UNIVERSITY OF TWENTE.

Faculty of Behavioral, Management and Social Sciences (BMS)

Memories and emotions in the Dutch population

A study of the relationship between memories and intensity of positive and negative emotions

MASTER THESIS

Positive Psychology and Technology
Course - 201300102

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27.08.2018

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Abstract

More and more people suffer from a mental disorder during their life. Hence, the need for mental health treatment is increasing and creates a challenge in the health sector. Especially, when the world population is growing rapidly. That is why a quick-acting solution is needed, so that fewer people develop a mental disorder. The present study examines the relationship between memories and positive and negative emotions using memories of the first measurement moment of a 1-year longitudinal study in the Dutch population. The sample, consisting of 2065 participants (female 53%, male 47%) with an age range between 18 and 92 years (M age = 57.6; SD age = 16.4), had an over-representation of older adults. Participants were asked to describe three memories by using the Self-Defining Memory Test (SDMT). They reported the age of the memories, the extent of vividness as well as the intensity of emotions during the recollection. In total, they provided 6158 memories at the first measurement moment of the study. Their memories were reliably coded for valence and content. First, the relationship between the age of a memory and the evoked intensive emotions has been examined. Second, the relationship between vividness of a memory and the evoked intensive emotions has been studied. Then, a comparison of these relationships between the positive (N=2187) and negative valence (N=2266) of a memory was made. Finally, seven content categories of a memory have been compared to the extent of positive and negative emotions. The results showed that the intensity of emotions was not influenced by time as expected. Also after a long time, people felt intensive emotions during the recollection of a past event. Vivid memories, however, had a positive relationship with intensive emotions. Especially, positive emotions have been more intensive than negative ones, when the memory was described as vivid. Moreover, participants felt more positive about experiences of free time activities and more negative about experiences of health issues, in comparison to other content categories. To sum up, this study provides insight into the power of positive memories on positive emotions across time. Vivid memories seem to evoke more intensive emotions, whereas memories of free time activities in the past produce the most intensive positive emotions during the recollection. These results suggest that it is worth to study the effects of positive memories across time in order to create new techniques for the enhancement and maintenance of positive emotions. In that manner, mental health professionals can use this information to develop new techniques in order to prevent or treat mental disorders, so that the general population as well as the clinical population can benefit from it. Further research should take these findings into account.

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Introduction

More and more people suffer from a mental disorder like depression, anxiety disorder or post-traumatic stress-disorder (PTSD). Almost 25% of the world population are affected by a mental or neurological disorder during their life. But only a few get access to treatment programs. More specific, between 35% and 50% in high-income countries and up to 85% in low- and middle-income countries receive no treatment at all (World Health Organization, 2001). According to United Nations (2018), the world population has grown up to 7.6 billion (Worldometers, 2018). With the growth of 83 (1.09%) million people each year, estimates predict that the world population will reach 9.8 billion in 2050 (United Nations, 2017). As people get older, the probability of developing a mental disorder increases (Bricker, 2014; Hilger & Fischer, n.d.). Hence, the need for mental health treatment is increasing and creates a challenge in the health sector, especially in the future. That is why a quick-acting solution is needed, so that fewer people develop a mental health disorder.

It is known that the experience of positive emotions is strongly related to life satisfaction (Kuppens, Realo & Diener, 2008), however, many people complain that they are unsatisfied with their lives and say that they have no purpose (Kuppens, Realo & Diener, 2008). Especially people, who have experienced one or several traumatic events in their life, tend to live in their memories of the past rather living in the present. According to Felitti (2004) „time does not heal all wounds“. Bad experiences cause psychological distress and increase the risk for different kinds of diseases in the future (Bricker, 2014; Nakazawa, 2015). The more people focus on negative emotions, the more negative they feel. This could lead the affected person into a vicious cycle (Lyness, 2013). On the contrary, people who experience more positive emotions every day, tend to be happier and healthier. For them, it seems to be easier to cope with difficult situations which could be influenced by the awareness of problem solving options (Lyness, 2013). Hence, positive emotions are beneficial during the stages of recovery from negative experiences (Fredrickson, 2001). The question is, how can we enhance and maintain positive emotions?

One approach seems to be promising in finding a solution to this challenge. Positive psychology is a scientific approach that studies human thoughts, feelings and behavior and focuses on the future, strengths and resources of humans (Peterson, 2008; Tellis-James & Fox, 2016). According to this approach, positive emotions can produce flourishing. Hence, positive emotions can help to achieve psychological growth and to improve well-being over time (Fredrickson, 2001). Moreover, this approach suggests that positive qualities can be built on negative experiences (Tellis-James & Fox, 2016). For instance, research has shown that people

