The Power of Social Interaction in the Moment: Exploring the Associations of Social Interaction Frequency and Perceived Social Connectedness with Momentary Mood Among University Students

Hannah Bösker (s2852519)

Faculty of Behavioural, Management and Social Sciences

Department of Psychology, University of Twente

202000384: BSc Thesis Psychology

First Supervisor: MSc Vanessa Michalski

Second Supervisor: Dr. Marcel Pieterse

July 1, 2025

Abstract

Background: University students frequently experience low mood, which negatively affects their well-being and academic performance. While social interaction has been identified as a key factor influencing mood, it remains unclear which dimensions of social interaction drive this effect.

Objective: This study aimed to examine to what extent two dimensions of social interaction-social interaction frequency and perceived social connectedness - are associated with momentary mood among university students.

Methods: Using convenience sampling, 33 students (M_{age} = 21.67, 72.73% female, 27.27% male) participated in an Experience Sampling Method (ESM) study by answering three daily questionnaires on social interaction frequency, perceived social connectedness and momentary mood over 15 days.

Results: Linear mixed-effects models revealed a positive within-person association between social interaction frequency and momentary mood (b = .021, p = .038) and between perceived social connectedness and momentary mood (b = .65, p < .001). Perceived social connectedness showed a significantly stronger within-person association with momentary mood than social interaction frequency (b = - .42, p < .001).

Conclusion: As expected, the quality of social interactions appears more important for momentary mood enhancement than their quantity. The results suggest that perceived social connectedness considerably shapes students' momentary mood. Future research should further investigate the identified associations, for instance, by conducting time-lagged or between-person analyses. Universities are recommended to enhance their students' momentary mood through social events promoting social connectedness. Teaching staff is advised to make their students feel more connected during class through adjusted teaching strategies to improve their academic performance.

The Power of Social Interaction in the Moment: Exploring the Associations of Social Interaction Frequency and Perceived Social Connectedness with Momentary Mood Among University Students

Mood fluctuations towards negative mood states present a major challenge for university students by lowering psychological well-being, increasing perceived stress, and impairing academic performance (Kuyumcu, 2013; McKinzie et al., 2006; Febrilia et al., 2011). While social interaction seems to considerably shape mood (Deiters, 2022; Forbes et al., 2023), the background behind this effect is not sufficiently explored. To better support students in their mood regulation and enhancement, it is crucial to examine what it is about social interaction that drives its effect on mood.

Mood

Moods are defined as sustained and internally endured feelings strongly affecting one's behaviour in the external world (Sekhon & Gupta, 2023). When it comes to situational influences on mood, *momentary (state) mood* is particularly relevant as it describes the affective experience a person has at a specific moment (Lischetzke, 2014). The experience is called affective to highlight that momentary (state) mood changes from one moment to another. To provide context, the flexible momentary (state) mood can be contrasted with the *trait level of mood* which refers to a stable baseline mood level varying from person to person. The momentary (state) mood deviates from the trait level of mood to varying extents in different situations, depending on the situation itself and how they engage with it.

Understanding the concept of mood is essential when considering its impact on specific populations, such as university students, among whom negative mood states are particularly prevalent. A study by Hu et al. (2024) emphasised this prevalence by outlining that 60.9% of the participating students reported that they had been in a depressive mood within a period of two weeks. Additionally, the results of a literature review by Ibrahim et al.

(2013) indicated that university students experience higher depression rates than the general population, suggesting that they are particularly suffering from persistent low moods. These findings are crucial, as previous research has shown that mood significantly affects university students in their personal and academic lives. Specifically, negative mood has been shown to decrease psychological well-being and predict stress among university students (Kuyumcu, 2013; McKinzie et al., 2006). Additionally, during a study conducted by Febrilia et al. (2011), it was observed that negative mood has a negative influence on learning among university students and thereby decreases their academic performance. Given the strong role of mood in students' lives, it is crucial to determine and address those factors contributing to its regulation and enhancement.

Factors influencing students' momentary mood either positively or negatively have been identified by previous research. Schiffrin and Nelson (2010) found that undergraduate students who perceived more stress reported to be less happy. According to this finding, stress perception may reduce students' momentary mood. This was supported by O'Flynn et al. (2018), who observed lower mood and increased anxiety among medical students during examination periods than during other times of the semester. In contrast, among physical education students from a Brazilian university, increased leisure-time physical activity was linked to an increase in mood state (Legey et al., 2017). Similarly, mindfulness activities, such as going for a walk every day, were found to result in significant improvements in university students' momentary mood (Ma et al., 2023).

A particularly important factor influencing momentary mood is social interaction. As supported by an ecological momentary assessment (EMA) study among adults, individuals experience enhanced momentary mood when engaging in social interactions compared to when being alone, as they reported higher levels of happiness and interest but lower levels of tiredness and pain (Bernstein et al., 2018). In alignment with this finding, social interactions,

particularly the perceived responsiveness of one's interaction partner, were found to be associated with lower depressed mood on the same day in a daily diary study by Kuczynski et al. (2022). Additionally, the negative influence of social isolation on mood states became evident during the COVID-19 pandemic, which was characterised by social restriction policies and the closure of communal spaces. For instance, a student survey from Erasmus University Rotterdam from 2020 outlined that 72% of the respondents felt more sad, low in mood and depressed since the COVID-related restrictions began (García-Gómez et al., 2024). Considering these findings, social interaction seems to be a key factor for impacting momentary mood among university students. Thus, it is essential to look at social interaction more closely and examine its specific dimensions through which it impacts momentary mood.

Social Interaction

Social interaction describes the dynamic engagement between two or more individuals wherein their behaviours and actions are interdependent while their autonomy is maintained (De Jaegher et al., 2010; Di Paolo & De Jaegher, 2012). Examples for social interactions are conversations, collaborative work, arguments, and collective action (De Jaegher et al., 2010).

The importance of social interaction as a fundamental part of human life is emphasised by numerous studies. Forbes et al. (2023) found that social interaction leads to improved momentary mood valence, reduced stress, calmness, and energetic arousal in the general population. Focusing on students specifically, social contact has been identified to be positively associated with well-being and negatively associated with depressive mood on a within-person level (Deiters, 2022). Thus, social interaction - considered broadly - seems to be a key factor positively impacting affective experiences within an individual's daily life.

Several research studies focused specifically on the frequency of social interactions and their impact on students. *Social interaction frequency* describes how often individuals engage in social interactions within a given timeframe. Sandstrom and Dunn (2014) found that students experience greater happiness and greater feelings of belonging on days when they interact with more classmates than usual. This finding aligns with research conducted during the COVID-19 pandemic emphasising that perceived social isolation is associated with elevated depressed and anxious mood (Ben Salah et al., 2021). Additionally, the frequency of social interactions improved momentary affect during the pandemic among the general population (Forbes et al., 2023). When following these research findings, social interaction frequency seems to enhance momentary mood among university students.

In contrast to studies that investigate social interaction frequency, others focus on the subjective experience of social interactions by examining perceived social connectedness. *Perceived social connectedness* is defined as "the sense of belonging and subjective psychological bond that people feel in relation to individuals or groups of others" (Haslam et al., 2015, p.1). According to Self-Determination Theory (SDT), relatedness, which can be used interchangeably with connectedness, is one of the three innate human needs that leads to enhanced well-being and perceived social integrity when it is met (Deci & Ryan, 1985; Ryan & Deci, 2000). This theoretical framework is consistent with previous research outlining the positive impact of perceiving oneself as socially connected. Saeri et al. (2018) compared the bidirectional relationships between social connectedness and mental health and found that social connectedness predicted subsequent mental health more strongly than mental health predicted subsequent social connectedness. The researchers claimed that their results demonstrate how the psychological resources derived from social connectedness possibly act as a cure for psychological distress. Similar results were outlined by research in educational settings: A survey study conducted among university students from the University of North

Florida revealed that social connectedness was negatively correlated with stress and health symptoms (Whittaker, 2008). Similarly, research by Duru and Poyrazli (2011) focused on Turkish international students studying in the United States and identified the lack of social connectedness as a predictor of adjustment difficulties. Thus, perceived social connectedness seems to positively impact university students' well-being and to contribute to enhanced mood. Notably, the results of a systematic literature review and meta-analysis by Liu et al. (2019) revealed a stronger association between qualitative features of social interactions (e.g. perceived social connectedness) with positive/negative affect than between quantitative features of social interactions (e.g. social interaction frequency) with positive/negative affect.

All these research findings together emphasise that both increasing the frequency of social interaction and supporting social connectedness are positively associated with momentary mood. By addressing the innate human need for relatedness, as emphasised by SDT and the findings of the meta-analysis by Liu et al. (2019), perceived social connectedness may play a special role in enhancing students' momentary mood.

Experience-Sampling-Method

When reviewing the existing research on social interaction frequency and perceived social connectedness, it stands out that only a few studies have examined within-person fluctuations among these variables and their real-time association with mood. However, as social interaction frequency, perceived social connectedness, and mood can vary throughout the day, methods that measure momentary experiences are particularly valuable. One type of such methods is *Experience-Sampling Methods* (ESM), which are defined as "a method of data collection in which participants respond to repeated assessments at moments over the course of time while functioning within their natural settings" (Napa Scollon et al., 2009, p.158). In contrast to cross-sectional surveys, ESM collects data as it occurs in real-time and thereby minimises memory biases and maximises ecological validity (Mölsa et al., 2022).

While ESM allows for hypothesis testing at the between and within-person level, it is particularly useful for the latter one due to the high frequency of assessments, usually multiple times per day (Palmer, 2025). These frequent assessments during individuals' everyday lives are crucial for examining fluctuating mood states throughout the day and for assessing to what extent momentary changes in social interaction frequency and perceived social connectedness are associated with these fluctuations.

