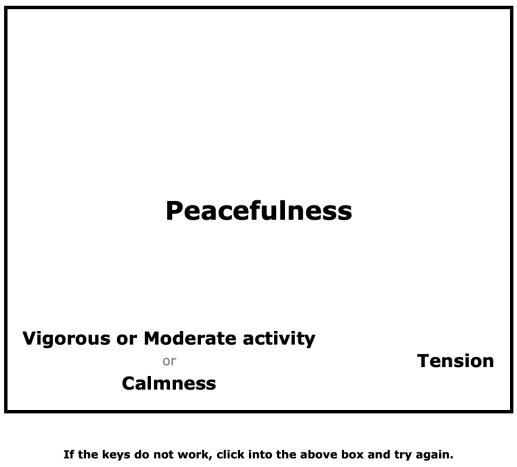
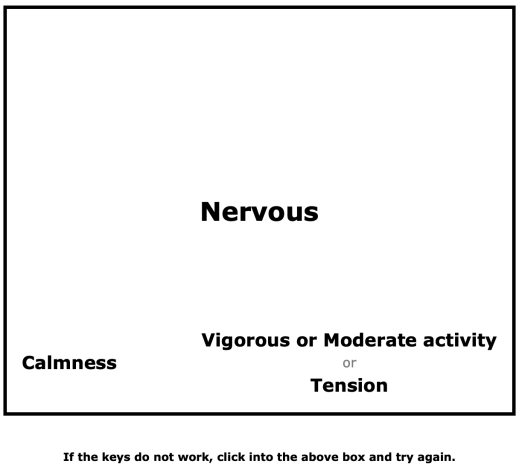


Figure 5

Example of the SC-IAT During the Second Round



In this research, participants are asked to distinguish between calmness and tension. Both stimuli are connected to vigorous or moderate activity and are divided over four blocks. For the first round, physical activity is paired with positive stimuli, for instance, peacefulness or serenity. During the second round, physical activity is paired with negative stimuli such as anxiousness or nervous. The IAT aims to see which combination the participant scores on faster by measuring their reaction times. Ergo, pre-existing associations are assessed, which is important to know whether a person has certain affective appraisals, or bias, towards physical exercise. Based on the reaction times on the four blocks, the survey software calculated a D-score. A positive D-score indicates that the relationship between physical activity and the positive stimulus calmness is stronger. Meaning that a negative D-score indicates a stronger relationship between physical activity and tension, the negative stimulus. These D-scores are the only scores in this research that can be both positive and negative. When the D-score is close to 0, no relationship between the concept and the evaluative dimension is found (Karpinski & Steinman, 2006). Whenever the participant did not respond or took too long, a D-score of -9 was given, which is considered a missing variable. If an error was made, it was

replaced by the mean of the block and a penalty of 400 milliseconds, lowering the score (Karpinski & Steinman, 2006).

Data analysis

The online survey platform SoSci Survey was used to create and operate the questionnaire. To statistically analyse the data, the data were downloaded from SoSci Survey and imported into Rstudio version 2024.04.0. First, the data were cleaned by eliminating incomplete data, for instance, if a participant did not complete the survey. Additionally, a D-score of -9 was considered an incorrect test score and was therefore also deleted. After this, all the questionnaires that were unnecessary for this research were removed. The variables for the moderate exercise intention and vigorous exercise intention questionnaires, core affective experience calmness-tension derived from the AFFEXX questionnaire, PSS, as well as the D-scores from the calmness-tension IAT were screened and some items from the core affective experience calmness-tension and the PSS had to be reverse-coded. When all the necessary variables were combined into one dataset, the distribution of the data needed to be analysed by using descriptive statistics to calculate the mean, median and standard deviation of these variables and by calculating their skewness values to assess the distributions. Next, the age, gender and nationality of the sample were analysed to create an overview of participant demographics.

To answer the first research question, implicit measures for the construct of calmness-tension derived from the SC-IAT and explicit measures derived from the core affective experience calmness-tension needed to be compared. A bivariate correlation analysis had to be conducted to check for any correlation between explicit and implicit measures. Data needs to be checked for normality by using the Shapiro-Wilk test and Q-Q plots. If the data are normally distributed, a Pearson correlation coefficient can be used to calculate the correlation between the two variables, if they are not normally distributed, using Spearman's Rank

coefficient would be considered more appropriate (see Appendix E for parametric assumption testing).

To answer the second research question, the variables core affective experience calmness-tension, intention to moderate activity and intention to vigorous activity needed to be compared. Either Pearson or Spearman correlation coefficients could be used to test the correlation between both calmness-tension and intention to moderate activity and calmness-tension and intention to vigorous activity, depending on whether the data are normally distributed, using the cor.test() function (Van den Berg, 2024). Data were tested for normality with the Shapiro-Wilk test and Q-Q plots, linearity and multicollinearity through the use of scatterplots and outliers by using boxplots (see Appendix E).

For the third research question, a moderation analysis needed to be done for the variable stress on the relationship between calmness-tension and vigorous exercise intention, which has been tested in the past research question. PSS as an interaction term had to be added to the product of the correlation analysis from the second research question with vigorous exercise intention as the dependent variable using the lm() function and the tidyverse package (Van den Berg, 2024). First, a linear model is fitted without the interaction term and then one were PSS is added. This could be parametric, such as a linear model with an interaction effect with normally distributed data or by transforming the data logarithmically, or non-parametric, such as a linear model with rank-transformed variables.

Results

Before analysing the questionnaire, the background variables age, gender, nationality, and exercise background were analysed. Only individuals aged 18 and older who understand English could participate in the questionnaire. Participants who did not meet these criteria were excluded from the dataset. This resulted in a final sample size of 81 participants who

completed the questionnaire. The participants were mostly young adults, and the majority were Dutch (59,3%). The mean number of days of exercising moderately (4.4) is higher than the mean number of days of exercising vigorously (2.6). This means that the sample is quite active daily, but not active enough to meet the national exercise guidelines (see Table 1).

Table 1

Descriptive Statistics of Background Variables

Variable	Participants (N = 81)
Age	
Mean (SD)	25.0 (9.5)
Gender	
Female	45 (55,6%)
Male	34 (42,0%)
Non-binary/Third Gender	1 (1,2%)
Other	1 (1,2%)
Nationality	
Dutch	48 (59,3%)
German	15 (18,5%)
Other	18 (22,2%)
Days Per Week of Moderate Exercise	
Mean (SD)	4.4 (2.4)
Median [Min, Max]	5 [0, 8]
Days Per Week of Vigorous Exercise	
Mean (SD)	2.6 (1.8)
Median [Min, Max]	2 [0, 7]

Table 2 presents the descriptive statistics for the questionnaires that were used in this research. The sample showed a high mean on both moderate and vigorous exercise intention,

meaning that participants were generally quite active moderately and vigorously. Moreover, participants reported low levels of stress over the past month, with a mean score (SD) of 2.7 (0.6) on the Perceived Stress Scale (PSS). They also reported relatively high levels of calmness during exercise, as evidenced by a mean (SD) of 5.2 (1.1) on the core affective experience calmness-tension scale. Furthermore, a mean D-score of 0.1 on the calmness-tension Implicit Association Test (IAT) indicated little to no relationship between the stimulus and physical activity. This entails that the relationship between the intention to be vigorously active and affective experiences expressed as calmness is small.

Table 2

Descriptive Statistics of Questionnaires

Variable	**M**	**SD**	**Skewness**
Moderate Exercise Intention	6	1.1	-1.49
Vigorous Exercise Intention	5.3	1.9	-0.96
Core Affective Experience Calmness-Tension	5.2	1.1	-0.93
Calmness-Tension SC- IAT[a] (D-score)	0.1	0.4	-0.55
Perceived Stress Scale	2.7	0.6	0.22

Note. N = 81

[a] Single Category Implicit Association Test.

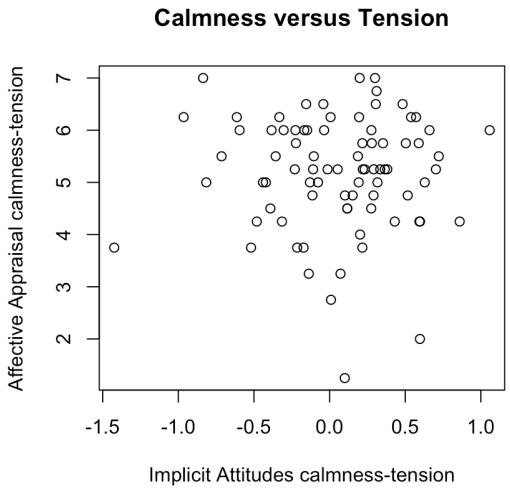
An assessment of assumptions for parametric tests followed. The Shapiro-Wilk test for normality indicated that the core affect calmness-tension was not normally distributed (W = .94, p = .002), with a significance level set at 0.05. The D-score of the calmness-tension SC-IAT showed a value of W = .98, p = .23, meaning that the data is approximately normally distributed. However, the assumptions for linearity and multicollinearity between the calmness-tension SC-IAT and the core affect calmness tension were not met, and both showed outliers.

Additionally, the parametric assumptions for both the total moderate and total vigorous exercise intention scores were not met. However, intention to moderate activity had a greater skewness value (-5,51 (SE = .27)) than intention to vigorous activity (-0,98 (SE = .27)), which indicates that participants generally intended to be quite active on a moderate level on a day-to-day basis. Nevertheless, both variables scored $p < 0.05$ on the Shapiro-Wilk test and did not show linearity and multicollinearity. However, the PSS did show a normal distribution ($W = .25$, $p = .52$) and no outliers.

After the parametric assumptions were checked, inferential statistical analyses were conducted to gain insight into the research questions. To analyse the first research question, the relationship between the core affective experience calmness-tension and the calmness-tension SC-IAT was tested. The Spearman's rank correlation analysis showed an insignificant relationship (r (79) = .01, $p = .94$) which was confirmed by a scatterplot (see Figure 6).

