Mental Health in daily life: Studying Mental Health, Stress and Acceptance using Ecological Momentary Assessment

Master Thesis

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Contents

Abstract

Background: In today's globalised and fast-living society, stress-related problems are experienced by many people. Stress influences health directly and can cause mental and physical issues, such as anxiety, depression, and headaches. One way to control perceived stress and its effects is through emotion regulation (ER). Emotion regulation focuses on peoples attempts to influence their emotions. This study uses the Experience Sampling Method (ESM) to investigates how state perceived stress is related to state levels of positive and negative affect, and to what extent trait acceptance moderates this relationship.

Methods: The participants (N = 54) had a mean age of 23.41 and 34.5% were female. All participants included in the study had to fill in 10 questionnaires per day over one week (7 days) and one baseline questionnaire at the start of the study. To analyse the extent to which acceptance moderates the relationship between perceived stress on affect, linear mixed models were run.

Results: A significant negative relationship was found between perceived stress and positive affect, and a significant positive relationship between perceived stress and negative affect. No significant effect was found regarding the moderation of acceptance of this relationship.

Conclusion: In conclusion, the results found in this study, indicate, that trait acceptance is not related to the relationship between stress and affect. This stands contrary to previous literature connecting trait acceptance to both, stress and affect. It is important to further research these variables as some literature suggest acceptance to play a role in stress recovery, but not stress management (in the moment). Further insights in the relationship between acceptance, stress and affect, could be useful for stress management intervention design, and consequently decrease the burden on the health care system.

Introduction

In today's globalised and fast-living society, stress-related problems are experienced by many people. Stress can be defined as “a state of worry or mental tension caused by a difficult situation” (World Health Organization, 2022). According to the American Psychological Association (2022), 27% of adults in America feel stressed to the extent that they cannot function. Additionally, this research suggests that the number goes up to 46% for people under 35 and overwhelming stress is perceived by slightly more women than men

(American Psychological Association, 2022). A meta-analysis combining five studies using the Depression, Anxiety and Stress Scale (DASS-21), with a combined sample size of 9074, reported the prevalence of stress as 29.6% in the general population during the Covid-19 pandemic (Salari et al., 2020). Another recent meta-analysis using data from 107 studies, including 398.771 participants from 32 different countries, reported a stress prevalence rate of 36.5% in the overall population and 30.4% for the European region (Nochaiwong et al., 2021). This perceived stress is caused in everyday life by stressors like high population density, work, financial problems, relationships or exposure to intensive noise (Cohen et al., 1983; Salari et al., 2020). As stress influences health directly and can cause mental problems, just as anxiety and depression, but also physical ones, like headaches, chest tightness or high blood pressure, it is a significant risk factor to consider when talking about health (Perez et al., 2015; Salari et al., 2020). Around three-quarters of American adults reported experiencing health impacts due to stress the month before the assessment (American Psychological Association, 2022). A meta-analysis of the psychological stress in student populations during the covid-19 pandemic, combining 31 studies with 855,564 participants, reported that 31% of the student population experience stress symptoms (Yang et al., 2022). Consequently, stress plays a significant role in the overall health of the general population.

One way to control perceived stress and its effects is through emotion regulation (ER). According to Gross & McRae (2020, p. 1), ER "focuses on people's attempts to influence emotions, defined as time-limited, situationally bound, and valanced (positive or negative) states." One prominent model that conceptualizes ER is the Process Model of Emotion Regulation (McRae & Gross, 2020). This model provides a theoretical framework of the workings and different dimensions of ER and consists of three levels: first, a sequential model of emotion generation (situation – attention – appraisal – response), second the five families of emotion regulation (situation selection, situation modification, attentional deployment, cognitive change, response modulation), ordered to the stage of emotion generation that they aim to influence, and third the processes by which emotion regulation is set into action (identification, selection, implementation, monitoring) (McRae & Gross, 2020) (Appendix A). Each of the five families of emotion regulation entails different ER strategies targeting various aspects of the emotion generation sequence (e.g., the ER strategy Cognitive reappraisal is in the family of cognitive change and targets the appraisal stage of emotion generation) (McRae & Gross, 2020). It was found that individuals with low capabilities of effective emotion regulation experience longer and more severe distress that can result in anxiety or depression (Aldao et al., 2010). Additionally, in an article based on a literature

review, it was reported that deficiencies in sufficient emotion regulation is associated with various forms of psychopathology (e.g., depression, substance use disorder, etc.) (Berking & Wupperman, 2012).

One emotion regulation strategy is acceptance. According to McRae and Gross (2020, p. 3) acceptance is "welcoming emotions with nonevaluative judgment". There are different processes involved in the emotion regulation with acceptance. First, acceptance differs from other frequently studied ER strategies, as it is not based on an active modification of emotions but rather on a passive state of receiving emotions without control attempts (Wojnarowska et al., 2020). Therefore acceptance changes how one relates to their emotions, by becoming aware of them without evaluating them negatively (Linehan et al., 2006; Segal et al., 2001). This is supported by the literature, as the use of acceptance has been associated with decreased negative affect (Kashdan et al., 2006; Troy et al., 2010). Second, regarding the relation of acceptance with positive emotions, Lindsay et al. (2018) state that practising acceptance may broaden the scope of awareness and creates a sense of openness, freeing attention to notice positive experiences. Therefore, acceptance might also be associated with positive affect (Lindsay et al., 2018). Last, in a book about appraisal and coping in relation to stress, Lazarus and Folkman (2013) stated that appraisal mediates the relationship between stress and mental health. In the process model of emotion regulation acceptance targets the appraisal stage of emotion generation, aiming at cognitive change (McRae & Gross, 2020). Therefore acceptance might buffer the relationship between stress and mental health.

