

**How Brooding and Reflection Affect Personal Growth After Momentary Stress: An
Experience Sampling Study**

Master Thesis

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Abstract

This study investigated if momentary stress is associated with personal growth, and if brooding or reflection moderates this relationship. Brooding, which is passive dwelling on the negative mood, was expected to hinder personal growth. In contrast, reflection, which entails the evaluation of one's cognitions, emotions, and behaviours in a solution-focused way, was hypothesized to be a facilitating factor. In an ESM study, participants ($N = 22$) answered questions about momentary stress, personal growth, brooding, and reflection on a smartphone application five times per day over the course of 10 days. Linear Mixed Modelling (LMM) was applied to analyse the data. Results indicated that there is a significant association between momentary stress and personal growth level ($b = 0.48$, $CI [0.40, 0.57]$, $p < .001$), and that there is a positive significant moderation effect of brooding ($b = 0.10$, $CI [0.03, 0.17]$, $p = .005$), but no significant moderation effect of reflection stress ($b = -0.05$, $CI [-0.11, 0.02]$, $p = .167$) on this association. Hence, the findings highlight the importance of momentary stress for personal growth, and that brooding enhances this association. This yields grounds for further within-person research on momentary stress and personal growth with reflection and especially brooding as potential moderators.

Keywords: momentary stress, personal growth, rumination, brooding, reflection, experience sampling method (ESM)

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How Brooding and Reflection Affect Personal Growth After Momentary Stress

Most of the worldwide population experiences highly distressing events at some point in their lives (Kessler et al., 2017). More specifically, about 70% of adults are exposed to at least one traumatic event within their lifetime (Kessler et al., 2017). Victims are likely to respond with fear, sadness, and helplessness, and stimuli associated with the trauma are avoided (Idsoe et al., 2012). Despite these serious consequences that some trauma victims face, research has shown that about 70% tend to grow beyond their previous level of psychological functioning after the event, due to making positive alterations in their lives (Linley & Joseph, 2004). When individuals grow from a traumatic event, they can experience what is called post-traumatic growth. According to the most influential model by Tedeschi and Calhoun (2004, p.1), post-traumatic growth (PTG) is defined as ‘positive psychological change experienced as a result of the struggle with highly challenging life circumstances’. After this change, the victim’s psychological state and well-being exceeds the one before the traumatic experience (Schubert et al., 2015). The individuals tend to grow in five different life domains; they tend to experience a greater appreciation of life, more intimate social relationships, enhanced feelings of personal strength, more engagement with spiritual questions, and realise new possibilities in their life (Jayawickreme & Blackie, 2014). Experiencing such positive changes may lead to greater life satisfaction (Jayawickreme & Blackie, 2014). When the traumatic experiences do not fit with their previous worldview, individuals are driven to resolve this dissonance and build a new assumption with a more fitting meaning for the experience (Splevins et al., 2010). This process is seen as growth, as it entails alterations in the individual’s perception of themselves, their relationships with others, and how they view the world (Splevins et al., 2010).

Personal Growth

The process of growth after traumatic events is well examined, while there is not much research on personal growth after stress in daily life. Personal growth can be defined as intentionally developing one’s personality and improving oneself in an individually meaningful way (Vittersø, 2014). Despite its less serious nature, momentary stress may still alter beliefs and cause distress, resulting in the individual’s need to deal with the event (LoSavio et al., 2011). Thus, also smaller distressing events may lead to changes in the individual’s functioning and provide opportunities for growth, for instance, positive changes in self-esteem, coping skills, social support, or spirituality (LoSavio et al., 2011). Further, Cann et al. (2009) stated that any distressing event may result in alterations of core beliefs and hence, can be linked with personal growth. Despite the belief of more ‘seismic’ events leading to greater personal growth

(Cann et al., 2009), also small distressing occurrences may induce psychological adjustment to new situations and re-considering crucial beliefs about the world, oneself, or others (LoSavio et al., 2011). Additionally, Tedeschi and Calhoun (1996) stated that victims of severe trauma were most likely to describe great positive alterations to their lives, but that those who experienced less traumatic events still mentioned at least a moderate positive alteration (LoSavio et al., 2011). Being exposed to minor stressors offers opportunities to develop resilience, which is the capability to adapt to a distressing situation after a reduction in psychological functioning (Crane & Searle, 2016). After dealing with momentary stressors, the individual may enhance their coping strategies and will be better able to deal with a similar problem in the future (Park, 2010). Furthermore, through experiencing momentary adversity, individuals tend to reflect on the event and themselves, through which they will become more aware of themselves, which in turn may facilitate personal growth (Crane & Searle, 2016). More specifically, when increasing self-awareness, the individual's priorities may become more visible as well, as in times of stress they need to focus on the most important values (Park, 2010). The skills needed for personal growth, such as being ready for change, being aware of and using one's resources and intentional behaviour, are all part of the construct of Personal Growth Initiative (PGI) (van Woerkom & Meyers, 2018). Robitschek et al. (2012) found that high levels of PGI serve as a buffer for psychological distress, as individuals high in PGI find opportunities for personal growth in distressing situations, and believe in their ability to cope with the adversity. As momentary stress may occur frequently, individuals with high levels of PGI tend to have generally higher levels of well-being (van Woerkom & Meyers, 2018).

Momentary Stress

Momentary stress can be defined as challenges to people's routines or daily life (Almeida, 2005). Stress develops when the person appraises themselves as unable to deal with their environment, as they lack the resources needed and/or their well-being is at risk (Schwarzer & Taubert, 2002). Many different types of stress potentially affect people's psychological well-being, e.g., arguments, malfunctioning technology, or everyday problems at work to give a few examples. Stress is mostly due to unpredictable circumstances, that affect the day-to-day life negatively. These relatively minor stressors might add up and not only have an immediate and direct effect on the psychological and physical well-being, but lead to constant irritability, annoyance, or burden for the individual (Lazarus, 1999).