Literature Gap

Even though scientific research on the association between social interaction and momentary mood is growing, there are several limitations in existing studies. First, most previous studies investigate social interaction frequency and perceived social connectedness in isolation, which makes it difficult to directly compare their associations with mood (e.g. Ben Salah et al., 2021; Olusegun-Emmanuel, 2023; Saeri et al., 2018). The lack of comparative research that simultaneously considers both social interaction frequency and perceived social connectedness makes it hard to determine which dimension of social interaction plays a more significant role in mood regulation. A recent meta-analysis by Liu et al. (2019) took an important step by focusing on intra-individual associations of quantitative and qualitative social interaction aspects with positive and negative affect. They found that qualitative aspects had stronger associations with positive and negative affect than quantitative aspects, suggesting that perceived social connectedness may have a stronger association with momentary mood than social interaction frequency. However, Liu et al. (2019) conducted separate meta-analyses for the association of quantitative aspects of social interaction with affect and the association of qualitative aspects with affect. Thereby, they could not compare the relative strengths of these associations within the same sample and the same model. Thus, research looking at the association of quantitative and qualitative social interaction dimensions with momentary mood within the same data is still lacking.

Second, previous studies investigating the association between social interaction and mood have used cross-sectional data (e.g. Lynch-Jordan et al., 2015; Miller et al., 2019; Brunes & Heir, 2020). Cross-sectional data focuses on between-person comparisons instead of exploring within-person fluctuations over time. Thereby, numerous studies fail to account for the dynamic nature of social interaction and mood states. To address this limitation of cross-sectional data, ESM is needed to accurately investigate the real-time associations of social interaction frequency and perceived social connectedness with momentary mood among university students.

Third, those few studies that employ ESM to examine the association between social interaction and mood have done so by looking at a sample out of the general population (e.g. Forbes et al., 2023; Sun et al., 2020). However, university students face unique challenges that seem to affect the association between social interactions and mood differently compared to other population groups (Daou & El Hajj, 2023). Consequently, it is crucial to examine the associations of social interaction frequency and perceived social connectedness with mood among a sample of university students. Filling the identified literature gaps is essential to better understand mood fluctuations among university students by examining their associations with interaction frequency and perceived social connectedness.

The Current Study

Consequently, this research addresses the identified research gaps by using ESM to examine and compare the associations of social interaction frequency and perceived social connectedness with momentary mood among university students. By focusing on concurrent associations, the study examines how immediate changes in these two social interaction dimensions relate to momentary mood in daily life. It aims to answer the following research question: *"To what extent are within-person variations in social interaction frequency and*

perceived social connectedness associated with momentary mood among university students?"

Based on previous research findings, the following hypotheses were formulated:

H1: *"Among university students, social interaction frequency is positively associated with momentary mood on a within-person level."*

H2: *"Among university students, perceived social connectedness is positively associated with momentary mood on a within-person level."*

H3: *"Among university students, perceived social connectedness has a stronger within-person association with momentary mood than social interaction frequency."*

As an addition to the main hypotheses, the study explores whether potential associations of social interaction frequency and perceived social connectedness with momentary mood are influenced by time of day to further improve the understanding of these associations.

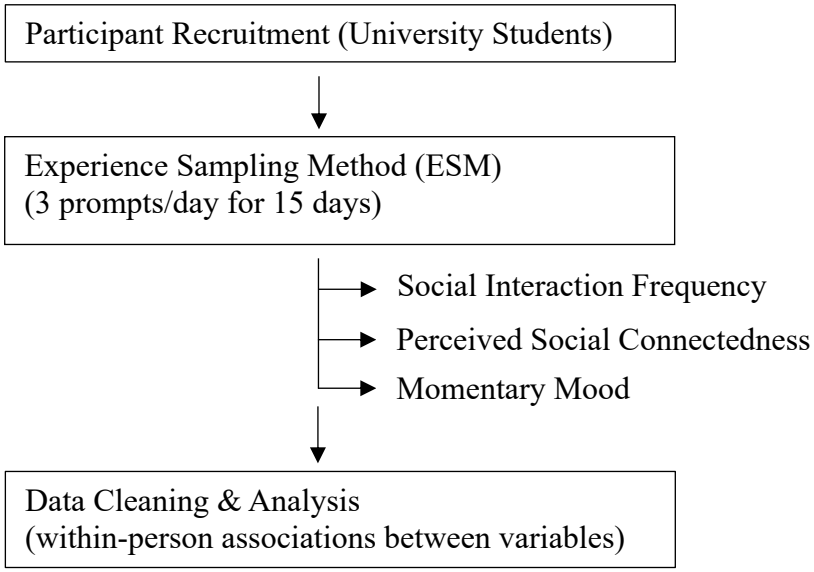
Methods

Design

The present study employed a quantitative, correlational, and within-person design using ESM to examine the associations of social interaction frequency and perceived social connectedness with momentary mood among university students (Figure 1). Applying ESM allowed for the investigation of real-time fluctuations among the variables in participants' daily lives through repeated self-reports (Myin-Germeys & Kuppens, 2022).

Figure 1

Flowchart of the Study Design



Participants

Participants were recruited using convenience sampling through word of mouth and *SONA systems*, an online recruitment tool of the University of Twente. Participants who signed up via SONA received 1.75 SONA credits as a reward for their participation. To participate, they had to fulfil the following requirements: being at least 18 years old, being enrolled in a university, having regular access to a mobile phone, and not experiencing severe mental health issues. Of 51 participants who took part in the study, 18 participants (35.29%) were excluded for having a compliance rate lower than 70%. Ethical approval for the study was granted by the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences (BMS) at the University of Twente in the domain of Humanities and Social Sciences (Protocol number: 250566).

Procedure

The participants took all steps on the *Twente Intervention and Interaction Machine* (TIIM) (Van ‘t Klooster et al., 2024). The total data collection period lasted from 28th March

2025 to 9th May 2025. Before this period, a trial phase of five days was conducted to test how the study functioned in the TIIM application.

Participants signed up for the study via the SONA system or by verbally expressing their willingness to take part. They were then provided with instructions on how to begin their participation. Participants who were recruited via SONA automatically received access to the instruction file via the platform. Those who were recruited through word of mouth received the same file via direct message through their preferred online medium. All participants downloaded the TIIM application, created an account, and subscribed for the study by entering the provided enrolment code. They were directly led to a “Welcome” page with information about the following steps. Subsequently, the participants were provided with the information page containing basic information about the study, such as its purpose, its benefits and risks, and the processing of personal information (see Appendix A). After reading the information page, participants responded to six ethical consent questions and three screening questions testing their eligibility for the study (see Appendix B). On the same day of their enrolment, participants were provided with demographic questions. From the first day after their enrolment onwards, the participants received three daily questionnaires for a total of 15 days. These daily questionnaires were provided between 10:00 am and 10:00 pm, specifically at 10:05 am, 2:05 pm, and 6:05 pm, and were each available for four hours. The daily questionnaires included items measuring social interaction frequency, perceived social connectedness, loneliness, and mood, in that order (see Appendix C). Loneliness is not further elaborated in this report.

For every daily questionnaire, the participants received a push-notification via the TIIM app. An additional notification was sent if a participant did not respond to a specific daily questionnaire 30 minutes after receiving it. Participants were sent a special warning notification for every third questionnaire they missed (e.g. after missing 3, 6, 9, etc.) to

remind them to stay consistent with completing the questionnaires. While participants with a compliance rate lower than 70% were excluded from the final analysis, they were allowed to complete the study.

Materials

The Twente Intervention and Interaction Machine (TIIM)

To carry out the present study, TIIM (version 3.1.7) was used. TIIM is a research platform developed by the BMS lab of the University of Twente (Van ‘t Klooster et al., 2024). While the dashboard’s web application of TIIM was used by the researchers to create the study, the participants used the TIIM mobile application. Using TIIM allowed for creating questionnaires, presenting them to participants based on a schedule, as well as sending notifications reminding participants to answer the questions in time.

The Social Interaction Frequency Question

Social interaction frequency was measured using the self-constructed question “How many social interactions did you have since the last prompt?”. To avoid misunderstanding, the participants were given a definition of social interactions, namely “real-time exchanges between two or more people, either in person or online”. Additionally, they were provided with examples of what social interaction includes (e.g. conversations) and what it excludes (e.g. WhatsApp chats with delayed responses). The question was answered by selecting a number from 0 to 20.

The Connection During Conversation Scale (abbreviated)

The perceived social connectedness of the participants during their latest social interactions was measured by using an adapted version of the Connection During Conversation Scale (CDCS, Okabe-Miyamoto et al., 2024). The original CDCS consists of 14 items across the four subscales *Shared Reality, Partner Responsiveness, Participant Interest, and Affective Experience*. It demonstrated strong psychometric properties in a sample from a

public American university (N = 235). Construct validity and discriminant validity were supported due correlations with related constructs, such as relatedness (r = .51) reaching from moderate to strong and weaker correlations with less related traits, such as extraversion (r = .32). While internal consistency was indicated for comparison measures, such as for the UCLA Loneliness Scale (α = .93), Cronbach's alpha values for the CDCS subscales were not specifically stated (Okabe-Miyamoto et al., 2024). For this study, the original CDCS was reduced to four items, with one item selected from each subscale (see Appendix C). The formulation of the four items was slightly modified to better fit the study's requirements, and the responses were measured using a seven-point Likert scale ranging from "Strongly Disagree (1)" to "Strongly Agree (7)". The mean score across the four items indicated the social connectedness perceived by a participant during their social interactions since the previous prompt. A higher score corresponded to greater perceived social connectedness.