One way acceptance is used in practice to improve mental health is Acceptance and Commitment Therapy (ACT) (Hayes et al., 1999). ACT is a prominent approach from the third wave of cognitive behavioural therapies, and is based on increasing psychological flexibility, the ability to consciously experience the present moment more fully, and to change behaviour when doing so (Hayes et al., 1999; Hayes et al., 2006). Psychological flexibility is increased by the six core ACT processes, one of which is acceptance (Hayes et al., 2006). Hereby, acceptance involves active and aware embrace of emotions and sensations without controlling them, especially as trying to control them will lead to psychological harm (Hayes et al., 2006). For example, anxiety patients learn to feel the feeling of anxiety without any defence (Hayes et al., 2006). In ACT acceptance is not used by itself, but as a technique to foster other ACT processes (Hayes et al., 2006). The literature suggests that ACT is working at improving mental health across a wide range of problems and severity levels (Hayes et al., 2006). There is also literature that suggests a relationship between mental health and acceptance by itself. A study that researched the relationship between acceptance and

psychological health moderated by stress in a sample of 1003 undergraduate students found accepting emotions to be associated with greater psychological health (Ford et al., 2018). Ford et al. (2018) found the relationship between acceptance and mental health to be consistent across different levels of stress, indicating that stress had no moderating effect. Another study researching the relationship between acceptance and negative affect, and acceptance and depression in 99 female undergraduate students from the University of Denver found accepting negative emotions to be associated with lesser negative affect, and fewer depressive symptoms in the face of high stress (Shallcross et al., 2010). In conclusion, acceptance is an effective ER strategy used in psychological interventions and is associated with improved mental health.

For this study an Experience Sampling Method (ESM) (or Ecological Momentary Assessment (EMA)) study design was chosen capable of considering the day-to-day, or even momentary fluctuations of stress. Stress fluctuates because it is a reaction to occurring events in life. These reactions to daily stressors are important to consider in the context of health and might even be a better predictor of future illness than major life stressors (South & Miller, 2013; Wagner et al., 1988). As EMA uses repeated measurements of participants' experiences or behaviours in real-time and in their natural environment, it is a fitting method to study these fluctuations (Shiffman et al., 2008). This method ensures the minimisation of recall bias and maximisation of ecological validity and allows us to study processes in the real-life context in which they occur (Shiffman et al., 2008). In the context of this study, this can give a good overview of within-person changes throughout a time period and how people react/respond to these changes regarding stress, affect and acceptance (Diener et al., 2009). A recent ESM study researching the interrelations between multiple trait and state variables (e.g., stress, affect, heart rate variability, etc.) in 44 participants found state stress to be the strongest predictor for positive and negative affect in the study (Määttänen et al., 2021). Additionally, Blanke et al. (2021) conducted a ESM study researching the relationship between acceptance and negative affect in a sample of 156 participants, and found a significant negative association between acceptance and negative affect. Another recent ESM study by Tschacher and Lienhard (2021), including 56 participants from a Buddhist mediation group, found state acceptance to be associated positively with positive affect and negatively with stress and negative affect.

This study will examine acceptance and its relation to stress and affect in daily life, as there is a considerable lack of research on this topic. Especially in the setting of daily life, there are only two recent studies that have researched this. The ones that did were Blanke et

al. (2021) and Tschacher and Lienhard (2021), which are described above. Additionally, a recent meta-analysis including 76 daily diary and ESM studies about the relationship between ER and affect in daily life stressed the need for further research regarding how acceptance functions in daily life, as there was not enough data to meta-analyse the relation between acceptance and affect (Boemo et al., 2022). Research on this is important as acceptance is considered a central part of psychological interventions (e.g., ACT) and a high-risk factor for affective disorders (Boemo et al., 2022). There is, until this point, no research on what effect acceptance might have on the relationship between stress and affect. Therefore, the study will examine: 1. how state perceived stress is related to the state levels of positive and negative affect over one week? It is hypothesised that stress has a negative relation with positive and a positive relation with negative affect. And 2. does the trait level of acceptance moderate the relationship between perceived stress and positive and negative affect? It is hypothesised that acceptance significantly moderates the association between stress and positive and negative affect. It is expected that higher levels of acceptance weaken that association.

Methods

This study was approved by the ethics committee of Behavioural, Management and Social Sciences of the University of Twente (request number: 2330038).

Participants

For recruiting the participants, a convenience sampling method was used. Convenience sampling is a non-probability sampling method that utilises the convenience of reaching participants (Nikolopoulou, 2023). This sampling method provides a cost and time-effective way of recruitment (Nikolopoulou, 2023). Additionally, because ESM studies pose a high burden on the participants, convenience sampling has the benefit that participants can be recruited based on their level of motivation.

The study recruited 66 participants. Van Berkel et al. (2017) reported an average sample size for ESM studies to be 53, leaving the sample size of this study above the average for ESM studies.

Materials

Measures

This study was part of a more extensive study, including more measurement tools. Only the relevant ones needed to answer the research questions of this study will be reported in the following.

Trait Measures

Acceptance

A person mean was calculated using the ESM acceptance data to assess acceptance as a trait measure. As trait measures reflect an average of measurements across many situations, the person mean can be used as a trait measure (Geiser et al., 2017).

State acceptance was measured with the use of a scale consisting of one item ("In the last hour, I could let go of my negative thoughts and feelings without acting upon them"), measures the momentary acceptance level, and is assessed on a seven-point Likert scale (rating from "not at all" (= 1) to "very much" (= 7)). A similar Item was used in previous studies to measure acceptance as an emotion regulation strategy (Blanke et al., 2021; Nittel et al., 2019).