Brooding and Reflection

Rumination, which is defined as repetitive thinking about a distressing event (Marshall et al., 2013) is an important factor influencing growth after a highly distressing event (Moulds

et al., 2020; Zoccola & Dickerson, 2012; García et al., 2017). The way the individual responds to the distressing situation is the maintaining factor that either perpetuates the negative mood, or helps the individual get out of it, instead of a ruminative personality only (Morrison & O'Connor, 2005). Ruminative thinking may help the individual to gain insight and answers to the alternating circumstances (Soo & Sherman, 2014). More specifically, rumination may lead to a decrease in the dissonance between the previous worldview with the one the individual starts to create (Soo & Sherman, 2014). It can be differentiated between two main subtypes of rumination, namely *brooding* and *reflection* (Soo & Sherman, 2014).

Brooding is a more passive form of rumination, where the focus lies on the causes or consequences of the negative mood and comparing the current situation with the unachieved one(s) (Garcia et al., 2015). Moreover, in this form of rumination people focus on the barriers that keep the problem situation unresolved. Hence, a problem is involuntarily repeated in the individual's mind (Krys & Reininger, 2023). A more active form of rumination is *reflection*, which deals with more deliberate and especially conscious attempts to adapt to and deal with the situation (Garcia et al., 2015). Brooding is rather problem-focused, while reflection entails more thinking about the solution and the future than dwelling on the problem situation itself (Soo & Sherman, 2014). The former type usually results in a more negative mood and well-being, it might even prolong the effect of the stressor, while the latter mostly facilitates alleviating symptoms and finding new meaning, which increases emotional recovery (García et al., 2017; Marshall et al., 2013). This is due to cognitive processing of the event, more specifically, it is suggested that brooding hinders cognitive processing, whereas reflection enhances it (Stockton et al., 2011). Conclusively, as brooding prolongs the feeling of stress and focuses more on the problem itself than on potential solutions, it is expected to impede the development of personal growth after facing adversity. In contrast, reflective thinking focuses more on the solution and making sense of what has happened and is thus expected to facilitate the development of personal growth after momentary stress.

The Current Study

With this paper, the aim is to explore (a) how momentary stress affects the development of personal growth within individuals and (b) how the type of rumination (brooding or reflection) moderates the development of personal growth after momentary stress within individuals. The current study is an Experience Sampling Method (ESM) study, that will assess momentary stress, personal growth, brooding and reflection several times per day. Based on existing research, the following hypotheses were formulated:

Hypothesis 1: Experiencing momentary stress leads to personal growth.

Hypothesis 2: Reflective rumination strengthens the association between momentary stress and personal growth.

Hypothesis 3: Brooding decreases the association between momentary stress and personal growth.

Method

Design

For the purpose of this study, a within-subjects design was employed by using the Experience Sampling Method (ESM), to measure the participant's momentary responses in daily life through self-reports. ESM studies are used to get insight into participant's feelings, emotions, thoughts, or behaviours in the respondents' natural environment (Myin-Germeys & Kuppens, 2021), which indicates a high ecological validity. This method also makes it possible to assess people's experiences in real time, which reduces retrospective biases. The independent variable was *momentary stress*, the dependent variable was *personal growth*, and the moderator variables were *brooding* and *reflection*.

Participants

The participants were recruited through convenience sampling and voluntary response sampling (Sona systems). Out of the 49 participants, 27 had to be excluded because of less than 30% of completed state measurements (van Berkel et al., 2017). This resulted in a sample of 22 participants.

The inclusion criteria were to have proficient English language skills and have a smartphone that they can use to download the app *Ethica*.

Materials

As the study was part of a bigger study with other researchers, there were other questionnaires included assessing self-efficacy, social support, optimism, and self-compassion. As they were not used for the current study, they will not be further discussed.

Ethica

Ethica is a smartphone application that is used for ESM studies (Ethica Data, 2023). Researchers can create an account and create their own study, to measure their participant's responses on a momentary state level (Ethica Data, 2023).

Demographics

The demographic data that was collected contained information about participants' age, nationality, gender, and highest educational degree completed.

State Measures

Momentary Stress Assessment. To assess the respondents' level of momentary stress throughout the day over the course of the study, one item was used. The item was derived from the ESM item repository, which is a database of items used in experience sampling studies and found to be used in a study protocol in a study by Helmich et al. (2020). On this item, namely "Think of the most striking event or activity in the last hour. How stressful was this event or activity?", answer options ranged from 1 (*not at all*) to 7 (*very much*) on a 7-point Likert Scale (Appendix A).

Personal Growth Assessment. To measure participant's momentary level of personal growth, two items were created. The first item, "In the last hour I felt capable of handling difficulties" (Appendix A), was adapted from the PTGI-SF and transformed into a state measurement for the purpose of this study. For the second item, "In the last hour, I felt that life is a continuous process of learning, changing and growth" (Appendix A), an item of the personal growth subscale from Ryff's Psychological Well-Being Scale (1989) was used, and transformed into a state measurement. On both items, participants could answer on a 7-point Likert scale, ranging from 1 (*totally disagree*) to 7 (*totally agree*). The internal consistency for these items was poor ($\alpha = .54$).

Ruminative Reflection. To measure momentary ruminative reflection, the item with the highest factor loading of the reflection subscale of the RRS by Trapnell and Campbell (1999) has been used, namely "I love exploring my "inner self". To be able to use this item for a state measurement, it was transformed into "In the last hour, I loved to explore my "inner" self" (Appendix A). Participants could answer on a 7-point Likert scale, ranging from 1 (*not at all*) to 7 (*very much*).