identified their strengths and resources built on negative experiences in the past (Tellis-James & Fox, 2016). The participants learned to understand and to accept their experiences. The findings of this study indicate that with the help of narratives, people can identify their own strengths and resources (Tellis-James & Fox, 2016). This example shows that people can learn to focus on positive aspects of their lives. In this matter, they are able to process their experiences and to gain positive emotions. Another study suggested that mental exercises (e.g. counting one's blessings) may benefit positive mood over time (Kennon & Lyubomirsky, 2007). All these techniques are based on experiences, which include the memories of past experiences. Moreover, these exercises can be performed in a clinical setting or at home by using a diary or (online) applications. Autobiographical recall may influence affective processing as well. Emotional information associated with the recalled event acts as a cue and guides subsequent information processing with spreading activations. Building on this effect, many studies employed autobiographical memory recall as a tool for mood induction (Lench, Flores, & Bench, 2011). Moreover, positive emotions seem to help in achieving psychological growth and well-being over time (Fredrickson, 2001). There is scientific evidence that positive psychology interventions are effective in increasing the quality of life. For instance, participants who have followed a training based on autobiographical memory, forgiveness and gratitude improved their memories and increased their life satisfaction (Ramírez, Ortega, Chamorro & Colmenero, 2014). Another research showed that online interventions like (1) *gratitude visit,* (2) *three good things* and (3) *using signature strengths in a new way* contributed to the increase of happiness (Proyer, Gander, Wellenzohn & Ruch, 2014). This means that the frequent use of these exercises can increase the quality of life. Due to the increasing population, technology might be a quick-acting and cost-effective solution. This option points out a way for new online interventions with the aim to increase positive emotions in both clinical and nonclinical populations (Quoidbach, Mikolajczak & Gross, 2015). Participants could make use of the online program with less guidance at any time they want. They would only need to use the memories of their past. In that way, they could enjoy their positive experiences more often. That is why it is important to investigate the effect of memories on emotions further.

Aims and objectives. The present research focuses on the impact of memories on positive and negative emotions in the Dutch population. The aim of the study is to illustrate which memories trigger intensive emotions. In order to investigate the relationship between different kinds of memories and the evoked positive and negative emotions, the following research question was formed: *Which memory characteristics are related to positive and negative emotions?*. On the one hand, this research can contribute to the literature on autobiographical

memory and intensive emotions by delineating how memories relate to positive and negative emotions over time. On the other hand, the results can help to understand what kind of memories evoke the most intensive positive emotions and benefit the mental health of the clinical and general population. These information can contribute to the development of new techniques for online interventions that use positive memories to enhance and maintain positive emotions over time.

Research question: *Which memory characteristics are related to positive and negative emotions?*

Theoretical framework

Autobiographical memory. Narratives are constructed through autobiographical reasoning (D'Argembeau, Cassol, Phillips, Balteau, Salmon & Van der Linden, 2014). Autobiographical reasoning is described as temporary mental constructions that contains information about personal experiences in the past (Conway, 2000, Sicking, 2014; Conway et. al (2004). These memories have some characteristics which include vividness, emotional valence and intensity, time and visual perspectives, coherence, sensory detail, distancing and accessibility (Sutin & Robins, 2007). People try to understand themselves and the world with the help of autobiographical memories (Kenyon & Randall, 1997). They use these memories in order to generate a coherent sense of narrative identity (Lieblich & Josselson, 1997; Habermas & Bluck, 2000; Bluck, 2003; Wilson & Ross, 2003; Singer, 2004). This process relies on positive and negative emotional memories (Wood & Conway, 2005; 2006).

Self-defining memories. According to Conway (2005) memories are constructed through specific personal experience about ourselves. All memories, that show who a person is and how he or she has become this way, are called "self-defining memories" (Habermas & Bluck, 2000; Pasupahti, Mansour & Brubaker, 2007) and represent a subcategory of autobiographical memories (Addis, 2011). Self-defining memories can be recalled, both wittingly and unwittingly (Singer & Salovey, 1993). These kinds of memories are vivid and filled with sensory detail. They are formed by important life events that contribute to the sense of identity (Singer & Salovey, 1993; Conway 2005; Lardi, D'Argembeau, Channel, Ghislette & Linden, 2010; Oosterwechel, 2014; Sicking, 2014) and evoke intensive emotions at the time of recollection (Blagov & Singer, 2004). In addition to that, they are related to the meaning of life

given by the individual (Conway, Singer & Tangini, 2004; Conway, 2005) and play an important role in emotion regulation processes and in achieving well-being (King, 2000).

Emotional memories. During autobiographical memory recollection, people often experience emotions and remember their emotions of the past event. For instance, a young man could experience a sense of pride when recalling his graduation and might remember the feelings of happiness at the time. These current emotions can be experienced as moderate or high intensive (Singer & Moffitt, 1991). If positive memories are used frequently to define the self, it can be described as the "personality positivity" (Liao, Bluck & Westerhof, 2018). Personality positivity refers to a trait that reflects the differences in positive emotional experience. Individuals with lower levels of positive affectivity seem to feel more sadness and distress. On the other hand, individuals with higher levels of positive affectivity seem to be more cheerful, enthusiastic and energetic (Fredrickson, 2001; 2013). That means that these people feel more positive in general (Lyness, 2013). This trait is known to have a positive effect on the daily life. That means, if people remember positive events more often, it can contribute not only to more positive emotions in everyday life. It can also influence the creativity and broaden the thought-action repertoire of the individual. Moreover, personality positivity can help to improve health by building personal resources. Fredrickson (2001) refers to the broaden-and-build model of positive emotions that helps to gain more insight into the functioning of positive emotions. According to this theory, positive emotions have an impact on the creativity and the thought-action repertoire. In this manner, the individual learns more through different situations and builds more personal resources (knowledge, skills, social support) that can help to increase life satisfaction and to cope with difficult situations (Fredrickson, 2001).

