The Role of Stress Intensity on the Effectiveness of Distraction and Rumination in Affective Stress Recovery

Mona Vogtt

Department of Behavioural and Social Science, University of Twente
First Supervisor: Thomas Vaessen
Second Supervisor: Magdalena Sikora

July 2nd, 2025

Abstract

Background. Emotion regulation (ER) strategies support affective stress recovery in daily life. However, it remains unclear whether distraction and rumination are adaptive or maladaptive strategies. Furthermore, research on the moderating role of stress intensity concerning distraction and rumination in enhancing stress recovery is limited, although it may influence the effectiveness of stress recovery. This study investigates the relationship between distraction and rumination and affective stress recovery in daily life while assessing a potential interaction with stress intensity.

Methodology By using the Experience Sampling Methodology (ESM), 35 university students completed eight daily measurements on 14 days. The questionnaire assessed the use of ER strategies, negative affect (NA), positive affect (PA), and stress intensity. Linear Mixed Models (LMM) were conducted with either NA or PA as the outcome variable, and either distraction or rumination as predictors. Additional LMMs tested the interaction with stress intensity.

Results Distraction was significantly associated with decreased subsequent PA (B = -4.81, SE = 2.26, t(669.44) = -2.13, p = .03, CI [-9.24, -0.37]), while the effects for rumination on stress recovery were non-significant. Neither distraction nor rumination was significant for NA. No interaction effect of either distraction or rumination and stress recovery was revealed.

Discussion The findings indicate that distraction may increase long-term PA. The lack of significant (interaction) effects may be explained by polyregulation, defined as using multiple ER strategies for one emotional experience. This process may weaken the effectiveness of individual strategies. Future research should focus on polyregulation by investigating effective combinations and sequences of ER strategies in different contexts.

Keywords: ESM, daily life, affective stress recovery, emotion regulation strategies, stress intensity, negative affect, positive affect

The Role of Stress Intensity on the Effectiveness of Distraction and Rumination in Affective Stress Recovery

In recent years, perceived stress has increased in the general population, leading to changes in moods, behaviours and well-being (Flores-Kanter et al., 2021; Valencia-Florez et al., 2023). Stress refers to the discrepancy between environmental demands and one's ability to adjust (Marcusson-Clavertz et al., 2022). Daily stress, however, describes inconveniences, stressors or annoyances related to daily routines (Sweeney et al., 2012). Concerning daily life stress, American adults describe feeling exposed to stressful experiences on at least 40% of days (Zawadzki et al., 2019). Of those who felt stressed, 51% reported feeling depressed and 61% felt anxious, while 37% indicated feeling lonely as a result of stress (*Stress: Statistics*, n.d.). Daily life stress can be investigated by using the Experience Sampling Methodology (ESM), which allows for an accurate representation of the individual's situation (Dogan et al., 2022; Myin-Germeys & Kuppens, 2022). It is used as an alternative to trait-based self-reports and laboratory experiments and ensures high ecological validity and low recall bias (De Calheiros Velozo et al., 2022), thereby allowing for a holistic assessment.

Affective Stress Recovery in Daily Life

Ongoing daily stress can interfere with daily functioning, and prolonged stress can contribute to the development of mental disorders (De Calheiros Velozo et al., 2022; Valenica-Florez et al., 2023). Daily stress becomes problematic when it is repeated or prolonged, meaning the continuation of stress over a longer period. Prolonged stress is associated with anxiety, major depression, and psychosis (De Calheiros Velozo et al., 2022; Lachowicz et al., 2025; Myin-Germeys et al., 2005; Valencia-Florez et al., 2023; Vassen et al., 2019). Hence, stress influences an individual's affect, whereby repeated or prolonged stress can lead to stronger reactions to smaller stressors, such as those encountered in daily life (De Calheiros Velozo et al., 2022). Furthermore, affective stress recovery has been suggested to be more important for mental health than the initial stress response. Affective stress recovery refers to the period that the individual needs for their affect to return to its baseline level after a stress response. This highlights the importance of resolving stress in daily life quickly and effectively.

However, the duration of stress recovery varies. Accordingly, affective stress recovery is commonly measured by analysing negative affect (NA) (De Calheiros Velozo et al., 2022), while measuring positive affect (PA) recovery is rare (Colombo et al., 2021). By marking the moment of stress and the moment of recovery, meaning when NA returns to its baseline level, an interval can be detected. This interval represents the time needed for affective stress recovery. Research indicates that NA recovery and PA recovery can be delayed, for instance, in individuals with mental disorders (Ader et al., 2022). As delayed affective recovery can occur, the question arises concerning how to make affective stress recovery more effective.

Emotion Regulation

One of the factors influencing stress recovery is emotion regulation (ER) (Li et al., 2024). ER refers to the process of influencing emotions and emotional states by regulating the intensity, frequency and duration of positive and/or negative emotions (Houben et al., 2023). By increasing resilience and buffering against negative impacts, ER influences stress recovery by regulating to what extent emotions fluctuate over time (Li et al., 2024; Jentsch & Wolf, 2024; Schraub et al., 2013).

Two relevant ER strategies are distraction and rumination. First, both ER strategies work with opposing mechanisms. Distraction is an attentional disengagement ER strategy defined as shifting the focus away from the situation, event or thought that causes stress. Rumination is described as an engagement strategy involving repeatedly thinking about negative emotions and experiences, including their causes and consequences (Brans et al., 2013; Socastro et al., 2022). Second, ER strategies are categorised as either adaptive or maladaptive based on research on momentary NA and PA, but the findings are inconsistent (Blanke et al., 2021; Brans et al., 2013). Thus, further research is needed to add to the inconclusive findings regarding the adaptiveness of distraction and rumination.

Looking at distraction, previous research on distraction indicates its adaptive function through a decrease in individuals' NA (Capobianco et al., 2018). However, Brans et al. (2013) found no association between distraction and either NA or PA. Others found no relationship with momentary NA either but found that distraction is positively related to next-hour PA (Boemo et al., 2022), thereby indicating faster stress recovery. Hence, the results regarding whether distraction should be categorised as maladaptive or adaptive remain inconsistent.

Concerning rumination and stress recovery, mixed results emerge. One study found no evidence of a relationship between rumination and increased NA (Hjartarson et al., 2021). However, a meta-analysis by Boemo et al. (2022) found a positive association between rumination and contemporary and next-hour NA, indicating slower recovery. As rumination is associated with the development and maintenance of depression, it is thus categorised as maladaptive because it does not help the individual in solving but rather worsens feelings of helplessness and increases negative feelings (Capobianco et al., 2018). Hence, while it is suggested that rumination maintains psychological distress and prolongs stress recovery, the evidence remains inconsistent. Altogether, findings on the effects of these ER strategies on affect remain inconsistent, indicating a need for further context-dependent daily life research.

Stress Intensity

One contextual factor that connects distraction and rumination is stress intensity, which refers to the subjective evaluation of the severity of a negative event (Blanke et al., 2021; Socrasto et al., 2022). Stress intensity has been suggested to influence the effectiveness and use of different ER strategies in daily life. Both ER strategies are preferred during high stress

intensity compared to low stress intensity (Blanke et al., 2021). Relating stress intensity to distraction, distraction is most frequently used in daily life and preferred over other strategies for high-intensity stressors, as it decreases NA for more intense stressors (Blanke et al., 2021; Hiekkaranta et al., 2023; Socrasto et al., 2022). Furthermore, higher intensity of negative events was found to be related to using distraction (Hiekkaranta et al., 2023). This suggests that distraction serves as an adaptive ER strategy in the context of high-intensity stress.

In line with distraction, rumination is frequently used during intense stressors in daily life. It is associated with strong increases in NA at higher stress intensity (Blanke et al., 2021). When accounting for momentary higher NA and lower PA levels, Boemo et al. (2024) found associations between rumination and higher NA and lower PA at higher stress, indicating slower stress recovery during higher stress levels. Accordingly, the higher the stress intensity, the more rumination was associated with increases in NA, which indicates a maladaptive effect.

Hence, stress intensity guides the selection of ER strategies and their effectiveness in daily life. However, research has yet to investigate how stress intensity moderates the relationship between distraction or rumination and stress recovery, particularly in daily life contexts. Current literature mostly focuses on the effects of distraction and rumination on concurrent affect instead of affect at a later point in time, and thus, neglects affective stress recovery. Additionally, stress intensity is predominantly investigated concerning momentary affect. Since distraction and rumination are both frequently used during intense stressors, and their categorisation regarding whether they are adaptive or maladaptive is inconclusive, it is important to investigate their influence on affective stress recovery in daily life. By addressing this gap, this research can provide insights into the contextual influence of stress intensity on which strategies may be more adaptive for stress recovery.

Present Study

The present study aims to provide real-life data on individuals' affective stress recovery by addressing the effectiveness of ER strategies and stress intensity. Distraction and rumination were included by using ESM as a daily life approach, as the categorisation of distraction and rumination into (mal)adaptive strategies remains unclear. Further, stress intensity was added as a potential moderator.

This leads to the subsequent research question: *What is the effect of the emotion regulation strategies distraction and rumination on affective stress recovery in daily life, and how does stress intensity moderate this relationship?*

To assess this research question, the following hypotheses were tested:

The use of distraction is associated with decreases in negative affect (H1a) and increases in positive affect (H1b), thereby indicating faster affective stress recovery.

The use of rumination is associated with increases in negative affect (H2a) and decreases in positive affect (H2b), thereby indicating slower stress recovery.

Stress intensity moderates the relationship between the use of distraction and affective stress recovery, such that the association between distraction and negative (H3a) and positive affect (H3b) is stronger when intensity is higher.

Stress intensity moderates the relationship between the use of rumination and affective stress recovery, such that the association between rumination and negative (H4a) and positive affect (H4b) is stronger when intensity is higher.

Methods

Design

This study is a within-person design that employed an empirical quantitative research design to gather daily life measurements. The ESM study lasted 14 days, during which participants digitally received eight questionnaires daily on the mPath Sense App.

Participants

After the Humanities and Social Sciences Ethics Committee approved the study with the application number 240932, participants were recruited via the SONA system, social media platforms, and a classroom announcement at the University of Twente. The aim was to collect a minimum of 80 participants to ensure sufficient participation. Inclusion criteria were being currently enrolled at university, being older than 18 years old, owning a mobile device with a stable Internet connection and speaking English.

Procedure

Participants were briefed in a 30-minute online or in-person meeting by two researchers from the research team, during which the procedure was explained to them. They were informed about the goal, procedure and duration of the study, and the storage of their data. It was explained to them that they could withdraw from the study at any time without giving reasons. A step-by-step instruction sheet was provided, including how to install the mPath Sense App and how to turn on notifications (Appendix B). Participants were asked to sign the informed consent in Qualtrics (Appendix C). They were informed about the data collected during the study. Participants were told to fill out the questionnaires as soon as possible. If not filled out immediately, a reminder was sent after 30 minutes, and the questionnaires expired after 45 minutes.

The questionnaires were sent starting the next morning after the instruction meeting. The morning questionnaire included ten items, while the evening questionnaire contained 17. The core questionnaire, consisting of eight items, was sent throughout the day (see Appendix D). After completing the study, participants were granted credit points for their participation according to the system of the University of Twente, and they received individual feedback reports via e-mail. These were created in RStudio and included graphs and the corresponding

explanations of their individual stress levels and positive and negative affect over the 14-day period, information about the stressors and coping strategies they indicated, as well as the stress levels they remembered at the end of the day compared to how they experienced these during the day.

Measures

Demographics

Participants were asked to provide information regarding their gender, age and study programme.

Stress Intensity

Regarding stress intensity, the item “At this moment I feel stressed” was used, which was rated from 0 (not at all) to 100 (very much). Only if the stress intensity was indicated as >10, follow-up questions, including the use of rumination and/or distraction, were asked.

Distraction and Rumination

To assess how participants coped with the stress, the use of the ER strategies of distraction and rumination was measured. First, for the use of distraction, the item “What did you do with this event/thought/feeling?” in the core questionnaire was used. The event/thought/feeling in the question refers to factors that resulted in stress or were experienced as being related to stress by the participant. The answer “I have tried to distract myself (e. g. by doing something else or to relax)” served as an indication of the ER strategy distraction. Second, to assess the use of rumination, the item “What did you do with this event/thought/feeling?” in the core questionnaire, with the answer “I worried about it or kept thinking about it”, was used. Based on the answer, a dichotomous variable was created for each strategy (0 = not selected, 1 = selected).

Affective Stress Recovery

Affective stress recovery was measured as a dynamic between stress at t = 0 and the next measurement at t = 1. Therefore, negative and positive affect were measured as an estimation of stress recovery. From the core questionnaires, the affect of each of the moments following (t + 1) a stressful experience (>10) was treated as the dependent variable, while the person-mean centred affect was used as the baseline control variable. Positive affect was measured by the item “At this moment my positive feelings are” on a scale from 0 (= not strong at all) to 100 (= very strong), and the same was done for negative affect with the item “At this moment my negative feelings are” on the same scale. A time-lagged variable was created separately for NA and PA to represent the affect during the next measurement, except for the last measurement of the day. Accordingly, the last questionnaire of the day was excluded when creating the lagged variable.

Data Analysis

The data from the mPath website was added to RStudio. Descriptive statistics regarding participants' gender, age, and study programme were computed. Linear Mixed Models (LMM) were used for all analyses as they consider the hierarchical structures and characteristics of ESM data. The significance level was set at p = .05, and the confidence interval at 95%.

For hypothesis one, examining whether the use of distraction is associated with affective stress recovery, two linear mixed models were performed, with either NA or PA as the outcome variable. The affect of each of the moments following (t + 1) a stressful experience (>10), which was created in a time-lagged variable, is the dependent variable. The use of distraction at the moment of stress (t = 0) served as a predictor, and the person-mean centred affect at the moment of stress (t = 0) served as a covariate. Random intercepts for participants were included to account for repeated measures.