State Measures

Perceived stress

The scale consists of one item ("How stressed do you feel right now?"), measuring the momentary level of stress perceived by the participant. The scale measures this on a seven-point Likert scale (rating from "not at all" (= 1) to "very much" (= 7)) (Appendix). Similar items for measuring stress can be found in the ESM item repository and were also used in previous studies (Kirtley et al., 2020; Atz, 2013).

Positive and negative affect

The scale consists of eight items and measures momentary assessment of positive and negative affect on a seven-point Likert scale (rating from "not at all" (= 1) to "very much" (= 7)). The first four items measure positive, and the last four negative affect (Positive affect: "How *cheerful* do you feel right now?", "How *enthusiastic* do you feel right now?", "How *satisfied* do you feel right now?", "How *relaxed* do you feel right now?"; Negative affect: "How *anxious* do you feel right now?", "How *irritable* do you feel right now?", "How *down* do you feel right now?", "How *guilty* do you feel right now?"). Similar items were previously used to measure positive and negative affect, derived from previous studies and the PANAS (Positive and Negative Affect Schedule) (Eisele et al., 2020; Lataster et al., 2011). As positive and negative affect was already used to measure mental health in previous ESM studies, it is used in this study as an operationalisation of mental health (Hu et al., 2014).

Ethica

Ethica is a Mobile application designed for data collection in ESM studies, available on Android and Apple (https://ethicadata.com). Ethica provides a framework for questionnaires at the baseline level and for momentary assessment. The participants are notified when a new ESM questionnaire is available. If the questionnaire is not filled in during a specific time frame after the notification, the questionnaire will disappear from the app.

Procedure

After receiving ethical approval from the ethics committee BMS at the University of Twente, participants were recruited using a convenience sampling scheme. As we used the sample data as a team of six students, every student recruited 15 to 20 participants. A convenience sampling scheme was used, as it poses the least costs and is sufficient for answering the research questions. This is due to six people recruiting participants, leading to a sample with different groups, and due to the fact that the research questions are partly interested in within-subject differences.

After the participants were recruited, they received an invitation email to the study. The study was an ESM study conducted at two separate points in time over the course of one week, starting on Monday. This was done to ensure the validity of the ESM data, as research found that people's mood changes are related to the fixed rhythm of the week (e.g., people might feel more depressed on Mondays) (Mayor & Bietti, 2021). The first measurement interval was scheduled in 2022 (7.11. - 13.11), and the second in 2023 (13.02. – 19.02.). This had no reason other than to obtain the required sample size.

Before the start of the study, participants gave their informed consent and a baseline questionnaire, including six independent scales and five demographic questions, was provided to them (Appendix B). A fixed interval sampling scheme was chosen. This scheme ensures that the assessment time points are predictable, resulting in higher compliance rates (Myin-Germeys & Kuppens, 2022). Additionally, many statistical processes assume an equal distance between time points (Myin-Germeys & Kuppens, 2022). Consequently, a fixed sampling scheme will not violate this assumption (Myin-Germeys & Kuppens, 2022). On the other hand, this sampling scheme can also lead to different biases, like an assessment selection bias, where specific data points are over- or underrepresented (Myin-Germeys & Kuppens, 2022). The ecological validity may also be decreased as the measurement prompts are predictable (Myin-Germeys & Kuppens, 2022). Twenty items were posed ten times per

day, from 7:30 to 22:30, in intervals of 90 minutes (Appendix B). The questionnaires expired after 15 minutes, if not answered to ensure the measurements were roughly at the right time.

Data analysis

After excluding participants with an insufficient completion rate (less than 33% of ESM questionnaires), 54 participants could be included in the study. Additionally, participants tested outside the two measurement intervals (07.11.22 – 13.11.22 and 13.02.23 – 19.02.23) were excluded. Intercorrelations between the used variables were calculated.

To answer the research questions (RQs), a linear mixed-effect model (LMM) analysis was conducted using the *lme4* package in R (Bates et al., 2015; R Core Team, 2023). Missing data is handled well by LMMs, as the missing values represent just one single observation within an individual (Brown, 2021). Therefore, the impact of missing data is relatively small compared to traditional fixed-effect models (Brown, 2021). This can be important in ESM studies, as they tend to have low response compliance due to the high demands placed on participants (Rintala et al., 2019). Additionally, LMMs are useful in handling nested, multilevel data, as they account for variability within and across participants by using random effects (Brown, 2021; Oberg & Mahoney, 2007).

To answer the first RQ, two LMMs were run with perceived stress as the independent variable and either positive or negative affect as the dependent variable, respectively. The participants were included as a random effect. To determine the best model fit, a model with random intercepts and a model with random intercepts and slopes were compared using log-likelihood ratio tests. This was done with the *anova* function of the *stats* package (R Core Team, 2023). The first-order autoregressive structure (AR1) was used, which assumes the correlation declines with more time between data points. The restricted maximum likelihood approach (REML) was used as an estimation method, and Satterthwait's method was used to calculate the degrees of freedom.

Two LMMs with perceived stress as the independent variable and either positive or negative affect as the dependant variable were also used to answer the second RQ, but trait acceptance was additionally included as a moderating variable. This was done by including an interaction term of acceptance and perceived stress in the LMMs.

Results

Sample characteristics

Due to technical problems, only 29 participants could complete the baseline questionnaire. Hence only the demographic data of these participants can be reported. The 29 participants, who completed the baseline questionnaire, had an average age of M=23.41 (SD=6.52). Most identified as male (62.1%), 34.5% as female and a minority as non-binary (3.4%). All of these participants were of European nationality, with the most being German (58.6%) and Dutch (34.5%). The sample of all the participants included in the study had a compliance rate of 64.9%. All relevant characteristics of the sample can be seen in Table 1.