In the current research, the term "intensity of emotions" is used to describe the extent to which participants experienced emotions during the recollection. These feelings can be negative or positive, depending on the past events which were primarily negative or positive in their valence (Moffitt & Singer, 1994). Moreover, these emotional reactions depend on current goals and concerns of the individual (Wood & Conway, 2006). On the other hand, people are able to create vivid and longer lasting memories when they feel emotional attached to a past event (Mackay, Shafto, Taylor, Marian, Abrams & Dyer, 2004; Psychologist world; n.d.).

Characteristics of memories. Self-defining memories are characterized in four dimensions: specificity, meaning, content and affect (Blagov & Singer, 2004). The current study has focused on the dimensions "content" and "affect", whereas the types of events in memories and the emotion during the recall have been studied. Moreover, the study made use of additional information, including emotional valence and intensity as well as vividness and

age of memory ("time"), to learn more about the types of memories which trigger intensive emotions. Figure 2 illustrates all characteristics of the memories and their relationships that are examined in this study. In this research it is assumed that the intensity of positive and negative emotions is influenced by the content, vividness and the age of the memories. Furthermore, the valence of a past event plays an important role in the concept. These characteristics were explored because they might help to get more insight into which memory characteristics of memories are related to intensive positive and negative emotions.

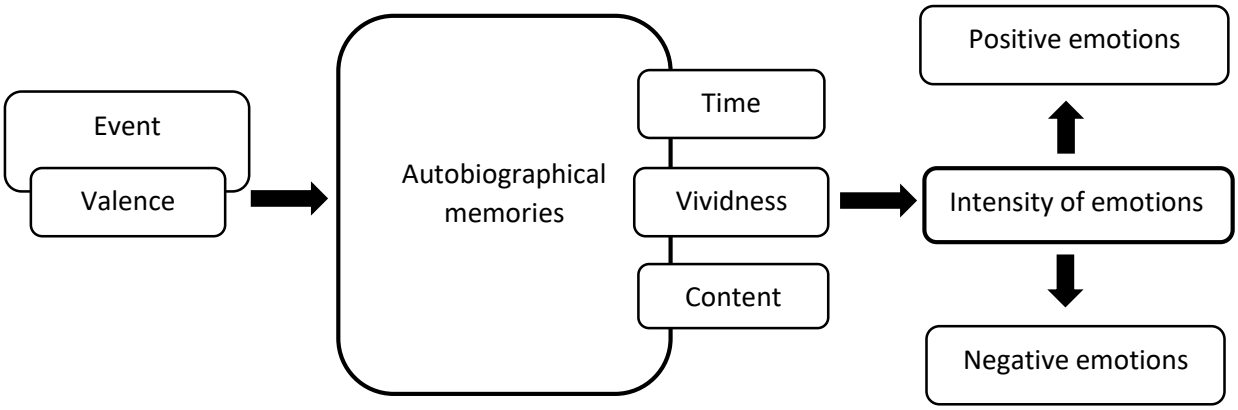

Figure 2. The characteristics of the memories used in the current study

Current study

In order to gain knowledge into which memory characteristics are related to positive and negative emotions the study has focused on six specific hypotheses. According to Bhandari and Wagner (2006), the time between the event and its memory has an impact on the accuracy of the memory. In other words, people are more likely to forget the details of the past event over time. The findings of their research suggested that the accuracy of the details decreases, the more time passes by. However, events which were experienced as traumatic, were easier to remember than neutral events (Bhandari and Wagner (2006). This means, that people forget the details of an experience over time, when the memory is not linked with strong emotions. In other words, people remember more details, when the event was experienced recently. For example, research has shown that people remember the items at the end of a list better than the rest (Kowalczyk, 2018). This memory bias is defined as the "recency effect" (Nugent, 2013; Kowalczyk, 2018). Based on these information, the first hypothesis "*People experience more intensive emotions when the remembered events are more recent (H1*)" was formed.

The second hypothesis "*The relation between time and intensive emotions is different for positive and negative memories (H2)*" was based on the "fading affect bias" (FAB). This term states that emotional intensity which is associated with memory recall of pleasant events generally fades more slowly across time than the emotional intensity associated with memories of unpleasant events (Ritchie, Skowronski, Hartnett, Wells & Walker, 2009). In other words, the negative affect fades faster across time (Ritchie, Skowronski, Wood, Walker, Vogl & Gibbons, 2006).

Another research has shown that depressed individuals have difficulties to recall positive memories (Moore, Watts, & Williams, 1988; Williams & Broadbent, 1986; Blagov & Singer, 2004). The reason is that they need more time to remember positive and negative events from their past. Moreover, they recall less specific details, especially of positive events, and remember some sequences rather than single episodes (Dalgleish & Kuyken, 1995; Williams & Scott, 1988). Research has also shown that emotional memories have an impact on how vivid we will recall the details. Moreover, it is more likely that the memory will be stored long-term (Gregoire, 2015). In order to examine whether participants of the current study feel more intensive emotions when the memories are experienced as vivid, the third hypothesis "*People experience more intensive emotions, when their memories are more vivid (H3)"* was formed.