The same two LMMs were performed for hypothesis two, stating that rumination is associated with affective stress recovery, but used rumination as a predictor instead of distraction.

To assess whether stress intensity moderates the relationship between distraction and affective stress recovery for hypothesis three, two LMMs were calculated, one for negative affect and one for positive affect following (t + 1) a stressful experience (>10). For both, distraction, stress intensity and their interaction were included as fixed effects. Additionally, affect at the moment of stress (t = 0) and random intercepts were included.

For hypothesis four, which dealt with the potential moderating effect of stress intensity on the relationship between rumination and affective stress recovery, the same analyses as for hypothesis three were performed, but rumination was included as the predictor instead of distraction.

Results

Demographics

The sample consisted of 35 participants, of whom 14.29% were male (n = 5) and 85.71% were female (n = 30). The age ranged from 18 to 27 (M = 21.09, SD = 1.94). The distributions of gender and study programme can be found in Table 1.

Table 1

Distributions of Gender and Study Programme

	n	*%*
Gender		
Female	30	85.71%

Male	5	14.29%
Study Programme		
Psychology	25	71.43%
Other	10	28.57%

Number of Observations, Compliance and Distributions

The total dataset consisted of *n* = 3646 measurement points. Of these, *n* = 1037 were used for further analyses as these indicated a stressful event, thought, or feeling and had corresponding following measurements. Compliance rates ranged from 4% to 98%, with a mean of 57.37%. Descriptive statistics of the distributions for NA, PA, rumination, distraction, and stress intensity are visualised in Table 2. Assumption checks for all relevant variables and models are presented in Appendix E.

Table 2

Scale Distributions for all Relevant Variables

Scale	*M/Frequency*	*SD/Percentage*
Negative Affect	20.57	20.92
Positive Affect	68.61	21.31
Rumination	151	14.56%
Distraction	80	7.71%
Stress Intensity	19.17	22.40

Distraction and Affective Stress Recovery

To test the first hypothesis that the use of distraction is associated with faster stress recovery compared to not using distraction as an ER strategy, no significant effect of distraction on NA was found (B = 4.04, SE = 2.34, t(673.79) = 1.72, p = .09, CI [-0.57, 8.63]). However, a significant effect of the use of distraction on PA was found (B = -4.81, SE = 2.26, t(669.44) = -2.13, p = .03, CI [-9.24, -0.37]), suggesting that the use of distraction is associated with slower recovery (see Figure 1). The recovery trajectories for PA depending on the use of distraction per participant are visualised in Figure 2. Thus, H1a and H1b can be refuted.

Figure 1

Effect of Distraction on Positive Affect When Using Distraction

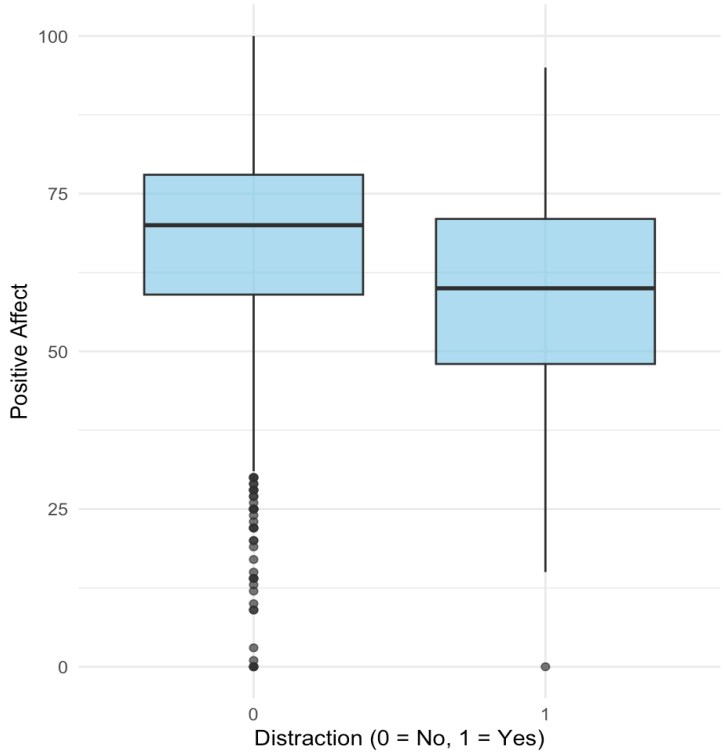
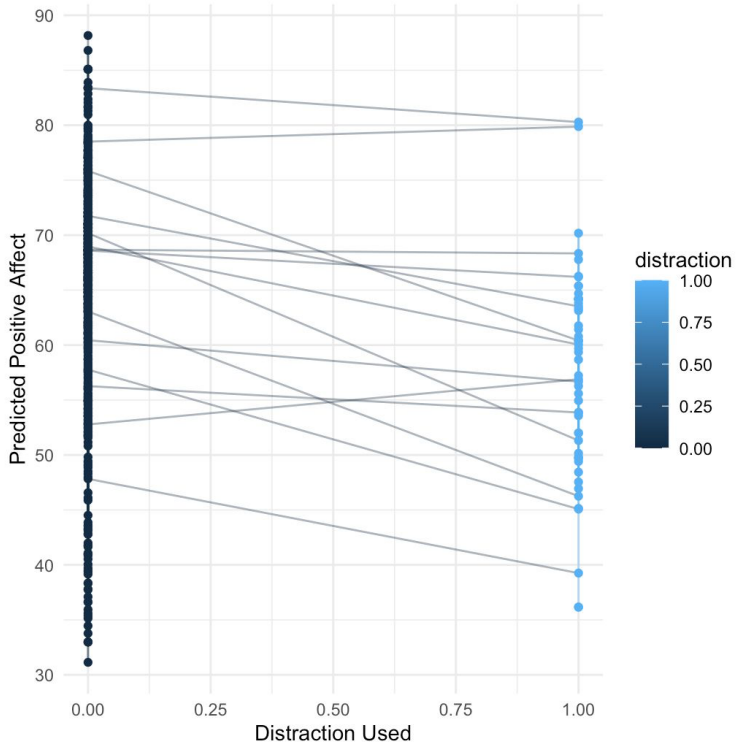


Figure 2

PA Recovery Trajectories Per Participant Depending on the Use of Distraction



Rumination and Affective Stress Recovery

To investigate the second hypothesis that the use of rumination is associated with slower stress recovery, results indicated non-significant effects of rumination on both NA (*B* = -0.96, *SE* = 1.96, *t*(687.86) = -0.49, *p* = .63, *CI* [-4.82, 2.90]) and PA separately (*B* = 1.50, *SE* = 1.90, *t*(688.07) = 0.79, *p* = .43, *CI* [-2.24, 5.23]). Hence, H2a and H2b can be rejected.

The Moderating Role of Stress Intensity and Distraction for Affective Stress Recovery

Regarding the third hypothesis of an interaction effect of stress intensity and the use of distraction on affective stress recovery, results showed no significant interaction effect on NA (*B* = 0.07, *SE* = 0.11, *t*(660.55) = 0.65, *p* = .51, *CI* [-0.14, 0.28]) or PA (*B* = -0.00, *SE* = 0.10, *t*(664.46) = -0.03, *p* = 0.98, *CI* [-0.21, 0.20]). As it was hypothesised that the association between distraction and affective stress recovery is stronger for higher stress intensity, these results reveal that H3a and H3b can be rejected.

The Moderating Role of Stress Intensity and Rumination for Affective Stress Recovery

The fourth hypothesis states that stress intensity moderates the relationship between rumination and affective stress recovery, hypothesising a weaker association for higher intensity stress. A non-significant interaction effect of rumination and stress intensity on NA (*B* = -0.14, *SE* = 0.09, *t*(670.89) = -1.67, *p* = .10, *CI* [-0.31, 0.03]) and PA (*B* = 0.14, *SE* = 0.08, *t*(665.50) = 1.70, *p* = 0.09, *CI* [-0.02, 0.31]) was found, suggesting that H4a and H4b can be rejected. The exact values of all analyses can be found in Table 3.

Table 3

Linear Mixed Model Results

	B	*SE*	*t-value*	*p-value*	*CI*
H1a					
distraction	4.03	2.34	1.72	.09	[-0.57, 8.63]
previous NA	0.32	0.04	8.82	<.001	[0.25, 0.40]
H1b					
distraction	-4.81	2.26	-2.13	.03	[-9.24, 0.37]
previous PA	0.34	0.04	9.14	<.001	[0.27, 0.42]
H2a					
rumination	-0.96	1.96	-0.49	.66	[-4.82, 2.90]
previous NA	0.33	0.04	9.09	<.001	[0.26, 0.40]
H2b					
rumination	1.50	1.90	0.79	.43	[-2.24, 5.23]
previous PA	0.36	0.04	9.49	<.001	[0.28, 0.43]
H3a					

distraction	0.84	5.04	0.17	.87	[-9.05, 10.70]
stress intensity	0.16	0.04	4.02	<.001	[0.08, 0.25]
previous NA	0.22	0.04	5.10	<.001	[0.13, 0.30]
distraction:intensity	0.07	0.11	0.65	.50	[-0.14, 0.28]
H3b					
distraction	-4.50	4.90	-0.92	.36	[-14.1, 5.11]
stress intensity	-0.06	0.04	-1.63	.10	[-0.14, 0.01]
previous PA	0.31	0.04	7.20	<.001	[0.22, 0.39]
distraction:intensity	-0.003	0.10	-0.03	.96	[-0.21, 0.20]
H4a					
rumination	4.70	4.09	1.15	.25	[-3.33, 12.7]
stress intensity	0.20	0.04	4.68	<.001	[0.12, 0.28]
previous NA	0.23	0.04	5.38	<.001	[0.15, 0.31]
rumination:intensity	-0.14	0.09	-1.67	.10	[-0.31, 0.03]
H4b					
rumination	-4.27	3.97	-1.08	.28	[-0.02, 0.31]
stress intensity	-0.09	0.04	-2.29	.02	[0.24, 0.41]
previous PA	0.33	0.04	7.63	<.001	[0.24, 0.41]
rumination:intensity	0.14	0.08	1.69	.09	[-0.02, 0.31]

Discussion

This study aimed to investigate the effect of the ER strategies distraction and rumination on affective stress recovery in daily life and the potential moderating effect of stress intensity. Results reveal that the use of distraction was linked to decreases in PA, thereby indicating slower stress recovery. The use of rumination is not significant for stress recovery. Further, no interaction effect of either distraction or rumination and stress intensity has been found.

Distraction and Positive Affect

Contrary to Boemo et al. (2022), a negative relationship between distraction and stress recovery was found in this study. Consistent with these findings, Oudo & Brinker (2014) found that distraction reduces PA by using a distraction task. Although they also reported inconsistencies with previous literature, they explained these findings by claiming that for people with tendencies to ruminate, short-term use of either distraction or rumination is an insufficient duration to elevate their mood to comparable levels of people without tendencies to ruminate (Oudo & Brinker, 2014). As trait-specific characteristics were not controlled for in this study, the factor of tendencies to rumination could have additionally influenced affect.

Hence, the categorisation of distraction as (mal)adaptive remains inconsistent and suggests the need to further investigate additional factors.

Furthermore, the finding that distraction is significant for reducing PA may not represent distraction as a cause of reducing PA but rather is an indicator that distraction may alleviate stress immediately, but not in the longer term (Layous et al., 2022). As distraction is a disengagement strategy, it shifts the attention away from processing the current affect before this emotional information is delivered to the working memory system, where stronger emotions would be produced (Zhang et al., 2022). Hence, this suggests that distraction is beneficial only for short-term affect. Accordingly, a short-term stress response has been defined as lasting from minutes to hours (Dhabhar, 2018). As the time interval in this ESM study consisted of about one and a half hours, it can be argued that the time in between measurements in this ESM study may be too long to reveal short-term effects. Additionally, some measurements may have been skipped by participants, which increased time intervals between measurement points, therefore suggesting that this study indicated long-term effects rather than short-term effects.

Non-significance of ER Strategies

However, distraction was not significant in reducing NA in this study. This supports the findings from Brans et al. (2013), who found no association between distraction and NA. However, the previous finding that NA decreases after using distraction (Capobianco et al., 2018) contrasts with this study's findings. This difference can be explained by considering the study design. While the study by Capobianco et al. (2018) used a laboratory setting during which distraction was unnaturally introduced and thus manipulated, in this study the use of distraction happened naturally. Hence, the inconsistent results indicate the importance of the nature of the study.

Contrary to expectations, rumination did not lead to a slower stress recovery, as no association with either NA or PA was found. This aligns with previous findings from Hjartarson et al. (2021), who found no association between rumination and increases in NA. However, it contrasts with other previous findings, which indicate increases in next-hour NA after using rumination (Boemo et al., 2022). The non-significance of rumination on stress recovery can be explained by considering the identification of rumination by the participants. As the ER strategies were not artificially introduced, participants needed to identify which strategy they used. Although they were informed about the meaning of each strategy in the instruction meeting, they may not have been able to implement the identification in practice, especially for study fields other than psychology. A qualitative study about rumination revealed that one-third of undergraduate participants had never heard of the term rumination (Joubert et al., 2022). Additionally, what participants identified as rumination may have been significantly milder compared to the correct definition of rumination, meaning that participants may not have

detected short or mild episodes of rumination. Accordingly, only 26% defined rumination as thinking deeply, and only 37% indicated that rumination is repetitive and difficult to stop (Joubert et al., 2022). Thus, especially for those students who indicated studying something other than psychology, the lack of practice in the correct identification of the strategies needs to be considered when interpreting the results.