Brooding. To assess the participant's momentary level of brooding, an item from the BSRI was used. The item "Right now, I wonder why I always feel the way I do." had the highest factor loadings in several samples (Marchetti et al., 2018). To make it coherent with the other items, it was transformed into "In the last hour, I wondered why I always feel the way I do" (Appendix A). Participants could answer on a 7-point Likert scale, ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Procedure

First of all, the BMS Ethics Committee of the University of Twente ethically approved the study design. The study was set up in Ethica. The participants were informed about the content, goal, and course of the study. Then they could give informed consent to the study. After this, they had to download the app Ethica and create a participant account. On the same

day, the participants filled in the baseline questionnaire for the trait measures and demographics. The next day, they started the daily questionnaires, which were randomized after the first item about momentary stress, for 10 consecutive days. Within each day, they received 5 signals after which they had to answer a short questionnaire with 13 items in the upcoming hour. If they did not fill it out, they received reminder notifications after 25 min and 40 min. After 1h, they did not have access to the questionnaire anymore. In total, every participant who completed the study received 50 notifications, additionally the reminders. Thus, the study used a signal-contingent random sampling method for a repeated measures design, and data was collected between the 21st of March and the 17th of April 2023.

Data Analysis

The datasets of the trait questionnaire and the state questionnaire were exported from Ethica and uploaded to IBM SPSS statistics (version 28). The Person-Mean-Centred scores (PMC) of momentary stress, personal growth, brooding, and reflection were calculated. This allowed for within-person analysis, meaning the difference between each measurement and the Person-Mean (PM) score could be assessed. Moreover, a time variable was created to include the difference between the start of the study and the time of measurement. Then, Little's Missing Completely at Random (MCAR) test was used to check if there is a relationship between missing data and the observed data. When the data are not missing at random, additional analyses must be conducted to see why this is the case (Li, 2013).

For both research questions, a Linear Mixed Model (LMM) was run to account for nested data, and the autoregressive covariance structure (AR1) was applied because it assumes a steady decay of correlation over time (Barnett et al., 2010). In this LMM, 'ID' was the subject's variable and 'time' was the repeated measures variable. To check the first hypothesis and see if there is a relationship between momentary stress and personal growth, the LMM was run with the PMC variables of momentary stress as independent variable and the PMC of personal growth as dependent variable. For the second research question about a moderation effect of brooding or reflection on the association of momentary stress on personal growth, two LMMs were run. Both had the PMC of personal growth as dependent variable, and the PMC of daily stress as fixed factor. For the first LMM, brooding was added and for the second LMM, reflection was added to assess the interaction effect.

Finally, boxplots and line graphs were created to demonstrate the variability of measurement data of momentary stress, personal growth, brooding, and reflection within a participant.

Results

Sample Characteristics and Preliminary Analyses

Most participants were German and female, and the mean age was 24.91 years ($SD = 6.91$). Most have completed their bachelor's or a similar higher, non-university degree. All relevant sample characteristics can be found in Table 1. The means and standard deviations for momentary stress, personal growth, reflection, and brooding for all participants can be found in Table 2. In this study, Little's MCAR test showed that the data are missing completely at random ($X^2(7) = 8.47, p = .29$), thus, is not dependent on the observed data.

Table 1

Sample Characteristics (N=22)

Characteristics	Categories	F	%
Gender	Female	17	77.3
	Male	5	22.7
	Other	0	0
Nationality	German	18	81.82
	Dutch	1	4.55
	Other	3	13.64
Highest Educational Degree Obtained	High School	3	13.6
	Bachelor	15	68.2
	Master	3	13.6
	Doctorate Degree or other higher degree	1	4.5

Table 2

Means and Standard Deviations of Total Scores of Every Participant.

Participant	Momentary Stress		Personal Growth		Brooding		Reflection	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	1.78	1.63	9.07	1.54	4.07	1.11	3.37	1.04
2	3.11	1.75	9.44	1.54	3.17	1.20	3.94	1.06
3	3.94	1.71	6.76	1.98	3.12	1.29	3.03	1.21

4	2.17	1.80	9.41	1.76	1.73	1.07	3.32	1.68
5	2.41	1.72	10.41	0.84	4.93	0.33	4.98	0.34
6	4.15	1.89	9.29	1.43	4.35	0.73	3.76	0.61
7	3.74	1.66	10.84	1.83	5.37	0.76	5.37	0.76
8	3.03	2.21	8.26	2.08	3.88	1.85	3.09	1.60
9	2.50	1.91	9.35	2.88	2.50	1.20	2.27	0.96
10	4.13	1.58	8.26	2.54	4.48	1.12	3.26	1.18
11	3.48	1.64	9.80	1.64	2.64	1.20	4.41	1.06
12	1.58	1.31	8.79	1.47	1.11	0.31	3.37	0.83
13	2.64	1.82	9.69	1.39	1.47	0.56	3.92	0.50
14	3.00	1.69	7.59	3.37	1.74	1.61	1.07	0.27
15	2.38	1.44	9.04	1.18	2.69	1.05	2.35	0.80
16	3.17	1.79	8.28	1.71	3.78	0.94	2.28	1.41
17	2.58	1.82	10.58	1.93	1.50	0.66	1.33	0.57
18	3.17	1.43	7.72	1.50	2.47	1.16	2.04	1.08
19	2.68	1.41	10.25	2.51	3.57	1.27	3.66	1.45
20	3.58	1.41	8.68	1.35	3.90	0.79	3.55	0.89
21	2.56	1.63	9.31	2.57	3.13	1.77	2.87	1.60
22	3.38	1.88	10.21	2.50	4.46	1.66	3.92	1.70