The Momentary Mood Question

The momentary mood of the participants was measured using the self-constructed question "How would you rate your mood right now?". The question was answered on a seven-point Likert scale ranging from "Very negative (1)" to "Very positive (7)". The single-item measure of mood was chosen for its conciseness, which is particularly crucial given that the participants were expected to complete 45 questionnaires in total. Recent research comparing single-item ratings with multiple-item questionnaires for assessing mood has shown that single-item ratings were usually in good agreement with multiple-item questionnaire results (Verster et al., 2021).

Data Analysis

The data was analysed using RStudio (version 2025.05.0-496). As a first step, the dataset was cleaned. Participants with a compliance rate lower than 70% were excluded from further analyses to ensure an adequate quality of the data.

Next, means and standard deviations were calculated for the three key variables - social interaction frequency, perceived social connectedness, and momentary mood - across all participants and all timepoints. Additionally, within-person and between-person variability of the three variables were computed with intra-class correlation coefficients (ICCs) and standard deviations for within-person and between-person variability to allow for an estimation of how much variance in each variable was due to fluctuations within individuals compared to differences between individuals.

Prior to the main analyses, the predictor variables - social interaction frequency and perceived social connectedness - were person-mean centred to isolate within-person fluctuations. To test the hypotheses, linear mixed-effects models (LMMs) were employed as they account for the nested structure of the data. Before fitting the models, the parametric assumptions were checked. Three separate LMMs were fitted: the first model examined the association between centred social interaction frequency and momentary mood (H1), the second model examined the association between centred perceived social connectedness and momentary mood (H2), and the third model included both predictors in a long-format interaction model to test whether perceived social connectedness had a significantly stronger association with momentary mood than social interaction frequency (H3). Each model included a random intercept to allow for individual differences in baseline mood and a random slope to allow the effect of the predictors on mood to vary across participants. The fixed effects of the three LMMs were interpreted to evaluate the hypotheses. In addition to the main analysis, an exploratory analysis was conducted to examine how momentary mood varies across the day, and whether the association of social interaction frequency and perceived social connectedness with mood are influenced by time of day.

Results

Sample characteristics

After cleaning the dataset and excluding those participants with a compliance rate below 70%, the sample resulted in a final total of 33 participants. In the original dataset before exclusion, compliance rates were on a range from 0% to 100%, with a mean of 70.4% (SD = 27.1%).

The final sample consisted of 9 males (27.27%) and 24 females (72.73%). The mean age was 21.67 years (SD = 1.9, range = 18-26). The majority of the participants were German undergraduate students (n = 28) residing in Germany and studying various fields, including psychology and medicine. Collected participant characteristics are summarised in Table 1.

Table 1

Sociodemographic Characteristics of Participants (N=33)

Characteristic	n	%
Nationality		
German	30	90.91
German & French	1	3.03
Norwegian	1	3.03
Azerbaijani	1	3.03
Country of Residence		
Germany	27	81.82
The Netherlands	4	12.12
Germany & The Netherlands	1	3.03
Norway	1	3.03
Level of Education		
Undergraduate	28	84.82
Graduate	3	9.1
Other	2	6.1
Study Programme		
Psychology	8	24.24
Medicine	2	6.06

Other	23	69.7
Marital Status		
Single	32	96.97
In a domestic partnership/civil union	1	3.03

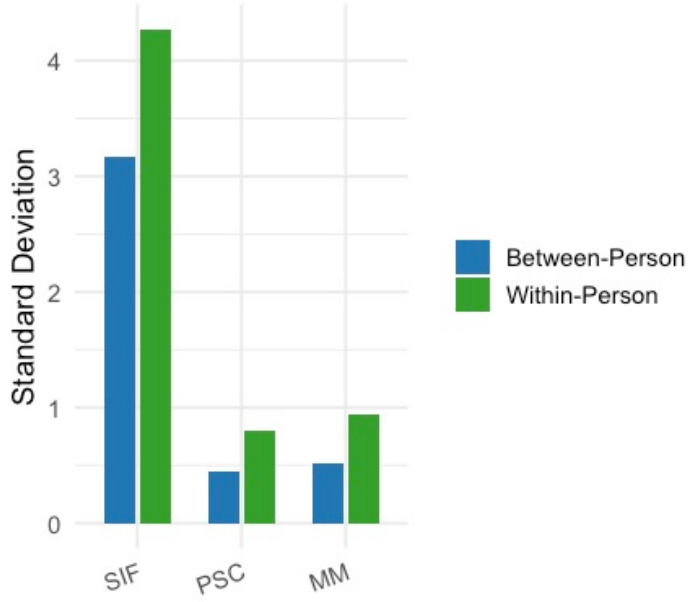
Descriptives

Means and standard deviations were calculated for social interaction frequency, perceived social connectedness, and momentary mood across all participants and all timepoints. Participants' mean social interaction frequency was 6.01 (SD = 5.26), their mean perceived social connectedness score was 5.32 (SD = .91), and their mean momentary mood score was 5.31 (SD = 1.06).

To understand how much variance in each variable was due to fluctuations within individuals compared to differences between individuals, intra-class correlation coefficients (ICCs) were calculated for each variable. The relatively low ICCs for social interaction frequency (*ICC* = .23), perceived social connectedness (*ICC* = .35), and momentary mood (*ICC* = .23) suggest that most variability occurred within individuals. Additionally, the standard deviations for within-person and between-person variability were visualised using a bar chart (see Figure 2). The within-person standard deviation was higher than the between-person standard deviation for each variable. These findings substantiate the use of within-person models to examine the extent to which changes in social interaction frequency and perceived connectedness are associated with momentary mood.

Figure 2

Standard Deviation by Variable: Within vs. between persons



Note. SIF = Social Interaction Frequency; PSC = Perceived Social Connectedness; MM = Momentary Mood

Linear Mixed-Effects Models

To test the hypotheses, linear mixed-effects models were employed as they account for the nested structure of repeated measurements within the participants.

Preparation of data for main analyses

Before fitting the models, the predictor variables – social interaction frequency and perceived social connectedness – were person-mean centred to isolate within-person fluctuations and remove within-person variance. The outcome variable, momentary mood, was not centred as the individual differences in baseline levels were later considered using random intercepts in the models. This also allowed for meaningful interpretation of absolute mood levels.

Model selection

For each of the three hypotheses, two model-versions were compared based on their model fit: one model including only a random intercept - accounting for individual differences in baseline mood -, and another model including a random slope in addition, allowing the strength of the association between the predictors and mood to vary across the participants. Likelihood ratio tests were conducted to compare model fits and resulted in a significantly better fit for the models including both random intercept and random slope, which was the case for all three hypotheses. These models were further used for interpretation.

Assumptions

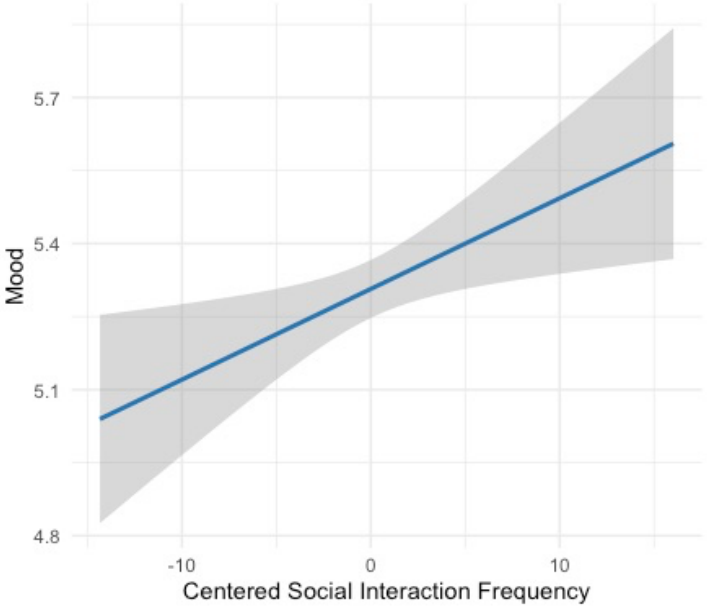
Parametric assumptions were assessed by evaluating residual plots for linearity, homoscedasticity, homogeneity of variance and normality of residuals (see Appendix D). The assumptions of homoscedasticity, homogeneity of variance and normality of residuals were adequately met. However, the assumption of linearity was partially violated as the residuals were not randomly scattered in the Residuals vs. Fitted plots (see Appendix D).

Hypotheses Testing Results

Hypothesis 1. The first linear mixed-effects model examined the association between social interaction frequency and momentary mood. Results displayed a small but significant positive association between social interaction frequency and mood, $b = .021$, $SE = .01$, $t(22.85) = 2.2$, $p = .038$ (see Figure 3). The outcome values indicated that participants had a slightly higher mood when they had more social interactions than their own average. Thereby, the results support H1.