Polyregulation

Another explanation for the non-significant effect of rumination and distraction on NA is the fact that individuals frequently use multiple ER strategies to deal with a single emotion, which is a process called polyregulation (Ladis et al., 2022). Hence, when multiple strategies are used either simultaneously or shortly followed by each other, the likelihood of finding an effective ER strategy is higher, which in turn causes individuals to think that they regulate their emotions well.

Concerning polyregulation, certain combinations of multiple ER strategies may be more adaptive for stress recovery compared to other combinations or single strategy use. It has been shown that the sequence of using distraction, followed by reappraisal, may be especially helpful in comparison to using single strategies (Gross, 2015, as cited in Ford, 2019). Importantly, it is not only the combination of distraction and reappraisal but additionally the sequence in which they are used that is important for effectiveness. Accordingly, it has been indicated that the reversed order can even lead to maladaptive effects, as the stressor intensity cannot successfully be reduced and thus, the individual cannot successfully process the stressor in the long term (Ford, 2019). Hence, the non-significant effects of distraction and rumination separately on stress recovery can be explained by polyregulation, as the combinations and sequences of using more than one strategy are suggested to be more effective than using a single strategy.

Stress Intensity

Regarding stress intensity, the results from this study revealed a lack of interaction effect of stress intensity with either distraction or rumination. This contrasts with previous findings from ESM studies that indicate an interaction effect (Blanke et al., 2021; Boemo et al., 2024; Socrasto et al., 2022). However, polyregulation serves as an explanation, as polyregulation is used more frequently during more intense situations, for instance, when trying a new strategy after a previous one did not work (Boemo et al. 2022; Ladis et al., 2022). Thus, it can be suggested that when using multiple ER strategies, the effects of single strategies, such as distraction and rumination, can be masked. Hence, no interaction effect could be detected. However, while stress intensity is known to guide the selection of ER strategies, the interaction of stress intensity with these strategies to significantly affect stress recovery is questioned and needs to be investigated further on a sample providing more statistical power.

Lastly, the stress intensity may not have been severe enough in this study to detect significant results. In this study, participants did not experience high-intensity stressors very often. Since this study focused on the beneficial effect of distraction and rumination during high-stress intensities, the small mean of stress intensity indicates that high-stress intensities were rarely present in this study, therefore making the investigation difficult.

Strengths and Limitations

A limitation of this study is that the sample consisted mostly of students, mainly studying psychology. Hence, the sample is only representative of university students and thus, a specific age range, and should not be generalised to other populations. Generalising findings from students to the public can be problematic if personal variables are included because students vary from the general population (Hanel & Vione, 2016). Additionally, different age groups respond differently to stress (Scott et al., 2013), which means that the generalisation of stress intensity and affect might differ for other age groups compared to students. Recently, it has even been suggested that the perception of stress differs among university students, depending on variables such as gender and ethnicity (Barbayannis et al., 2022). Hence, the generalisability of the results to other groups is limited.

Another limitation of this study is that the study used single items for measuring PA and NA, as well as for distraction and rumination. Especially regarding affect, a multidimensional scale including more adjectives than “positive feelings” would provide higher reliability and better representativeness of the actual affect. For instance, PA could be assessed by including separate scales for “happy”, “relaxed”, “energetic” and “satisfied”, while including “stressed”, “anxious”, “irritated” and “down” for measuring NA (Eisele et al., 2021). Thereby, a better representation of the affect could be indicated.

However, there are important strengths of this study. A significant strength of this study is the use of ESM, which enables an accurate representation of the participants’ emotions and ER strategies, and therefore allows a detailed representation of the participants’ daily life. This study design significantly reduces memory biases, particularly because of the high frequency of eight measurements per day and the long duration of 14 days. Regarding the results, this means that the collected data is representative and ecologically valid for university students, thereby offering an accurate representation of this group.

Conclusion

This study aimed to investigate how distraction and rumination influence affective stress recovery in daily life and whether stress intensity moderates this relationship. The findings of this ESM study challenge the previous categorisation of strategies into adaptive or maladaptive ones. Rumination did not significantly influence affective stress recovery, while distraction indicated a slower stress recovery. However, polyregulation explains dampened effects and the lack of interaction. Future research should further focus on polyregulation to

investigate the effectiveness of combinations and sequences of ER strategies on affective stress recovery. As no interaction effect with stress intensity was found, the stressor intensity moderation is questioned but should be further investigated with a bigger sample and the inclusion of polyregulation.

References

Ader, L., Schick, A., Simons, C., Delespaul, P., Myin-Germeys, I., Vaessen, T., & Reininghaus, U. (2022). Positive Affective Recovery in Daily Life as a Momentary Mechanism Across Subclinical and Clinical Stages of Mental Disorder: Experience Sampling Study. *JMIR Mental Health*, *9*(11), e37394. https://doi.org/10.2196/37394

Barbayannis, G., Bandari, M., Zheng, X., Baquerizo, H., Pecor, K. W., & Ming, X. (2022). Academic Stress and Mental Well-Being in College Students: Correlations, affected groups, and COVID-19. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.886344

Blanke, E. S., Bellingtier, J. A., Riediger, M., & Brose, A. (2021). When and How to Regulate: Everyday Emotion-Regulation Strategy Use and Stressor Intensity. *Affective Science*, 3(1), 81–92. https://doi.org/10.1007/s42761-021-00087-1

Boemo, T., Nieto, I., Vazquez, C., & Sanchez-Lopez, A. (2022). Relations between emotion regulation strategies and affect in daily life: A systematic review and meta-analysis of studies using ecological momentary assessments. *Neuroscience & Biobehavioral Reviews*, *139*, 104747. https://doi.org/10.1016/j.neubiorev.2022.104747

Boemo, T., Martín-Garcia, O., Pacheco-Romero, A. M., Blanco, I., Lafit, G., Myin-Germeys, I., & Sanchez-Lopez, A. (2024). Not just emotion regulation, but cognition: An experience sampling study testing the relations of ecological interpretation biases and use of emotion regulation strategies with momentary affective states during daily life functioning. *Behaviour Research and Therapy*, 177, 104550. https://doi.org/10.1016/j.brat.2024.104550

Brans, K., Koval, P., Verduyn, P., Lim, Y. L., & Kuppens, P. (2013). The regulation of negative and positive affect in daily life. *Emotion*, 13(5), 926–939. https://doi.org/10.1037/a0032400

Capobianco, L., Morris, J. A., & Wells, A. (2018). Worry and rumination: do they prolong physiological and affective recovery from stress? *Anxiety Stress & Coping*, 31(3), 291–303. https://doi.org/10.1080/10615806.2018.1438723

Colombo, D., Pavani, J., Fernandez-Alvarez, J., Garcia-Palacios, A., & Botella, C. (2021). Savoring the present: The reciprocal influence between positive emotions and positive emotion regulation in everyday life. *PLoS ONE*, *16*(5), e0251561. https://doi.org/10.1371/journal.pone.0251561

De Calheiros Velozo, J., Lafit, G., Viechtbauer, W., Van Amelsvoort, T., Schruers, K., Marcelis, M., Goossens, L., Simons, C., Delespaul, P., Claes, S., Myin-Germeys, I., & Vaessen, T. (2022). Delayed affective recovery to daily-life stressors signals a risk for depression. *Journal of Affective Disorders,* 320, 499–506. https://doi.org/10.1016/j.jad.2022.09.136

Dhabhar, F. S. (2018). The short-term stress response – Mother nature's mechanism for enhancing protection and performance under conditions of threat, challenge, and opportunity. *Frontiers in Neuroendocrinology*, *49*, 175–192. https://doi.org/10.1016/j.yfrne.2018.03.004

Dogan, G., Akbulut, F. P., Catal, C., & Mishra, A. (2022). Stress Detection Using Experience Sampling: A Systematic Mapping Study. *International Journal of Environmental Research and Public Health,* 19(9), 5693. https://doi.org/10.3390/ijerph19095693

Eisele, G., Lafit, G., Vachon, H., Kuppens, P., Houben, M., Myin-Germeys, I., & Viechtbauer, W. (2021). Affective structure, measurement invariance, and reliability across different experience sampling protocols. *Journal of Research in Personality*, *92*, 104094. https://doi.org/10.1016/j.jrp.2021.104094

Flores-Kanter, P. E., Moretti, L., & Medrano, L. A. (2021). A narrative review of emotion regulation process in stress and recovery phases. *Heliyon,* 7(6), e07218. https://doi.org/10.1016/j.heliyon.2021.e07218

Ford, B. Q., Gross, J. J., & Gruber, J. (2019). Broadening our field of view: the role of emotion polyregulation. *Emotion Review*, *11*(3), 197–208. https://doi.org/10.1177/1754073919850314

Hanel, P. H. P., & Vione, K. C. (2016). Do student samples provide an accurate estimate of the general public? *PLoS ONE*, *11*(12), e0168354. https://doi.org/10.1371/journal.pone.0168354

Hiekkaranta, A. P., Kirtley, O. J., Eisele, G., Houben, M., Lafit, G., & Myin-Germeys, I. (2023). Time to reappraise or distract? temporal and situational context in emotion regulation in daily life. *Current Psychology*, *43*(12), 11139–11156. https://doi.org/10.1007/s12144-023-05233-5

Hjartarson, K. H., Snorrason, I., Bringmann, L. F., Ögmundsson, B. E., & Ólafsson, R. P. (2021). Do daily mood fluctuations activate ruminative thoughts as a mental habit? Results from an ecological momentary assessment study. *Behaviour Research and Therapy*, *140*, 103832. https://doi.org/10.1016/j.brat.2021.103832

Houben, M., Kalokerinos, E. K., Koval, P., Erbas, Y., Mitchell, J., Pe, M., & Kuppens, P. (2023). The Association Between the Selection and Effectiveness of Emotion-Regulation Strategies and Psychopathological Features: A Daily Life Study. *Clinical Psychological Science,* 12(5), 973–983. https://doi.org/10.1177/21677026231203662

Jentsch, V. L., & Wolf, O. T. (2024). The bidirectional interplay between stress and cognitive emotion regulation. *Psychoneuroendocrinology*, *160*, 106719. https://doi.org/10.1016/j.psyneuen.2023.106719

Joubert, A. E., Moulds, M. L., Werner-Seidler, A., Sharrock, M., Popovic, B., & Newby, J. M. (2022). Understanding the experience of rumination and worry: A descriptive

qualitative survey study. *British Journal of Clinical Psychology*, *61*(4), 929–946. https://doi.org/10.1111/bjc.12367

Lachowicz, A. M., Vaessen, T., Lafit, G., Achterhof, R., Akcaoglu, Z., Bamps, E., Hagemann, N., Hiekkaranta, A. P., Hermans, K. S. F. M., Janssens, J. J., Lecei, A., Kirtley, O., Myin-Germeys, I., & Houben, M. (2025). The link between delayed affective recovery from daily stressors and anxiety symptoms in youth. *International Journal of Stress Management*. https://doi.org/10.1037/str0000347

Ladis, I., Toner, E. R., Daros, A. R., Daniel, K. E., Boukhechba, M., Chow, P. I., Barnes, L. E., Teachman, B. A., & Ford, B. Q. (2022). Assessing Emotion Polyregulation in Daily Life: Who Uses It, When Is It Used, and How Effective Is It? *Affective Science*, *4*(2), 248–259. https://doi.org/10.1007/s42761-022-00166-x

Layous, K., Kumar, S. A., Arendtson, M., & Najera, A. (2022). The effects of rumination, distraction, and gratitude on positive and negative affect. *Journal of Personality and Social Psychology*, *124*(5), 1053–1078. https://doi.org/10.1037/pspp0000440

Li, X., Vaessen, T., Lafit, G., Van Aubel, E., Hiekkaranta, A. P., Houben, M., Beijer-Klippel, A., De Haan, L., Schirmbeck, F., Reininghaus, U., & Myin-Germeys, I. (2024). Higher emotion regulation flexibility predicts more stable negative emotions and faster affective recovery in early psychosis: an experience sampling study. *Psychological Medicine,* 1–10. https://doi.org/10.1017/s0033291724000151

Marcusson-Clavertz, D., Sliwinski, M. J., Buxton, O. M., Kim, J., Almeida, D. M., & Smyth, J. M. (2022). Relationships between daily stress responses in everyday life and nightly sleep. *Journal of Behavioral Medicine,* 45(4), 518–532. https://doi.org/10.1007/s10865-021-00281-3

Myin-Germeys, I., Delespaul, P., & Van Os, J. (2005). Behavioural sensitization to daily life stress in psychosis. *Psychological Medicine*, 35(5), 733–741. https://doi.org/10.1017/s0033291704004179

Myin-Germeys, I., & Kuppens, P. (Eds.). (2022) *The open handbook of experience sampling methodology: A step-by-step guide to designing, conducting, and analyzing ESM studies* (2nd ed.). Leuven: Center for Research on Experience Sampling and Ambulatory Methods Leuven

Odou, N., & Brinker, J. (2014). Self-compassion, a better alternative to rumination than distraction as a response to negative mood. *The Journal of Positive Psychology*, *10*(5), 447–457. https://doi.org/10.1080/17439760.2014.967800

Schraub, E. M., Turgut, S., Clavairoly, V., & Sonntag, K. (2013). Emotion regulation as a determinant of recovery experiences and well-being: A day-level study. *International Journal of Stress Management*, *20*(4), 309–335. https://doi.org/10.1037/a0034483

Scott, S. B., Sliwinski, M. J., & Blanchard-Fields, F. (2013). Age differences in emotional responses to daily stress: The role of timing, severity, and global perceived stress. *Psychology and Aging*, *28*(4), 1076–1087. https://doi.org/10.1037/a0034000