In addition to that, the fourth hypothesis *"The relation between vividness and intensive emotions is different for positive and negative memories (H4)"* was formed in order to get more insight into the relationship between the extent of vividness and intensive emotions based on the valence of past events.

Finally, to find an answer to what kind of memories trigger more intensive positive emotions, the last two hypotheses were formed. They focus on the content of the memory, associated with more positive or more negative emotions. Some studies investigated automatic pre-attentive processes of people by using eye tracking devices. The findings of these studies revealed that when participants saw an emotional (positive or negative) picture next to a neutral one, they first looked at the emotional picture. These results indicate that people are attracted by emotional information rather than neutral ones **(**Steinmetz & Kensinger, 2010). Based on these information the fifth hypothesis "*People experience more intensive emotions, depending on the content of the memory (H5)"* and the sixth hypothesis "*The intensity of emotions is different for positive and negative memories, depending on the content of the memory (H6)"* were formed.

Hypothesis 1: People experience more intensive emotions when the remembered events are more recent.

Hypothesis 2: The relation between time and intensive emotions is different for positive and negative memories.

Hypothesis 3: People experience more intensive emotions, when their memories are more vivid.

Hypothesis 4: The relation between vividness and intensive emotions is different for positive and negative memories.

Hypothesis 5: People experience more intensive emotions, depending on the content of the memory.

Hypothesis 6: The intensity of emotions is different for positive and negative memories, depending on the content of the memory.

Method

Design

The research is part of the Longitudinal Internet Studies in the Social Sciences (LISS) panel, administered by CentERdata in the Netherlands. This longitudinal design consists of three measurement moments which took place within one year (t1 = May 2012; t2 = November 2012; t3= May 2013). This part of the research will focus on the first measurement moment (t1).

Participants

The participants were randomly selected from the Dutch municipality registers in cooperation with Statistics Netherlands. With 5000 households (more than 11.000 individuals), the panel is a good representation of the Dutch population, especially for the elderly people above 55 years (65.3%). The majority of the sample (86.5%) was of Dutch origin. For the participation, computers with internet access were provided, so that the participants could complete the online surveys. One person from each household was asked to participate in this study, whereas 3076 participants took actually part. Due to the fact that not every person, who had been asked, filled in three memories or participated in all three measurement moments or at all, this research sample consists of 2065 participants (female 53%, male 47%) with an average age of 57.6 (SD = 16.4). While 55.5% of the participants were married, 41.4% received a lower level of education (29.6% intermediate level and 28.6% higher level). With a total number of 6158 memories, the sample provided 2187 positive and 2266 negative memories (appendix C).

Inclusion/ exclusion criteria

All participants were required to be at least 18 years old and to be a citizen of the Netherlands with adequate Dutch language skills. Participants, who haven't provided any memories or haven't filled in all the questions about the vividness of their memories and their current emotions, were excluded from this research.

Table 1. Demographical data of the participants (N= 2065)

Demographics	**N**	**%**
Age		
15 – 24 years	89	4.3
25 – 34 years	157	7.6
35 – 44 years	223	10.8
45 – 54 years	247	12.0
55 – 64 years	525	25.4
65 +	824	39.9

Gender		
male	971	47
female	1094	53
Civil status		
married	1146	55.5
separated	13	0.6
divorced	252	12.2
widow or widower	238	11.5
never been married	416	20.1
Level of education*		
low level	855	41.4
intermediate level	611	29.6
high level	591	28.6
Origin		
Dutch background	1786	86.5
Foreign background	242	11.7

*Note. *low level = primary school; vmbo [intermediate secondary education], intermediate level = havo/vwo [higher secondary education/preparatory university education]; mbo [intermediate vocational education], high level = hbo [higher vocational education]; wo [university]*

Instruments and procedure

Self-defining Memory Task (SDMT). This instrument instructs the participants to recall a self-defining memory with five attributes: vividness, emotions, repetitive recall, importance and connection to other memories (appendix A). The instructions were as follows:

"*When we describe to other people who we are, we often tell something about our past. We would like to ask you to describe some personal memories that show who you are. These are memories that are very characteristic for you as a person. What type of memories are we asking about? They are personal memories that are important to you. They vividly come to your mind. They evoke strong positive or negative feelings. You will often have thought about them. We would like to ask you to describe three memories of this type which are at least 1 year old." (Blagov & Singer, 2004).*

Emotion. To assess the extent to which participants experience emotions during the recall of their memories, two questions were used: "*How positive do you feel about this memory?*" and "*How negative do you feel about this memory?*". Participants rated the intensity of emotions (1 = not at all, 6 = very much) while remembering the specific event in the past.

Time. To get information about the age of the memory, participants were asked one

question: "*How many years ago happened the remembered event?*". The memory of the event should have been at least one year old.

Vividness. To assess the vividness of each memory, the participants were asked the following question: "How vivid is this memory for you?" and rated the memory (1= not at all, 6 = very much) how vivid it felt in present time.

Content. To assess the content of each memory, the coder categorized the narratives in 7 codes: (1) social relations; (2) school, education, study and job; (3) free time activities; (4) health; (5) property and history; (6) specific period in life; and (7) other (table 2) (Westerhof, 2013). Two coders used 50 narratives from a pilot study in the LISS panel for training (Liao, Bluck & Westerhof, 2018). One of the coders coded all memory narratives for the event valence and content. The coding scheme of the content of the memories is presented in table 2. The inter-coder reliability was good (Cohen's kappa = .86).