Figure 6

Relationship Between Implicit and Explicit Measurements of Calmness-Tension



The second research question poses the question of to what extent the core affective experience calmness-tension is positively associated with the intention to engage in moderate and vigorous physical activity. To investigate this relationship, Spearman's rank correlation coefficient was used. The Spearman's rank correlations (see Table 3) showed a significant

positive effect for moderate activity on the core affective experience calmness-tension (r (79) = .34, p = .002). It also showed a significant positive effect for vigorous activity on the core affective experience calmness-tension (r (79) = .38, p < .001).

Table 3

Results of Spearman's Rank Correlation of the Core Affective Experience Calmness-Tension, Perceived Stress Scale, Moderate and Vigorous Exercise Intention (r)

	1.	2.	3.	4.
1.Moderate Exercise Intention	1	-	-	-
2.Vigorous Exercise Intention	-	1	-	-
3.Core Affective Experience Calmness-Tension	.34**	.38***	1	-
4.Perceived Stress Scale	-	-.30	-.17	1

Note. * p < 0.05, ** p < 0.01, *** p <0.001

The third research question is to what extent the stress levels moderate the association between the core affective experience calmness-tension and the intention for vigorous physical activity. First, a Spearman's rank correlation (see Table 3) was conducted for the relationship between PSS and vigorous exercise intention since it is important to understand the relationship between the moderator and dependent variables. A significant negative correlation was found for this relationship (r (79) = -.30, p = .006), meaning that increased perceived stress is associated with lower intention to exercise vigorously.

Since the data were not normally distributed, a logarithmic transformation was used. However, the data still did not show a normal distribution. Therefore, a rank-transformed linear regression analysis was conducted to assess the interaction effect of stress levels on the relationship between the core affective experience calmness-tension and perceived stress levels. First, a linear model without the moderator variable PSS was conducted, with core

affective experience calmness-tension and PSS as the dependent variables and vigorous exercise intention as the independent variable (see Table 4), which was significant $F(2,78) = 9.96$, $p < 0.001$ and explained 20.3% of the variance in the intention for vigorous exercise ($R^2 = 0.20$, $R^2_{adj} = 0.18$).

Table 4

Effects of the Core Affective Experience Calmness-Tension and Stress Levels on Vigorous Exercise Intention

Rank variable	**Estimate**	**SE**	**t-value**	**p-value**
Intercept	36.95	6.83	5.41	<0.001
Core Affective Experience Calmness-Tension	.34	.10	3.32	0.001
Perceived Stress Scale	-.24	.10	-2.36	.021

Furthermore, the main effect of the core affective experience calmness-tension was significant (ß = .34, $t(78) = 3.32$, $p = .001$). This indicates that, if the variables are constant, an increase of one unit in the core affective experience calmness-tension is associated with a .34 unit increase in intention for vigorous exercise. That means that higher levels of calmness are associated with higher intentions for vigorous exercise. After adding stress as a moderator variable, the regression model was found to be significant ($F(3,77) = 9.15$, $p < 0.001$) and explained 26.3% of the variance in the intention for vigorous exercise ($R^2 = 0.26$, $R^2_{adj} = 0.23$) (see Table 5). The interaction effect between the core affective experience calmness-tension and stress was significant and added 6% to the explained variance (ß = -0.01, $t(77) = -2.49$, $p = .015$), suggesting that stress levels negatively moderate the relationship between the core affective experience calmness-tension and vigorous exercise intention. As calmness-tension increases, vigorous exercise intention increases for individuals with high and low stress, but this happens at a much slower rate for individuals with high stress compared to those with low stress as the steepness of the lines indicates (see Figure 7). Thus, the positive relationship

between the core affective experience calmness-tension and the intention to vigorous exercise is weakened by high stress levels and strengthened by low stress levels.

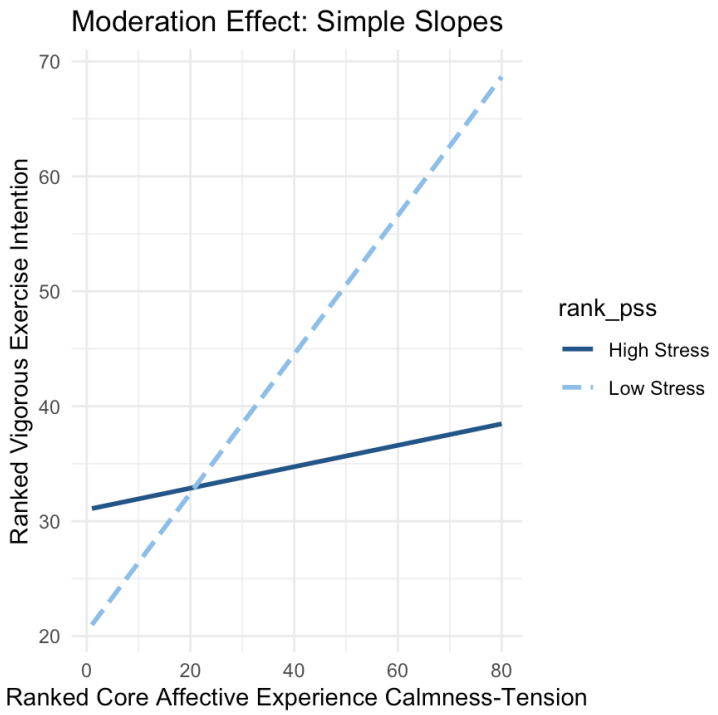
Table 5

Moderating Effects of Perceived Stress Levels of the Core Affective Experience Calmness-Tension on Vigorous Exercise Intention

Rank variable	**Estimate**	**SE**	**t-value**	**p-value**
Intercept	16.41	10.57	1.55	.125
Core Affective Experience Calmness-Tension	.79	.21	3.83	<0.001
Perceived Stress Scale	.23	.21	1.07	.289
Core Affective Experience Calmness-Tension * Perceived Stress Scale	-.01	.004	-2.49	.015

Figure 7

Interaction Plot of the Perceived Stress Scale on the Relationship between the Core Affective Experience Calmness-Tension and Vigorous Exercise Intention



Discussion

Physical activity holds a different meaning for everyone, underlining the importance of considering the differences in beliefs and affect to draw a more concrete picture of why people exercise or why they do not (Ekkekakis et al., 2021). This research aims to compare the implicit and explicit measurements of the core affective experience calmness-tension, to test their connection towards exercise intention and the moderating effects of stress on this relationship. This research has touched upon important variables that inhibit or facilitate both moderate and vigorous exercise intention, providing important insights into the differences in exercise intentions between individuals.

The first research question aims to explore the difference between the implicit measurement of the core affective experience calmness-tension through the use of a SC-IAT, and the explicit measurement with the AFFEXX questionnaire. When answering this question, the results show that there was no significant correlation. Therefore, the first hypothesis that there is a significant positive relationship between the core affective experience calmness-tension measured by the AFFEXX questionnaire and the implicit attitude towards exercise measured by the SC-IAT must be rejected. These results have made it evident that the two tests differ more from each other than merely measuring conscious and unconscious biases. Even though these findings align with the Affective-Reflective Theory (ART), a dual process model that distinguishes between type 1 and type 2 processes (Brand & Ekkekakis, 2018). The SC-IAT is similar to the unconscious type 1 processes, whereas the AFFEXX corresponds with the slower type 2 processes requiring cognitive evaluation. Multiple studies found that the strength of the relationship between explicit and implicit measures may be linked to the importance of the attitude. An attitude of high importance allows an individual to evaluate and elaborate on that attitude, leading to a similar score on implicit and explicit measurements (Karpinski et al., 2005; Nosek et al., 2002). Similarly,

topics with high social desirability concerns, such as certain prejudices, have a higher risk of participants changing their answers on explicit self-report measures. In that case, the answers on the SC-IAT would be more reliable. Therefore, the correlation between implicit and explicit measures on sensitive topics is lower (Greenwald et al., 2009; Hofmann et al., 2005; Nosek et al., 2002). A study by Karpinski and Hilton (2001) found that even when the pressure to give socially desirable answers was minimised, a correlation between the two measures was not found. They also state that the IAT can be influenced by one's environment, shifting the IAT from a measure of predicting behaviour to a measure of one's shaping environment and culture. Another reason for the low correlation might be the differences in the evaluation of memories in the explicit measure and forced spontaneity in the implicit measure (Hofmann et al., 2005). Participants might have deliberately processed their answers during the AFFEXX questionnaire, choosing moments in which they were exercising differently, while this was not possible during the automatic activation of the SC-IAT. Thus, it is important to consider that reporting on past affective experiences through a self-report measure might give a biased reflection of present affective experiences (Ekkekakis et al., 2021) and may therefore not align with scores on the SC-IAT. In conclusion, it is important to view the AFFEXX and the SC-IAT as independent measures and emphasise the complexity of combining these methods to measure the same construct.

Subsequently, the second research question investigates to what extent the core affective experience calmness-tension is associated with the intention to engage in moderate and vigorous physical activity. The results show that the core affective experience calmness-tension is moderately associated with the intention to engage in both moderate and vigorous exercise. This is in line with previous research from Ekkekakis et al. (2021), which found similar scores. Also, according to Ekkekakis et al. (2021) and Schinkoeth & Brand (2020), negative core affective valence can play an important role in exercise intentions, as it

influences one's reasoning about engaging in exercise, which affects behaviour through behavioural urges. The ART focuses on both the implicit and explicit nature of behaviour, whereas intentions are generally considered to be deliberate cognitions. However, according to the ART, the two processes are constantly working together. Therefore, it can be concluded that the ART's core affective experiences directly affect behavioural intention (Brand & Ekkekakis, 2018; Ekkekakis et al., 2021). Thus, the hypothesis that there is a bivariate correlation between the core affective experience calmness-tension and exercise intention can be accepted; suggesting that individuals who feel calmer are more likely to have the intention to exercise both moderately and vigorously when compared to individuals who experience higher levels of tension. Limited research has been done within the theoretical framework of this study on the relationship between the calmness-tension dimension and behavioural intention rather than the actual behaviour. Nonetheless, a study by Rhodes & Plotnikoff (2006) found that self-efficacy beliefs were important determinants of exercise intention, which is in line with the TPB that states that attitudes, subjective norms and perceived behavioural control influence behaviours. Additionally, self-efficacy and the core affective experience calmness-tension were found to be moderately correlated (Ekkekakis et al., 2021). Hence, individuals who experience more calmness in their lives have higher self-efficacy beliefs, leading to more positive attitudes and a higher perceived behavioural control. This means that the core affective experience calmness-tension might be an important predictor of exercise intention, but it is important to consider it within the greater framework of behaviour change interventions.