Socastro, A., Everaert, J., Boemo, T., Blanco, I., Rodríguez-Carvajal, R., & Sanchez-Lopez, A. (2022). Moment-to-Moment Interplay Among Stress Appraisals and Emotion Regulation Flexibility in Daily Life. *Affective Science,* 3(3), 628–640. https://doi.org/10.1007/s42761-022-00122-9

Stress: Statistics. (n.d.). Mental Health Foundation. https://www.mentalhealth.org.uk/explore-mental-health/statistics/stress-statistics

Sweeney, C. R. U., Turner, J. R., Turner, J. R., Barrett, C., Soto, A. V., Whang, W., Korbel, C., Matwin, S., Gorrin, D., Schroeder, B., Turner, J. R., Dekker, J., Levin, B., Turner, J. R., Pishori, A. Z., Grabowski, J., Yard, S., Nelson, K., Denton, E., . . . Rieckmann, N. (2012). Daily Stress. In *Springer eBooks* (pp. 537–538). https://doi.org/10.1007/978-1-4419-1005-9_942

Vaessen, T., Viechtbauer, W., Van Der Steen, Y., Gayer-Anderson, C., Kempton, M. J., Valmaggia, L., McGuire, P., Murray, R., Garety, P., Wykes, T., Morgan, C., Lataster, T., Lataster, J., Collip, D., Hernaus, D., Kasanova, Z., Delespaul, P., Oorschot, M., Claes, S., . . . Myin-Germeys, I. (2019). Recovery from daily-life stressors in early and chronic psychosis. *Schizophrenia Research*, *213*, 32–39. https://doi.org/10.1016/j.schres.2019.03.011

Valencia-Florez, K. B., Sanchez-Castillo, H., Vázquez, P., Zarate, P., & Paz, D. B. (2023). Stress, a brief update. *International Journal of Psychological Research,* 16(2), 105–121. https://doi.org/10.21500/20112084.5815

Zawadzki, M. J., Scott, S. B., Almeida, D. M., Lanza, S. T., Conroy, D. E., Sliwinski, M. J., Kim, J., Marcusson-Clavertz, D., Stawski, R. S., Green, P. M., Sciamanna, C. N., Johnson, J. A., & Smyth, J. M. (2019). Understanding stress reports in daily life: a coordinated analysis of factors associated with the frequency of reporting stress. *Journal of Behavioral Medicine*, *42*(3), 545–560. https://doi.org/10.1007/s10865-018-00008-x

Zhang, N., Zhang, K., Wang, J., & Sun, X. (2022). Distract or Reappraise? The Mechanism of Cognitive Emotion Regulation Choice and Its Influential Factors. *Psychology Research and Behavior Management*, *Volume 15*, 3699–3708. https://doi.org/10.2147/prbm.s389835

Appendix A

Use of Generative AI

During the preparation of this work, the author used Scribbr for a general structure of the reference list in APA 7 format. Further, Grammarly was used for spelling and grammar correction, and ChatGPT was used to generate and adapt R codes for data analysis, as well as for correcting error codes. After using these tools, the content was reviewed and edited. The author takes full responsibility for the content of the work.

Appendix B

Information Sheet

Dear participant,

Welcome to the study "Flexible coping with stress in daily life: what works in which context?" **,** of the department of Psychology of the University of Twente, under the faculty Behavioural Management and Social Sciences and the education Psychology.

It is important that you learn about the procedure of this study before it starts, so please read the following text carefully. If anything is unclear to you, feel free to ask the researcher directly, or contact them through email: … The researcher will be happy to answer any questions you may have.

Goal of the study

The study aims to investigate the effectiveness of different coping styles in daily life. It will investigate their effectiveness depending on contextual factors such as social setting, mood, activity, location and the time of the day using a combination of mobile questionnaires, and information collected by phone sensors (location and phone use).

Procedure of the study

You can do this study in English. This study will begin with an information sheet to explain the study and set up the smartphone app we will use for data collection (m-Path Sense). You will also fill in the informed consent online.

You will complete a series of questionnaires administered eight times per day over a period of fourteen days. The questionnaire is designed to capture your emotional state, stress levels, and coping strategies.

Over the two weeks, you will receive on most days eight notifications daily, prompting you to complete brief questionnaires throughout the day. The first questionnaire (2 minutes), delivered in the morning, will ask about your sleep, affect and stress. The next six questionnaires (2 minutes), sent throughout the day, will only ask about affect and stress. During this questionnaire, you will also be asked to activate your momentary location, Bluetooth devices and ambient noise in your environment. The final evening questionnaire (5 minutes) will include questions from the earlier prompts and additional items on daily events, physical complaints and overall daily stress. In addition to the questionnaires, passive data (location and phone use) will be collected continuously during the week to capture daily activity patterns. You will receive a personal feedback report at the end of the study if you filled out at least 90% of the questionnaires showing your fluctuations in mood and stress levels over the week. At the end of the week there is a final questionnaire assessing overall stress levels that takes about 1 minute to fill out, and you can share your experiences and provide feedback on the study via an online questionnaire (circa 5 minutes).

In addition to the questionnaires, passive data (location and phone use) will be collected continuously during the 2 weeks to capture daily activity patterns. You will receive a personal feedback report at the end of the study if you filled out at least 80% of the questionnaires showing your fluctuations in mood and stress levels over the week. At the end of the week there is a final questionnaire assessing overall stress levels that takes about 1 minute to fill out, and you can share your experiences and provide feedback on the study via an online questionnaire (circa 5 minutes).

If you want to receive SONA credits, please be aware of the division of the credits according to the participation rate:

Who can participate?

To participate in this study, you must a) be at least 18 years old; b) understand English at a sufficient level; c) use an iOS or Android phone as your primary phone in daily life d) currently study at a (Dutch) university

Compensation

The participants will be rewarded with SONA - Credits and feedback about their coping with stress.

What passive data will be collected?
Below is the overview of the types and frequency of data collected by phone sensors during the one week period.

Type of Data	**Description**	**iOS**	**Android**	**Frequency**
Location	GPS coordinates every minute.	Yes	Yes	iOS: every 10 meter moved; Android: continuous
Device	Information about your device (e.g.: name, version, available working memory, battery level).	Yes	Yes	Continuous
Weather	Weather and air quality from the internet based on current location.	Yes	Yes	Continuous
Pedometer	Number of steps according to the pedometer of your mobile phone.	Yes	Yes	Continuous
Activity	Number of minutes walking, cycling, driving, etc.	Yes	Yes	Event (change of activity such as still or walking)
Screen	Time of screen on/off/unlocked events.	No	Yes	
Battery	Amount of battery left, if battery is charging or not.	Yes	Yes	Event (with screen off or on).
App usage	Usage time per app since the last measurement.	No	Yes	Event (e.g. starting to start charging)
Connectivity	Connected to Wi-Fi or data.	Yes	Yes	
WIFI	Wi-Fi networks in the vicinity.	Yes	Yes	Continuous

				Event (e.g. connecting to Wi-Fi) Continuous
Accelerometer	Accelerometer (acceleration)	Yes	Yes	Continuous
Bluetooth	Information about Bluetooth devices in your area (e.g.: name, ID, signal strength)	Yes	Yes	Only when asked to activate
Ambient noise	Volume (in decibels) of ambient noise. No audio is saved.	Yes	Yes	Only when asked to activate

For the data collected from the smartphone, we will **not have access** to the specific content of that data. For instance, we can track that a particular app is being used, but we cannot see what actions were taken or what was viewed within the app. For GPS coordinates, we are not focused on your exact addresses or specific locations. Instead, we aim to determine whether they align with the places you have reported visiting, allowing us to see if the app can accurately detect when you are near these locations. Additionally, the locations will be grouped into broader categories, such as "restaurant" or "park," rather than identifying individual places.

Risks

We believe there are no known risks associated with this research study. However, as with any online related activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. This means that your data will only be accessible within the research team. All personal data will be coded, encrypted, and stored separately from other types of data. The audio recordings from the survey responses will be transcribed as text, and the recording will be destroyed after transcription. Furthermore, an independent research assistant, who does not know any of the participants, will pseudonymize all personally identifiable information (e.g., information in text boxes). Because of this pseudonymization, the researchers will not be able to link the collected data to any specific participant. This research project has been reviewed and approved by the **BMS Ethics Committee**, University of Twente.

Withdrawal from the study

Your participation in this study is voluntary: you are not obligated to participate. You may decide to stop your participation during the study, and you can also decide to withdraw after the study. You do not have to provide a reason for stopping. If you decide to withdraw, your data will no longer be used for the research and will be completely deleted. You can indicate directly to the researcher that you wish to stop or withdraw from participation via email. Please note that you can withdraw from the study up to 2 months after your participation. After this period, the data will have been anonymized, meaning we will no longer be able to link the data to your identity. As a result, it will not be possible to delete your data once this process is complete.

Retention period

Research data will be retained for minimally 10 years.

Further information

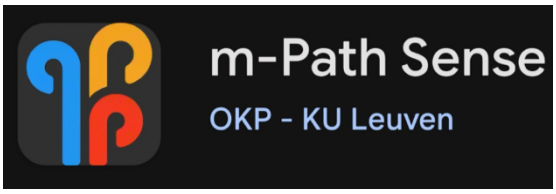
If you have any questions about the study, either before you participate or afterwards, please feel free to contact the responsible researcher via mobile-health-bms@utwente.nl. If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), or if you want to file a complaint about this study, please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl.

Below, you find chronological step-by-step instructions for participating in this study.
Once we receive your registration in the m-Path Sense app, you will receive the first questionnaire within a few hours.
Note: Please sign up for this pilot study no later than May 15, 2025.
Do not hesitate to reach out to us if you have any questions or run into any issues (contact email: mobile-health-bms@utwente.nl.
Thank you so much in advance for your time and participation!

Step-by-Step Instructions:

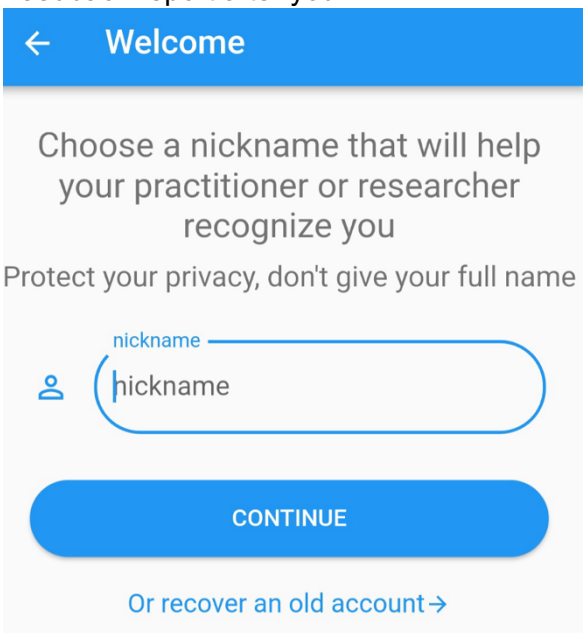
1. **Information Letter** - Please first read the participant information letter of this study.
2. **Informed Consent** - As a second step, you need to consent before being able to participate in this study.

4. **Download the App** - After, download the *m-Path Sense App* on your phone via the Apple or Play Store (note: not the m-Path App, but the *m-Path **Sense** App*).



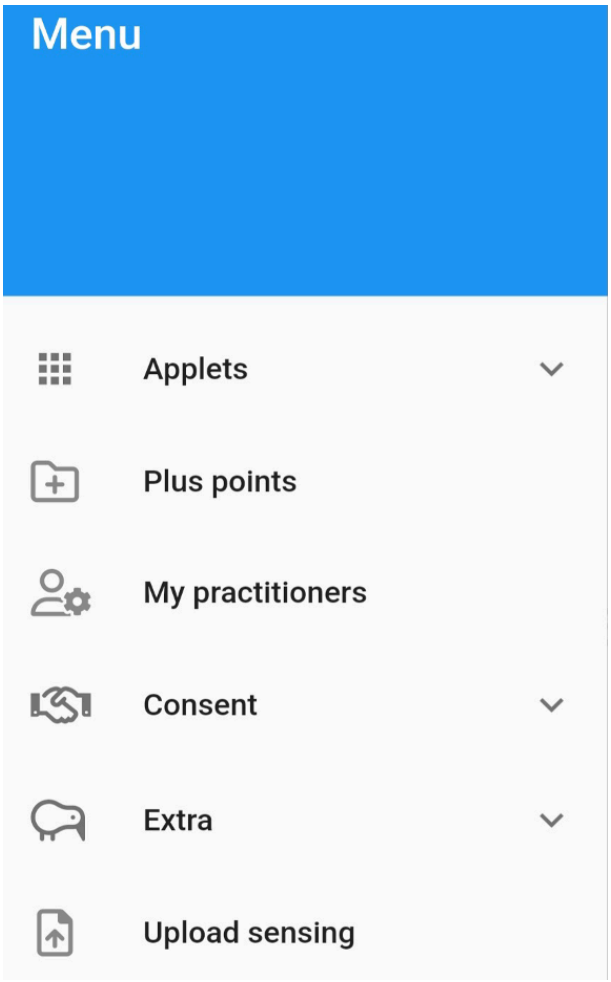
5. **Choose a Nickname** - Choose a nickname in the *m-Path Sense App* and **pass on the chosen nickname to the researchers present at the information meeting.** This is needed to share the correct questionnaire with you to participate in the study, and a

personalized feedback report after your participation.



6. **Activate the Questionnaire** - Add the EMA taskforce as your so-called 'practitioner' in the app - **practitioner code:** @ss226 **[Stress in action]**.