Table 2. Coding scheme of the content of memories (Westerhof, 2013)

Code	**Content**
1. Social relations	Meeting partner, wedding, childbirth, divorce, activities with others, life of children and grandchildren, illness or death of others etc.
2. School, education, study, job	Experiences at school, university, exams, first job, work experience, dismissal, pension etc.
3. Free time activities	Hobbies, sports, free time, birthday, parties, Christmas etc.
4. Health	Illness, accident etc.
5. Property and history	Money, finances, buying materials, objects (e.g house), moving to a new location, poverty, war etc.
6. Specific period in life	Childhood, puberty, young adulthood, etc.

7. Other	This code is only used when the content is not clear.

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Valence. To assess valence for each memory, the coder categorized the narratives as positive, neutral or negative (table 3). Memories representing birth, wedding or achievements were coded as positive. Events like illness, divorce or death were coded as negative. Descriptions of memories that were clearly without evaluation were coded as neutral (Westerhof, 2013). The inter-coder reliability was good (Cohen's kappa = .85).

Table 3. Coding scheme of the valence of memory (Westerhof, 2013)

Code	**Event**
Positive event or period	wedding, birth, becoming parents or grandparents, activities (e.g. vacation), achievements (e.g. exams, diploma) etc.
Neutral event or period	moving to a new location, retirement etc.
Negative event or period	illness, accident, divorce, death etc.

At the first moment of measurement (t1), participants needed to fill in the questionnaire about socio-demographics. Then, they were asked to provide three self-defining memories by carrying out instructions (appendix A). Participants provided three memories by writing a short caption to describe the specific memory and a memory narrative to describe the memory in much detail. Moreover, they explained why these memories are contributing to their identity. After that, they rated the extent to which they experience positive, neutral and negative emotions for each memory. Finally, they provided the age of each memory and rated how vivid the memory still is.

Data Analysis

Before starting the analysis, the data set had been prepared in SPSS. Only the first measurement moment was relevant for this part of the research. So, only data related to the six hypotheses had been used. The variables *intensity of positive and negative emotions*, *time*, *vividness*, *content* and *valence* were listed for every memory. Each of them had been merged together in one variable. At the beginning, descriptive statistics were conducted to analyze the data and create an overview of the sample (table 1). Also, the frequency of the variables *positive and*

negative intensive emotions, vividness and valence (table 4) have been examined in order to create an overview of the vivid and emotional memories divided into the three valence categories (positive, neutral and negative). Then, the first four hypotheses were tested by using correlational analyses.

First, to investigate whether people experience more intensive emotions when the remembered events are more recent (H1), two two-sided Spearman's rank order correlations were computed, one for positive and one for negative emotions. For these analyses, the variables *time* (in years) and the *intensity of positive and negative emotions* were used. In addition to that, another four two-sided Spearman's rank order correlations were computed in order to examine whether the relation between time and intensive emotions is different for positive and negative memories (H2). To measure the first two strengths of association, only the *positive valence* was selected and the variables *positive and negative intensive emotions* and *time* have been used for the analyses. After that, only the *negative valence* was selected with the same variables. Then, the four correlation coefficients were compared. Moreover, to study whether people experience more intensive emotions, when their memories are more vivid (H3), two two-sided Spearman's rank order correlations were computed, one for positive and one for negative emotions. For these analyses, the variables *vividness* and the *intensity of positive and negative emotions* were used. Additionally, another four two-sided Spearman's rank order correlations were computed in order to figure out whether the relation between vividness and intensive emotions is different for positive and negative memories (H4). To measure the first two strengths of association, only the *positive valence* was selected and the variables *vividness* and *positive and negative intensive emotions* have been used for the analyses. Then, only the *negative valence* was selected with the same variables. Furthermore, to explore whether people experience more intensive emotions, depending on the content of the memory (H5), two one-way analyses of variance (ANOVA) with a significance level of .05 were conducted. These analyses were used to determine whether there are any significant differences between the means of the seven content categories. To compare the extent of positive emotions between the seven content categories of the memory, *intensity of positive emotions* was used as the dependent variable and *content* as the factor. For the second analysis, the variable *intensity of negative emotions* was used as the dependent variable. Finally, in order to test whether the intensity of emotions differs between positive and negative remembered events, depending on the content of the memory (H6), two one-way analyses of variance (ANOVA) with a significance level of .05 were conducted. These analyses were used to determine whether there are any significant differences between the means of the seven content categories, when only

one valence type is selected. To compare the differences in the extent of intensive emotions between the content categories while a positive or a negative valence have been selected, the same variables have been used as for the fifth hypothesis.

For the reason that the first four hypotheses were analyzed by correlational analyses, the correlational criteria need to be discussed in order to clarify when a hypothesis can be supported or rejected. The correlation coefficients can vary from a perfect negative or positive linear relationship ($r = -1$ or 1) to no relationship at all ($r = 0$) (Hinkle, Wiersma & Jurs, 2003; Statistics Solutions, 2013). A correlation coefficient of .70 to .90 represents a high correlation and above .90 a very high correlation. A correlation coefficient of .50 to .70 represents a moderate correlation, whereas a coefficient of .30 to .50 represents a low correlation. Less than .30 can be considered as a negligible correlation (Hinkle, Wiersma & Jurs, 2003) (appendix B). Based on these criteria, the first four hypotheses will be supported by a correlational coefficient of .30 to 1.00, because the big sample size makes it more likely to find significant results. On the contrary, the last two hypotheses will be supported by a significance level of $p<.05$.