Figure 3

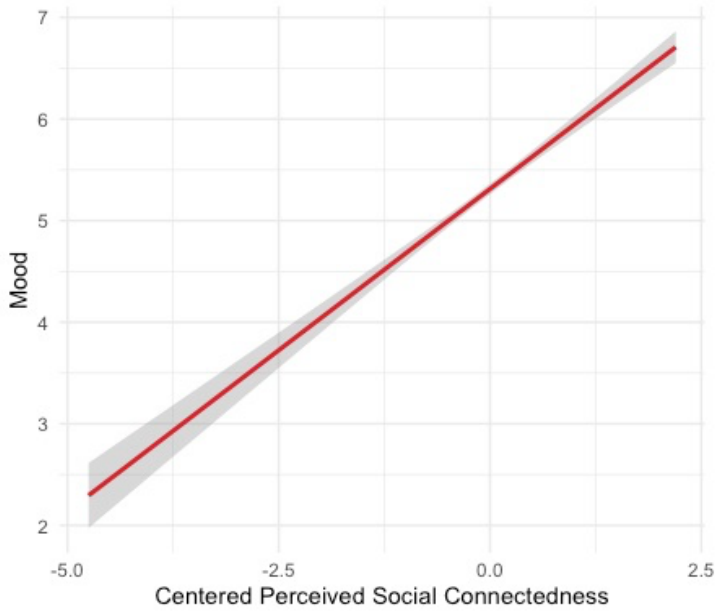
H1: Association Between Social Interaction Frequency and Momentary Mood



Hypothesis 2. The second model examined the association between perceived social connectedness and momentary mood. The results showed a strong positive association between perceived social connectedness and mood, $b = .65$, $SE = .05$, $t(27.82) = 13.11$, $p < .001$ (see Figure 4). Thus, participants reported a higher mood when perceiving a higher social connectedness than their own average. H2 is supported by these results.

Figure 4

H2: Association Between Perceived Social Connectedness and Momentary Mood

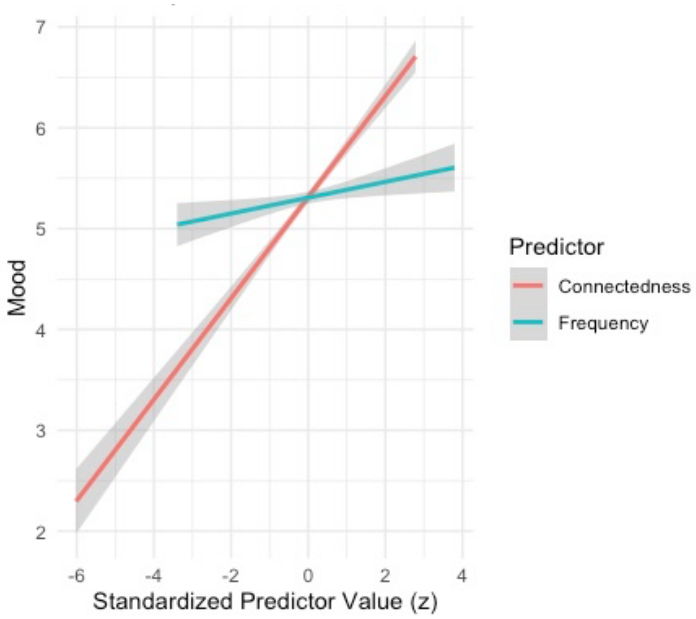


Hypothesis 3. The third model examined whether perceived social connectedness had a stronger association with momentary mood than social interaction frequency (H3). This was done by using an interaction term between predictor type and predictor value. As social interaction frequency and perceived social connectedness were measured on different scales, predictor values were standardised to allow for direct comparison. In the model, perceived social connectedness was used as the reference category, so the interaction term indicated how the effect of frequency differed. The interaction term was negative and significant, b = -.42, SE = .04, $t(1024)$ = -11.39, $p < .001$, indicating that the association between perceived social connectedness and momentary mood was significantly stronger than the one between social interaction frequency and momentary mood (see Figure 5). These results support H3. Additionally, while the two predictors were included simultaneously in the model, both remained significant. Social interaction frequency (b = .09, SE = .03, $t(63.1)$ = 2.9, p = .005)

and perceived social connectedness (b = .51, SE = .03, t(62.7) = 16.48, p < .001) showed a significant positive association with momentary mood.

Figure 5

H3: Comparison: Association Between Social Interaction Frequency and Momentary Mood vs. Association Between Perceived Social Connectedness and Momentary Mood



Exploratory analysis

As an addition to the main analysis, an exploratory analysis was conducted to examine how momentary mood varies across the day, and whether the association of social interaction frequency and perceived social connectedness with mood are influenced by time of day. The aim of this analysis was to gain a better understanding of the impact of temporal dynamics in ESM studies and to what extent they may affect the main results. This is particularly relevant in ESM studies where participants respond at specific times per day, as it was the case in this study.

Zooming in on individual mood patterns

As a first step, two participants were selected to observe their variability in mood across different times of the day. While participant 6 showed a decrease in mood from morning until evening, participant 30 showed more stable mood levels across the three times (see Figures 6 and 7). These observations outline that mood changed across the day for some individuals, emphasising the value of further analysis at the group level.

Figure 6

Mood by Time of Day for Participants 6 and 30

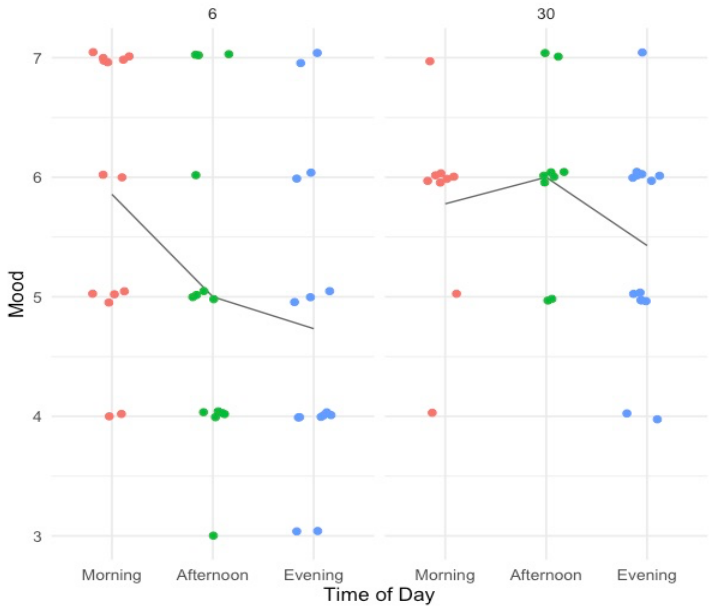
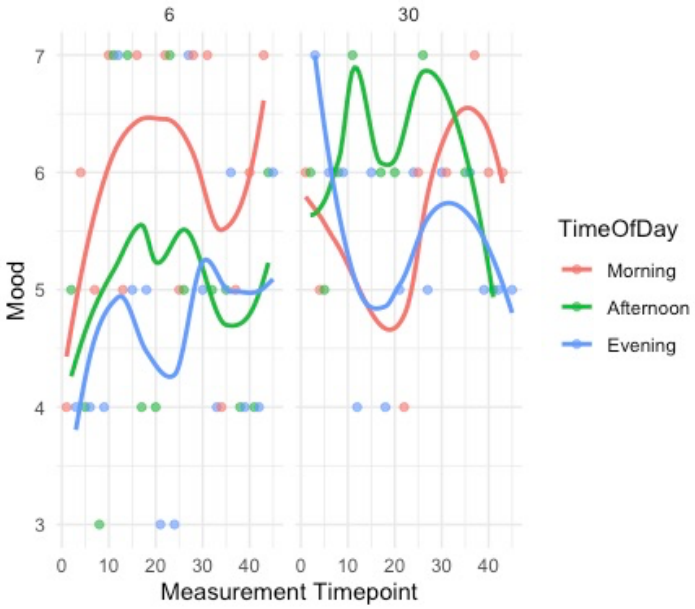


Figure 7

Mood Over Time for Each Time of Day



Interaction between predictors and time of day

Returning to group-level analyses, two linear mixed-effects models were fitted to examine whether the association of social interaction frequency and perceived social connectedness with momentary mood changed according to the time of day.

For the interaction between social interaction frequency and time of day, the interaction term was not statistically significant for afternoon (b = .01, SE = .02, t(1191) = .86, p = .389) while it approached significance for evening (b = .03, SE = .2, t(1189) = 1.92, p = .056) (morning was treated as the reference). These findings suggest that the positive association between social interaction frequency and mood may be stronger in the evening compared to morning and afternoon (see Figure 8).

For the interaction between perceived social connectedness and time of day, the interaction term with afternoon (b = .13, SE = .08, t(1187) =1.78, p = .075) and the interaction term with evening *(*b = .02, SE = .07, t(1188) = .32, p = .749) did not reach

statistical significance. As displayed in Figure 9, perceived social connectedness was a strong predictor of momentary mood across all times of the day.