Lastly, to answer the third research question "To what extent are stress levels moderating the association between the core affective experience calmness-tension and the intention for vigorous physical activity?", the analyses showed a significant negative effect for the interaction of stress levels on the relationship between vigorous exercise intention and

the core affective experience calmness-tension. Therefore, hypothesis 3 suggesting that stress levels moderate the relationship between the core affective experience calmness-tension and the intention for vigorous exercise intention can be accepted, meaning that the relationship is stronger for individuals with lower stress levels and weaker for those with higher stress levels. A study by Pfeffer et al. (2020) researched the intention-behaviour gap. The study showed that stress was a moderator for exercise intention in combination with self-control, meaning that low levels of stress together with medium to high levels of self-control were associated with a higher intention to engage in physical activity. This means that stress might not be the only moderator variable in this research, or a different effect could be found for other study designs. Englert and Rummel (2016) found that self-control mediated the relationship between stress and exercise intention. Self-control strength was found to be lower on days when stress levels were high. Therefore, it can be concluded that stress is a barrier to having and maintaining an active lifestyle, but numerous other factors such as self-efficacy and self-control play a role in exercise intention as well. These findings are also interesting to combine with the two processes from the ART, due to the fact that they are constantly in interplay with each other just like self-control and self-efficacy consist of a combination of conscious and unconscious processes. Ultimately, this leads to a deliberate, conscious decision to engage in physical activity.

Strengths and Limitations

Several strengths can be identified when reflecting upon this research's findings. Particularly the scope of the study is considered to create a solid foundation for this research. The contradicting values of calmness and tension concerning exercise intention have been measured both implicitly and explicitly, with the focus on obtaining broader and more reliable results. Moreover, the research has been open to all individuals aged 18 years and older, regardless of their demographic and exercise backgrounds. This is unlike other research that

has been done in this field that focused on specific groups of people such as elite male athletes (Jun & Kim, 2024), women (Mouchacca et al., 2013) or college students (Buckworth & Nigg, 2004). Therefore, this research gives a better perspective on the exercise behaviours of the general population and allows this study to draw conclusions that apply to a wider range of individuals.

However, it is also important to acknowledge the limitations of this research. Firstly, the questionnaire took longer than the study information stated, which led to quite a lot of participants dropping out. Since the SC-IAT was part of the last block of questions and considered cognitively demanding, the participants who did complete the entire questionnaire had likely lost their concentration near the end which could have affected their answers and reaction times. Thus, the scores might not give an accurate representation of the sample. Further, the sample size might be too small to draw correct conclusions. Relatively many people started the questionnaire, but only 81 cases were deemed valid. This is due to missing variables from the SC-IAT or unacceptable D-scores that were given out by the software in the case of reaction times that were missing or too long. A low completion rate might mean that there is a selection bias, meaning that only those individuals who have the motivation and time to finish the questionnaire are included in the sample. Especially when measuring stress, this selection bias is important to account for since it might skew the results, which can influence the generalisability of the sample. Additionally, the IATs were perceived as quite difficult on a cognitive level, meaning that the combination of a loss of concentration and agitation due to the duration of the questionnaire might have influenced the results. A study by Greenwald et al. (2003) highlighted the cognitively challenging aspect of the IAT and indicated that participants who had prior experience with completing an IAT experienced a reduced cognitive load. Also, it is important to keep in mind that the statistical reliability of the regular IAT is too low to measure individual differences, especially the test-retest

reliability needs to be improved, for example by administering the test twice to the same individual or combining it with multiple self-report measures (Greenwald et al., 2009; Greenwald et al., 2021). Therefore, it can be concluded that the demanding nature of the IAT, issues concerning reliability and validity and the fact that it was part of the last block of questions might have negatively influenced the results, which is important to consider when analysing and interpreting the D-scores.

Suggestions for Future Research

The findings of this research would suggest that future interventions focused on changing exercise-related behaviours should aim to reduce stress in individuals before they are encouraged to exercise. This could enhance long-term exercise intentions by creating more durable behaviour change by shifting the focus to the root cause of the problem. When combining this knowledge with other behaviour change theories, a more comprehensive exercise intervention can be created.

Furthermore, a Single Category Implicit Association Test (SC-IAT) was chosen in this research because of its shorter duration and its flexibility, however, the test-retest reliability of the regular IAT was proven to be higher than the SC-IAT when testing for physical activity and sedentary behaviour (Chevance et al., 2017; Karpinski & Steinman, 2006). The SC-IAT might fail to apprehend the results from the full perspective because of its narrow spectrum and because it is not yet as robust as a regular IAT. Therefore, in future research, it is important to carefully consider the differences between the SC-IAT and the regular IAT and critically evaluate which one might be better equipped to answer the research question.

Lastly, it is important to take into account the discrepancies between the SC-IAT and the AFFEXX in future research. The outcome of this study indicates that there is no correlation between the two measures, even when the construct that is measured is the same. Therefore, in future research, the SC-IAT and the AFFEXX should not be used

interconnectedly but rather as two separate measures with their own unique strengths and limitations.

Conclusion

To conclude, this research has underlined the importance of analysing the complex interplay between the core affective experience calmness-tension, exercise intention and the role of stress levels in this relationship. This research has provided new insights by highlighting the relevance of shifting attention towards stress levels when creating interventions to promote vigorous physical activity and underlining the implications of using a SC-IAT. The question of why some people inherently enjoy exercise while others detest the thought of it remains difficult to answer. Nevertheless, acknowledging the critical role of stress on exercise intention is a step in the right direction for the creation of future behavioural change interventions and the first step to increasing the number of people in the Netherlands who meet the national exercise guidelines.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior And Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-t

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology & Health*, *26*(9), 1113–1127. https://doi.org/10.1080/08870446.2011.613995

Brand, R., & Ekkekakis, P. (2018). Affective–Reflective Theory of physical inactivity and exercise. *German Journal Of Exercise And Sport Research*, *48*(1), 48–58. https://doi.org/10.1007/s12662-017-0477-9

Buckworth, J., & Nigg, C. (2004). Physical Activity, Exercise, and Sedentary Behavior in College Students. *Journal Of American College Health*, *53*(1), 28–34. https://doi.org/10.3200/jach.53.1.28-34

Budden, J. S., & Sagarin, B. J. (2007). Implementation intentions, occupational stress, and the exercise intention-behavior relationship. *Journal Of Occupational Health Psychology*, *12*(4), 391–401. https://doi.org/10.1037/1076-8998.12.4.391

Chevance, G., Bernard, P., Chamberland, P. É., & Rebar, A. L. (2019). The association between implicit attitudes toward physical activity and physical activity behaviour: a systematic review and correlational meta-analysis. *Health Psychology Review*, *13*(3), 248–276. https://doi.org/10.1080/17437199.2019.1618726

Chevance, G., Héraud, N., Guerrieri, A., Rebar, A. L., & Boiché, J. (2017). Measuring implicit attitudes toward physical activity and sedentary behaviors: Test-retest reliability of three scoring algorithms of the Implicit Association Test and Single Category-Implicit Association Test. *Psychology Of Sport And Exercise*, *31*, 70–78. https://doi.org/10.1016/j.psychsport.2017.04.007

Cijfers en feiten sport en bewegen. (n.d.). Loketgezondleven.nl. https://www.loketgezondleven.nl/gezondheidsthema/sport-en-bewegen/cijfers-en-feiten-sport-en-bewegen

Cohen, S., Kamarck, T. W., & Mermelstein, R. J. (1983). A Global Measure of Perceived Stress. *Journal Of Health And Social Behavior/Journal Of Health & Social Behavior*, *24*(4), 385. https://doi.org/10.2307/2136404

Deslandes, A. C., Moraes, H., Ferreira, C., Veiga, H., Silveira, H., Mouta, R. J. O., Pompeu, F., Coutinho, E. S. F., & Laks, J. (2009). Exercise and Mental Health: Many Reasons to Move. *Neuropsychobiology*, *59*(4), 191–198. https://doi.org/10.1159/000223730

Ekkekakis, P., Zenko, Z., & Vazou, S. (2021). Do you find exercise pleasant or unpleasant? The Affective Exercise Experiences (AFFEXX) questionnaire. *Psychology Of Sport And Exercise*, *55*, 101930. https://doi.org/10.1016/j.psychsport.2021.101930

Englert, C., & Rummel, J. (2016). I want to keep on exercising but I don't: The negative impact of momentary lacks of self-control on exercise adherence. *Psychology Of Sport And Exercise*, *26*, 24–31. https://doi.org/10.1016/j.psychsport.2016.06.001

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal Of Personality And Social Psychology*, *74*(6), 1464–1480. https://doi.org/10.1037/0022-3514.74.6.1464

Greenwald, A. G., Nosek, B. A., University of Washington, University of Virginia, & Harvard University. (2003). Understanding and Using the Implicit Association Test: I. An Improved Scoring Algorithm. *Journal Of Personality And Social Psychology*, *85–85*(2), 197–216. https://doi.org/10.1037/0022-3514.85.2.197

Greenwald, A. G., Poehlman, T. A., Uhlmann, E. L., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *Journal Of Personality And Social Psychology*, *97*(1), 17–41. https://doi.org/10.1037/a0015575

Greenwald, A. G., Brendl, M., Cai, H., Cvencek, D., Dovidio, J. F., Friese, M., Hahn, A., Hehman, E., Hofmann, W., Hughes, S., Hussey, I., Jordan, C., Kirby, T. A., Lai, C. K., Lang, J. W. B., Lindgren, K. P., Maison, D., Ostafin, B. D., Rae, J. R., . . . Wiers, R. W. (2021). Best research practices for using the Implicit Association Test. *Behavior Research Methods*, *54*(3), 1161–1180. https://doi.org/10.3758/s13428-021-01624-3

Hagger, M. S., Chatzisarantis, N. L., & Biddle, S. J. (2002). A Meta-Analytic Review of the Theories of Reasoned Action and Planned Behavior in Physical Activity: Predictive