Note. *SD* = Standard Deviation

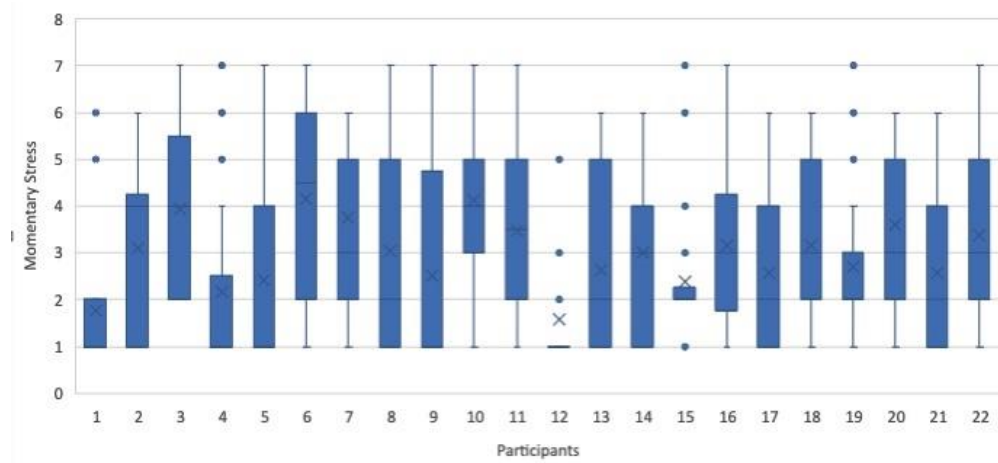
Variability

The boxplots display the individual variation in scores for momentary stress, personal growth, brooding and reflection within every participant (Figure 1, 2, 3, and 4).

For momentary stress, most participant's scores range between 2-4 (Figure 1). There are rather few participants with low to no variation in scores. More specifically, participant 1, 4, 12, 15 and 19 have very short boxplots. In contrast, some participants show rather high variation, such as participant 6, 8, 9, and 13. The mean score for momentary stress of the sample was 4.47 ($SD = 1.62$), indicating a medium level of momentary stress overall.

Figure 1

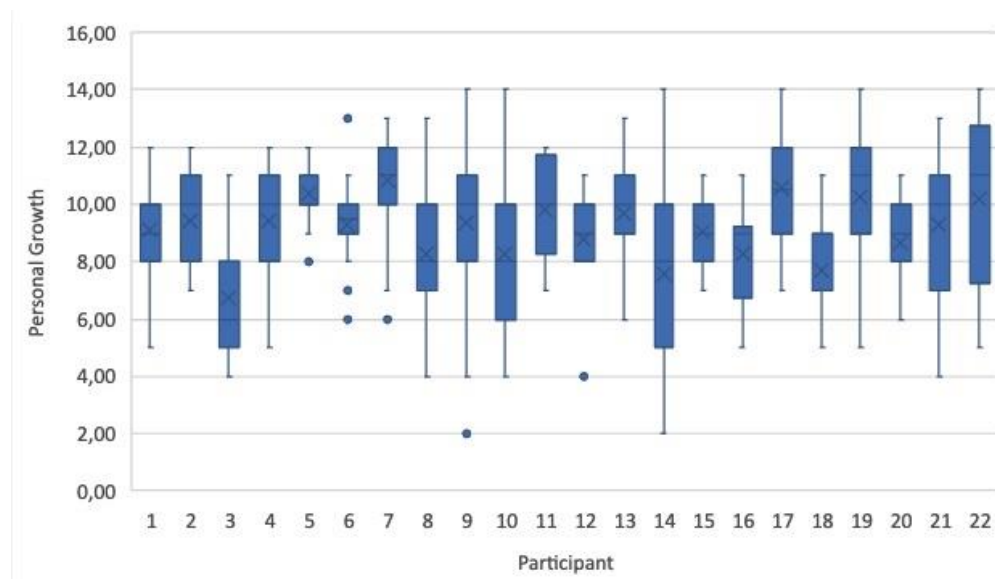
Boxplots displaying the variation in experiencing momentary stress for every participant



For personal growth, the participants had lower variation compared to momentary stress, both between and within participants (Figure 2). The participants with the highest variation were participants 9, 14 and 22. The sample mean was 9.15 ($SD = 2.19$), indicating a rather high level of personal growth.

Figure 2

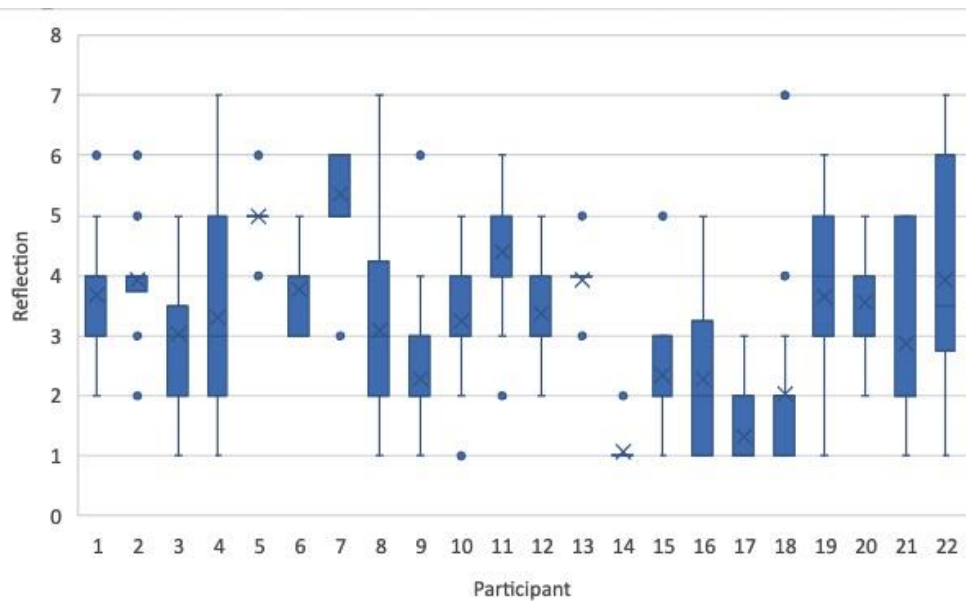
Boxplots displaying the variation in experiencing personal growth for every participant