Table 1

Sample characteristics (N = 29)

Variable	Category	%	N
Age	Range: 18 to 53 (M=23.41, SD=6.52)	-	29
Gender	Male	62.1	18
	Female	34.5	10
	Other	3.4	1
Nationality	Dutch	34.5	10
	German	58.6	17
	Other	6.9	2
Educational level	Middle school	3.4	1
	Highschool	51.7	15
	Bachelor	41.4	12
	Master	3.4	1
	PhD	0	0
	Other	0	0
Occupation	Working	20.7	6
	Self-employed	3.4	1
	Student	58.6	17
	Student and working	13.8	4
	Not working	3.4	1
	Other	0	0

The four state and trait measures used are significantly intercorrelated. Especially, negative affect and perceived stress show a high positive correlation (.8) in this sample, as well as perceived stress and positive affect show a high negative correlation (-.43). Positive affect and negative affect show a relatively low negative correlation (-.3). Acceptance has significant negative correlations with negative affect and perceived stress. All details can be seen in Table 2.

Table 2

Mean Scores, Standard Deviations and Pearson Correlation of Trait and State measures

	Mean	SD	1	2	3	4
1. Perceived stress	2.56	0.94	-			
2. Positive affect	4.13	0.71	-.43**	-		
3. Negative affect	2.01	0.72	.8**	-.3*	-	
4. Acceptance	4.11	1.12	-.38**	.28*	-.35**	-

*$p < .05$ **$p < .01$

The intercorrelations become apparent when plotting all the person means of the state variables. Perceived stress and negative affect seem highly correlated, as the peaks in the bar chart follow each other closely (Figure 1). A negative correlation between positive affect and perceived stress can be seen in Figure 2. This correlation is not as strong as the one between negative affect and perceived stress, as it shows more irregularity in the change related to perceived stress. (Figure 1 & Figure 2)

Figure 1

Bar chart depicting person mean scores of state negative affect, and state perceived stress per participant (n=54), ordered from low to high mean stress levels.

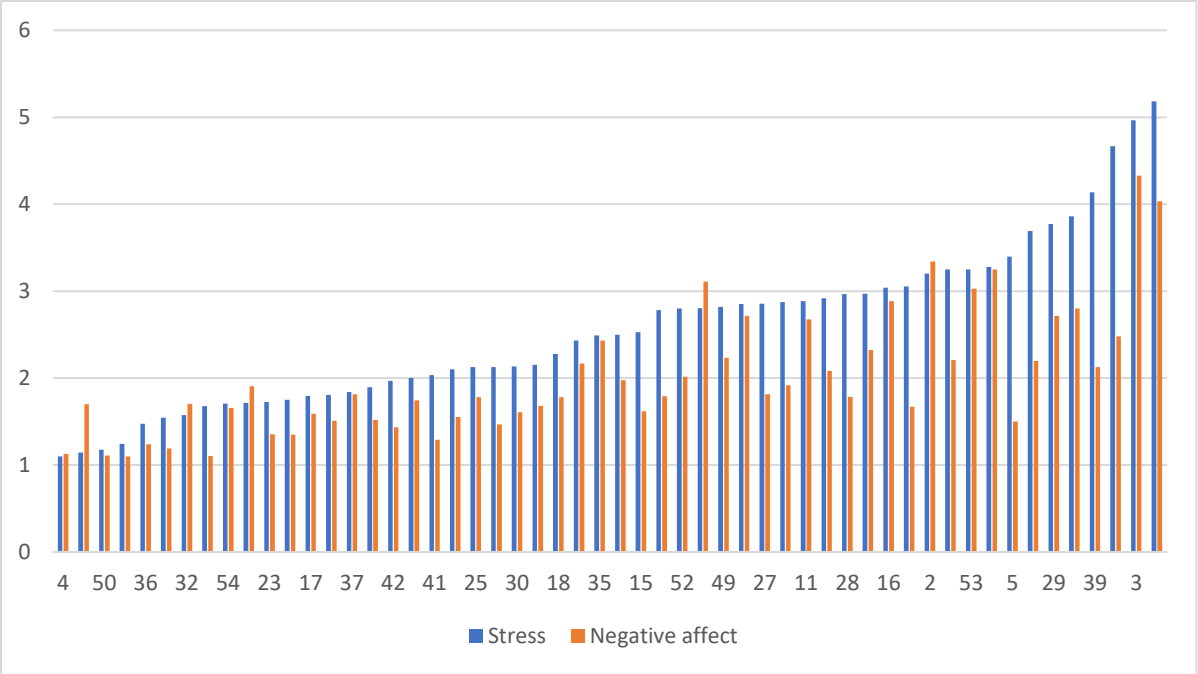
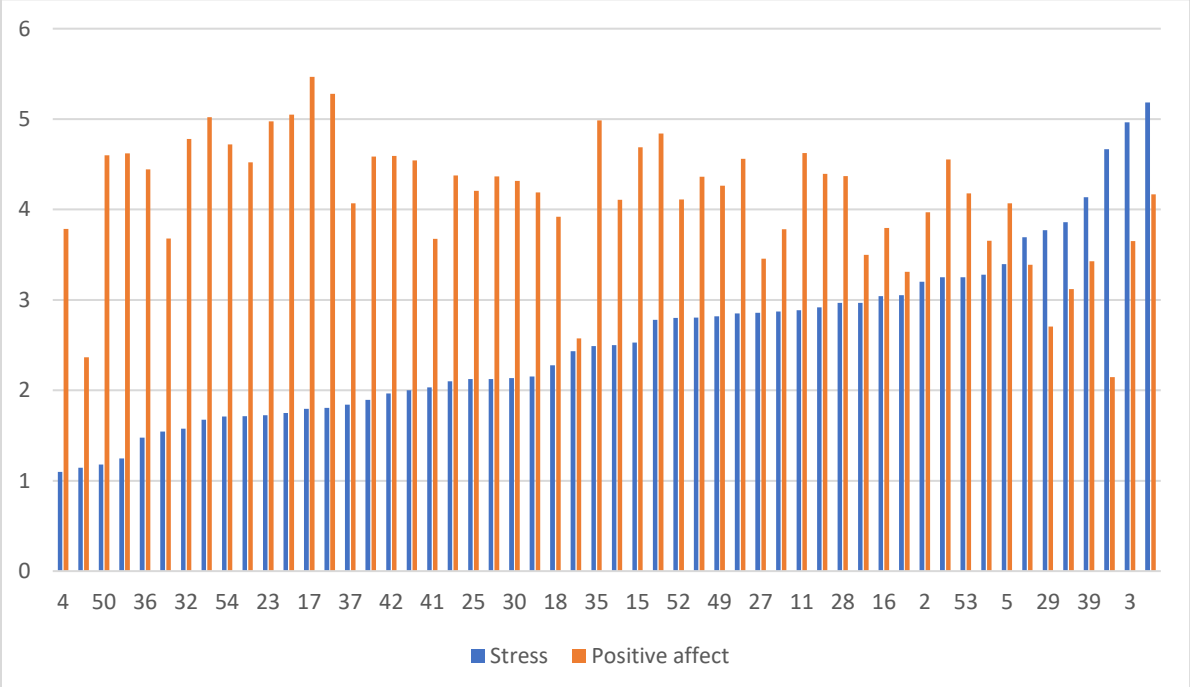