Validity and the Contribution of Additional Variables. *Journal Of Sport & Exercise Psychology*, *24*(1), 3–32. https://doi.org/10.1123/jsep.24.1.3

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A Meta-Analysis on the Correlation Between the Implicit Association Test and Explicit Self-Report Measures. *Personality & Social Psychology Bulletin*, *31*(10), 1369–1385. https://doi.org/10.1177/0146167205275613

Jun, M., & Kim, S. (2024). Differences in Exercise Stress, Job Satisfaction, Intention to Quit Exercise, and Quality of Life According to the Psychological Abuse Experiences of Elite Male Athletes. *Behavioral Sciences*, *14*(5), 392. https://doi.org/10.3390/bs14050392

Karpinski, A., & Steinman, R. B. (2006). The Single Category Implicit Association Test as a measure of implicit social cognition. *Journal Of Personality And Social Psychology*, *91*(1), 16–32. https://doi.org/10.1037/0022-3514.91.1.16

Lee, E. (2012). Review of the Psychometric Evidence of the Perceived Stress Scale. *Asian Nursing Research*, *6*(4), 121–127. https://doi.org/10.1016/j.anr.2012.08.004

McEwen, B. S. (2007). Physiology and Neurobiology of Stress and Adaptation: Central Role of the Brain. *Physiological Reviews*, *87*(3), 873–904. https://doi.org/10.1152/physrev.00041.2006

Mouchacca, J., Abbott, G. R., & Ball, K. (2013). Associations between psychological stress, eating, physical activity, sedentary behaviours and body weight among women: a longitudinal study. *BMC Public Health*, *13*(1). https://doi.org/10.1186/1471-2458-13-828

Nosek, B. A., Banaji, M., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics*, *6*(1), 101–115. https://doi.org/10.1037/1089-2699.6.1.101

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, *18*(2), 189–193. https://doi.org/10.1097/00001504-200503000-00013

Pfeffer, I., Englert, C., & Mueller-Alcazar, A. (2020). Perceived stress and trait self-control interact with the intention–behavior gap in physical activity behavior. *Sport, Exercise, And Performance Psychology*, *9*(2), 244–260. https://doi.org/10.1037/spy0000189

Rhodes, R. E., & Plotnikoff, R. C. (2006). Understanding action control: Predicting physical activity intention-behavior profiles across 6 months in a Canadian sample. *Health Psychology*, *25*(3), 292–299. https://doi.org/10.1037/0278-6133.25.3.292

Schimmack, U. (2019). The Implicit Association Test: A Method in Search of a Construct. *Perspectives On Psychological Science*, *16*(2), 396–414. https://doi.org/10.1177/1745691619863798

Schinkoeth, M., & Brand, R. (2020). Automatic associations and the affective valuation of exercise: disentangling the type-1 process of the affective–reflective theory of physical inactivity and exercise. *German Journal Of Exercise And Sport Research*, *50*(3), 366–376. https://doi.org/10.1007/s12662-020-00664-9

Stults-Kolehmainen, M., & Sinha, R. (2013). The Effects of Stress on Physical Activity and Exercise. *Sports Medicine*, *44*(1), 81–121. https://doi.org/10.1007/s40279-013-0090-5

Taylor, J. (2015). Psychometric analysis of the Ten-Item Perceived Stress Scale. *Psychological Assessment*, *27*(1), 90–101. https://doi.org/10.1037/a0038100

Van den Berg, S. M. (2024). *Chapter 9 Moderation: testing interaction effects | Analysing Data using Linear Models*. https://bookdown.org/pingapang9/linear_models_bookdown/moderation.html

VanKim, N. A., & Nelson, T. F. (2013). Vigorous Physical Activity, Mental Health, Perceived Stress, and Socializing among College Students. *American Journal Of Health Promotion*, *28*(1), 7–15. https://doi.org/10.4278/ajhp.111101-quan-395

Wang, F., & Boros, S. (2019). The effect of physical activity on sleep quality: a systematic review. *European Journal Of Physiotherapy*, *23*(1), 11–18. https://doi.org/10.1080/21679169.2019.1623314

World Health Organization: WHO. (2022, 5 oktober). *Physical activity*. https://www.who.int/news-room/fact-sheets/detail/physical-activity

Zhai, X., Wu, N., Koriyama, S., Wang, C., Shi, M., Huang, T., Wang, K., Sawada, S. S., & Fan, X. (2021). Mediating Effect of Perceived Stress on the Association between Physical Activity and Sleep Quality among Chinese College Students. *International Journal Of Environmental Research And Public Health*, *18*(1), 289. https://doi.org/10.3390/ijerph18010289

Appendix A

AI statement

During the preparation of this work, the author used no artificial intelligence tools.

Appendix B

Informed Consent Form

What are the intentions of this study?
You are invited to take part in a research study that aims to investigate the relationship between conscious and unconscious emotions towards Physical activity, with the ultimate goal to transform negative associations towards activity in more positive ones.

What does this study look like?
In this first part, you will be asked to fill in a questionnaire. After filling it in, there will be a field to leave your e-mail address. It is important to note that this e-mail address is only going to be used to invite you to the second part of the study, which will consist of an Implicit Association Test. Afterwards, your e-mail address will be deleted from the dataset.

Can I also take part in this study?
If you are 18 years or older, and have sufficient skills in the English language (e.g. reading a text fluently and understanding most of the terms), you are suitable to take part in this study.

Do I need to take part?
No. Participation in this study is voluntary, and you have the right to withdraw at any time without any consequences. If you decide to withdraw, your data will not be used in the study, and any information collected till that point will be discarded.

What will happen when I agree to take part in this study?
When you decide to take part in this study, you will automatically be redirected to the questionnaire, which will take around 20 minutes. In this questionnaire, none of the answers are right or wrong, and we are only interested in your own experiences/opinions.

What are the risks of taking part in this study?
During this research, you will answer questions about yourself, and about experiences that you had with exercise in the past. If at some part you might struggle with possible traumas or other factors detrimental to health, feel free to inform one of the following links:
- https://www.113.nl/ or https://www.slachtofferhulp.nl/ (Dutch)
- https://www.hilfe-info.de (German)
- https://www.mind.org.uk/information-support/types-of-mental-health-problems/trauma/useful-contacts/ (English)

After the data collection, what is going to happen with my results?
For the data analysis, no identifiable information will be used, and every possible thing that could link you to the answers is going to be anonymized. The collected data will be stored on a highly encrypted device which are only accessible for us and our supervisor.

If I have any other questions, whom can I contact then?
The research team for this questionnaire is always open to answering questions, and they are reachable by the following email adresses:
- G.R. Bekhuis (g.r.bekhuis@student.utwente.nl)
- A.M. van den Berg (a.m.vandenberg-1@student.utwente.nl)
- G.S. van Beveren (g.s.vanbeveren@student.utwente.nl)

- A.M. Freiberg (a.m.freiberg@student.utwente.nl'
- L.C. Hessels (l.c.hessels@student.utwente.nl)
- G.P. Kaczmarek (g.p.kaczmarek@student.utwente.nl)
- T. Zandstra (t.zandstra@student.utwente.nl)

Who are the supervisors of the project?
The two supervisors for this project are:
- A. Braakman-Jansen (l.m.a.braakman-jansen@utwente.nl)
- M.E. Pieterse (m.e.pieterse@utwente.nl)

After reading the information on the last page thoroughly and carefully, please indicate if you agree to participate and confirm that you understand the information that is provided. If there are still any questions or concerns present, feel free to ask before proceeding.

Appendix C

Complete Questionnaire

1. **Socio-Demographic Data**

   1.1. Age: How old are you? (write number)

   1.2. Language: Are you proficient in the English language (yes/no)

   1.3. Gender: What gender do you identify with? (female, male, diverse, other, prefer not to say)

   1.4. Nationality: What is your nationality (Dutch, German, other)

   1.5. Main Occupation: What describes your main occupation/job best? (Highschool Student, University Student, Full-Time office job, Part-Time office job, Full-time physically active job, Part-time physically active job, retired, unable to work, unemployed)

   1.6. Marital Status: What is your marital status? (single, partnered, married, divorced, other, prefer not to say)

   1.7. Living Area: What describes the area you live in best? (rural (e.g. smaller town, village), urban (e.g. bigger town, city)

2. **Exercise-related Demographics**

   2.1. In the past: How many different types of sports were you engaged with at least once per week? (write number)

   2.2. Over the past month: How many different types of sports (e.g. football, swimming, jogging, etc.) are you engaged in at least once per week? (write number)

   2.3. What type of sports do you prefer? (indoor vs. outdoor; team vs. individual; ball vs. non-ball; competitive vs. non-competitive; cardio vs. non-cardio) (Polarity scale right-middle-left)

3. **International Physical Activity Questionnaire - Short Form (IPAQ-SF)**

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3.1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

3.2. How much time did you usually spend doing vigorous physical activities on one of those days?

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3.3 During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

3.4. How much time did you usually spend doing moderate physical activities on one of those days?

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

3.5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

3.6. How much time did you usually spend walking on one of those days?

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

3.7. During the last 7 days, how much time did you spend sitting on a weekday?

4. **Intention to Moderate Exercise** (7-point Likert scale; 1= Strongly disagree; 7= Strongly agree)

Moderate exercise is less intense than vigorous exercise and can be sustained for longer periods of time, such as brisk walking, cycling on flat terrain or recreational sports like golf or tennis.

4.1. How likely is it that you will engage in moderate exercise 1-2 times per week over the next month?

4.2. Do you have confidence in your ability to engage in moderate exercise 1-2 times a week?

4.3. How motivated are you to incorporate moderate exercise in your daily routine?

4.4. How determined are you to engage in moderate exercise, despite obstacles you may face?

5. **Intention to Vigorous Exercise**

5.1. How likely is it that you will engage in vigorous exercise 1-2 times per week over the next month?

5.2. Do you have confidence in your ability to engage in vigorous exercise 1-2 times a week?

5.3. How motivated are you to incorporate vigorous exercise in your daily routine?

5.4. How determined are you to engage in vigorous exercise, despite obstacles you may face?

6. **AFFEXX** (7-point bipolar scale)

6.1. Exercising is stimulating. vs. Exercising is boring.

6.2. When my doctor asks if I exercise, I can answer with my head held high. vs. When my doctors ask me if I exercise, I bow my head in shame.