Figure 8

Interaction Effect: Social Interaction Frequency and Time of Day

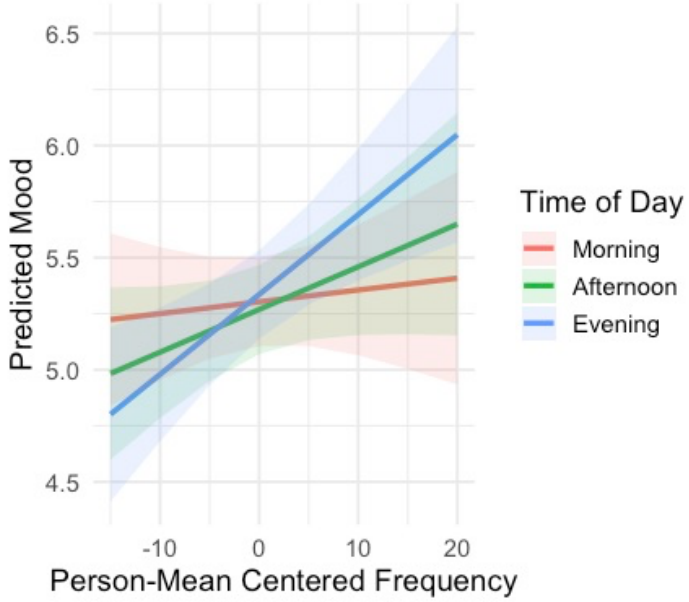
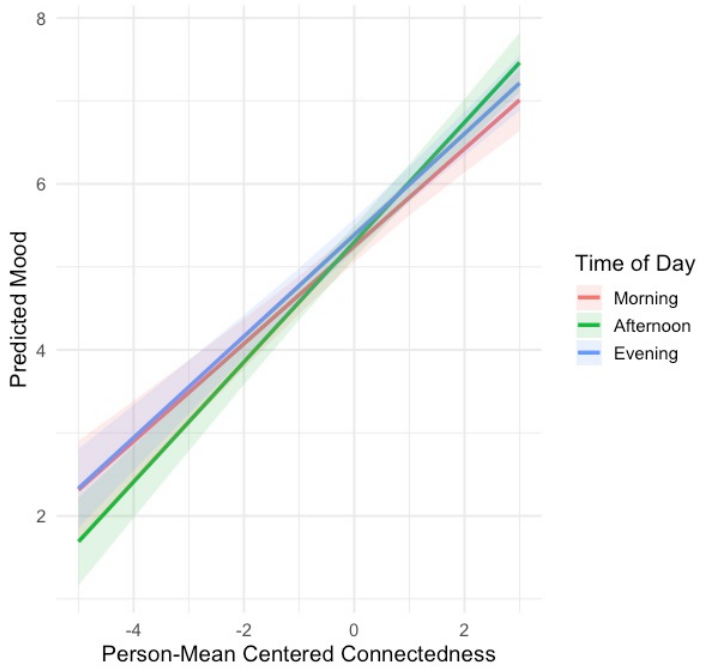


Figure 9

Interaction Effect: Perceived Social Connectedness and Time of Day



All in all, the findings of the exploratory analysis suggest that the association between social interaction frequency and mood may become stronger in the evening, although the interaction effect did not reach significance. Perceived social connectedness seems to predict mood regardless of the time of day.

Discussion

This study aimed to investigate to what extent social interaction frequency and perceived social connectedness are associated with momentary mood among university students. Using ESM, the study required all participants to respond to three daily questionnaires for 15 days via the TIIM app. These daily questionnaires included items measuring social interaction frequency, perceived social connectedness, and momentary mood. To analyse the associations between the variables on a within-person level, LMMs were employed. It was found that both social interaction frequency and perceived social connectedness had a positive association with momentary mood among university students. Perceived social connectedness

was found to have a stronger positive association with momentary mood than social interaction frequency.

Key Findings

The study investigated three hypotheses. Hypothesis 1 assumed that social interaction frequency is positively associated with momentary mood among university students. This expectation was based on previous research findings outlining that frequent social interaction leads to greater happiness and greater feelings of belonging in university students, while social isolation was found to be associated with elevated depressed and anxious mood (Sandstrom & Dunn, 2014; Ben Salah et al., 2021). The results confirmed the hypothesis as participants reported higher momentary mood when having participated in more social interactions than their own average level. One explanation for this finding may be that social interactions distract people from internal stressors, such as academic worries. In the question on social interaction frequency, social interactions were defined as real-time exchanges between two or more people (see Appendix C). Thus, the participating students were instructed to only count interactions with immediate responses. As previous research suggests, such interactions - regardless of whether they are experienced as pleasant - require attention and cognitive involvement, thereby likely distracting them from internal stressors (Schilbach et al., 2013). In support of this possible explanation, Van Ryzin and Roseth (2021) found that more frequent social contact led to a reduction in stress and emotional problems. Thus, it might be the case that the more often individuals socially interact, the more often they are distracted from internal stressors, which leads to enhanced momentary mood.

Another explanation for the confirmation of Hypothesis 1 may be that frequent social interactions assist students in organising their daily life, which enhances their momentary mood. Specifically, social interactions may function as temporal cues, around which students can organise their other activities and tasks. As outlined by Alhasani et al. (2022), having an

organised time management significantly promotes students' perceived control and reduces stress. In support of this explanation, it has been outlined that a destabilisation of individuals' daily life structure caused by social changes leads to a decline in mood (Murray et al., 2021). Thus, when having frequent social interactions, the participating students likely perceived their day as better organised and thereby experienced an increase in momentary mood.

A third explanation for the confirmation of Hypothesis 1 may be a bi-directional causality between social interaction frequency and momentary mood. Thus, it may not only be the case that an individual is in a better mood when engaging in more social interactions, but positive mood might also increase the frequency of social interactions an individual engages in. An experimental study by Whelan and Zelenski (2012) revealed that individuals with positive moods feel more social and more drawn to engage in social interaction than individuals with neutral or negative moods. This mood-driven increase in social interaction frequency likely explains a part of the identified association between social interaction frequency and momentary mood.

Hypothesis 2 proposed that perceived social connectedness is positively associated with momentary mood among university students. This hypothesis was based on SDT defining relatedness as one of the three innate human needs (Deci & Ryan, 1985; Ryan & Deci, 2000), and previous research identifying perceived social connectedness to be a predictor of subsequent mental health and a negative correlate of stress and adjustment difficulties in university students. (Saeri et al., 2018; Whittaker, 2008; Duru & Poyrazli, 2011). As the students participating in this study showed higher mood when feeling more socially connected than their average level, Hypothesis 2 was confirmed. One explanation for this positive association can be derived from SDT (Deci & Ryan, 1985; Ryan & Deci, 2000). As perceived social connectedness describes the extent to which an individual feels a "sense of belonging and subjective psychological bond" (Haslam et al., 2015, p.1) with other people, it fulfils the

innate psychological need for relatedness. This fulfilment leads to personal well-being and a sense of integrity – factors that suggest an increase in momentary mood.

Another explanation for the confirmation of Hypothesis 2 may be that perceived social connectedness, as one qualitative factor of social interaction, is positively associated with further qualitative factors, thereby enhancing the subjective experience of respective interactions which ultimately leads to improved momentary mood. Previous research suggests that perceived social connectedness is positively associated with qualitative aspects of social interactions, such as trust, empathy, and shared feelings that considerably influence how social interactions are experienced (Glanville et al., 2013; Wang et al., 2025; Cwir et al., 2011). While trust has been shown to increase feelings of security and optimism, empathy seemingly leads to higher perceived social support, and sharing their feelings makes people feel closer to their interaction partners (Adedeji et al., 2023; Fu et al., 2022; Puusepp, 2023). Thus, the association of perceived social connectedness with further qualitative factors of social interactions likely leads to an improved subjective experience of social interactions and thereby may explain a part of the association between perceived social connectedness and momentary mood.

Hypothesis 3 stated that among university students, perceived social connectedness has a stronger within-person association with momentary mood than social interaction frequency. This expectation was based on a literature review and meta-analysis by Liu et al. (2019), revealing a stronger association between qualitative features of social interactions with affect than between quantitative features of social interactions with affect. As the results of the present study indicated that the mood increase was stronger when students perceived higher social connectedness than when reporting higher social interaction frequency compared to their own averages, the hypothesis was confirmed. A possible explanation for this finding may lie in the nature of social interaction frequency and perceived social connectedness. Social interaction frequency is a non-valenced behavioural construct and was measured by asking the students to

count all social interactions since the last prompt that involved real-time exchanges (see Appendix C). Thus, the reported frequency included not only positive interactions but also neutral and negative ones. As negative interactions, such as fights or arguments, have been shown to be associated with increased negative emotions, the non-valence of the construct may account for the lower association with momentary mood (Shin & Gyeong, 2022). In contrast, perceived social connectedness is a valenced experience as it describes "the sense of belonging and subjective psychological bond that people feel in relation to individual or groups of others (Haslam et al., 2015, p.1). Thereby, it conceptually overlaps with momentary mood, which is a valenced subjective experience as well (Lischetzke, 2014). This conceptual overlap, along with the non-valence of social interaction frequency, may explain why perceived social connectedness showed a stronger association with momentary mood than social interaction frequency.

In addition to testing the hypotheses, an exploratory analysis was conducted to investigate whether the associations of social interaction frequency and perceived social connectedness with momentary mood change according to the time of day. The results suggest that participants consistently experienced increased mood when perceiving themselves as more socially connected, regardless of the time of day. However, the association between the social interaction frequency and momentary mood was stronger in the evening than in the morning and afternoon, although this effect only approached significance. A possible explanation for the trend toward a stronger association between social interaction frequency and momentary mood in the evening may be that social interactions at that time of day are more personal and meaningful for students compared to interactions in the morning and afternoon, when students rather engage in university-related social interactions. As Wong and Chapman (2023) found that different types of social interactions are associated with different aspects of student satisfaction, it may be these different types that cause the trend toward a greater mood increase

when having more frequent social interactions in the evening compared to the morning or afternoon.