   In case the app does not immediately prompt you to add a practitioner, go to *Settings* (top left symbol in the app), click on '*My Practitioners*' (see picture), and then click on the *bottom left blue + circle* to add "@ss226**"** as your practitioner. This allows us to share the questionnaire with you.



7. **Activate Notifications** - Lastly, please check your phone settings to make sure you can receive notifications from *m-Path Sense*. Usually, this can be found in *Settings* **-->** *Apps* **-->** *m-Path Sense* **-->** *Permissions*

Appendix C

Informed Consent

Welcome to this EMA study about coping with stress!

In this pilot study we utilize ecological momentary assessment (EMA), measuring stress and stress-related emotions, thoughts and behaviours in everyday life. Specifically, participants will receive a smartphone notification on random moments during the day to fill out a brief (<2min) questionnaire. Because it is important for us to get a complete picture of your daily-life stress, it is important that you fill out as many questionnaires as possible. It is also important that you answer the questionnaires as soon as possible after receiving the notification, and fill them out thinking about the moment right before you received the notification.

The last questionnaire of the day is slightly longer (~5min) and here we will ask you to describe a situation that happened that day. You will get an option to write this down using the app, or to record your voice while you talk about it. In either the written or verbal option, we urge you to **not provide full last names, but only first names (and the last letter of the last name if people have the same first name).**

On most days you will receive 5 notifications; on some days a few more. After 7 days, you will receive the Perceived Stress Scale (~1 min) and a final questionnaire (~5min) to be able to give feedback on participation in the study.

The Ethical Committee of the University of Twente approved this study. The data of this study will be used for publications. Your participation in this study is entirely voluntary and you can withdraw at any time without providing a reason. We believe there are no known risks
associated with this research study; however, as with any online related activity the risk of a breach is always possible.

To the best of our ability, your answers in this study will remain confidential. Your data will not be linked to your name in any way and will only be accessible within our research team. All personal data will be coded, encrypted, and stored separately from other types of data.

Study contact details for further information: mobile-health-bms@utwente.nl
Supervisor: Dr. T.R. Vaessen

General questions:

What is your gender?

- Female
- Male
- Other, namely….

What is your age?

……

How would you describe “stress”? For instance, what gives you stress, and how does it feel?

……

This consent form below will be translated into questions on Qualtrics:

	Yes	No
Taking part in the study		
I have read and understood the study information, or it has been read to me.		
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.		
I understand that taking part in the study involves watching a one min information movie, one-week daily questionnaires, and answering a final questionnaire about how experienced the study.		
Use of the information in the study		
I give permission to process the survey responses, passive sensing data (see information sheet) and transcribed recordings collected during this study.		
I understand that information I provide will be used for publications.		
I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.		
I agree that my information (pseudonymized) can be quoted in research outputs.		
Future use and reuse of the information by others		
I give permission for the pseudonymized survey responses, passive sensing data (see information sheet) and transcribed interview that I provide to be archived in p-drive of the University of Twente so it can be used for future research and learning.		

Appendix D

Questionnaires

Morning Questionnaire

Item	Scale
How many hours did you sleep last night?	time scale
How did you sleep?	slider from very poor to very good
At this moment my positive feelings are	slider from not strong at all to very strong
At this moment my negative feelings are	slider from not strong at all to very strong
At this moment I feel mentally overloaded	slider from not at all to very much
At this moment I feel tension in my body	slider from not at all to very much
At this moment I feel stressed	slider from not at all to very much
conditional (if previous question answered with >10) What has contributed to your stress? This was a…	multiple choice answer options: - event (e. g. an argument or having to rush) - thought (e. g. worrying or ruminating) - feeling (e. g. sadness, irritation, hunger, pain, tiredness)
conditional: Describe these events, thoughts, and/or feelings	text entry
conditional: I feel I can deal with these events, thoughts, and/or feelings.	slider from not at all to very much
conditional: What did you do with these events, thoughts, and/or feelings?	multiple choice answer options: - I tried to think of a solution - I worried about it or kept thinking about it - I tried to look at it in a positive way - I tried to accept it - I told someone about it (in-person, via the phone, or social media) - I expressed my feelings about it (e. g. I cried or cursed) - I ignored it - I have tried to distract myself (e. g. by doing something else or to relax) - I actively dealt with it - Otherwise, namely… - I did not do anything yet, but I am planning to - I did nothing
With whom were you at this moment?	multiple choice answer options: - no one - my partner - friends - housemates - my parents

	- my child(ren) - other family members - colleagues - fellow students - acquaintances - I have online contact with others - someone else, namely…
Where are you at this moment?	multiple choice answer options: - home - friends/family place - work - school - bar/restaurant/café - on the way (train, car, bike) - in nature - somewhere else, namely…
What were you doing just before the questionnaire?	multiple choice answer options: - nothing - resting/sleeping - working - studying - eating/drinking - passive leisure activities (TV, computer, gardening, going out) - active leisure activity (hiking, sporting, gardening, going out) - travelling - household chores (cleaning, cooking food, errands) - personal care (getting dressed, brushing teeth) - social interaction/conversation - something else, namely…

Daily Questionnaire

Item	**Scale**
At this moment my positive feelings are	slider from not strong at all to very strong
At this moment my negative feelings are	slider from not strong at all to very strong
At this moment I feel mentally overloaded	slider from not at all to very much
At this moment I feel tension in my body	slider from not at all to very much
At this moment I feel stressed	slider from not at all to very much
conditional (if previous question answered with >10) What has contributed to your stress? This was a…	multiple choice answer options: - event (e. g. an argument or having to rush) - thought (e. g. worrying or ruminating) - feeling (e. g. sadness, irritation, hunger, pain, tiredness)
conditional: Describe these events, thoughts, and/or feelings	text entry

conditional: I feel I can deal with these events, thoughts, and/or feelings.	slider from not at all to very much
conditional: What did you do with these events, thoughts, and/or feelings?	multiple choice answer options: - I tried to think of a solution - I worried about it or kept thinking about it - I tried to look at it in a positive way - I tried to accept it - I told someone about it (in-person, via the phone, or social media) - I expressed my feelings about it (e. g. I cried or cursed) - I ignored it - I have tried to distract myself (e. g. by doing something else or to relax) - I actively dealt with it - Otherwise, namely… - I did not do anything yet, but I am planning to - I did nothing
Which whom are you at this moment?	multiple choice answer options: - no one - my partner - friends - housemates - my parents - my child(ren) - other family members - colleagues - fellow students - acquaintances - I have online contact with others - someone else, namely…
Where are you at this moment?	multiple choice answer options: - home - friends/family place - work - school - bar/restaurant/café - on the way (train, car, bike) - in nature - somewhere else, namely…
What were you doing just before the questionnaire?	multiple choice answer options: - nothing - resting/sleeping - working - studying - eating/drinking

	- passive leisure activities (TV, computer, gardening, going out) - active leisure activity (hiking, sporting, gardening, going out) - travelling - household chores (cleaning, cooking food, errands) - personal care (getting dressed, brushing teeth) - social interaction/conversation - something else, namely…

Evening Questionnaire

Item	**Scale**
At this moment my positive feelings are	slider from not strong at all to very strong
At this moment my negative feelings are	slider from not strong at all to very strong
At this moment I feel mentally overloaded	slider from not at all to very much
At this moment I feel tension in my body	slider from not at all to very much
At this moment I feel stressed	slider from not at all to very much
conditional (if previous question answered with >10) What has contributed to your stress? This was a…	multiple choice answer options: - event (e. g. an argument or having to rush) - thought (e. g. worrying or ruminating) feeling (e. g. sadness, irritation, hunger, pain, tiredness)
conditional: Describe these events, thoughts, and/or feelings	text entry
conditional: I feel I can deal with these events, thoughts, and/or feelings.	slider from not at all to very much
conditional: What did you do with these events, thoughts, and/or feelings?	multiple choice answer options: - I tried to think of a solution - I worried about it or kept thinking about it - I tried to look at it in a positive way - I tried to accept it - I told someone about it (in-person, via the phone, or social media) - I expressed my feelings about it (e. g. I cried or cursed) - I ignored it - I have tried to distract myself (e. g. by doing something else or to relax) - I actively dealt with it - Otherwise, namely… - I did not do anything yet, but I am planning to I did nothing
Which whom are you at this moment?	multiple choice answer options:

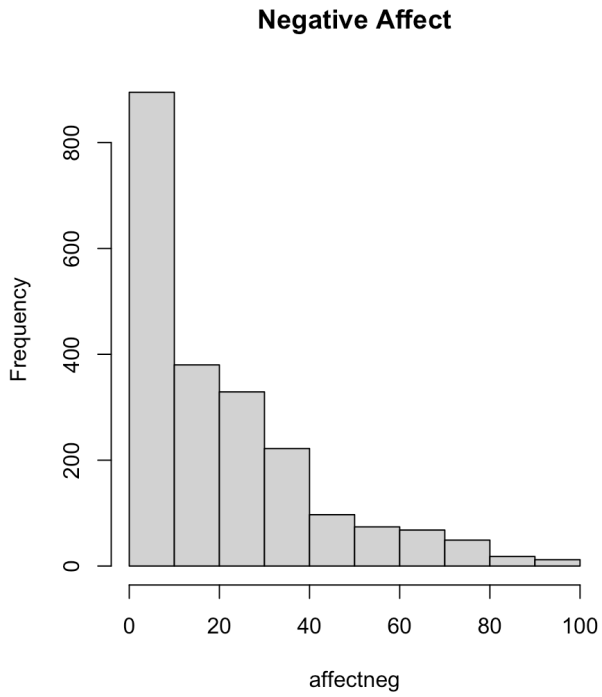
	- no one - my partner - friends - housemates - my parents - my child(ren) - other family members - colleagues - fellow students - acquaintances - I have online contact with others - someone else, namely…
Where are you at this moment?	multiple choice answer options: - home - friends/family place - work - school - bar/restaurant/café - on the way (train, car, bike) - in nature - somewhere else, namely…
What were you doing just before the questionnaire?	multiple choice answer options: - nothing - resting/sleeping - working - studying - eating/drinking - passive leisure activities (TV, computer, gardening, going out) - active leisure activity (hiking, sporting, gardening, going out) - travelling - household chores (cleaning, cooking food, errands) - personal care (getting dressed, brushing teeth) - social interaction/conversation - something else, namely…
Today I felt physical discomfort (e. g. fatigue, flu, headache, backache, tinnitus, tension, hay fewer, menstrual pain)	yes/no
conditional (if previous question was answered with "yes"): What kind of physical discomfort?	text field
conditional: I suffered from these complaint(s).	text field
How was your day?	slider from very bad to very good
How stressful was your day?	Draw a line how your stress feelings changed during the day
In the next question you will be asked to briefly describe your day using the stressful	multiple choice answer options: - type

moments of today. Do you want to type or record this?	- record
conditional (if choosing “record”): Think about all stressful moments you experienced today. Briefly describe your day using the stressful moments, why they were stressful, and how you dealt with them.	recording
conditional (if choosing “type”): Think about all stressful moments you experienced today. Briefly describe your day using the stressful moments, why they were stressful, and how you dealt with them.	text field
Was there anything you didn’t do today that you were planning to do? For example exercising, going outside, or seeing friends?	multiple choice answer options: - no - yes, namely…
Today I felt that I had control over the important things in my life	slider from never to very often
Today I felt confident that I could handle my problems	slider from never to very often
Today I felt that things were going the way I wanted	slider from never to very often
Today I felt that difficulties were piling up so high that I could no longer cope with them	slider from never to very often