6.3. Exercise is something I dread. vs. Exercise is something I look forward to.

6.4. Exercise is very dull. vs. Exercise is very exciting.

6.5. I love that exercising makes me feel stronger. vs. I hate that exercise may injure me.

6.6. Exercise is an uninviting activity. vs. Exercise is a tempting activity

6.7. I feel good to be getting all the great benefits from exercising. vs. I feel horrible because I feel like I may get hurt from exercise.

6.8. When I exercise, I'd rather be invisible. vs. When I exercise, I love showing off.

6.9. I feel great exercising in a group. vs. I feel intimidated exercising in a group.

6.10. Exercise is enjoyable in a group. vs. Exercise is not enjoyable in a group.

6.11. Exercise makes me feel worse. vs. Exercise makes me feel better.

6.12. Exercise leaves me feeling exhausted. vs. Exercise leaves me feeling energized.

6.13. I feel drained after exercise. vs. I feel revitalized after exercising.

6.14. I would choose exercise over most other activities. vs. I would choose most other activities over exercise

6.15. After exercise, I feel discouraged. vs. After exercise I feel encouraged.

6.16. Exercise gives me a sense of failure. vs. Exercise gives me a sense of accomplishment.

6.17. For me, exercise is a relaxing activity. vs. For me, exercise is a stressful activity.

6.18. Exercise is very tiring. vs. Exercise is very invigorating.

6.19. Exercise gives me serenity. vs. Exercise stresses me out.

6.20. Exercise makes me feel drowsy. vs. Exercise makes me feel refreshed.

6.21. Exercise is something everyone ought to be doing but I am sorry to say that I do not. vs. Exercise is something everyone ought to be doing and I am happy to say that I am.

6.22. Exercise soothes me. vs. Exercise makes me feel tense.

6.23. Exercise is interesting. vs. Exercise is uninteresting.

6.24. When others look at me when I exercise, it makes me feel great. vs. When others look at me when I exercise, it makes me feel terrible.

6.25. Exercise is near the top on the list of things I like. vs. Exercise is near the bottom on the list of things I like.

6.26. I enjoy the thought that exercise builds up my body's defences. vs. The idea that exercise puts stress on my body scares me.

6.27. I love when others watch me as I exercise. vs. I hate it when others watch me as I exercise.

6.28. Exercise deflates my ego. vs. Exercise boosts my ego.

6.29. Exercise is low on my priority list. vs. Exercise is high on my priority list.

6.30. The feeling I get from exercise is awful. vs. The feeling I get from exercise is fantastic.

6.31. Exercise makes me feel peaceful. vs. Exercise makes me feel aggravated.

6.32. Exercise worsens my mood. vs. Exercise improves my mood.

6.33. I love exercising with others. vs. I hate exercising with others.

6.34. Being a regular exerciser is so gratifying. vs. Being an on-and-off exerciser is so embarrassing.

6.35. Exercise feels terrible. vs. Exercise feels wonderful.

6.36. Exercise makes me feel incompetent. vs. Exercise makes me feel like I could do anything.

7. **Body Image Shame Scale (BISS)** (5-point Likert Scale; 1 = Never; 5 = Almost always)

The following questionnaire will ask you about your experiences with bodily shame. The answers range from "never" to "almost always". Please answer which applies to you to most. Each question should only be answered once.

7.1. I avoid social situations because of my appearance

7.2. The relationship I have with my body prevents me from having an intimate relationship with someone

7.3. I avoid moving my body in public places because I feel I am exposing my physical appearance to the criticism of others

7.4. I feel uncomfortable in social situations because I feel that people may criticise me because of my body shape

7.5. My physical appearance makes me feel inferior in relation to others

7.6. I do not like to exercise in front of others because I am afraid of how they might evaluate me

7.7. The relationship I have with my physical appearance makes it difficult for me to feel comfortable in social situations

7.8. I avoid wearing tight clothes that reveal my body shape

7.9. It bothers me to see my body undressed

7.10. When I see my body in the mirror, I feel that I am a defective person

7.11. I choose clothes that hide parts of my body that I consider ugly or disproportional

7.12. I pay close attention to the movements and posture of my body to hide parts that I do not like

7.13. I feel bad about myself when I use clothes that reveal my body shape

7.14. There are parts of my body that I prefer to hide

8. **Emotions during Physical Education classes** (5-point Likert scale; 1 = Strongly Disagree; 5 = Strongly Agree)

8.1. I was proud to be able to keep up with the physical education class

8.2. Because I took pride in my accomplishments in physical education, I am motivated to continue

8.3. I was motivated to go to the physical education class because it is exciting

8.4. I enjoyed being in the physical education class.

8.5. I felt anger welling up in me during the physical education class

8.6. Thinking about all the useless things I had to learn in physical education, annoyed me

8.7. I felt nervous in the physical education class

8.8. I got scared that I might say/do something wrong in the physical education class, and I would rather not say/do anything.

8.9. It was pointless to prepare for the physical education class because I was bad at it anyway.

8.10. I would have rather not gone to the physical education class because it was impossible to perform the exercises correctly

8.11. I got bored during the physical education class.

8.12. I found the physical education class fairly dull

9. **Pittsburgh Sleep Quality Index (PSQI)**

9.1. During the past Month at what time have you usually gone to bed?

9.2. During the past month, how long (in minutes) has it usually takes you to fall asleep each night?

9.3. During the past month, what time have you usually gotten up in the morning?

9.4. 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 spent in bed.)

For each of the remaining questions, check the one best response. Please answer all questions (1 = Not during the past month; 2 = Less than once a week; 3= Once or twice per week; 4 = Three or more times per week)

During the past month, how often have you had trouble sleeping because you…

9.5. … Cannot get to sleep within 30 minutes

9.6. … Wake up in the middle of the night or early morning

9.7. … Have to use the bathroom

9.8. … Cannot breathe comfortably

9.9. … Cough or snore loudly

9.10. … Feel too cold

9.11. … Feel too hot

9.12. … Had bad dreams

9.13. … Have pain

9.14. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

9.15. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

10. Perceived Variety in Exercise Questionnaire (6-point Likert-scale; 1= False; 6 = True)

10.1. I feel like I engage in a variety of exercises.

10.2. I feel like I try a range of exercises

10.3. I feel like I change the types of exercise that I do

10.4. I feel like my exercise program is varied

10.5. I feel like I experience variety in my exercise

11. Sleep Quality Scale (SQS) (1= Rarely, 2= Sometimes, 3= Often, 4= Almost always)

In the past week, how often have you experienced the following:

11.1. I have difficulty falling asleep

11.2. I fall into a deep sleep

11.3. I fall into a deep sleep

11.4. I have difficulty getting back to sleep once I wake up in the middle of the night

11.5. I wake up easily because of noise

11.6. I toss and turn

11.7. I never go back to sleep after awakening during sleep

11.8. I feel refreshed after sleeping

11.9. I feel unlikely to sleep after sleep

11.10. Poor sleep gives me headaches

11.11. Poor sleep makes me irritated

11.12. I would like to sleep more after waking up

11.13. My sleep hours are enough

11.14. Poor sleep makes me lose my appetite

11.15. Poor sleep makes it hard for me to think

11.16. I feel vigorous after sleep

11.17. Poor sleep makes me lose interest in work or others

11.18. My fatigue is relieved after sleep

11.19. Poor sleep causes me to make mistakes at work

11.20. I am satisfied with my sleep

11.21. Poor sleep makes me forget things more easily

11.22. Poor sleep makes it hard to concentrate at work

11.23. Sleepiness interferes with my daily life

11.24. Poor sleep makes me lose desire in all things

11.25. I have difficulty getting out of bed

11.26. Poor sleep makes me easily tired at work

11.27. I have a clear head after sleep

11.28. Poor sleep makes my life painful

12. Perceived Stress Scale (0 = Never, 1 = Almost never, 2 = Sometimes, 3 = Fairly often, 4 = Very often)

The questions in this scale ask you about your feeling and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

12.1. In the last month, how often have you been upset because of something that happened unexpectedly?

12.2. In the last month, how often have you felt that you were unable to control the important things in your life?

12.3. In the last month, how often have you felt nervous and “stressed”?

12.4. In the last month, how often have you felt confident about your ability to handle your personal problems?

12.5. In the last month, how often have you felt that things were going your way?

12.6. In the last month, how often have you found that you could not cope with all the things that you had to do?

12.7. In the last month, how often have you been able to control irritations in your life?

12.8. In the last month, how often have you felt that you were on top of things?

12.9. In the last month, how often have you been angered because of things that were outside of your control?

12.10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

13. Athletic Identity Measurement Scale (AIMS) (7-point Likert scale; 1= Strongly disagree; 7= Strongly agree)

13.1. I consider myself an athlete

13.2. I have many goals related to sport

13.3. Most of my friends are athletes

13.4. Sport is the most important part of my life

13.5. I spend more time thinking about sport than anything else

13.6. I feel bad about myself when I do poorly in sport

13.7. I would be very depressed if I were injured and could not compete in sport

14. Ten-Item Personality Inventory (TIPI) (7-point Likert Scale; 1 = Strongly Disagree; 7= Strongly Agree)

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

I see myself as…

14.1. … Extraverted, enthusiastic.

14.2. … Critical, quarrelsome.

14.3. … Dependable, self-disciplined.

14.4. … Anxious, easily upset.

14.5. … Open to new experiences, complex.

14.6. … Reserved, quiet.

14.7. … Sympathetic, warm.

14.8. … Disorganized, careless.

14.9. … Calm, emotionally stable.

14.10. … Conventional, uncreative.