Results

In this research 2065 participants provided three memories at the first measurement. While everyone described the first memory, less participants have written down a second (N=2049) and a third one (N=2045). In total, they provided 6159 memories, whereas 35.5% were memories of positive events and 36.7% were coded as negative (table 4). 11.9% of the memories could not be coded with the help of the coding scheme or were missing. Table 4 shows that almost 70% of all coded memories were rated as more vivid (>4 on a scale from 1 to 6), whereas participants reported more positive and negative vivid memories than neutral ones. Moreover, the most intensive positive emotions were evoked by memories of positive events and the most intensive negative emotions by negative events. Overall, participants felt more intensive positive emotions during the recall of 3114 memories (57.4%). On the contrary, only 816 reported memories (15%) evoked intensive negative emotions. These results show that valence plays a role in how vivid and emotional the memories are experienced.

Table 4. Overview of the vivid and emotional memories divided into three valence types

	Memories		**Intensity of emotions****	
Valence*	**N (%)**	**Vividness****	**Positive emotions**	**Negative emotions**
Positive events	2187 (35.5)	1643	1902	52
Neutral events	975 (15.8)	601	574	100
Negative events	2266 (36.7)	1515	638	664
Total	5428 (100)	3759 (69.3)	3114 (57.4)	816 (15.0)

Note. *missing value or valence not coded (N=731; 11.9%)

**vividness of the memories and intensive emotions rated on the scale > 4 (1 = not at all, 6 = very much)

Hypothesis 1: *People experience more intensive emotions when the remembered events are more recent.*

Two Spearman's rank order correlations were computed to assess the relationship between the intensity of positive and negative emotions and the time between the measurement and the remembered event. An overview of all correlations is presented in table 5. There was a significant positive, but too weak correlation between the variables *time* and *positive intensive emotions* [r = .103, n = 6159, p<.001] and between *time* and *negative intensive emotions* [r = .051, n = 6159, p<.001]. This means that a negligible relationship was found between time and

intensive (positive and negative) emotions. However, according to the criteria of Hinkle, Wiersma and Jurs (2003), the first hypothesis could not be supported because the correlation coefficients are less than .30.

Hypothesis 2: *The relation between time and intensive emotions is different for positive and negative memories.*

Additionally, four Spearman's rank order correlation were computed, but this time only the data of one valence type (positive or negative) was selected. When the positive valence was selected, no significant correlation was found between *intensive positive emotions* and *time* [r = -.013, n = 2187, p=.267] and between *intensive negative emotions* and *time* [r = -.016, n = 2187, p=.448]. When the negative valence was selected, a significant negative, but too weak correlation was found between *intensive negative emotions* and *time* [r = -.076, n = 2266, p<.001]. No significant correlation was found for *intensive positive emotions* and *time,* when negative valence was selected [r = -.019, n = 2266, p =376] (table 5). These results indicate that there is no relationship between time and intensive positive and negative emotions when only one valence type is selected. Besides, there is not a big difference between the correlation coefficients for positive and negative memories. Moreover, both correlation coefficients are under .30. That is why the second hypothesis was rejected.

Hypothesis 3: *People experience more intensive emotions, when their memories are more vivid.*

Another two Spearman's rank order correlation were computed to assess the relationship between the intensity of positive and negative emotions and the vividness of the memory. The results can be found in table 5. There was a significant weak positive correlation between the two variables *vividness* and *positive intensive emotions* [r = .442, n = 6159, p<.001] and a significant positive, but too weak correlation between *vividness* and *negative intensive emotions* [r = .045, n = 6159, p<.001]. These results suggest that there is a negligible relationship between vivid memories and negative intensive emotions, and a weak relationship between vivid memories and intensive positive emotions. That means that the more vivid a memory is, the more positive intensive emotions are evoked. In other words, people experience more intensive positive emotions when their memories are more vivid. Based on these results the third hypothesis was supported.

Hypothesis 4: *The relation between vividness and intensive emotions is different for positive and negative memories.*

In addition to that, more correlational analysis were conducted in order to analyze the relationship between vividness and intensive emotions, but this time only the data of one valence type (positive or negative) was selected. When the positive valence was selected, a significant moderate positive correlation was found between *intensive positive emotions* and *vividness* [r =.597, n = 2187, p<.001] and a significant negative, but weak correlation was found between *vividness* and *intensive negative emotions* [r = -.236, n = 2187, p<.001]. When the negative valence was selected, a significant positive, but weak correlation was found between *negative intensive emotions* and *vividness* [r =.143, n = 2266, p< .001] (table 5). No significant correlation was found between *vividness* and *intensive positive emotions*, when the negative valence was selected [r = -.016, n = 2266, p=.445]. These results indicate that there is a moderate relationship between vividness and intensive positive emotions evoked by positive events. This means that the more vivid the memory of a positive event is, the more intensive positive emotions are evoked. Because the other correlation coefficients are under .30, they indicate a negligible relationship between the variables when only one valence type is selected. The findings show that the relation between vividness and intensive emotions is different for positive and negative memories. That is why the fourth hypothesis was supported.