Figure 2

Bar chart depicting person mean scores of state positive affect, and state perceived stress per participant (n=54), ordered from low to high mean stress levels.



The relation between perceived stress and positive/negative affect

To answer the first research question and analyse the relation between perceived stress and positive/negative affect, two LMMs were used (see Table 3). Based on these models, it

can be seen that perceived stress has a significant negative relationship with positive affect (ß = -.46, $p < .001$) (Table 3) and a significant positive relationship with negative affect (ß = .41, $p < .001$) (Table 3). The effects of perceived stress on affect (positive and negative) are similar in magnitude (around .45).

Table 3

Estimates of Fixed Effects with Perceived Stress as Independent Variable and Positive and Negative affect as Dependent Variable

Positive affect							
						95% CI	
Parameter	b	SE	df	t	Sig	Lower Bound	Upper Bound
Intercept	5.30	.14	51.52	38.54	<.001	5.03	5.58
Perceived Stress	-.46	.03	43.68	-14.78	<.001	-.52	-.40
Negative affect							
						95% CI	
Parameter	b	SE	df	t	Sig	Lower Bound	Upper Bound
Intercept	.94	.06	45.24	15.31	<.001	.82	1.07
Perceived Stress	.41	.02	48.10	17.20	<.001	.36	.46

The relation between perceived stress and positive/negative affect, moderated by trait acceptance

Two linear mixed models were run to answer the second research question, with perceived stress as the predictor, positive/negative affect as the dependent variable, and trait acceptance as the moderator (Table 4 and Table 5). A nonsignificant interaction was found by acceptance on perceived stress and positive affect (ß = -.03, $p = .26$) (all results regarding positive affect are displayed in Table 4).

Table 4

Estimates of Fixed Effects with Perceived Stress as Independent Variable, Positive affect as Dependent Variable and Acceptance as Moderator

						95% CI	

Parameter	ß	SE	df	t	Sig	Lower Bound	Upper Bound
Intercept	4.80	.53	52.35	9.06	<.001	3.77	5.84
Perceived Stress	-.33	.12	44.52	-2.74	<.01	-.57	-.09
Acceptance	.12	.12	51.78	.99	.32	-.12	.37
Perceived Stress*Acceptance	-.03	.03	46.92	-1.13	.26	-.09	.03

It can be seen in Table 5 that the interaction effect by acceptance on perceived stress and negative affect was found to be nonsignificant (ß = .01, p = .64) (all results regarding negative affect are displayed in Table 5).

Table 5

Estimates of Fixed Effects with Perceived Stress as Independent Variable, Negative affect as Dependent Variable and Acceptance as Moderator

						95% CI	
Parameter	ß	SE	df	t	Sig	Lower Bound	Upper Bound
Intercept	1.42	.23	46.56	6.19	<.001	.97	1.86
Perceived Stress	.37	.09	49.26	3.99	<.001	.19	.55
Acceptance	-.12	.05	45.44	-2.15	<.05	-.22	-.01
Perceived Stress*Acceptance	.01	.02	50.99	.47	.64	-.03	.05

Discussion

Main Findings

Regarding the first research question, it was found that perceived stress has a significant negative effect on positive affect and a significant positive effect on negative affect. This is in line with the expectation that stress decreases mental health in daily life. These findings also reflect what the previous literature reported: stress was associated with different mental and physical health risks, like depression, anxiety, and headaches (Perez et al., 2015; Salari et al., 2020). As it was recently found by Gordon et al. (2023) that mind and body are interconnected, the decrease in mental health due to stress may already pose a risk

factor for physical symptoms to appear. Additionally, as the daily effects of stress on mental health were quite prominent in this study, the number of people experiencing high-stress levels seems quite alarming. The American Psychological Association (2022) reported that 46% of Americans under 35 years of age experience very high levels of stress (to the point that they cannot function properly anymore). Taking the reports of Perez et al. (2015) or Salari et al. (2020) into account, this means that almost half of the American population under the age of 35 is at risk of developing either an anxiety or a depressive disorder, as well as comorbid physical symptoms. This can put high demands on the whole healthcare system. Teaching stress-managing techniques, like emotion regulation, can be essential for increasing the overall quality of life in the population, saving financial resources and lowering the demand on the healthcare system (Aldao et al., 2010; Wang & Saudino, 2011).