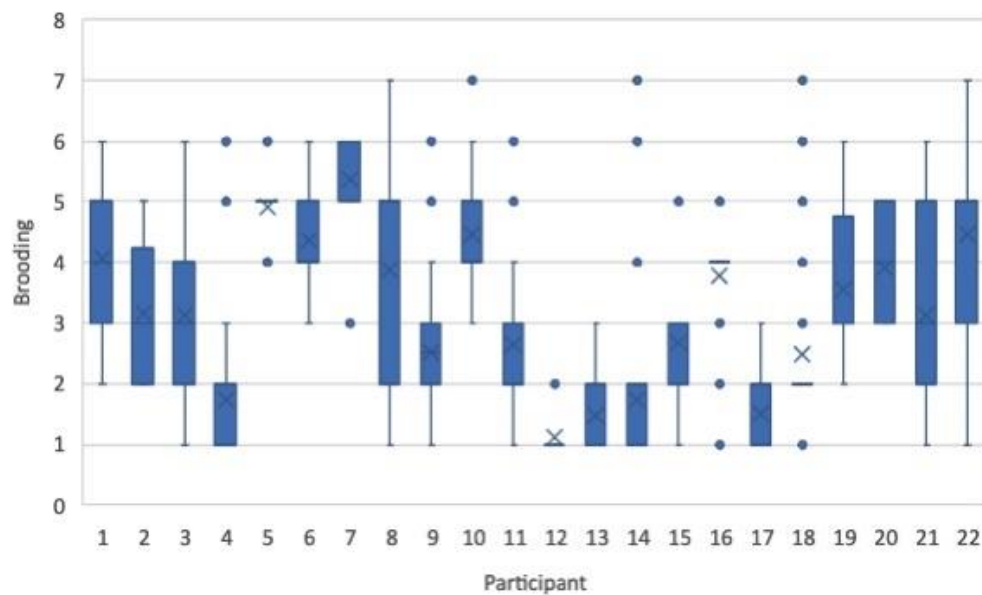
For reflection (Figure 3) and brooding (Figure 4) the variability between participants and within participants is shown. For example, participants 7, 11, and 17 show lower variability on both reflection and brooding than others. Overall, a similar pattern is visible between the boxes of both variables, as well as the group means, which are 3.15 ($SD = 1.60$) for reflection and 3.28 ($SD = 1.49$) for brooding.

Figure 3

Boxplots displaying the variation in experiencing reflection for every participant

**Figure 4**

Boxplots displaying the variation in experiencing brooding for every participant.



Hypothesis Testing

Association between Momentary Stress and Personal Growth

The outcome of the LMM showed a significant positive correlation on a within-person level ($b = 0.48$, $CI [0.40, 0.57]$, $p < .001$), as can be seen in Table 3. This means that the higher the level of momentary stress is, the greater are the scores of personal growth on a momentary level. Hence, H1 was confirmed.

Table 3

Estimates of Fixed Effects with Momentary Stress as Independent Variable and Personal Growth as Dependent Variable

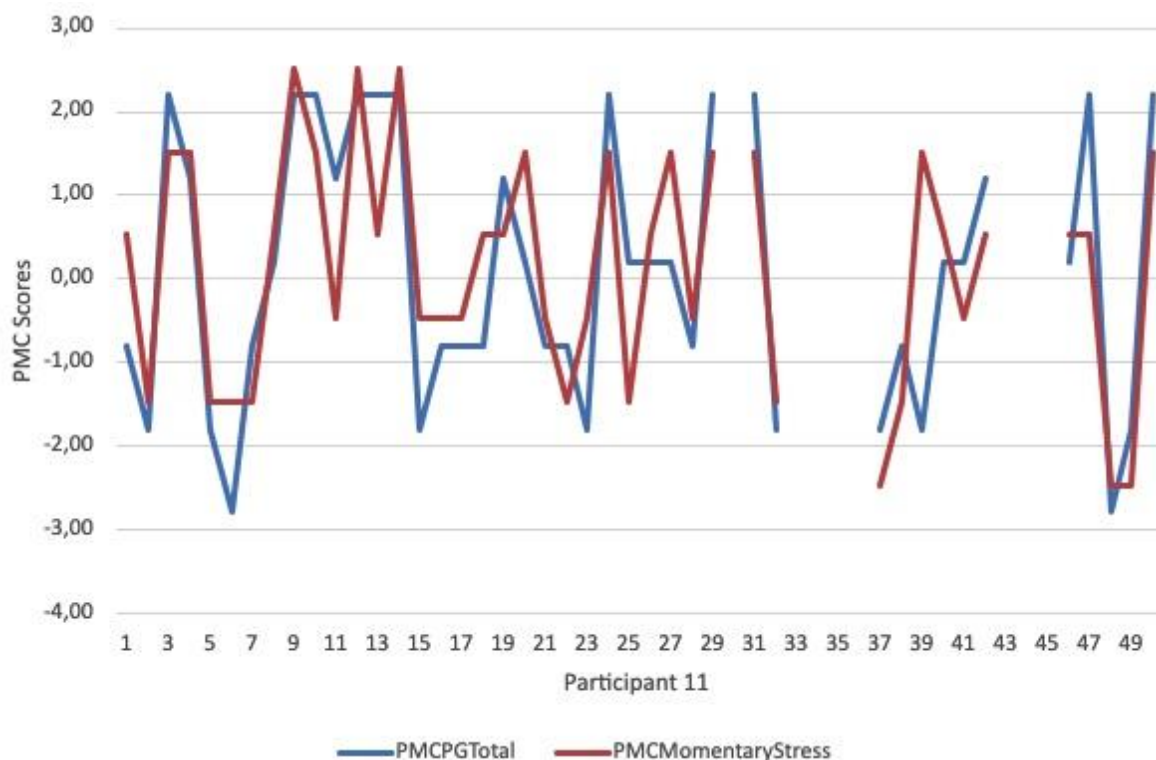
Parameter	<i>b</i>	SE	<i>df</i>	<i>t</i>	Sig	95% CI	
						Lower Bound	Upper Bound
Momentary Stress	0.48	.04	666.72	11.22	<.001	0.40	0.57

Note. *df* Degrees of freedom, *CI* Confidence interval of unstandardized estimates.