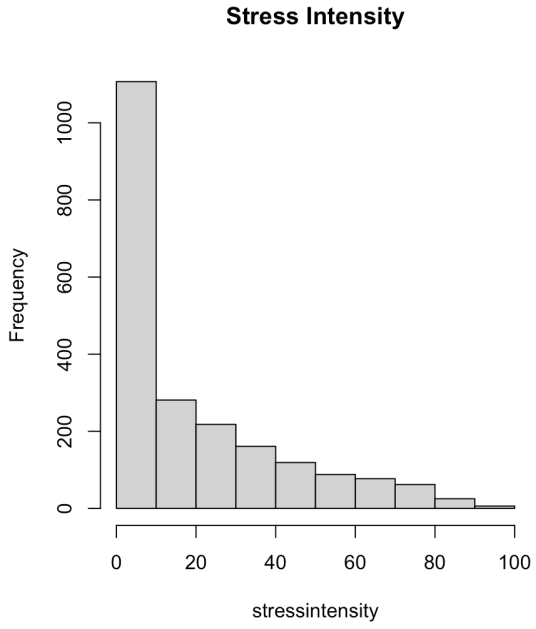
Appendix E

Results of the Assumption Checks

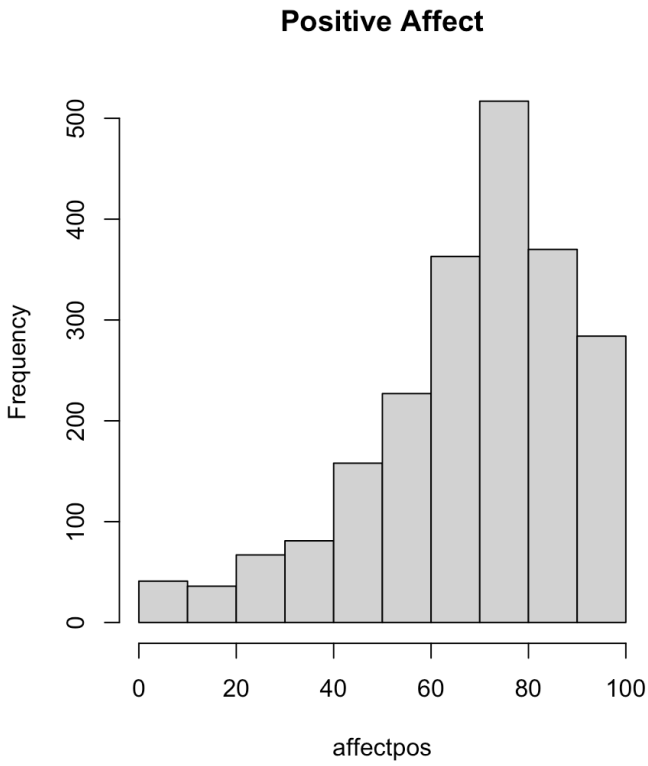
Distribution of Negative Affect



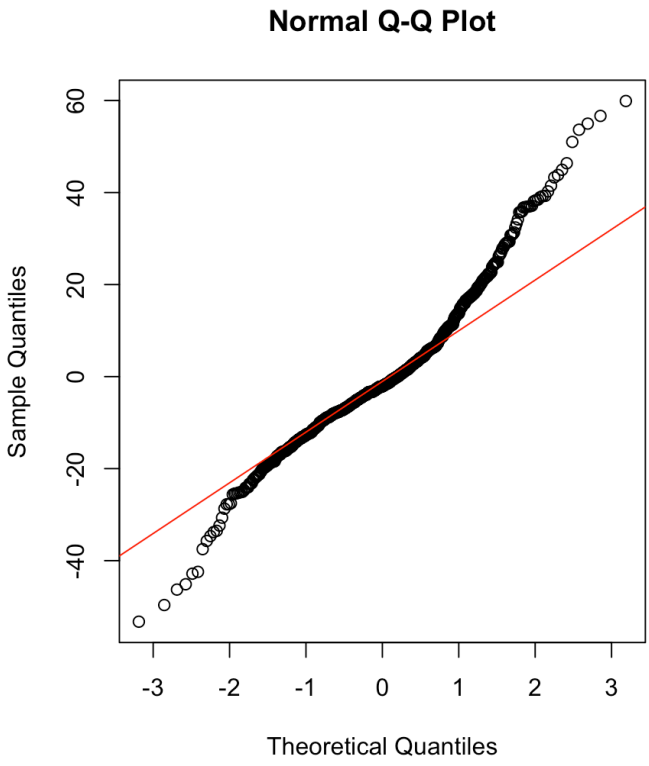
Distribution of Stress Intensity

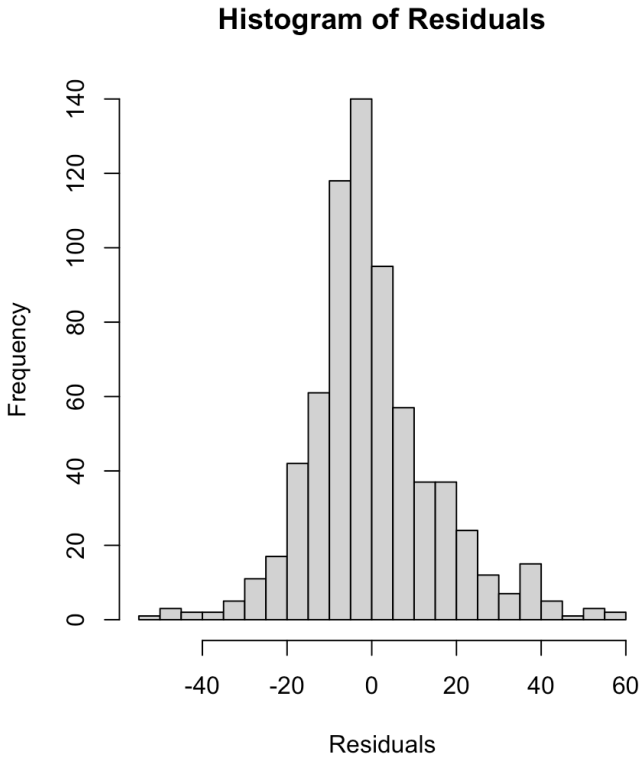


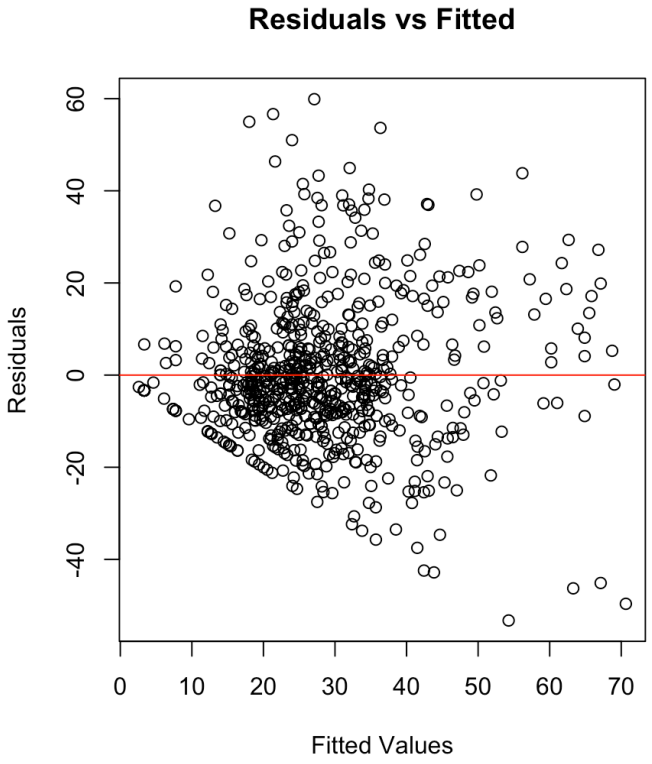
Distribution of Positive Affect



H1a:

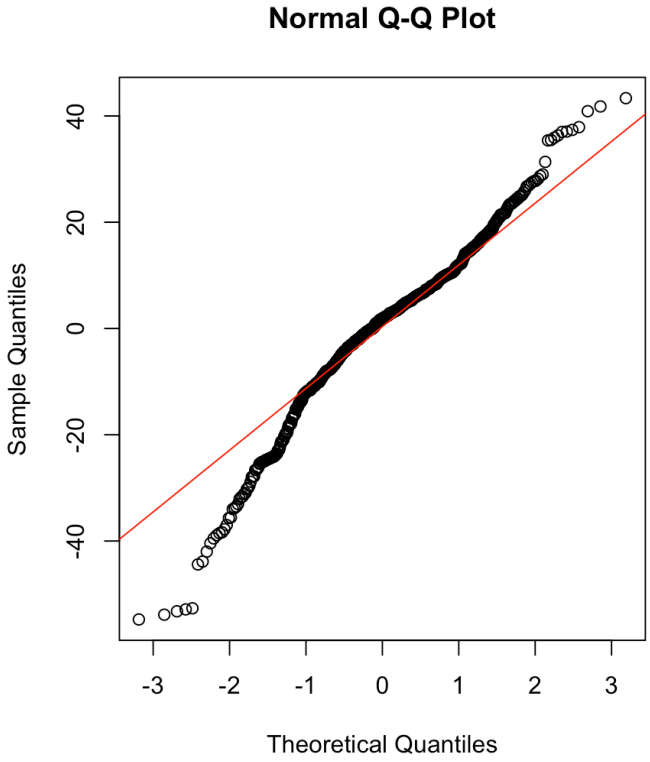


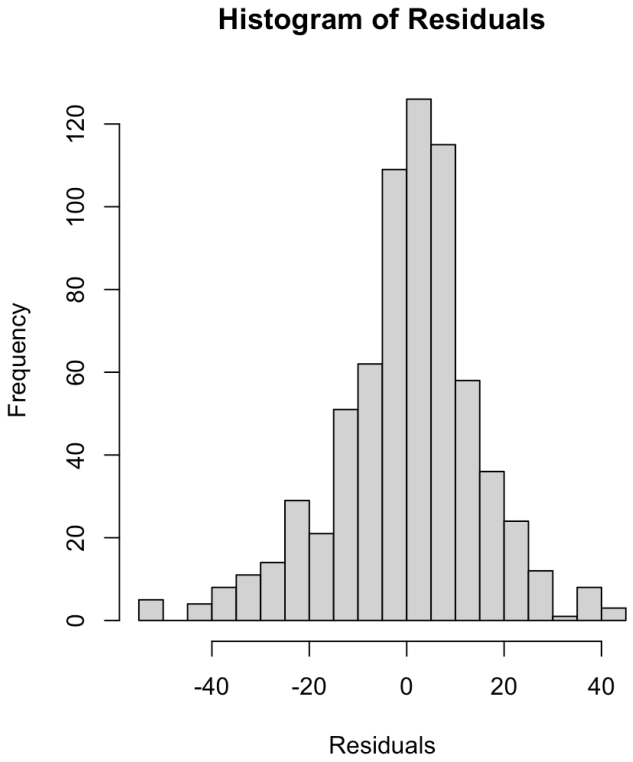


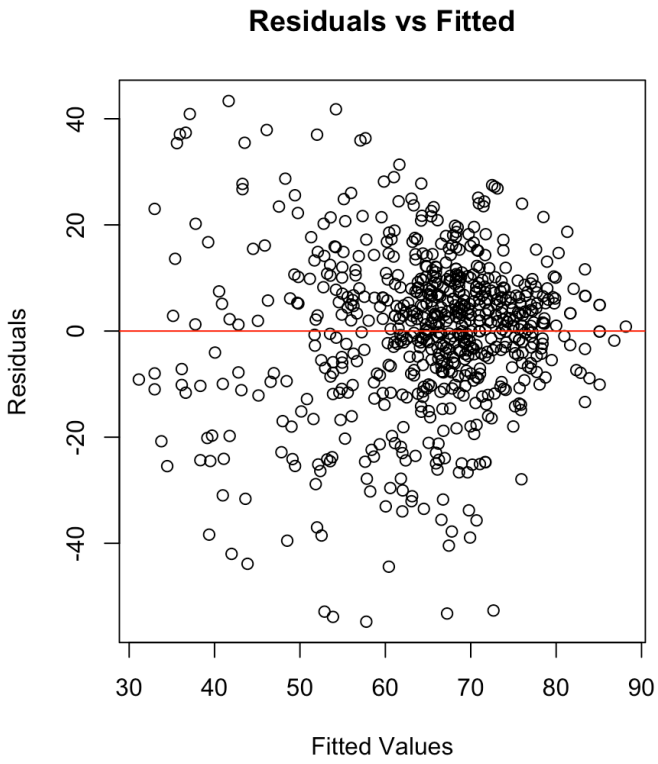


autocorrelated residuals detected ($p < .001$)

H1b:

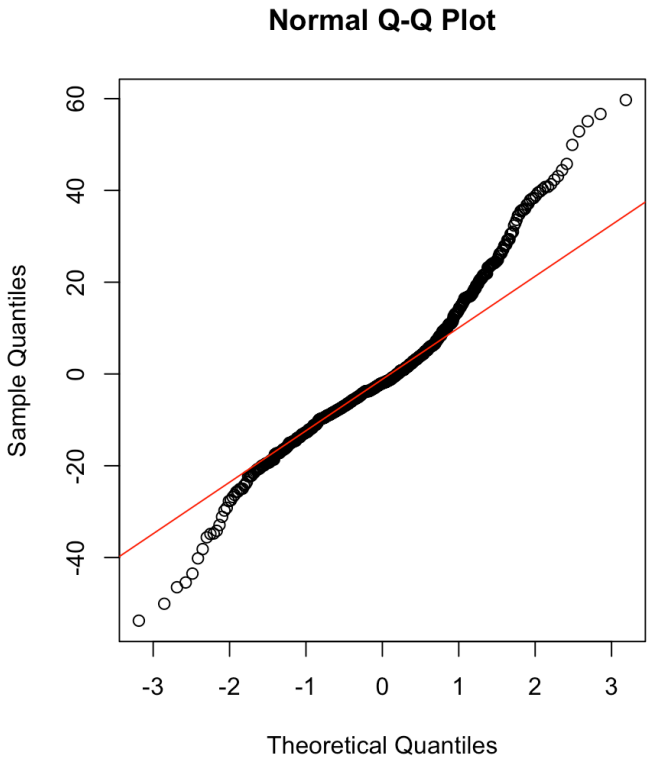

Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
-40
-20
0
20
40
-3
-2
-1
0
1
2
3