Table 5. Overview of the correlations between the intensity of positive and negative emotions, vividness, time and valence.

Spearman's correlation (2-tailed)	Intensity of emotions	
	Positive emotions	Negative emotions
Time (N=6159)	.103*	.051*
Positive valence (N=2187)	-.013	-.016
Negative valence (N=2266)	-.019	-.076*
Vividness (N=6159)	.442*	.045*
Positive valence (N=2187)	.597*	-.236*
Negative valence (N=2266)	-.016	.143*

Note. *p< .001

Hypothesis 5: *People experience more intensive emotions, depending on the content of the memory.*

A one-way ANOVA was conducted to compare the extent of emotions between the different content categories. All results of this analysis are presented in table 6. There was a statistically significant difference between the content categories for positive intensive emotions [F(6, 5421) = 50.823, p<.005] as well as for negative intensive emotions [F(6, 5421) = 56.745, p<.005]. Post hoc comparisons using the Tukey HSD test indicated that the mean scores for the categories *health* (M= 3.5, SD = 1.7) and *free time activities* (M = 4.96, SD = 1.3) were significantly different from the rest (p<.005). However, the other categories *social relations, school, education, study, job, property and history, specific period of time* and *other* did not significantly differ from each other. The mean scores indicate that memories about free time activities evoke the most intensive positive emotions and memories about health the least intensive positive memories. Taken together, these results suggest that content of the memories does have an effect on intensity of emotions. Based on these results, the fifth hypothesis was supported.

Table 6. Analysis of variance (ANOVA) between the content of all memories and the related intensive emotions

Content	**Positive emotions***	**Negative emotions****	
	Mean (SD)	**Mean (SD)**	**N**
Social relations	4.12 (1.8)	2.54 (1.7)	2390
School, education, study, job	4.33 (1.6)	2.31 (1.5)	806
Free time activities***	4.96 (1.3)	1.64 (1.2)	1111
Health***	3.50 (1.7)	3.03 (1.7)	391
Property and History	3.93 (1.8)	2.57 (1.7)	448
Specific period in life	4.27 (1.7)	2.33 (1.6)	205
Other	4.47 (1.6)	2.38 (1.6)	77
Total	4.27 (1.7)	2.35 (1.6)	5428

Note. * F(6, 5421) = 50.823, p< .005; **F(6, 5421) = 56.745, p<.005

*** Tukey HSD analysis shows the means for groups in homogeneous subsets: "free time activities" (M=4.96, SD=1.3) form one group with the highest score and "health" (M=3.5, SD=1.3) with the lowest score for positive emotions (p<.005). For negative emotions, it is the other way round: "free time activities" (M=1.64, SD=1.2) form one

group with the lowest score and "health" (M=3.03, SD=1.7) with the highest score (p<.005). No significant difference was found or the rest.

Hypothesis 6: *The intensity of emotions is different for positive and negative memories, depending on the content of the memory.*

On the one hand, a one-way ANOVA was conducted to compare the extent of emotions between the different content categories coded with a positive valence. All results of this analysis are presented in table 7. There was a statistically significant difference between the positive-coded content categories for positive intensive emotions [F (6, 2180) = 4.695, p< .001] as well as for negative intensive emotions [F (6, 2180) = 2.925, p<.05]. Post hoc comparisons using the Tukey HSD test indicated that the mean scores of positive emotions for the positive-coded categories *property and history* (M = 5.11, SD = 1.2), *school, education, study, job* (M = 5.23, SD = 1.0) and *health* (M = 6.0, SD = 0.0) were significantly different from the rest (p<.001). However, the other categories *social relations*, *free time activities*, *specific period of time* and *other* did not significantly differ from each other. Furthermore, the mean scores of negative emotions for the positive-coded categories were not significantly different from the rest. Taken together, these results suggest that participants felt the most intensive positive emotions when they thought about their health, followed by memories about social relations and free time activities (table 7).

On the other hand, another one-way ANOVA was conducted to compare the extent of emotions between the different content categories coded with a negative valence. The results are presented in table 8. There was a statistically significant difference between the negative-coded content categories for positive intensive emotions [F(6, 2259) = 5.097, p<.001] as well as for negative intensive emotions [F(6, 2259) = 3.77, p<.005]. Post hoc comparisons using the Tukey HSD test indicated that the mean scores of negative emotions for the negative-coded categories *free time activities* (M = 2.89, SD = 1.7), *other* (M = 3.03, SD = 1.6), *health* (M = 3.13, SD = 1.7), *social relations* (M = 3.33, SD = 1.7) and *specific period of time* (M = 3.84, SD = 1.7) were significantly different than the rest (p<.001). However, the other categories *property and history* and *school, education, study, job* did not significantly differ from each other. Taken together, these results suggest that participants felt the most intensive negative emotions when they thought about a specific period of time, followed by memories about property and education (table 8).

These findings show that there is a difference in the extent of positive and negative

emotions between the content categories. Based on these results, the sixth hypothesis was supported.