Strengths and Limitations

To fully understand the relevance of the key findings for future research and practical implications, it is crucial to put them into context by reflecting on the study's strengths and limitations. A major strength of this study lies in the use of ESM. Questionnaires were sent via the mobile phone application TIIM, which resulted in the collection of real-time data within the daily lives of university students. As the students could only respond to every questionnaire within a period of four hours, there is a reduced risk of memory biases, which are a common limitation of retrospective surveys (Mölsa et al., 2022). By providing the participants with the questionnaire three times per day for a period of 15 days, the study provides insights into momentary changes in social interaction frequency, perceived social connectedness, and their associations with momentary mood. Another strength is the study's within-person design, which accounts for the dynamic nature of social interaction and mood. Numerous previous studies examining the association between social interaction and mood have used cross-sectional data (e.g. Lynch-Jordan et al., 2015; Miller et al., 2019; Brunes & Heir, 2020) and thereby did not take into account the baseline levels of social interaction frequency, social connectedness, and mood which are different for each individual. For instance, previous research proved that extroverted people participate in more frequent social interactions than introverted people (Srivastava et al., 2008). These baseline differences make it difficult to isolate how changes in social interaction frequency and perceived social connectedness influence momentary mood. Thus, comparing the students' scores to their own scores across different time points provides greater value than comparing between them and provides a perspective which has been overlooked by most previous studies on this topic. Finally, another strength of this study is the direct comparison of social interaction frequency and perceived

social connectedness based on their association with momentary mood. While previous research has focused separately on these two social interaction dimensions (e.g. Ben Salah et al., 2021; Olusegun-Emmanuel, 2023; Saeri et al., 2018), this study's comparative approach is particularly insightful as it provides recommendations on which dimensions of social interaction to prioritise when aiming at the enhancement of university students' mood.

Besides the strengths of this study, it is crucial to acknowledge certain limitations that may have affected the findings and their generalizability. First, most of the participants were German female undergraduate students, which indicates a sampling bias. According to Henrich et al. (2010), samples relying on homogeneous samples are limited in their generalizability to the general population. In the case of this study, the findings may not be generalizable to the broader student population. Second, the compliance rate of the questionnaires was quite low, which is a common limitation of ESM (Napa Scollon et al., 2009) and led to the exclusion of approximately 35% of those participants who originally took part in the study, thereby reducing the final sample size. Third, the study did not control for confounding variables potentially influencing momentary mood among university students. Momentary mood is a complex construct and can be influenced by various factors, such as stress and physical activity (Schiffrin & Nelson, 2010; Legey et al., 2017). As the participants responded to the questionnaires during their daily lives, there may have been situational factors affecting their momentary mood ratings independently of social interaction frequency and perceived social connectedness.

Recommendations for Future Research

Regarding future research, several methodological recommendations can be made based on the identified limitations. First, future studies should aim for a more diverse sample that is representative of the broad student population. In addition, efforts should be made to increase the compliance rate and thereby improve data quality. For instance, researchers could

motivate their participants to keep engaging with the study content through higher incentives, the use of even shorter questionnaires, and more appealing interfaces of digital platforms. Moreover, to control for confounding variables, such as the stress level or unexpected daily events, future research studies could integrate specific items or open-ended questions capturing potentially relevant influences on momentary mood.

Besides methodological recommendations, this study gives recommendations for directions of future research. While positive associations were found between social interaction frequency and momentary mood as well as between perceived social connectedness and momentary mood, future research could examine temporal and causal dynamics behind these associations by using the same dataset to do time-lagged and prospective analyses. Thereby, it may be determined whether social interaction frequency and perceived social connectedness genuinely enhance momentary mood or if momentary mood rather increases these two social interaction dimensions, which is crucial to better inform interventions aimed at enhancing students' mood.

Additionally, the current study examined within-person associations among all participating students by person-mean centring the predictor variables, thereby disregarding important subsamples in which the impact of social interaction frequency or perceived social connectedness on momentary mood might be much stronger or weaker. Future research studies could investigate how these associations vary between students depending on various personal factors, such as personality traits. For instance, it would be crucial to find out whether the association of perceived social connectedness with momentary mood is stronger in introverted individuals than in extraverted individuals. These findings would outline which individuals particularly benefit from interventions focused on supporting social interaction connectedness or social interaction frequency. This would allow for better adjustment of the interventions to the needs of these individuals.

Furthermore, as the trend for a stronger association between social interaction frequency and momentary mood in the evening compared to other times of day may be explained by different types of social interactions, future studies are recommended to look more closely at these types. Examining to what extent different types of social interactions impact students' momentary mood would be insightful as it suggests which exact types students should engage in more frequently to improve their mood.

Finally, as this study only focused on mentally healthy university students, it would be insightful to investigate a clinical sample. Specifically, research can shed light on whether a rise in perceived social connectedness can lead to mood enhancement in students suffering from a mood disorder, such as depression, and whether this influence would merely enhance their momentary (state) mood moment or also alleviate their symptoms in the longer term by increasing their trait level of mood.

Practical Implications

The findings of this study provide practical implications for student well-being initiatives in higher education. Specifically, they advise universities to not only promote an increase in social interaction frequency but, more importantly, improve the quality of these interactions, as the qualitative factor of perceived social connectedness was shown to have a stronger association with momentary mood than the quantitative factor of social interaction frequency. Thus, universities should organise events that build up meaningful connections, such as conversations in small groups, socialising events, and support circles. Considering the trend towards a stronger association between social interaction frequency and momentary mood in the evening compared to the morning and afternoon, events organised by the university should take place in an informal setting and particularly integrate interactions that are perceived as a part of free time instead of a university-related activity.

Besides convincing students to participate in social events, universities should try to raise awareness for the importance of social connectedness and the quality of social interaction in general. This may be done through campaigns informing students that not all social interactions are equally beneficial for their momentary mood and advising them to choose those interactions that make them feel connected with their peers. Supporting students in prioritizing social interactions which make them feel socially connected would likely enhance their momentary mood, as well as factors that have been shown to be related, such as psychological well-being, perceived stress, and academic performance (Kuyumcu, 2013; McKinzie et al., 2006; Febrilia et al., 2011).

As mood has been found to affect students' academic performance (Febrilia et al., 2011), professors and tutors are recommended to adjust their teaching strategies accordingly. Specifically, they are advised to use collaborative exercises, such as group discussions or icebreaker activities that support social connectedness among students within the classroom. Through this change of teaching strategies, students will likely feel more connected with their peers, which leads to enhanced momentary mood during the courses and finally to an improved academic performance.

Conclusion

This study aimed to examine to what extent social interaction frequency and perceived social connectedness are associated with momentary mood among university students. In line with the hypotheses, the results indicated that social interaction frequency and perceived social connectedness were each positively associated with momentary mood, while perceived social connectedness had a stronger association with momentary mood than social interaction frequency. The findings contribute to the research and practice of mood enhancement in university students. Regarding the research, future studies are advised to make methodological adjustments addressing the identified limitations and investigating topics, such as the temporal

and causal dynamics underlying the identified associations, between-person differences in these associations, the effect of different interaction types on momentary mood, and the impact of increased perceived social connectedness on clinical samples. Regarding the practice, universities are recommended to organise social events building up meaningful connections among students and use campaigns advising students to prioritise social interactions which make them feel socially connected over increasing the frequency of social interactions to enhance their momentary mood. Additionally, universities' teaching staff is recommended to foster perceived social connectedness in class to enhance their students' momentary mood, which ultimately benefits their academic performance.

References

Adedeji, A., Olawa, B. D., Hanft-Robert, S., Olonisakin, T. T., Akintunde, T. Y., Buchcik, J., & Boehnke, K. (2023). Examining the pathways from general trust through social connectedness to subjective wellbeing. *Applied Research in Quality of Life*, *18*(5), 2619–2638. https://doi.org/10.1007/s11482-023-10201-z

Alhasani, M., Alkhawaji, A., & Orji, R. (2022). Mental health and time management behavior among students during COVID-19 pandemic: Towards persuasive technology design. *Human Behavior and Emerging Technologies*, *2022*, 1–13. https://doi.org/10.1155/2022/7376748

Ben Salah, A., DeAngelis, B. N., & al'Absi, M. (2021). Resilience and the role of depressed and anxious mood in the relationship between perceived social isolation and perceived sleep quality during the COVID-19 pandemic. *International Journal of Behavioral Medicine*, *28*(3), 277–285. https://doi.org/10.1007/s12529-020-09945-x

Bernstein, M. J., Zawadzki, M. J., Juth, V., Benfield, J. A., & Smyth, J. M. (2018). Social interactions in daily life: Within-person associations between momentary social experiences and psychological and physical health indicators. *Journal of Social and Personal Relationships*, *35*(3), 372–394. https://doi.org/10.1177/0265407517691366

Brunes, A., & Heir, T. (2020). Social interactions, experiences with adverse life events and depressive symptoms in individuals with visual impairment: a cross-sectional study. *BMC Psychiatry*, *20(1)*, Article 224. https://doi.org/10.1186/s12888-020-02652-7

Cwir, D., Carr, P. B., Walton, G. M., & Spencer, S. J. (2011). Your heart makes my heart move: Cues of social connectedness cause shared emotions and physiological states among strangers. Journal of Experimental Social Psychology, 47(3), 661–664. https://doi.org/10.1016/j.jesp.2011.01.009

Daou, L., & El Hajj, C. (2023). Challenges and opportunities faced by the students and faculty members. In N. Azoury & G. Yahchoichi (Eds.), *Governance in Higher Education* (pp. 89–105). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-40586-0_5

De Jaegher, H., Di Paolo, E., & Gallagher, S. (2010). Can social interaction constitute social cognition? *Trends in Cognitive Sciences*, *14*(10), 441–447. https://doi.org/10.1016/j.tics.2010.06.009

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer. https://doi.org/10.1007/978-1-4899-2271-7

Deiters, R. (2022). *Relationships of well-being and depressive mood with social contact in students' daily life: An experience sampling study* [Master's Thesis, University of Twente]. https://essay.utwente.nl/89524/

Di Paolo, E., & De Jaegher, H. (2012). The interactive brain hypothesis. *Frontiers in Human Neuroscience*, *6*, 163. https://doi.org/10.3389/fnhum.2012.00163