This association between momentary stress and personal growth is illustrated in Figure 5. It shows that for participant 11, the PMC scores of momentary stress and personal growth are relatively high at similar time points, while when they showed lower levels of momentary stress, they also showed lower levels of personal growth.

Figure 5

Line Graph showing the PMC scores of personal growth and momentary stress for participant 11 over the course of the study.



Moderation Effect of Brooding on the Relationship Between Momentary Stress and Personal Growth

The analysis shows a significant main effect between momentary stress and personal growth ($b = 0.47$, $CI [0.38, 0.55]$, $p < .001$). No significant main effect was found between

brooding and personal growth ($b = -0.08$, $CI [-0.20, 0.04]$, $p = .181$). However, a significant positive moderation effect of brooding on momentary stress and personal growth was found ($b = 0.10$, $CI [0.03, 0.17]$, $p = .005$). This means, the higher the participant's score in brooding, the greater is the association between momentary stress and personal growth. As this effect is significant but positive, H2 was rejected, as a negative moderation effect was expected. The results of the analysis can be found in Table 4.

Table 4

Estimates of Fixed Effects with Momentary Stress and Brooding as Independent Variable and Personal Growth as Dependent Variable

Parameter	b	SE	df	t	Sig	95% CI	
						Lower Bound	Upper Bound
Momentary Stress	0.47	.04	661.04	10.93	<.001	0.38	0.55
Brooding	-0.08	.06	665.73	-1.34	.181	-0.20	0.04
Momentary Stress*Brooding	0.10	.04	658.50	2.83	.005	0.03	0.17

Moderation Effect of Reflection on the Relationship Between Momentary Stress and Personal Growth

The third analysis showed a significant main effect between personal growth and momentary stress ($b = 0.40$, $CI [0.31, 0.48]$, $p < .001$). Also, a significant main effect was observed between reflection and personal growth ($b = 0.43$, $CI [0.30, 0.55]$, $p < .001$). Finally, no significant moderation effect was found by reflection on the association between personal growth and momentary stress ($b = -0.05$, $CI [-0.11, 0.02]$, $p = .167$). All results of this analysis can be found in Table 5. Thus, H3 was rejected.

Table 5

Estimates of Fixed Effects with Momentary Stress and Reflection as Independent Variable and Personal Growth as Dependent Variable

Parameter	b	SE	df	t	Sig	95% CI	
						Lower Bound	Upper Bound
Momentary Stress	0.40	.04	652.14	9.08	<.001	0.31	0.48

Reflection		0.43	.06	665.51	6.62	<.001	0.30	0.55
Momentary *Reflection	Stress	-0.05	.03	665.94	-1.38	.167	-0.11	0.02

To illustrate the results of the moderation analysis, line graphs were created for participant 5 (Figure 6) and 11 (Figure 7). Participant 5 shows lower variation in reflection, and higher variation in personal growth and momentary stress (Figure 6). Participant 11 shows higher variation in reflection, as well as personal growth and momentary stress (Figure 7).

Figure 6

Line Graph displaying the variation of personal growth, momentary stress, and reflection for participant 5 over the course of the study.

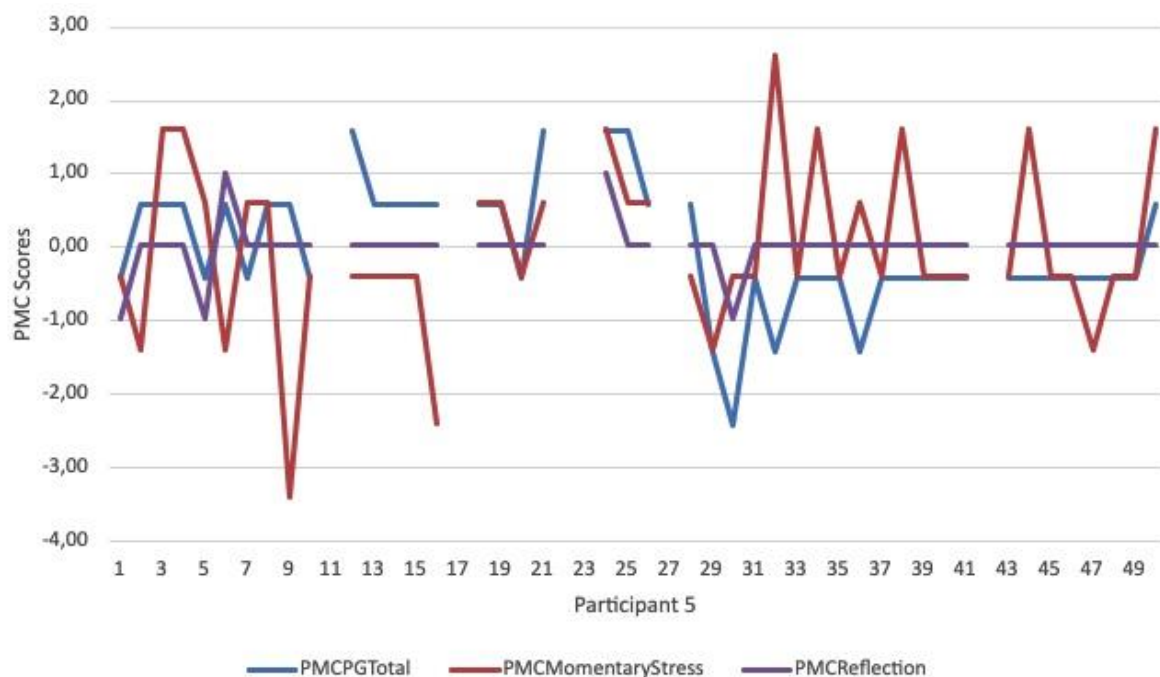
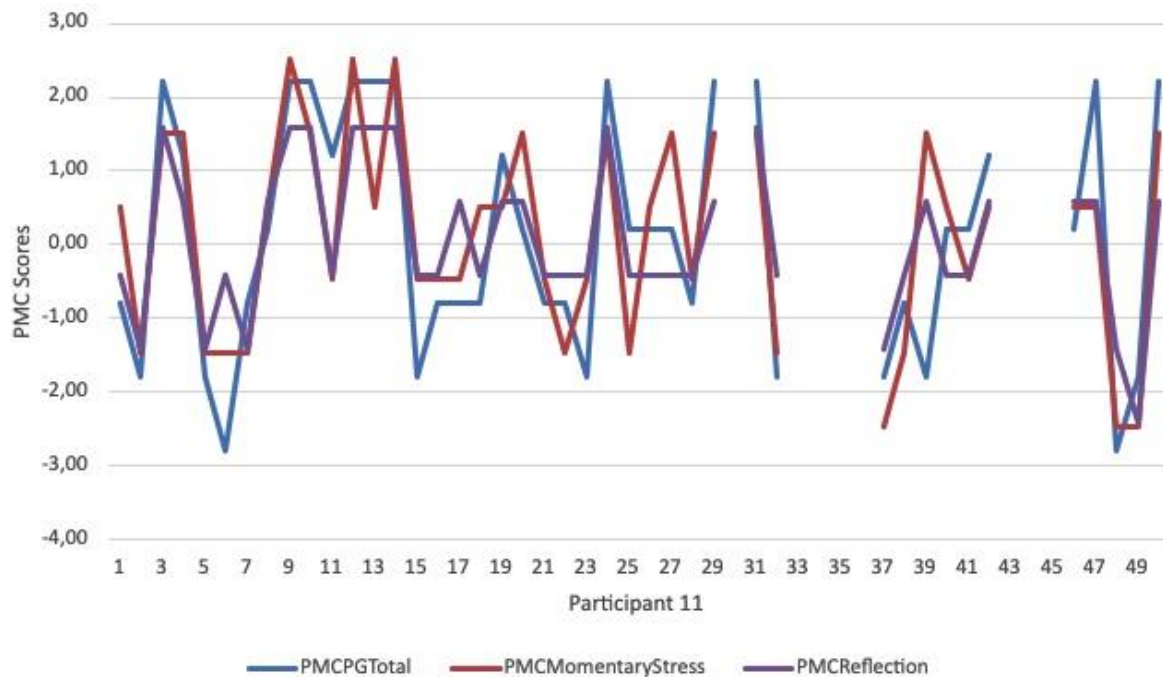