Regarding the second research question, it was found that acceptance has no significant moderation effect on the relationship between perceived stress and mental health. This contradicts the expectations and the previous literature, which suggests acceptance as a valuable strategy to attain better psychological health by reducing negative emotions in response to stressors (Ford et al., 2018). Troy et al. (2018) reported that the habitual use of acceptance in daily life is associated with decreased negative affect. ACT also uses acceptance mainly regarding negative emotions or events (Hayes et al., 1999). As for the short-term effects of acceptance, Troy et al. (2018) argue that the literature suggests inconsistent findings. Some studies suggest acceptance decreases negative affect, while others found no difference (Troy et al., 2018). A Meta-analysis including 30 relevant laboratory studies of emotion regulation indicates no reliable effect of acceptance on negative emotions (Kohl et al., 2012). A possible explanation for these inconsistent findings may be found in a study by Campbell-Sills et al. (2006). They reported acceptance leading to an increase in negative affect during a distressing video clip but a decrease in the recovery period after the video clip (Campbell-Sills et al., 2006). Therefore, acceptance might not immediately decrease negative affect during an emotional or stressful event but may help emotional recovery by diffusing the experience of negative emotions (Troy et al., 2018). Velozo et al. (2023) found in their ESM study about affective recovery to daily-life stressors in 349 participants that delayed affective recovery is associated with a risk for depression. As stress and negative affect were measured momentarily, at roughly the same time in this study, acceptance may not have moderated that relationship because it only aids the recovery process. It might be that the negative affect levels are high because the stress levels are high, and acceptance is not yet involved in the

interaction, as high-stress levels indicate a stressful event in recent times. When stress levels are low, negative affect levels are also low, and the recovery process is already over. As acceptance helps the emotional recovery process by making it easier to let go of negative emotions, which will be indicated, by a faster recovery process, the analysis used in this study is unsuitable for measuring this. Examining this process in lagged models over time, might yield different results, as acceptance could be a moderator for the relationship between stress recovery and mental health. Doing this would require empirical scrutiny regarding the time scales at which this process happens. As we already know from previous literature, that the average recovery time from stress is 90 minutes (Velozo et al., 2023), the sample frequency would need to be high. Another possible explanation for the findings in this study can be found in a recent article by Karl and Fischer (2022). They found that changes in negative affect are negatively related to changes in acceptance and vice versa (Karl & Fischer, 2022). This strongly indicates a reciprocal relationship between negative affect and acceptance (Karl & Fischer, 2022). Considering the findings from Karl and Fischer (2022), the acceptance and negative affect scores might have influenced each other. As trait acceptance was computed by taking the average of the state scores, the acceptance score might be influenced by the negative affect levels, which would not have been the case when using a baseline acceptance score. The acceptance score also somewhat represents the negative affect score, possibly leading to the insignificant moderation effect. In conclusion, it is still unclear whether acceptance moderates the relationship between stress and negative affect, at least looking at the short-term effects.

The relationship between acceptance, stress, and positive affect remains unclear due to a lack of literature (Troy et al., 2018). Even though this study could not find a significant interaction effect of acceptance on the relationship between stress and positive affect, some literature suggests a link between acceptance and positive affect. Richards (2017) found that emotion regulation techniques affect positive and negative affect after stressful events. Lindsay et al. (2018) proposed a theory where acceptance broadens the scope of awareness and frees attention to notice positive experiences. Karl and Fischer (2022) also found a reciprocal relationship between acceptance and positive affect. This indicates that the lack of moderation could be due to the same reasons for positive as for negative affect. In conclusion, not much literature exists on the topic of acceptance, stress and positive affect. Even though there is literature suggesting a link between these variables, no relationship could be identified in this study.

Strength and Limitations

One of the strengths of this study is that it measured stress and mental health in everyday situations where it has the most impact on the general population. Mental reactions to stressful events were assessed in a short time period after the event. Acceptance was also measured daily and combined into a general acceptance score. This score accurately reflects the level of acceptance during that time interval, which would not have been the case using a baseline trait score.

In the following, the limitations of this study will be discussed. First, even though convenience sampling is a common technique used in ESM research, it has drawbacks. The sample in this study primarily consists of students between the ages of 20 and 25, and 90% of the sample is either of German or Dutch origin. This makes the sample not representative of the general population, and especially the sample's age has to be taken into account when interpreting the results of this study, as stress and mental health can differ a lot across different ages. Second, as is always the case with ESM studies or studies that put a high demand on participants, there might be some characteristics of participants that influence their compliance rate. If that is the case, participants with certain characteristics are excluded from the study due to insufficient compliance, which is not considered when interpreting the results.