Duru, E., & Poyrazli, S. (2011). Perceived discrimination, social connectedness, and other predictors of adjustment difficulties among Turkish international students. *International Journal of Psychology: Journal International de Psychologie*, *46*(6), 446–454. https://doi.org/10.1080/00207594.2011.585158

Febrilia, I., Warokka, A., & Abdullah, H. (2011). University students' emotion state and academic performance: New insights of managing complex cognitive. *Journal of e-learning & higher education*, Article 879553. https://doi.org/10.5171/2011.879553

Forbes, P. A. G., Pronizius, E., Feneberg, A. C., Nater, U. M., Piperno, G., Silani, G., Stijovic, A., & Lamm, C. (2023). The effects of social interactions on momentary stress and mood during COVID-19 lockdowns. *British Journal of Health Psychology*, *28*(2), 306–319. https://doi.org/10.1111/bjhp.12626

Fu, W., Wang, C., Chai, H., & Xue, R. (2022). Examining the relationship of empathy, social support, and prosocial behavior of adolescents in China: a structural equation modeling approach. *Humanities & Social Sciences Communications*, *9*(1), 1–8. https://doi.org/10.1057/s41599-022-01296-0

García-Gómez, P., d'Uva, T.B., & Moghani, V. (2024). The battle with mental health problems among university students. *Backbone,* 22-25. https://www.eur.nl/en/news/battle-mental-health-problems-among-university-students

Glanville, J. L., Andersson, M. A., & Paxton, P. (2013). Do social connections create trust? An examination using new longitudinal data. *Social Forces; a Scientific Medium of Social Study and Interpretation*, *92*(2), 545–562. https://doi.org/10.1093/sf/sot079

Haslam, C., Cruwys, T., Haslam, S.A., Jetten, J. (2015). Social Connectedness and Health. In: Pachana, N. (Ed.), *Encyclopedia of Geropsychology* (pp. 1-10). Springer, Singapore. https://doi.org/10.1007/978-981-287-080-3_46-2

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *The Behavioral and Brain Sciences*, *33*(2–3), 61–83; discussion 83-135. https://doi.org/10.1017/S0140525X0999152X

Hu, B., Huang, X., Zhang, C., & Ye, J. (2024). Analysis of factors influencing depressive mood: A focus on medical students in targeted employment. *Revista Colombiana de Psiquiatria*. https://doi.org/10.1016/j.rcp.2022.05.005

Ibrahim, A. K., Kelly, S. J., Adams, C. E., & Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research*, *47*(3), 391–400. https://doi.org/10.1016/j.jpsychires.2012.11.015

Kuczynski, A. M., Halvorson, M. A., Slater, L. R., & Kanter, J. W. (2022). The effect of social interaction quantity and quality on depressed mood and loneliness: A daily diary study.

Journal of Social and Personal Relationships, *39*(3), 734–756. https://doi.org/10.1177/02654075211045717

Kuyumcu, B. (2013). The Predictive Power of University Students' Positive-Negative Moods in Their Psychological WellBeing. *Journal of Theoretical Educational Science*, *6*(1), 62–76.

Legey, S., Aquino, F., Lamego, M. K., Paes, F., Nardi, A. E., Neto, G. M., Mura, G., Sancassiani, F., Rocha, N., Murillo-Rodriguez, E., & Machado, S. (2017). Relationship among physical activity level, mood and anxiety states and quality of life in physical education students. *Clinical Practice and Epidemiology in Mental Health: CP & EMH*, *13*, 82–91. https://doi.org/10.2174/1745017901713010082

Lischetzke, T. (2014). Mood. In: Michalos, A.C. (Ed.), *Encyclopedia of Quality of Life and Well-Being Research*, (pp. 4115-4119). Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_1842

Liu, H., Xie, Q. W., & Lou, V. W. Q. (2019). Everyday social interactions and intra-individual variability in affect: A systematic review and meta-analysis of ecological momentary assessment studies. *Motivation and Emotion*, *43*(2), 339–353. https://doi.org/10.1007/s11031-018-9735-x

Lynch-Jordan, A. M., Sil, S., Bromberg, M., Ting, T. V., & Kashikar-Zuck, S. (2015). Cross-sectional study of young adults diagnosed with juvenile fibromyalgia: Social support and its impact on functioning and mood. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, *57*(5), 482–487. https://doi.org/10.1016/j.jadohealth.2015.07.015

Ma, J., Williams, J. M., Morris, P. G., & Chan, S. W. Y. (2023). Effectiveness of a mindful nature walking intervention on sleep quality and mood in university students during

Covid-19: A randomised control study. *Explore (New York, N.Y.)*, *19*(3), 405–416. https://doi.org/10.1016/j.explore.2022.08.004

McKinzie, C., Altamura, V., Burgoon, E., & Bishop, C. (2006). Exploring the effect of stress on mood, self-esteem, and daily habits with psychology graduate students. *Psychological Reports*, *99*(2), 439–448. https://doi.org/10.2466/pr0.99.2.439-448

Miller, K. J., Mesagno, C., McLaren, S., Grace, F., Yates, M., & Gomez, R. (2019). Exercise, mood, self-efficacy, and social support as predictors of depressive symptoms in Older Adults: Direct and interaction effects. *Frontiers in Psychology*, *10*, 2145. https://doi.org/10.3389/fpsyg.2019.02145

Mölsä, M. E., Lax, M., Korhonen, J., Gumpel, T. P., & Söderberg, P. (2022). The experience sampling method in monitoring social interactions among children and adolescents in school: A systematic literature review. *Frontiers in Psychology*, *13*, 844698. https://doi.org/10.3389/fpsyg.2022.844698

Murray, G., Gottlieb, J., & Swartz, H. A. (2021). Maintaining daily routines to stabilize mood: Theory, data, and potential intervention for circadian consequences of COVID-19. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie*, *66*(1), 9–13. https://doi.org/10.1177/0706743720957825

Myin-Germeys, I., & Kuppens, P. (2022). Experience sampling methods, an introduction. In I. Myin-Germeys & P. Kuppens (Eds.), *The Open Handbook of Experience Sampling Methodology* (2nd ed., pp. 7–19). The center for Research on Experience sampling and Ambulatory methods Leuven (REAL).

Napa Scollon, C., Prieto, C.-K., & Diener, E. (2009). Experience sampling: Promises and pitfalls, strength and weaknesses. In *Assessing Well-Being* (pp. 157–180). Springer Netherlands.

O'Flynn, J., Dinan, T. G., & Kelly, J. R. (2018). Examining stress: an investigation of stress, mood and exercise in medical students. *Irish Journal of Psychological Medicine*, *35*(1), 63–68. https://doi.org/10.1017/ipm.2017.54

Okabe-Miyamoto, K., Walsh, L. C., Ozer, D. J., & Lyubomirsky, S. (2024). Measuring the experience of social connection within specific social interactions: The Connection During Conversations Scale (CDCS). *PloS One*, *19*(1), e0286408. https://doi.org/10.1371/journal.pone.0286408

Olusegun-Emmanuel, F. (2023). *Social connectedness and its relation to perceived stress and loneliness* [Honours Thesis, Western University]. https://ir.lib.uwo.ca/brescia_psych_uht/46

Palmer, C. (2025). *The benefits of experience sampling for longitudinal research*. American Psychological Association. https://www.apa.org/research-practice/conduct-research/sampling-longitudinal-research

Puusepp, V. (2023). Becoming closer to one another: Shared emotions and social relationships. *Philosophical Psychology*, *37*(8), 2533–2559. https://doi.org/10.1080/09515089.2023.2171858

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066x.55.1.68

Saeri, A. K., Cruwys, T., Barlow, F. K., Stronge, S., & Sibley, C. G. (2018). Social connectedness improves public mental health: Investigating bidirectional relationships in the New Zealand attitudes and values survey. *The Australian and New Zealand Journal of Psychiatry*, *52*(4), 365–374. https://doi.org/10.1177/0004867417723990

Sandstrom, G. M., & Dunn, E. W. (2014). Social interactions and well-being: The surprising power of weak ties: The surprising power of weak ties. *Personality & Social Psychology Bulletin*, *40*(7), 910–922. https://doi.org/10.1177/0146167214529799

Schiffrin, H. H., & Nelson, S. K. (2010). Stressed and happy? Investigating the relationship between happiness and perceived stress. *Journal of Happiness Studies*, *11*(1), 33–39. https://doi.org/10.1007/s10902-008-9104-7

Schilbach, L., Timmermans, B., Reddy, V., Costall, A., Bente, G., Schlicht, T., & Vogeley, K. (2013). Toward a second-person neuroscience. *The Behavioral and Brain Sciences*, *36*(4), 393–414. https://doi.org/10.1017/S0140525X12000660

Sekhon, S., & Gupta, V. (2023). Mood disorder. In *StatPearls*. StatPearls Publishing.