15. IAT 1: Energy (Positive) vs. Tiredness (negative and Vigorous or Moderate Activity

15.1. Energy words: Energizing, Strength, Power, Motivation, Active, Full of Energy, Drive, Energetical, Endurance

15.2. Tiredness words: Exhausted, Sore, Tired, Fatigued, Weakness, Sleepiness, Drained, Slow, Heavy

15.3. Vigorous or Moderate Activity words: Cycling, Running, Weightlifting, Swimming, Jogging, Bootcamp, Working Out

16. IAT 2: Calmness (Positive) vs. Tension (Negative) and Vigorous or Moderate Activity

16.1. Calmness words: Peace, Peacefulness, Calm, Serenity, Untroubled, Restful, Harmony

16.2. Tension words: Stress, Anxiousness, Nervous, Pressure, Restless, Tense

16.3. Vigorous or Moderate Activity words: Cycling, Running, Weightlifting, Swimming, Jogging, Bootcamp, Working Out

17. IAT 3: Pleasure (Positive) vs. Displeasure (Negative) and Vigorous or Moderate Activity

17.1. Pleasure words: Enjoyment, Love, Fun, Satisfaction, Joy, Happy, Cheer

17.2. Displeasure words: Discontent, Dissatisfaction, Frustration, Discomfort, Irritation, Distress, Upset

17.3. Vigorous or Moderate Activity words: Cycling, Running, Weightlifting, Swimming, Jogging, Bootcamp, Working Out

18. End

You have now completed the survey! Thank you for your participation! :)

For any questions/wish to withdraw send an email to one of the researchers

Appendix D

Variable (number of items)	Variable type	Variable scale
Exercise experiences (5x)	Ordinal	3-point Likert scale
Intention to moderate activity (4x)	Ordinal	7-point Likert scale
Intention to vigorous activity (4x)	Ordinal	7-point Likert scale
AFFEXX core affective experience calmness-tension (4x)	Continuous	7-point bipolar scale
PSS (10x)	Ordinal	5-point Likert scale
Calmness-tension IAT	Metric	D-score

Appendix E

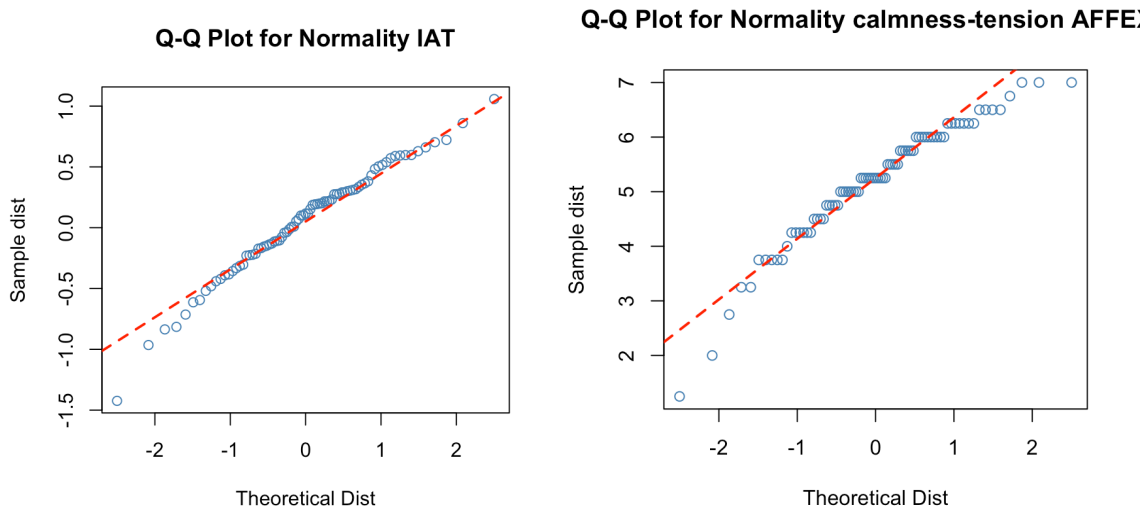
Parametric Assumptions Analysis

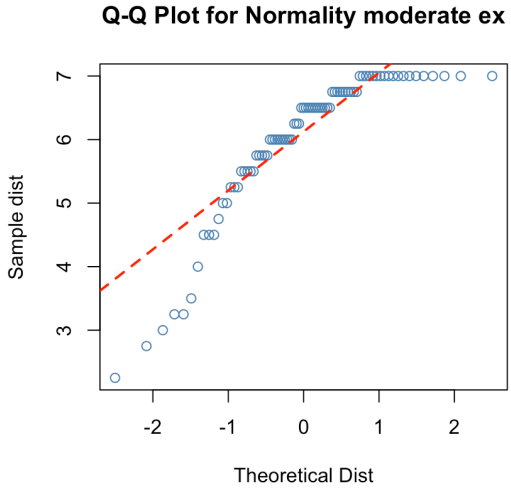
The data is tested for parametric assumptions in R prior to conducting correlation, moderation and interaction analyses. The assumptions that were tested are normality with the Shapiro-Wilk test and a Q-Q plot, linearity and multicollinearity through the use of a scatterplot and outliers by using a boxplot.

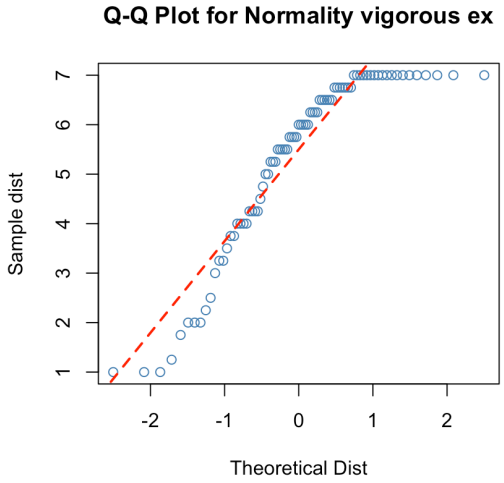
Firstly, the skewness values were observed. Core affective experience calmness-tension scored -.93, the IAT scored -.55, the PSS had a skewness value of -.22intention to moderate exercise showed a skewness value of -1.49 and intention to vigorous exercise showed a skewness value of -.96. Thus, all variables were negatively skewed, which was confirmed by their histograms.

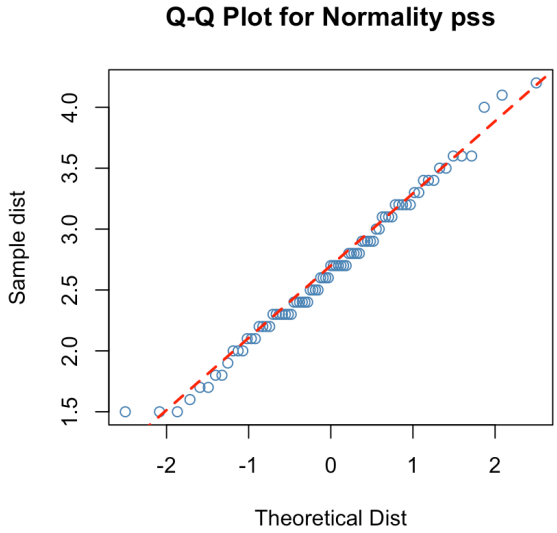
Secondly, the Shapiro-Wilk test was conducted to tests for normality. Only the Calmness-tension IAT and the PSS were normally distributed, showing a p- value that was >0.05. This was confirmed by the Anderson-Darling test and Q-Q plots (see Figure B1).

Figure B1
Q-Q Plots for Normality for All Variables









Lastly, scatterplots were created to assess the linearity and multicollinearity of the data (see Figure B2). And boxplots were made to check whether there were any outliers (see Figure B3).

Figure B2

Scatterplots to Assess Linearity

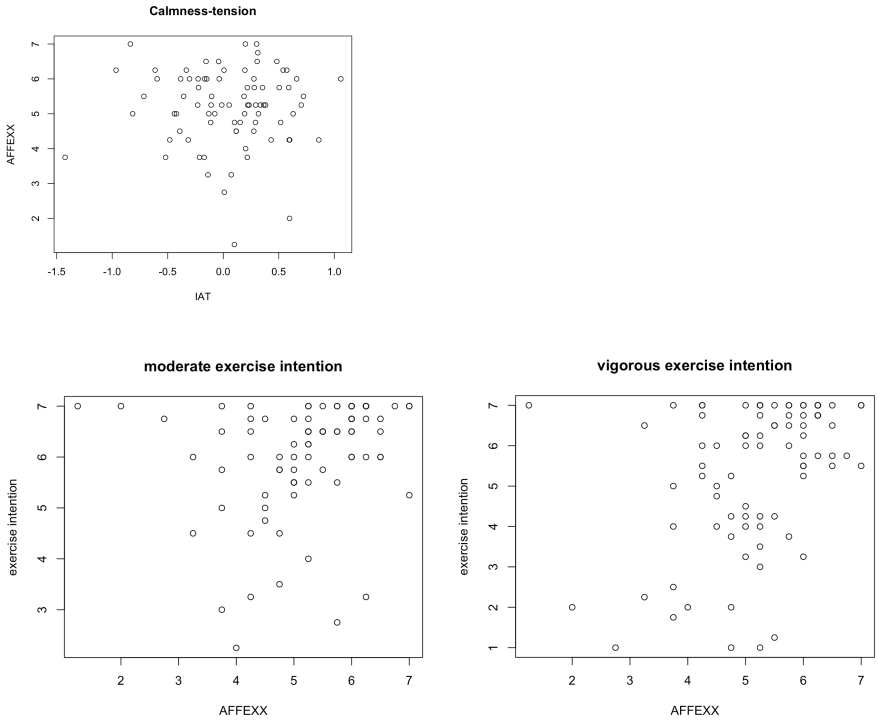
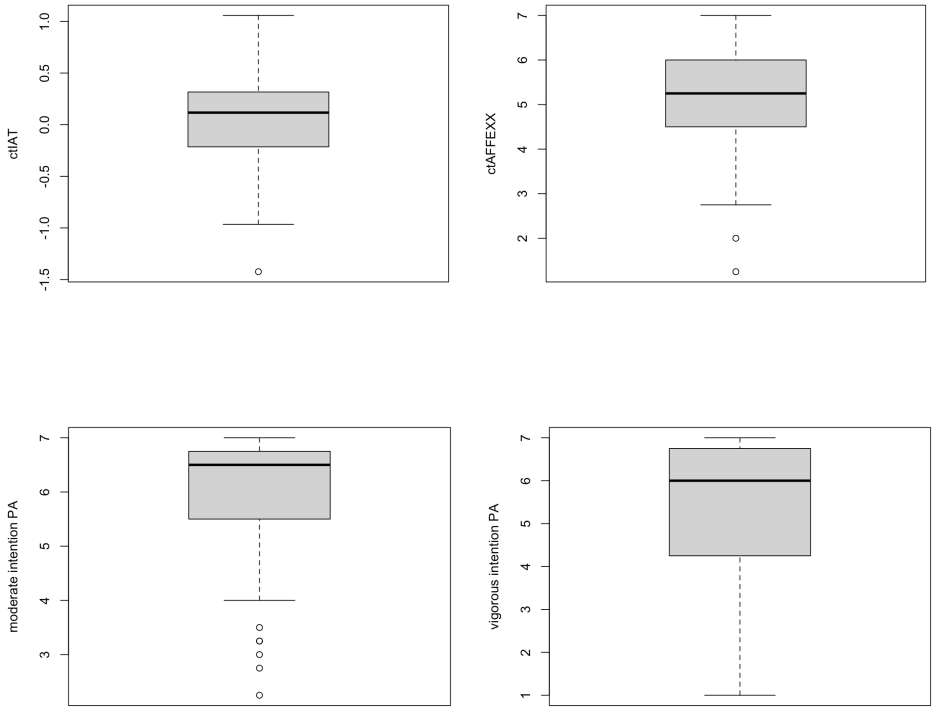