Future research

Future research should focus on the effectiveness of different emotion regulation strategies on stress in everyday life. As stress is a growing problem in society and poses a health risk for the wider population, more research has to be done on the effectiveness and efficiency of stress management techniques (like emotion regulation) in everyday life. It is important to know what might help the general population to manage stress to design interventions accordingly and lower the demand on the healthcare sector. This could be done by developing new stress management techniques or incorporating existing techniques found to be effective into new interventions. A promising approach in this regard are Ecological Momentary Interventions (EMIs). EMIs are interventions that are provided in every-day life and in the natural environment of the participant (Balaskas et al., 2021). Due to the computational capabilities of smartphones nowadays, EMIs become an important tool to consider for treating mental illness (Balaskas et al., 2021). There is still a considerable lack of research on the quality of these mobile health interventions, indicated through the poor adoption of current mental health apps (Bidargaddi et al., 2020). With more knowledge on the processes of acceptance in daily life, better interventions can be designed. Additionally,

research on the EMIs themselves is important to increase adoption by the population. A possible way to research this would be the use of micro randomised control trials (RCTs). For example, Kroska et al. (2020) published a protocol using micro RCTs to optimize ACT Microinterventions via a mobile app. With more knowledge on the working processes of acceptance in daily life and EMIs, more effective and less expensive interventions can be developed, reducing the burden of stress-related disorders on the population and the healthcare sector. Additionally, it would be interesting to research whether acceptance is correlated with what facets of mental health (e.g., does acceptance only influence negative emotions or also positive emotions). Even though no moderating effect was found in this study, more research is needed to validate these findings, as there is not enough literature on the topic of acceptance moderating the relationship between stress and positive and negative affect. Doing this in a daily life setting can yield important insights into how stress and emotions are regulated on a daily basis.

Conclusion

In conclusion, this study showed that mental health is significantly related to stress in daily life. Acceptance showed no significant moderation effect in the relation between stress and affect. This leaves the question of how stress can be best managed in daily life, as it poses much risk for health issues, and how acceptance is related to stress and mental health as the previous literature suggests a link to both. Acceptance might be related with stress recovery, but more research on this topic is needed. There is a general lack of research on how different emotion regulation techniques are related to stress and affect in daily life. Researching the processes behind the relation of stress, affect and acceptance, but also other ERs, might bring new insights for developing effective interventions to reduce stress in daily life and increase mental health. These interventions could reduce the burden on the health care system and increase quality of life in the general population.

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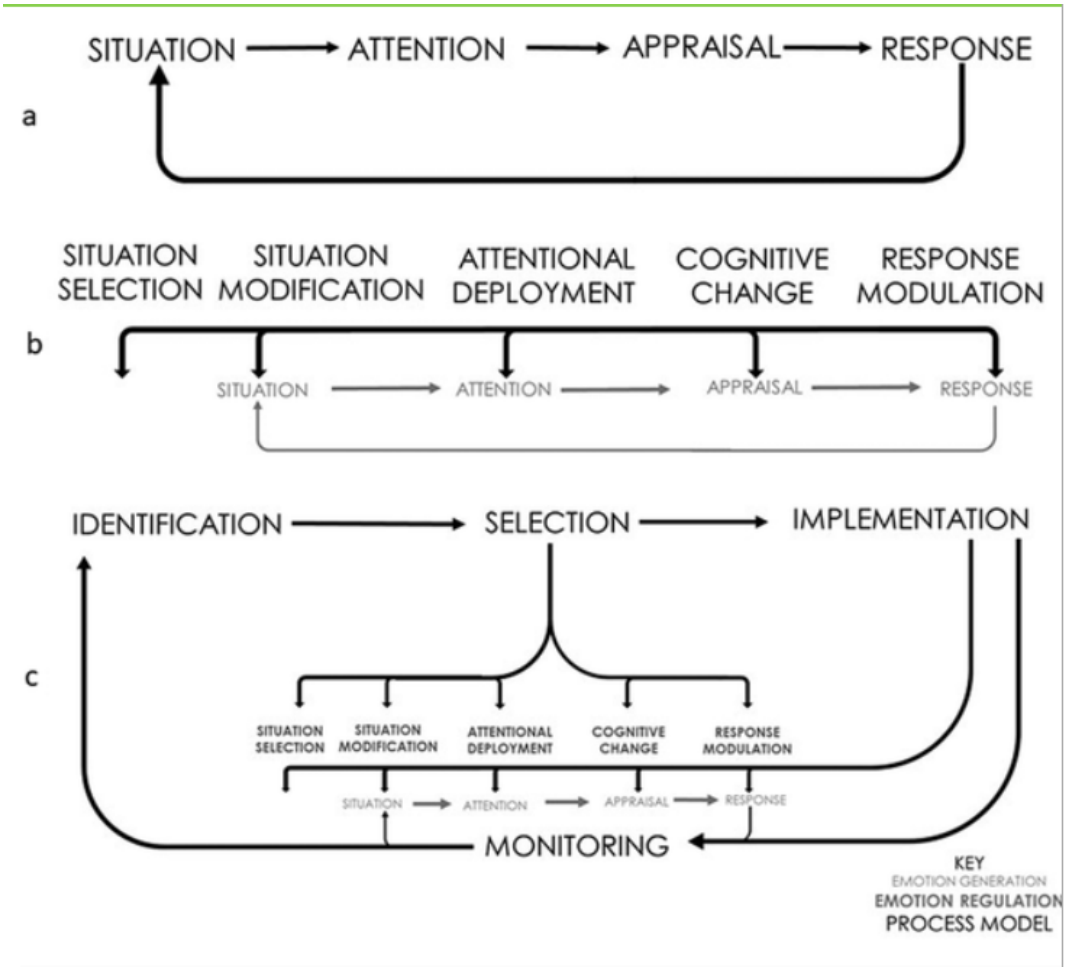
Appendix

Appendix A



Appendix B

Baseline questionnaire

Triggered once in the beginning, reminder after 8, 24 and 72 hours, does not expire

Demographics

- Age: How old are you?
- Gender: What gender do you identify as? Male, female, other
- Nationality: What is your nationality? Dutch German Other
- Occupation: What is your current occupation? Student, Working, Self-employed, studying and working, not working, other
- Highest degree obtained: Middle school (such as MBO, MTS, MEAO or Haupt- oder Realschule), High school (such as HAVO, VWO, HBS or Gymnasium/ Berufsschule/ Berufskolleg), High school, Bachelor, Master, PhD, Other

Mental well-being (MHC-SF)

During the past month, how often did you feel...