Shin, H., & Gyeong, S. (2022). Effects of supportive and conflicting interactions with partners and friends on emotions: Do the source and quality of relationships matter? *Frontiers in Psychology*, *13*, 1020381. https://doi.org/10.3389/fpsyg.2022.1020381

Srivastava, S., Angelo, K. M., & Vallereux, S. R. (2008). Extraversion and positive affect: A day reconstruction study of person–environment transactions. *Journal of Research in Personality*, *42*(6), 1613–1618. https://doi.org/10.1016/j.jrp.2008.05.002

Sun, J., Harris, K., & Vazire, S. (2020). Is well-being associated with the quantity and quality of social interactions? *Journal of Personality and Social Psychology*, *119*(6), 1478–1496. https://doi.org/10.1037/pspp0000272

Van Ryzin, M. J., & Roseth, C. J. (2021). The cascading effects of reducing student stress: Cooperative learning as a means to reduce emotional problems and promote academic engagement. *The Journal of Early Adolescence*, *41*(5), 700–724. https://doi.org/10.1177/0272431620950474

Van ’t Klooster, J.-W. J. R., Rabago Mayer, L. M., Klaassen, B., & Kelders, S. M. (2024). Challenges and opportunities in mobile e-coaching. *Frontiers in Digital Health*, *5*, 1304089. https://doi.org/10.3389/fdgth.2023.1304089

Verster, J. C., Sandalova, E., Garssen, J., & Bruce, G. (2021). The use of single-item ratings versus traditional multiple-item questionnaires to assess mood and health. *European Journal of Investigation in Health Psychology and Education*, *11*(1), 183–198. https://doi.org/10.3390/ejihpe11010015

Wang, K., Joshi, J., & Cho, Y. (2025). Streaming to Connect: Exploring How Social Connectedness Relates to Empathy Types and Physiological States in Remote Virtual Audiences. *Sensors*, *25*(3), 872. https://doi.org/10.3390/s25030872

Whelan, D. C., & Zelenski, J. M. (2012). Experimental evidence that positive moods cause sociability. *Social Psychological and Personality Science*, *3*(4), 430–437. https://doi.org/10.1177/1948550611425194

Whittaker, S. S. (2008). *Investigation of social connectedness in a college population and its relationship to perceived stress and health symptoms* [Master’s Thesis,University of North Florida]. https://digitalcommons.unf.edu/etd/314

Wong, W. H., & Chapman, E. (2023). Student satisfaction and interaction in higher education. *Higher Education*, *85*(5), 957–978. https://doi.org/10.1007/s10734-022-00874-0

AI statement

During the preparation of this work, the author used ChatGPT for brainstorming and ideation as well as including minor revisions for conciseness and clarity of writing. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the work.

Appendix A

Information Page

Research study title

Examining the associations of social interaction frequency, perceived connectedness, and loneliness with momentary mood among university students.

Principal investigators

Matteo Schroer

Hannah Bösker

Purpose of the research

This research seeks to examine the associations of social interaction frequency, perceived social connectedness, and loneliness with momentary mood among university students.

Benefits and Risks of Participating

Benefits

The participants have the possibility to gain SONA credits. Additionally, participating in this study encourages participants to reflect on their daily social interactions, loneliness, and mood which promotes greater self-awareness. This self-awareness may empower participants to make positive changes in their social interactions or general routines that can improve their mood or mental well-being.

Risks

There are minimal risks associated with participating. Participants may experience minor disruptions in their daily routines due to the prompts they receive during the day. Responding to questions about social interactions, loneliness, and mood may require some mental effort. All necessary measures will be taken to minimize these disruptions. Participants are allowed

to postpone prompts but are encouraged to respond as soon as possible after receiving them. They can only answer a questionnaire until they receive the next one. The questions are formulated to ensure they maintain participant comfort and are easy as well as quickly to answer.

This research has been reviewed and approved by the BMS Ethics Committee in the domain of Humanities & Social Sciences.

Procedures for Withdrawal

Participation is voluntary and you can withdraw from this study at any time without any penalty or loss of benefits. If you want to withdraw, simply stop responding to the prompts. Your data will not be used in the analysis. Beyond that, you can request that your data are removed from the study up until the data analysis begins.

Collection and Processing of Personal Information

The data will consist of responses to the prompts about social interaction frequency, perceived social connectedness, loneliness, and mood. Additionally, at the beginning of the study, we will ask demographic questions regarding age, gender, education level, study field, country of residence, nationality, and marital status. These demographic questions are used solely for categorizing participants and providing context for the study results.

All data will be anonymous and stored securely. Your responses will not be linked to your identity.

Data Usage and Confidentiality

The data will be used exclusively for research purposes.

Retention period for the research data

The data will be retained for a period of up to five years following the completion of the study.

Contact Details of the Researchers

If you have any questions or concerns regarding this study or your participation, please contact the researchers:

Matteo Schröer (m.schroer3@student.utwente.nl)

Hannah Bösker (h.bosker@student.utwente.nl)

Vanessa Michalski (v.michalski@utwente.nl)

Contact Details of the BMS Ethics Committee

ethicscommittee-hss@utwente.nl

Appendix B

Ethical Consent Questions and Screening Questions

Ethical Consent Questions

3. I have read and understood the study information. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

□ Yes □ No

2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions, and I can withdraw from the study at any time, without having to give a reason.

□ Yes □ No

3. I understand that taking part in the study involves responding to prompts three times per day for 15 days. These prompts will ask me to reflect on my social interactions, loneliness, and mood.

□ Yes □ No

4. I understand that taking part in the study involves the following risks:

- potential minor disruptions to my daily life routine due to receiving prompts 3 times per day
- the requirement for some mental effort to reflect on my social interactions, loneliness, and mood.

□ Yes □ No

5. I give permission for the data that I provide to be archived so it can be used for future research and learning.

□ Yes □ No

Screening Questions

3. Are you currently enrolled as a university student?

□ Yes □ No

2. Do you have regular access to a mobile phone that allows you to respond to short surveys three times per day?

□ Yes □ No

3. Do you currently experience severe mental health issues that may cause distress during daily social interaction, loneliness, and mood reporting?

□ Yes □ No

Appendix C

Daily Questionnaire

Social Interaction Frequency

How many social interactions did you have since the last prompt?

Social interactions = real-time exchanges between two or more people, either in person or online

Include: conversations, video calls, group discussions, instant messaging with immediate replies, brief interactions (e.g. when ordering a coffee), etc.

Exclude: delayed responses (e.g. sending a message and receiving a reply an hour later), passive social media use, etc.

□1 □2 □3 □4 □5 □6 □7 □8 □9 □10 □11 □12 □13 □14

□15 □16 □17 □18 □19 □20

Perceived Social Connectedness

During my social interactions since the last prompt, I felt like I shared a lot in common with my interaction partners.

□Strongly Disagree □Disagree □Somewhat Disagree □Neutral

□Somewhat Agree □Agree □Strongly Agree

During my social interactions since the last prompt, I felt like my interaction partners were interested in my thoughts and feelings.

□Strongly Disagree □Disagree □Somewhat Disagree □Neutral

□Somewhat Agree □Agree □Strongly Agree

During my social interactions since the last prompt, I was truly attentive.

□Strongly Disagree □Disagree □Somewhat Disagree □Neutral

□Somewhat Agree □Agree □Strongly Agree

During my social interactions since the last prompt, I felt that my energy was drained (reversed).

□Strongly Disagree □Disagree □Somewhat Disagree □Neutral

□Somewhat Agree □Agree □Strongly Agree

Momentary Mood

How would you rate your mood right now?

□Very Negative □Negative □Somewhat Negative □Neutral

□Somewhat Positive □Positive □Very Positive

Appendix D

Residual plots for Assumption Checking

Figure D1

Residuals vs. Fitted Plot for Each Model

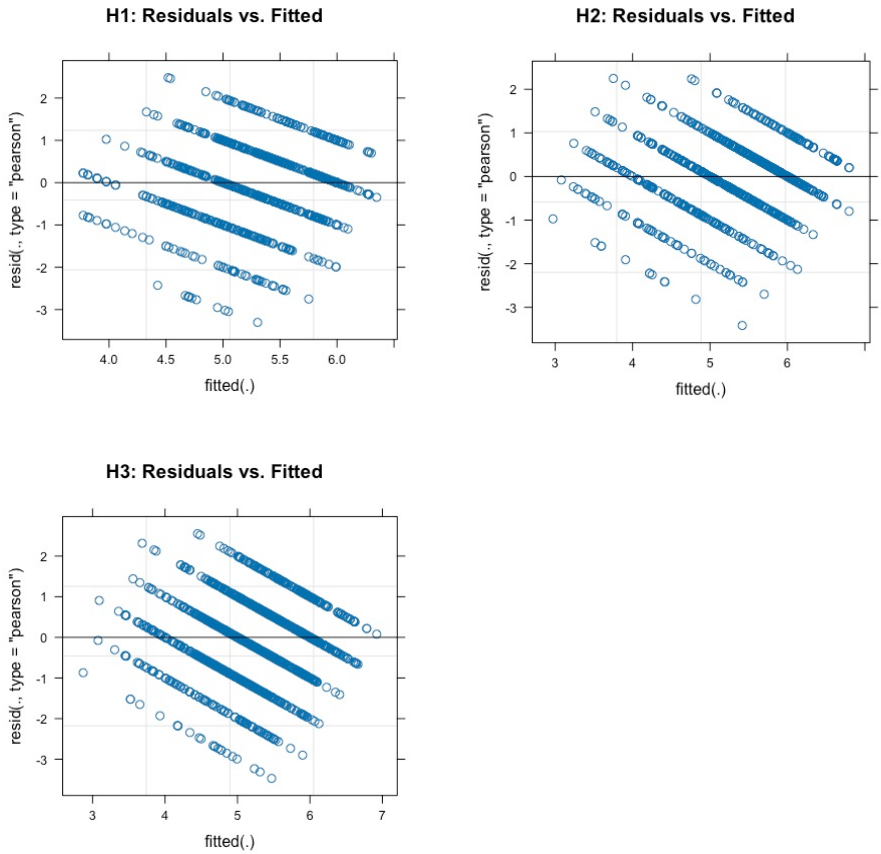


Figure D2

Q-Q Plot of Residuals for Each Model