Figure B3
Boxplots to Assess the Number of Outliers



Appendix F

Rstudio script

```
#### DATA CLEANING ####

## install required packages ##
install.packages("tidyverse")
install.packages("lsmeans")
install.packages("emmeans")
install.packages("topicmodels")
install.packages("janitor")
install.packages("car")
install.packages("tidyr")
install.packages("ltm")
install.packages("lme4")
install.packages("psych")
install.packages("dplyr")
install.packages("ggplot2")
install.packages("e1071")
install.packages("quantreg")
install.packages("effects")
install.packages("readxl")
install.packages("table1")
install.packages("nortest")
install.packages("np")
library(np)
library(nortest)
library(table1)
library(readxl)
library(effects)
library(quantreg)
library(e1071)
library(tidyverse)
library(lsmeans)
library(emmeans)
library(dplyr)
library(topicmodels)
library(foreign)
library(broom)
library(janitor)
library(car)
library(tidyr)
library(ltm)
library(lme4)
library(psych)
library(dplyr)
library(ggplot2)
```

```
## import data ##
data <- read_excel("Soscidata_new.xlsx")

## remove row 1 containing question descriptions ##
data <- data[-1, ]

## check variables and remove unneccessary ones ##
column_names <- colnames(data)
print(column_names)
print(class(data))
print(dim(data))
cols.dont.want <- c("CASE", "SERIAL", "REF", "QUESTNNR", "MODE", "STARTED",
                    "A102", "B101_01", "C106_03", "C107_01", "C110", "C111", "C112",
                    "C201_01", "D103_01", "D103_02", "D107_01", "D107_02", "D109_01",
"D110_01",
                    "D110_02", "D112_01", "D112_02", "C201_01", "C203_01",
                    "E201_01", "E201_02", "E201_03", "F201_01",
                    "F201_02", "F201_03", "F201_04", "F201_05", "F201_06",
                    "F201_07", "F201_08", "F201_09", "F201_10", "F201_11",
                    "F201_12", "F201_13", "F201_14", "F301_01", "F301_02",
                    "F301_03", "F301_04", "F301_05", "F301_06", "F301_07",
                    "F301_08", "F301_09", "F301_10", "F301_11", "F301_12",
                    "F401", "F402", "F403", "F404", "F405_02_CN", "F405_02_1",
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                    "F405_05_1", "F405_05_2", "F405_05_3", "F405_05_4", "F405_06_CN",
                    "F405_06_1", "F405_06_2", "F405_06_3", "F405_06_4", "F405_07_CN",
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                    "G101mL2", "G101mL3", "G101mL4", "G101i1", "G101i2", "G101i3",
                    "G101i4","G301i0", "G301xD", "G301xD1", "G301xD2", "G301xD3",
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                    "G301nE1", "G301nE2", "G301nE3", "G301nE4", "G301mL1", "G301mL2",
                    "G301mL3", "G301mL4", "G301i1", "G301i2", "G301i3", "G301i4",
```

```
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                "MAILSENT", "LASTDATA", "FINISHED", "Q_VIEWER", "LASTPAGE",
"MAXPAGE",
                "MISSING", "MISSREL", "TIME_RSI","G201i0", "G201xD1","G201xD2",
"G201xD3",
                "G201nT1", "G201nT2", "G201nT3", "G201nT4", "G201nX1",
                "G201nX2", "G201nX3", "G201nX4", "G201nN1", "G201nN2",
                "G201nN3", "G201nN4", "G201nE1", "G201nE2", "G201nE3",
                "G201nE4", "G201mL1", "G201mL2", "G201mL3", "G201mL4",
                "G201i1", "G201i2", "G201i3", "G201i4")
data <- data[, ! names(data) %in% cols.dont.want, drop = F]
view(data)

## add NA in blank cells ##
data[data == "" | data == " "] <- NA

## make the dataframe numeric ##
data <- as.data.frame(data)
data <- mutate_all(data, as.numeric)
str(data)

## check and remove missing variables ##
col_has_na <- colSums(is.na(data)) > 0
print(names(data)[col_has_na])
is.na(data)
data <- na.omit(data)
data <- data[complete.cases(data), ]
data <- data[data$G201xD != -9, ]
view(data)

## reverse code AFFEXX and PSS ##
AFFEXX_keys <- c("E102_01", "E102_02", "E102_05", "E102_07", "E102_09", "E102_10",
                 "E102_14", "E102_17", "E102_19", "E102_22", "E102_23", "E102_24",
                 "E102_25", "E102_26", "E102_27", "E102_31", "E102_33", "E102_34")
PSS_keys <- c("F701_04", "F701_05", "F701_07", "F701_08")

data[ , AFFEXX_keys] = 8 - data[ , AFFEXX_keys]
data[ , PSS_keys] = 6 - data[ , PSS_keys]

## get an overview of the data ##
names(data)
head(data)
str(data)
summary(data)
```

```
view(data)

#### DESCRIPTIVE STATISTICS ####

## check the data class and structure ##
print(class(data))

## calculate mean and sd of age ##
mean_age <- mean(data$C101_01, na.rm = TRUE)
print(mean_age)

std_dev_age <- sd(data$C101_01, na.rm = TRUE)
print(std_dev_age)

med_dev_age <- median(data$C101_01, na.rm = TRUE)
print(med_dev_age)

min_age <- min(data$C101_01, na.rm = TRUE)
max_age <- max(data$C101_01, na.rm = TRUE)
print(paste("Minimum Age: ", min_age))
print(paste("Maximum Age: ", max_age))

## calculate gender distribution ##
gender_distribution <- table(data$C105)
names(gender_distribution) <- c("Female", "Male", "Non-binary/Third gender",
                                "Other")
print(gender_distribution)

# create a bar plot
colors <- c("#1f77b4", "#ff7f0e", "#2ca02c", "#d62728")
barplot(gender_distribution, col = colors, main = "Gender Distribution",
        xlab = "Gender", ylab = "Count", border = NA)

legend("topright", legend = names(gender_distribution), fill = colors)

## calculate most frequent nationality ##
result <- data %>%
  count(C106) %>%
  top_n(3) %>%
  arrange(desc(n)) %>%
  mutate(C106 = factor(C106, levels = unique(C106)))

print(result)

ggplot(result, aes(x = C106, y = n)) +
  geom_bar(stat = "identity") +
  labs(x = "Nationality", y = "Frequency", title = "Frequency of Nationalities") +
  theme_minimal()

## sports background ##
```

```
mean_modPA <- mean(data$D106_01, na.rm = TRUE)
print(mean_modPA)

std_modPA <- sd(data$D106_01, na.rm = TRUE)
print(std_modPA)

med_modPA <- median(data$D106_01, na.rm = TRUE)
print(med_modPA)

min_moderate <- min(data$D106_01, na.rm = TRUE)
max_moderate <- max(data$D106_01, na.rm = TRUE)
print(min_moderate)
print(max_moderate)

mean_vigPA <- mean(data$D102_02, na.rm = TRUE)
print(mean_vigPA)

std_vigPA <- sd(data$D102_02, na.rm = TRUE)
print(std_vigPA)

med_vigPA <- median(data$D102_02, na.rm = TRUE)
print(med_vigPA)

min_vigorous <- min(data$D102_02, na.rm = TRUE)
max_vigorous <- max(data$D102_02, na.rm = TRUE)
print(min_vigorous)
print(max_vigorous)

# create a descriptive statistics table
label(data$C101_01) <- "Age"
label(data$C105) <- "Gender"
label(data$C106) <- "Nationality"
label(data$D102_02) <- "Days per Week of Vigorous PA"
label(data$D106_01) <- "Days per Week of Moderate PA"

data$C105 <- factor(data$C105, levels = c(1, 2, 3, 4), labels = c("Female", "Male", "Non-
binary/Third Gender", "Other"))
data$C106 <- factor(data$C106, levels = c(1, 2, 3), labels = c("Dutch", "German", "Other"))

table1(~C101_01 + C105 + C106 + D102_02  +
       D106_01 , data = data, na.rm = TRUE, digits = 1, format.number = TRUE)


#### IAT ####

## descriptive statistics ##
summary(data$G201xD)
sd_dscore <- sd(data$G201xD)
print(sd_dscore)
```

```
ggplot(data, aes(x = G201xD)) +
  geom_histogram(binwidth = 0.5, fill = "skyblue", color = "black") +
  labs(x = "D-score", y = "Frequency", title = "Distribution of D-scores")

#### AFFEXX ####
AFFEXX <- c("E102_01", "E102_02","E102_03", "E102_04", "E102_05", "E102_06",
          "E102_07", "E102_08", "E102_09", "E102_10", "E102_11", "E102_12",
          "E102_13", "E102_14", "E102_15", "E102_16", "E102_17", "E102_18",
          "E102_19", "E102_20", "E102_21", "E102_22", "E102_23", "E102_24",
          "E102_25", "E102_26", "E102_27", "E102_28", "E102_29", "E102_30",
          "E102_31", "E102_32","E102_33", "E102_34", "E102_35", "E102_36")

## calculate AFFEXX calmness-tension score ##
data$calmtens <- rowMeans(data[, c("E102_17", "E102_19",
                                   "E102_22", "E102_31")],
                          na.rm = TRUE)

mean_calmtens_score <- mean(data$calmtens)
print(mean_calmtens_score)

# checking internal consistency
alpha_result1 <- alpha(data[, c("E102_17", "E102_19",
                                "E102_22", "E102_31")])
print(alpha_result1)

#### PSS ####
PSS <- c("F701_01", "F701_02", "F701_03", "F701_04", "F701_05", "F701_06", "F701_07",