Figure 7

Line Graph displaying the variation of personal growth, momentary stress, and reflection for participant 11 over the course of the study.



Discussion

The purpose of the current study was to investigate if momentary stress has the potential to increase personal growth, and if this relationship is moderated by brooding or reflection. The first hypothesis, namely that momentary stress leads to personal growth was confirmed. The second hypothesis, stating that reflective rumination strengthens the association between momentary stress and personal growth, was rejected. Finally, the third hypothesis predicting that brooding decreases the association between momentary stress and personal growth, was also rejected.

Findings

First of all, the significantly positive association between momentary stress and personal growth indicated that participants with higher levels of momentary stress experienced higher levels of personal growth. This result supports the hypothesis and is in line with previous research about the relationship between stress and personal growth. Several studies have shown that stress-related events not only lead to negative outcomes, but also positive ones such as better coping skills, strengthening of social relations, increased self-efficacy or enhanced self-awareness (Popa & Podea, 2013).

Moreover, Paustian-Underdahl et al. (2022) showed that the stress-is-enhancing mindset is important in how people can grow from stressful events. Individuals who apply a stress-is-enhancing mindset, show to have greater work performance, (mental) health and well-being. This mindset can be developed but is also dependent on several factors such as personality traits (e.g., optimism), self-efficacy, previous experiences, or religiousness (Popa & Podea, 2013; Shigemoto et al., 2016). Therefore, it is not the stressor itself that leads to either personal growth or reduced mental health, but the interpretation thereof and the way the individual deals with it (Bienertova-Vasku et al., 2020). This closely aligns with the PGI, as both concepts have the main idea that the individual needs to be aware of the impact of the stressor and have the willingness to change something (Paustian-Underdahl et al., 2022; van Woerkom & Meyers, 2018). Conclusively, in this study participants may have been more aware of the stressor and reflected more on how they (want to) deal with it, as they were asked about it several times per day, which leads to developing the stress-is-enhancing mindset, thus increasing personal growth.

Furthermore, the second hypothesis was rejected, which means that the higher scores participants had on brooding, the stronger was the relationship between momentary stress and personal growth. This finding is against the assumption that brooding, which is described as negative dwelling on the causes and consequences of the negative mood (Garcia et al., 2015), decreases this association. A reason for it to positively moderate the association between stress and growth is that dwelling on the situation, even in a negative way, may enhance understanding of oneself and thus lead to an increase in personal growth (Schoofs et al., 2010). Similarly in a study by Marshall et al. (2013), it was found that brooding after a break-up leads to intrusive thoughts about the former partner, and these intrusive thoughts were related to reflection and personal growth later. Additionally, individuals engage in brooding only when the distress is relevant to them, and they cannot dissociate themselves from it. Hence, even if the situation seems to be uncontrollable and frightening, they are driven to resolve it, which increases personal growth (Krys & Reininger, 2023). Finally, through brooding the unresolved problem stays in the mind of the individual, which may foster finding a solution or ways to ameliorate the situation, even if the thoughts are rather passive and mostly contain negative aspects (Vahle-Hinz et al., 2017).