1. Happy
2. Interested in life
3. Satisfied with life
4. That you had something important to contribute to society
5. That you belonged to a community
6. That our society is a good place or is becoming a better place, for all people
7. That people are basically good
8. That the way our society works makes sense to you
9. That you liked most parts of your personality
10. Good at managing the responsibilities of your daily life
11. That you had warm and trusting relationships with others
12. That you had experiences that challenged you to grow and become a better person
13. Confident to think or express your own ideas and opinions
14. That your life has a sense of direction or meaning to it
    a. Never
    b. Once or twice
    c. About once a week
    d. About 2 or 3 times a week

e. Almost every day
f. Every day

Anxiety (GAD-7)

Over the last two weeks, how often have you been bothered by the following problems?

1. Feeling nervous, anxious, or on edge
2. Not being able to stop or control worrying
3. Worrying too much about different things
4. Trouble relaxing
5. Being so restless that it is hard to sit still
6. Becoming easily annoyed or irritable
7. Feeling afraid, as if something awful might happen
    a. Not at all
    b. Several days
    c. More than half the days
    d. Nearly every day

Depression (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems?

1. Little interest or pleasure in doing things
2. Feeling down, depressed, or hopeless
3. Trouble falling or staying asleep, or sleeping too much
4. Feeling tired or having little energy
5. Poor appetite or overeating
6. Feeling bad about yourself or that you are a failure or have let yourself or your family down
7. Trouble concentrating on things, such as reading the newspaper or watching television
8. Moving or speaking so slowly that other people could have noticed. Or the opposite being so fidgety or restless that you have been moving around a lot more

than usual

9. Thoughts that you would be better off dead, or of hurting yourself
    a. Not at all

b. Several days
c. More than half the days
d. Nearly every day

Resilience (BRS)

Please respond to each item by marking one box per row

1. I tend to bounce back quickly after hard times
2. I have a hard time making it through stressful events.
3. It does not take me long to recover from a stressful event.
4. It is hard for me to snap back when something bad happens.
5. I usually come through difficult times with little trouble.
6. I tend to take a long time to get over set-backs in my life

Strongly disagree
Disagree
Neutral
Agree
Strongly agree

Perceived Stress (PSS)

The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, please indicate your response by placing an "X" over the circle representing HOW OFTEN you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and "stressed"?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?

6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Never
Almost never
Sometimes
Fairly often
Very often

Cognitive reappraisal (ERQ subscale)

1. When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about
2. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.
3. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm
4. When I want to feel more positive emotion, I change the way I'm thinking about the situation
5. I control my emotions by changing the way I think about the situation I'm in
6. When I want to feel less negative emotion, I change the way I'm thinking about the situation.

1 Strongly disagree
2
3
4 Neutral
5
6
7 strongly agree

Rumination (CERQ subscale)

1. I often think about how I feel about what I have experienced.
2. I am preoccupied with what I think and feel about what I have experienced.
3. I want to understand why I feel the way I do about what I have experienced
4. I dwell upon the feelings the situation has evoked in me.

Almost never
Rarely
Occasionally
Frequently
Almost always

Acceptance (CERQ subscale)

1. I think that I have to accept that this has happened.
2. I think that I have to accept the situation.
3. I think that I cannot change anything about it.
4. I think I must learn to live with it.

Almost never
Rarely
Occasionally
Frequently
Almost always

ESM questionnaire

Triggered ten times a day at random moments between 07.30 until 22.30 in blocks of 90 minutes for a period of one week, no reminder, expires after 15 minutes

Positive and negative affect

Below you can find several questions about your current feelings. Please try to indicate how you felt right before you started to answer the questionnaire!

- How *cheerful* do you feel right now?
- How *enthusiastic* do you feel right now?
- How *satisfied* do you feel right now?
- How *relaxed* do you feel right now?
- How *anxious* do you feel right now?
- How *irritable* do you feel right now?
- How *down* do you feel right now?
- How *guilty* do you feel right now?
    - 1 (not at all) to 7 (very much)

Perceived stress

- How stressed do you feel right now?
    - 1 (not at all) to 7 (very much)

Stressful event + coping

Think of the most striking event or activity in last hour. How (un)pleasant was this event or activity?

- -3 (very unpleasant) to +3 (very pleasant)

How did you deal with this event?

- I kept thinking about it (rumination/savoring)
- I tried to distract my attention from it (distraction)
- I expressed my emotions (emotion expression)
- I talked to others about it (social support seeking)
- I tried to look at it in a different way (positive/negative reappraisal)
    - Yes/no

Think of the most striking event or activity in the last hour. How stressful was this event or activity?

- 1 (not at all) to 7 (very much)

Social context

Who are you with right now?

- Family member, friend, romantic partner, co-worker/fellow-student, unknown people/others, I am alone
- **If not alone:**
    - **I like this company**
    - 1 (not at all) to 7 (very much)
    - **I would rather be alone**
    - 1 (not at all) to 7 (very much)

Cognitive reappraisal

In the last hour, I tried to look at my problems from a different perspective

- 1 (not at all) to 7 (very much)

Rumination

In the last hour, I have been thinking about my problems

- 1 (not at all) to 7 (very much)

Acceptance

In the last hour, I could let go of my negative thoughts and feelings without acting upon them

- 1 (not at all) to 7 (very much)