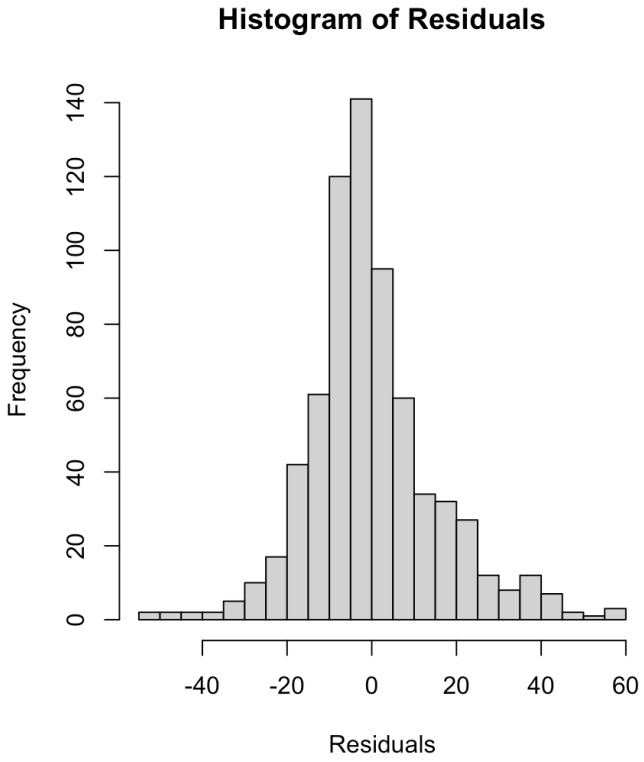

Histogram of Residuals
Frequency
Residuals
0
20
40
60
80
100
120
-40
-20
0
20
40

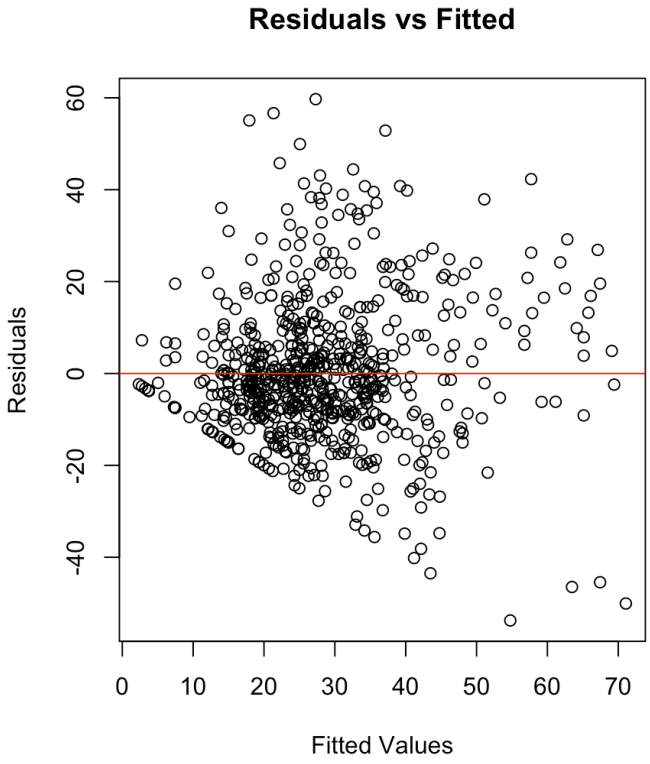


autocorrelated residuals detected ($p < .001$)

H2a:

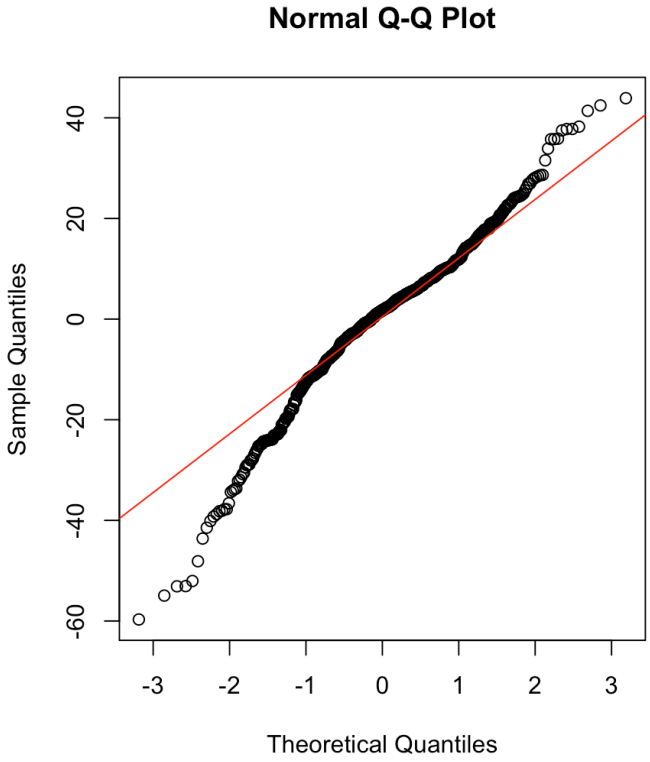


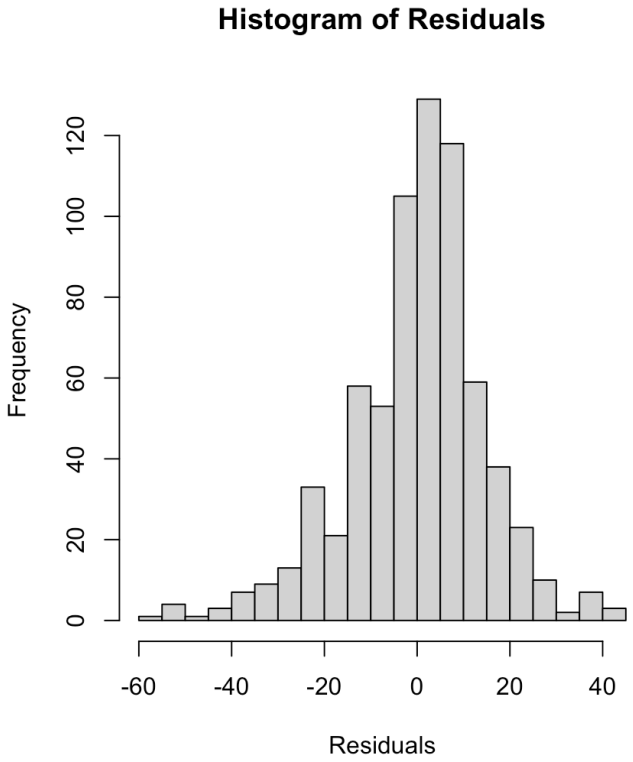


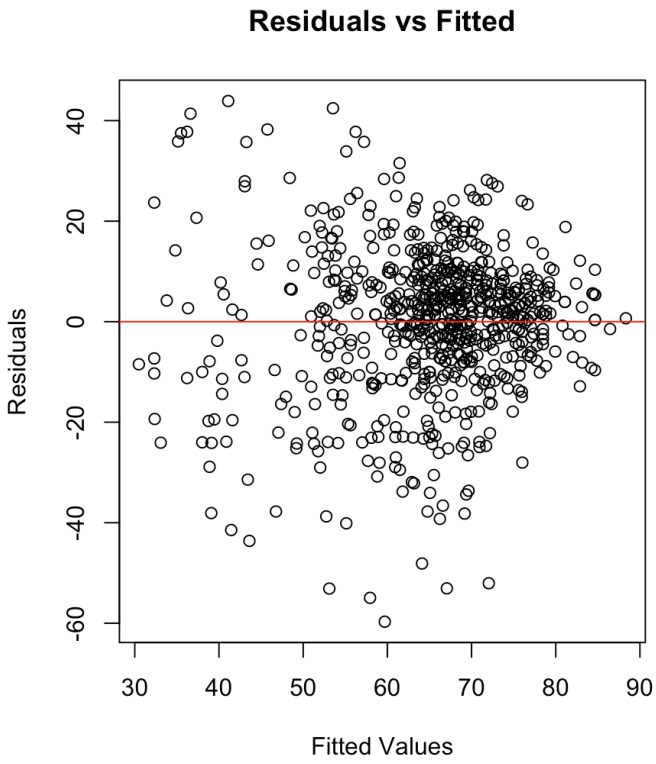


autocorrelated residuals detected ($p < .001$)

H2b:

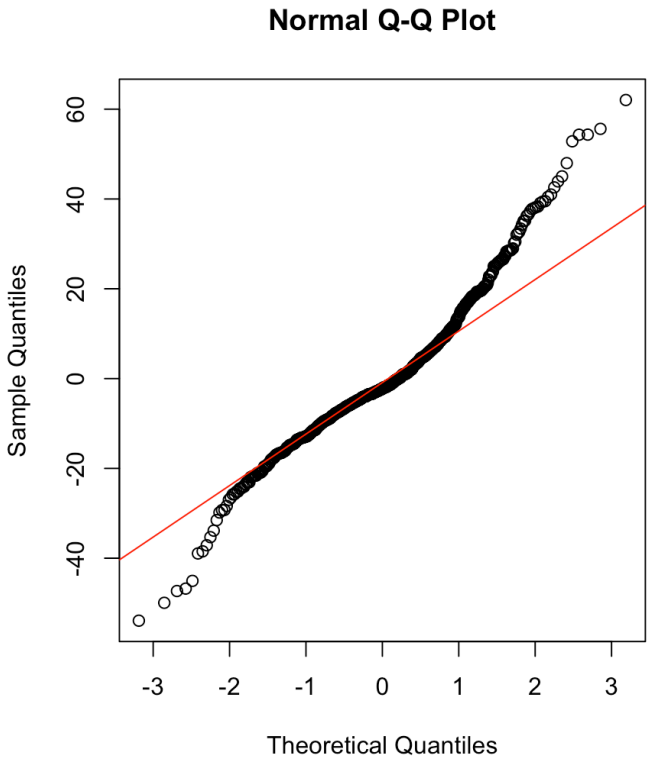

Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
-60
-40
-20
0
20
40
-3
-2
-1
0
1
2
3

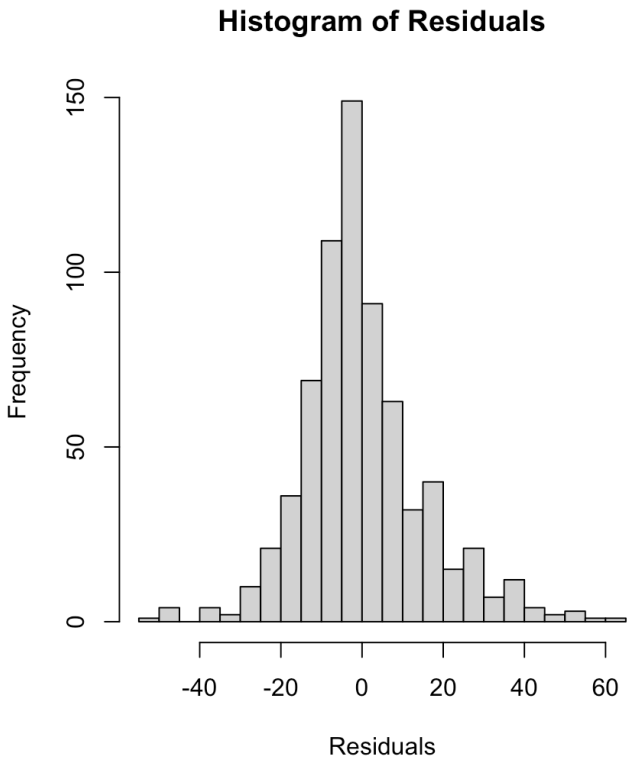

Histogram of Residuals
Frequency
Residuals
0
20
40
60
80
100
120
-60
-40
-20
0
20
40

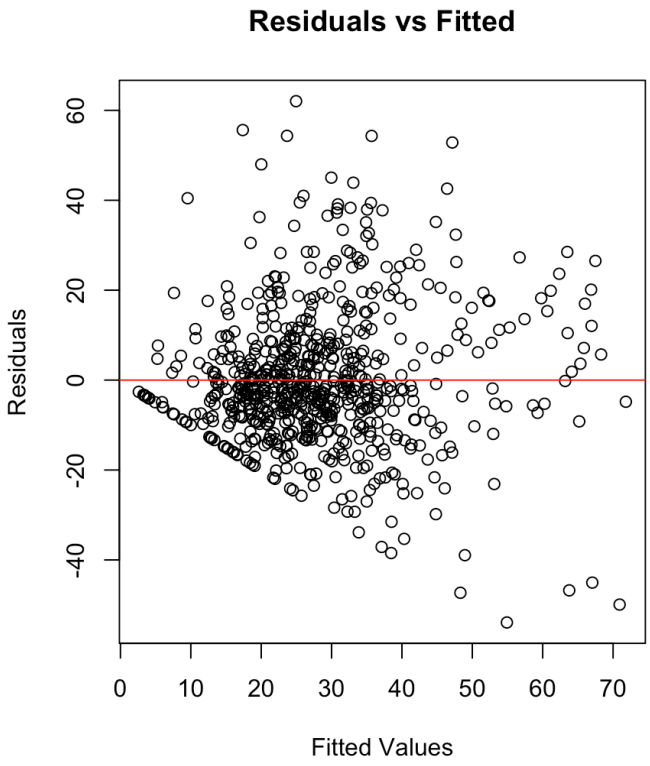


autocorrelated residuals detected ($p < .001$)

H3a:

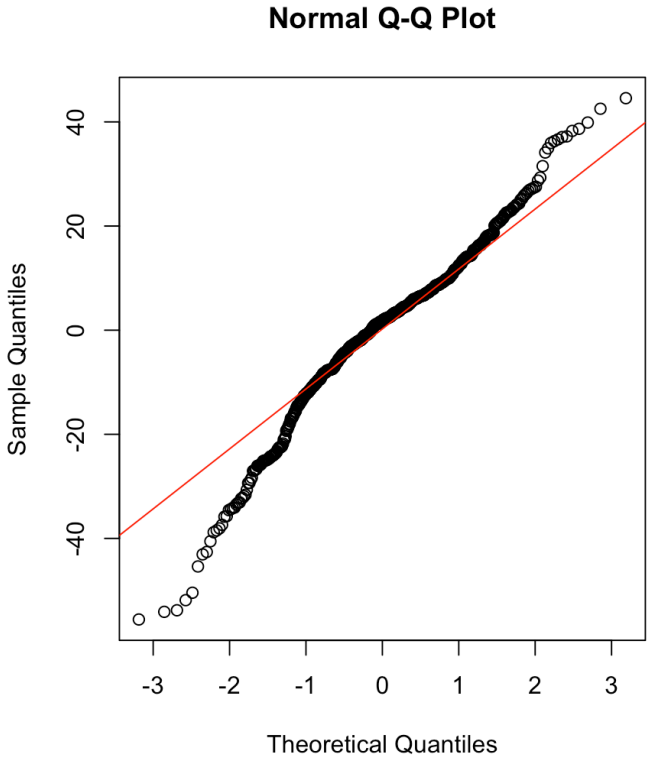


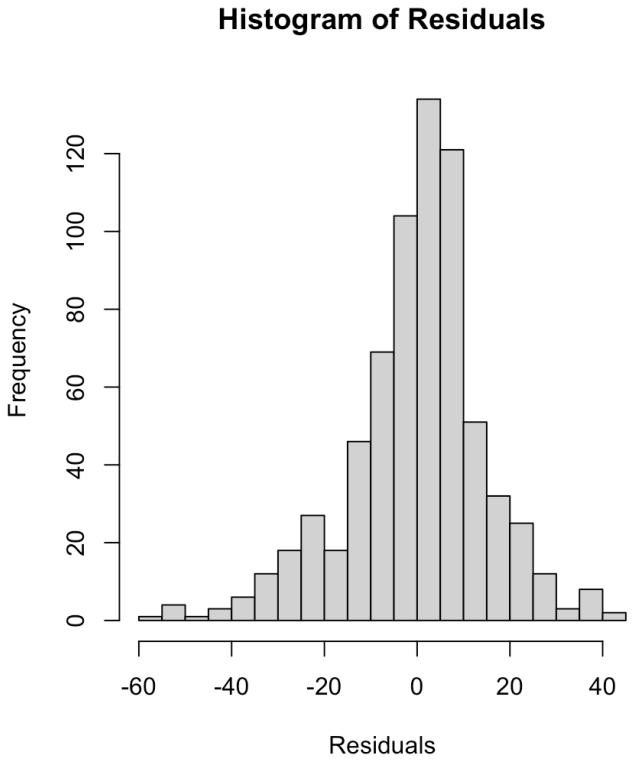


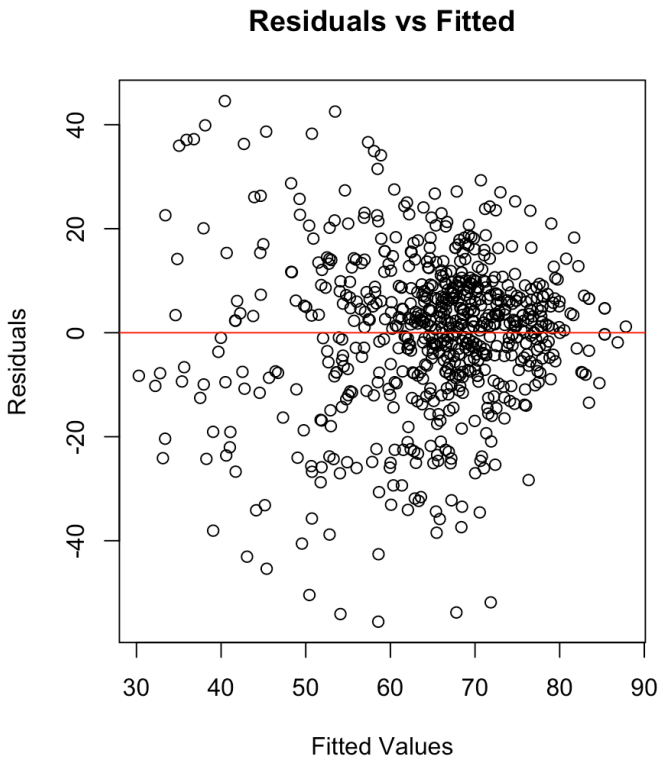


autocorrelated residuals detected ($p < .001$)

H3b:

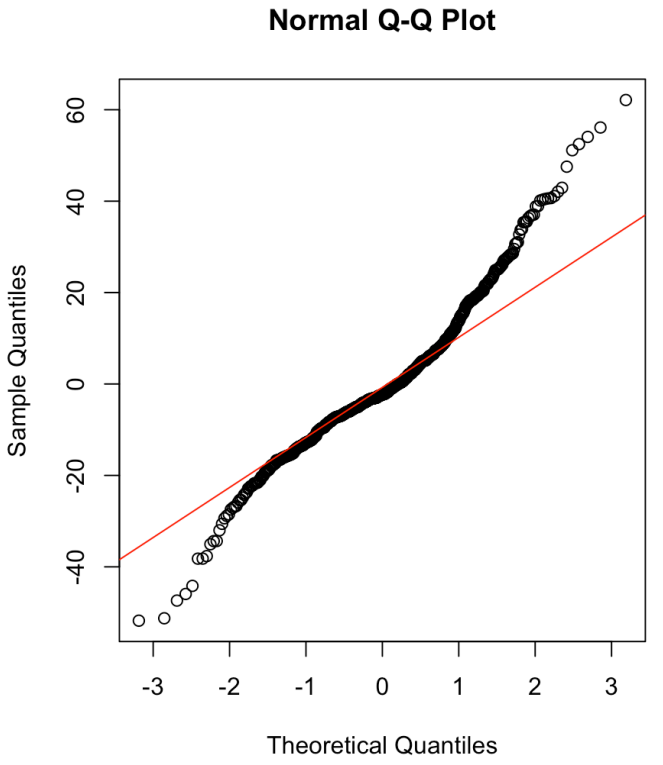

Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
-40
-20
0
20
40
-3
-2
-1
0
1
2
3

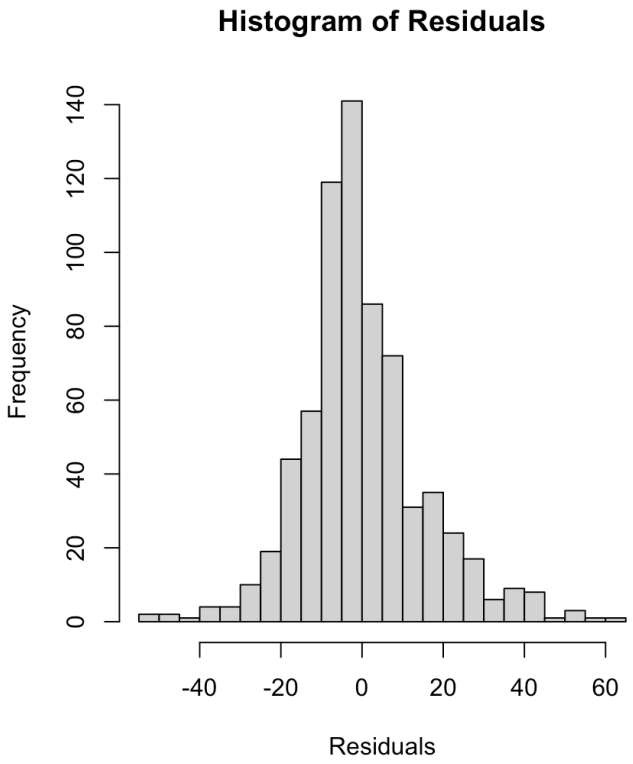

Histogram of Residuals
Frequency
Residuals
0
20
40
60
80
100
120
-60
-40
-20
0
20
40

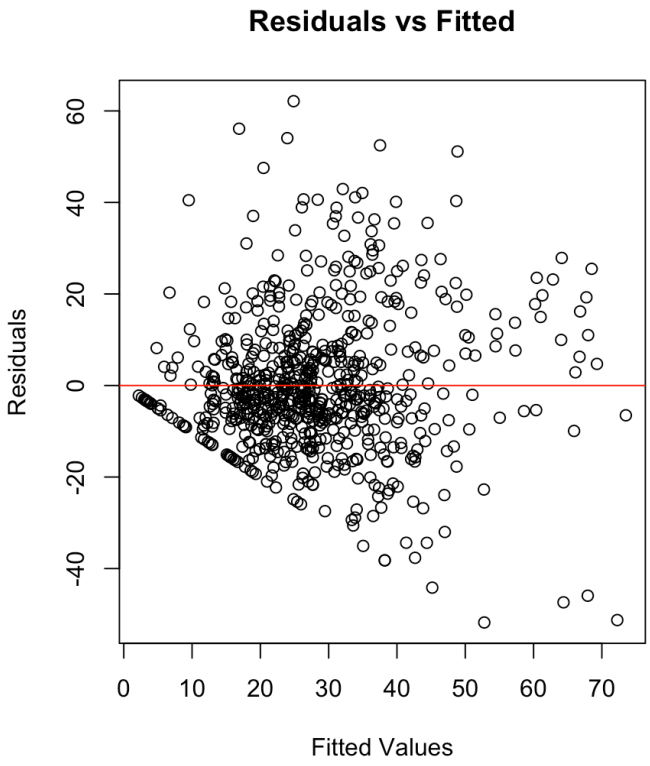


autocorrelated residuals detected ($p < .001$)

H4a:

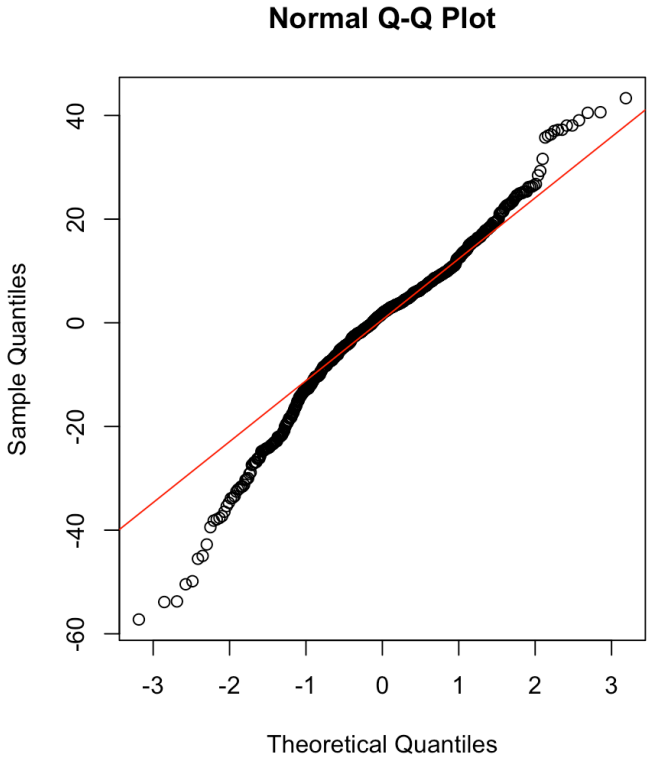


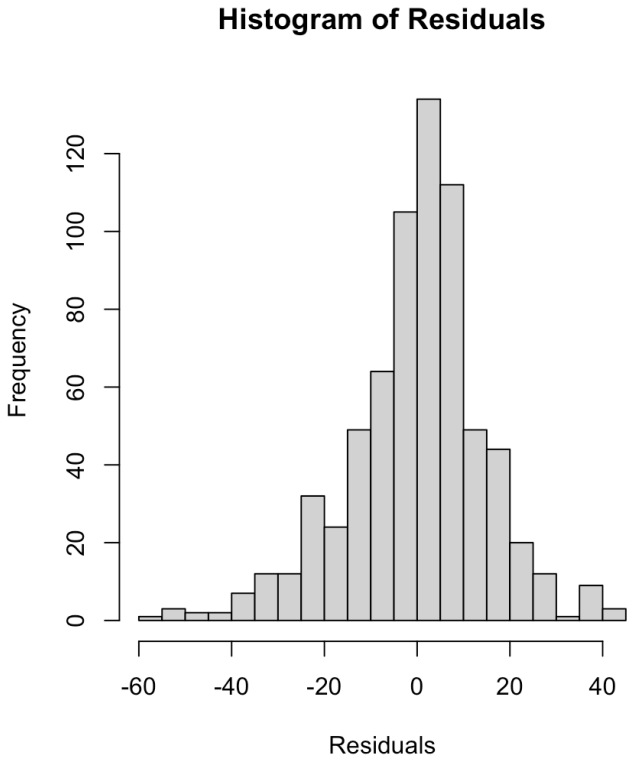


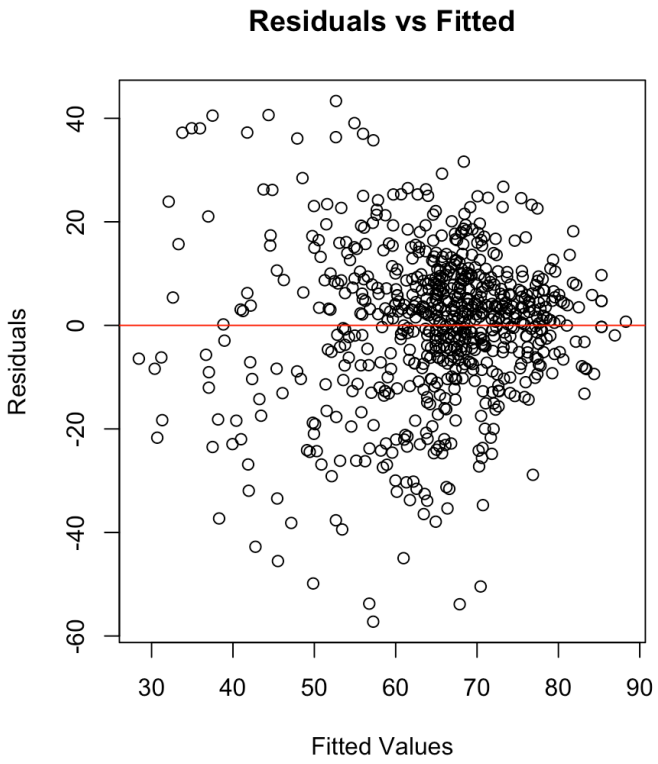


autocorrelated residuals detected ($p < .001$)

H4b:


Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
-60
-40
-20
0
20
40
-3
-2
-1
0
1
2
3


Histogram of Residuals
Frequency
Residuals
0
20
40
60
80
100
120
-60
-40
-20
0
20
40



autocorrelated residuals detected ($p < .001$)