Furthermore, the third hypothesis was rejected, meaning that the tendency to engage in reflection does not necessarily influence the effect of momentary stress on personal growth. Firstly, this might be because the participants had to answer the questions during their daily life, where they might not have the time to engage in in-depth self-reflection. The Systematic

Self-Reflection (SSR) model proposes that when momentary stress occurs, there are five steps for adaptive self-reflection; being self-aware, identifying the trigger, reappraising the stressor, evaluating and then focusing on the future (Falon et al., 2021). Some steps may take more time to be fulfilled than others, depending on the situation and the individual themselves. When the steps are fulfilled, the individual may become more resilient to future stress and thus experience personal growth. As in this study, participants were asked about how much they engaged in reflection only briefly after the distressing situation, they might not have felt like they could thoroughly reflect on the event yet.

Strengths and Limitations

The first strength of this study is its study design. With the ESM, data over the course of 10 days could be gathered, with five measurements per day. This design allowed to assess fluctuations within participants. Also, momentary stress could be assessed in the best way possible, as respondents had to answer the questions within an hour during their daily life. Thus, there was less retrospective recall bias (Myin-Germeys et al., 2018). Finally, to our knowledge, this is the first ESM study investigating the effect of momentary stress on personal growth taking ruminative tendencies into account.

Despite having important strengths, the design also shows some limitations. For instance, the response rate in this study was rather low. For this type of study, it is recommended to include more than 50% of responses, but this was not possible because too many participants had more than 50% of missing data. Therefore, the cut-off score was set to >30% of responses.

Another limitation is the sampling method, which was convenience sampling. Through this method, participants were chosen by the researchers based on easy accessibility and willingness to participate in the study (Etikan et al., 2016). This was the most convenient sampling method given the time and circumstances, however, it has some implications. For example, the sample of this study consisted mainly of participants who are highly educated, female and German. As women are more likely to engage in both types of rumination than men, for instance, the scores for brooding and reflection may be less representative of the whole population (Shigemoto et al., 2016). Thus, it reduces the ecological validity tremendously.

Lastly, the psychometric properties of the personal growth items were poor, which means that the items measuring this construct were not closely related. However, as each item covers a different aspect of personal growth, namely the feeling of self-efficacy and willingness to change and reflect (Maurer et al., 2023), both items were used in this study.

Implications and Future Research

The major finding of the study at hand is that momentary stress has the potential to enhance personal growth. Therefore, this study emphasizes that stress in daily life is not only related to negative outcomes for the individual, which is still the consensus in a lot of research (Bremner et al., 2020; Thoits, 2012; Mohler-Kuo et al., 2021). Another implication is that brooding may lead to greater levels of personal growth than literature assumed until now. Especially in clinical settings, the clinician should be aware of these findings and for example find ways to help the client to benefit from the stress in their lives, e.g., through working on their coping strategies or allow their clients to engage in brooding.

For future research, this is also an important realization, as everyone experiences distressing events on a relatively daily basis, therefore it would be useful to gain more understanding about it to find ways to strengthen individuals' skills to deal with them. More specifically, it would help to understand which kinds of momentary stress have the potential for personal growth, and which characteristics and skills people should develop to use these stressors for their own benefit and development. For instance, Bienertova-Vasku et al. (2020) suggest that different types of stress should not be differentiated, as it is not the stressor itself, but how the individual deals with it, that determines the outcome. However, the intensity of the stressor is proven to be a highly important factor (Ord et al., 2020; Bienertova-Vasku et al., 2020). Lower stress-inducing events seem to be less effective in developing personal growth, as well as events connected to high stress levels (Ord et al., 2020). This is because the individual may not have the adequate coping skills to deal with extremely high stress levels, at least at that moment. In particular, research has shown that situations in which the individual needs to use their coping skills are more likely to lead to personal growth (Ord et al., 2020).

Finally, to draw better conclusions about the results of the general population, the researcher should aim for a more representative sample, especially when gender differences are proven to be relevant for the measured constructs.

Conclusion

This study gave new insights into the associations between momentary stress, personal growth, brooding and reflection. As far as we know, this is the first study using the ESM method to assess the relationship between momentary stress and personal growth, including brooding and reflection as potential moderators. Major findings were that momentary stress is associated with personal growth, meaning that the more momentary stress people experienced, the greater was their level of personal growth. Finally, while brooding was found to positively moderate this relationship, reflection was not found to be a moderating factor. This paper demonstrates

the need for future research about momentary stress, and shows that stress in daily life is not only related to negative consequences, but instead there seems to be great potential for individual's personal growth, influenced by reflection and especially brooding.

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Appendices

Appendix A: Questionnaires

Baseline Measurement

1 What's your gender?

Female

Male

Non-binary/Third gender

Prefer not to say

3 What's your age?

4 What's your nationality?

Dutch

German

Other

5 What is the highest degree or level of school you have completed? If currently enrolled, mark the

highest degree already received.

High school graduate

Bachelor's degree

Master's degree

Doctorate degree or higher

Other

6 What is your Sona ID? Fill in your personal number.

Daily Momentary Assessment

Hello,

It's time again for your daily questions.

Let's begin and tell us how you feel at the moment.

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

In the last hour, I wondered why I always feel the way I do.

In the last hour, I loved to explore my "inner" self.

In the last hour, I felt capable of handling difficulties.

In the last hour, I felt that life is a continuous process of learning, changing and growth.

Good job!

Thank you for your response, we appreciate it.

See you soon.

Appendix B: Informed Consent

This study focuses on responses to momentary stress and consists of two parts. In the first part, you have to fill out some general questionnaires. You only need to do this once and it takes about 20 minutes. The second part of the study lasts for 10 days. Per day, you will get 5 notifications to complete a short questionnaire. Completing this short questionnaire will take about 5 minutes.

Your participation in this study is completely voluntary and all your responses are treated anonymously. None of the responses will be connected to identifying information and wouldn't be shared with third parties. Data will only be used for statistical analyses. However, you can withdraw from the study at any time! By simply stopping answering the daily questions without the need to give any reasons.

If you would like to have further information about the research, now or in the future, feel free to contact *Mirjam Radstaak* at:

m.radstaak@utwente.nl.

If you have any complaints about this research, please direct them to Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente, email: **ethicscommittee-bms@utwente.nl**.