         "F701_08", "F701_09", "F701_10")
data$pss <- rowMeans(data[, c("F701_01", "F701_02", "F701_03", "F701_04", "F701_05",
"F701_06", "F701_07",
                              "F701_08", "F701_09", "F701_10")],
                     na.rm = TRUE)

# checking internal consistency
alpha_result2 <- alpha(data[, c("F701_01", "F701_02", "F701_03", "F701_04", "F701_05",
"F701_06", "F701_07",
                                "F701_08", "F701_09", "F701_10")])
print(alpha_result2)

#### INTENTION SCORES ####
intention_mod_items <- c("D201_01", "D201_02", "D201_03",
                         "D201_04")
intention_vig_items <- c("D202_01", "D202_02", "D202_03",
                         "D202_04")
data$intention_mod <- rowMeans(data[, c("D201_01", "D201_02", "D201_03",
                                        "D201_04")],
                               na.rm = TRUE)
data$intention_vig <- rowMeans(data[, c("D202_01", "D202_02", "D202_03",
                                        "D202_04")],
                               na.rm = TRUE)
```

```
# checking internal consistency
alpha_result3 <- alpha(data[, c("D201_01", "D201_02", "D201_03",
                          "D201_04")])
print(alpha_result3)
alpha_result4 <- alpha(data[, c("D202_01", "D202_02", "D202_03",
                           "D202_04")])
print(alpha_result4)

#### PARAMETRIC ASSUMPTIONS ####
## check assumptions RQ 1##
# normality
skewness_data <- skewness(data$G201xD)
print(skewness_data)
skewness_calmtens <- skewness(data$calmtens)
print(skewness_calmtens)

hist(data$G201xD)
hist(data$calmtens)

qqnorm(data$G201xD, main = 'Q-Q Plot for Normality IAT', xlab = 'Theoretical Dist',
      ylab = 'Sample dist', col = 'steelblue')
qqline(data$G201xD, col = 'red', lwd = 2, lty = 2)

qqnorm(data$calmtens, main = 'Q-Q Plot for Normality calmness-tension AFFEXX', xlab =
'Theoretical Dist',
      ylab = 'Sample dist', col = 'steelblue')
qqline(data$calmtens, col = 'red', lwd = 2, lty = 2)

ad.test(data$G201xD)
ad.test(data$calmtens)
shapiro.test(data$G201xD)
shapiro.test(data$calmtens)

# linearity
plot(data$G201xD, data$calmtens)

# multicollinearity
plot(data$G201xD, data$calmtens, xlab = "IAT", ylab = "AFFEXX", main = "Calmness-
tension")

#outliers
boxplot(data$G201xD,
       ylab = "ctIAT"
)

boxplot(data$calmtens,
       ylab = "ctAFFEXX"
)
```

```
## check assumption RQ 2 + RQ 3##
# normality
skewness_intention_mod <- skewness(data$intention_mod)
print(skewness_intention_mod)
skewness_intention_vig <- skewness(data$intention_vig)
print(skewness_intention_vig)
skewness_pss <- skewness(data$pss)
print(skewness_pss)

shapiro.test(data$intention_mod)
shapiro.test(data$intention_vig)
shapiro.test(data$pss)
ad.test(data$intention_mod)
ad.test(data$intention_vig)
ad.test(data$pss)

hist(data$intention_mod)
hist(data$intention_vig)
hist(data$pss)

qqnorm(data$intention_mod, main = 'Q-Q Plot for Normality moderate ex', xlab =
'Theoretical Dist',
      ylab = 'Sample dist', col = 'steelblue')
qqline(data$intention_mod, col = 'red', lwd = 2, lty = 2)

qqnorm(data$intention_vig, main = 'Q-Q Plot for Normality vigorous ex', xlab = 'Theoretical
Dist',
      ylab = 'Sample dist', col = 'steelblue')
qqline(data$intention_vig, col = 'red', lwd = 2, lty = 2)

qqnorm(data$pss, main = 'Q-Q Plot for Normality pss', xlab = 'Theoretical Dist',
      ylab = 'Sample dist', col = 'steelblue')
qqline(data$pss, col = 'red', lwd = 2, lty = 2)

# linearity
plot(data$calmtens, (data$intention_mod))
plot(data$calmtens, (data$intention_vig))
plot(data$pss, (data$intention_vig))

# multicollinearity
plot(data$calmtens, data$intention_mod, xlab = "AFFEXX", ylab = "exercise intention",
main = "moderate exercise intention")
plot(data$calmtens, data$intention_vig, xlab = "AFFEXX", ylab = "exercise intention", main
= "vigorous exercise intention")
plot(data$pss, data$intention_vig, xlab = "AFFEXX", ylab = "exercise intention", main =
"vigorous exercise intention")

# outliers
boxplot(data$intention_mod,
       ylab = "moderate intention PA"
```

```
)

boxplot(data$intention_vig,
        ylab = "vigorous intention PA"
)

boxplot(data$pss,
        ylab = "Perceived Stress Scale"
)


#### ANSWER RESEARCH QUESTIONS ####

#### RQ 1 ####

## descriptive analysis ##
summary(data$G201xD)
summary(data$calmtens)

## assumptions not met --> Spearman correlation test ##
cor.test(data$G201xD, data$calmtens, method = 'spearman')

## visualise data ##
plot(data$G201xD, data$calmtens,
     xlab = "Implicit Attitudes calmness-tension",
     ylab = "Affective Appraisal calmness-tension",
     main = "Calmness versus Tension")


#### RQ2 ####

## assumptions not met --> Spearman correlation test ##
cor.test(data$calmtens, data$intention_mod, method = 'spearman')
cor.test(data$calmtens, data$intention_vig, method = 'spearman')

## visualise data
# scatter plot for moderate exercise intention with fitted line
plot(data$calmtens, data$intention_mod,
     main = "Moderate Exercise Intention vs. Calmness-Tension",
     xlab = "Calmness-Tension",
     ylab = "Moderate Exercise Intention",
     pch = 19,
     col = "gray")
lines(data$calmtens, predicted_mod_values, col = "blue", lwd = 2)
legend("topright", legend = c("Observed", "Fitted"),
       col = c("gray", "blue"), pch = c(19, NA), lty = c(NA, 1), lwd = c(NA, 2))
text(min(data$calmtens), max(data$intention_mod),
     labels = paste("Spearman's ρ = 0.338, p = 0.002"), pos = 4)

# scatter plot for vigorous exercise intention with fitted line
```

```
plot(data$calmtens, data$intention_vig,
    main = "Vigorous Exercise Intention vs. Calmness-Tension",
    xlab = "Calmness-Tension",
    ylab = "Vigorous Exercise Intention",
    pch = 19,
    col = "gray")
lines(data$calmtens, predicted_vig_values, col = "red", lwd = 2)
legend("topright", legend = c("Observed", "Fitted"),
      col = c("gray", "red"), pch = c(19, NA), lty = c(NA, 1), lwd = c(NA, 2))
text(min(data$calmtens), max(data$intention_vig),
    labels = paste("Spearman's ρ = 0.383, p < 0.001"), pos = 4)


#### RQ3 ####

## correlation between pss and vigorous PA intention
cor_stress_intention <- cor.test(data$pss, data$intention_vig, method = "spearman")
print(cor_stress_intention)

## correlation between pss and calmness-tension
cortest <- cor.test(data$pss, data$calmtens, method = "spearman")
print(cortest)

## apply logarithmic transformation
data <- data %>%
  mutate(
    log_pss = log(pss + 1),
    log_calmtens = log(calmtens + 1),
    log_intention_vig = log(intention_vig + 1)
  )

# check the transformed variables for normality
hist(data$log_pss, main = "Log-Transformed Stress Levels", xlab = "Log Stress Levels")
hist(data$log_calmtens, main = "Log-Transformed Core Affective Experiences", xlab = "Log
Calmness vs Tension")
hist(data$log_intention_vig, main = "Log-Transformed Intention for Vigorous Physical
Activity", xlab = "Log Intention")

shapiro.test(data$log_intention_vig)
shapiro.test(data$log_pss)
shapiro.test(data$log_calmtens)

## rank transformation of the data
data$rank_intention_vig <- rank(data$intention_vig)
data$rank_calmtens <- rank(data$calmtens)
data$rank_pss <- rank(data$pss)
data$interaction_term <- data$rank_calmtens * data$rank_pss

# compute a regression model without the moderator
model_main <- lm(rank_intention_vig ~ rank_calmtens + rank_pss, data = data)
```

```
summary(model_main)

## compute a regression model with the moderator
lm_rank_model <- lm(rank_intention_vig ~ rank_calmtens * rank_pss, data = data)
summary(lm_rank_model)

## visualise data ##
install.packages("interactions")
library(interactions)
install.packages("sandwich")
library(sandwich)

# calculate simple slopes + mean and SD
simple_slopes <- sim_slopes(lm_rank_model, pred = rank_calmtens, modx = rank_pss)
print(simple_slopes)

mean_pss <- mean(data$rank_pss)
sd_pss <- sd(data$rank_pss)

# define modx.values as mean +/- 1 SD
modx_values <- c(mean_pss - sd_pss, mean_pss + sd_pss)

# create custom lables for the x and y axis
modx_labels <- c("Low Stress", "High Stress")

# plot simple slopes
interact_plot(lm_rank_model, pred = rank_calmtens, modx = rank_pss, modx.values =
modx_values, modx.labels = modx_labels) +
  theme_minimal() +
  labs(
    title = "Moderation Effect: Simple Slopes",
    x = "Ranked Core Affective Experience Calmness-Tension",
    y = "Ranked Vigorous Exercise Intention"
  )
```