Table 7. Analysis of variance (ANOVA) between the content of positive memories and the related intensive emotions

	Positive valence		
	Positive emotions*	**Negative emotions****	
Content	**Mean (SD)**	**Mean (SD)**	**N**
Social relations	5.47 (0.9)	1.32 (0.8)	830
School, education, study, job	5.23 (1.0)	1.53 (0.9)	296
Free time activities	5.32 (1.0)	1.36 (0.9)	841
Health	6.00 (0.0)	1.00 (0.0)	5
Property and History	5.11 (1.2)	1.42 (0.9)	106
Specific period in life	5.34 (0.9)	1.43 (0.9)	77
Other	5.34 (1.1)	1.66 (1.4)	32
Total	5.35 (0.9)	1.38 (0.9)	2187

Note. * $F(6, 2180) = 4.695$, $p < .001$; **$F(6, 2180) = 2.925$, $p < .05$

Table 8. Analysis of variance (ANOVA) between the content of negative memories and the related intensive emotions

	Negative valence		
	Positive emotions*	**Negative emotions****	
Content	**Mean (SD)**	**Mean (SD)**	**N**
Social relations	3.21 (1.8)	3.33 (1.7)	1308
School, education, study, job	2.81 (1.6)	3.49 (1.7)	219
Free time activities	3.23 (1.8)	2.89 (1.7)	99
Health	3.39 (1.7)	3.13 (1.7)	348
Property and History	2.94 (1.7)	3.53 (1.7)	208
Specific period in life	2.39 (1.5)	3.84 (1.7)	51
Other	3.45 (1.6)	3.03 (1.6)	33
Total	3.16 (1.7)	3.32 (1.7)	2266

Note. * $F(6, 2259) = 5.097$, $p < .001$; **$F(6, 2259) = 3.77$, $p < .005$

Discussion

Findings. The current investigation focused on investigating how vividness, content and age of a memory might relate to the intensity of positive and negative emotions while remembering a past event.

Recency. It was expected that people experience more intensive emotions when the remembered events are more recent (H1). Although the associations between time and the intensity of emotions have been significant, according to the correlational criteria of Hinkle et al. (2003) the correlations were too weak. With regard to this, the first hypothesis was not supported, which means that also very old memories can still evoke intensive emotions. Second, the relation between time and intensive emotions was compared between positive and negative memories (H2). Also the second hypothesis was rejected because no big difference between the correlation coefficients for positive and negative memories was found.

Continuity effect. As the results show, time was not related to emotions as expected. The participants reported no less intensive emotions during the recollection of a very old memory. That means that time can preserve an emotional memory including the evoked emotions. Thus, the findings are in line with Felitti (2004) who stated that, also after a long time, emotions can be preserved. These results indicate that the age of a memory is not as important as the type of a memory (e.g. vividness, valence and content).

Time estimates. In addition, the time between the event and the memory plays another role in this research. Intensive emotions of the participants could distort the time estimates of the remembered event during the recall. For instance, people diagnosed with depression or an anxiety disorder might feel that time passes more slowly. In other words, individuals who are anxiously waiting for something, might experience time passing slowly. On the other hand, time flies when people are having fun (Droit-Volet, 2013). On top of this, as people get older, time seems to pass faster. For instance, summer goes quite fast for a 50-year-old adult, but it seems to be a long time for a child. This could be explained by the idea that time tend to speed up with familiarity. For older people, things become more familiar, which means that daily routine makes experiences less intensive (Burdick, 2017). It is possible that the estimates for the age of the memories were biased by a mental health disorder or the age-related time experience of the participants.

Fading affect bias. Another explanation for this phenomenon could be the "fading affect bias" (FAB). According to prior research, which examined the effects of retention intervals on the recollection of emotional content of events, ratings of pleasantness or unpleasantness of an event became less extreme as the retention interval increased. Especially, the effect for

unpleasant events was larger than for pleasant events (Walker, Vogl & Thompson, 1997). The findings of the present study are in line with the research of Walker et al. (1997). Because the correlations were not high enough to support the hypothesis, it can be suggested investigating this in further research.

Vividness. It was expected that people experience more intensive emotions when the memories are more vivid (H3) and that the relation between intensity of emotions and vividness is different for positive and negative memories (H4). The findings have demonstrated that the vividness of the memory can be related to the intensity of emotions. Only a weak relationship between vividness and intensive positive emotions was found. That means that the more vivid a memory is, the more positive intensive emotions are evoked. Moreover, the correlation between vividness and positive intensive emotions was higher than the correlation of negative intensive emotions. These findings indicate that the relation between vividness and intensive emotions is different for positive and negative memories. That is why the third and fourth hypotheses were supported.

A robust body of previous research has shown that the more emotional impact a memory has, the more vividly we will recall its details and the more likely it will be stored in long-term memory. Even though people tend to forget most details of an event, however, new findings have shown that emotional events can selectively preserve memory for previously encountered information that seemed insignificant at the time (Gregoire, 2015). This could explain, why participants of the current research felt more intensive emotions while having vivid memories of past events.

Positivity affect bias. Another explanation for these results could be that personality traits of the participants could have influenced the recollection of the past events during the current research (Nauert, 2012). In that case, the results could be explained by the positivity affect bias (or positivity affectivity). In fact, people with higher levels of positivity affectivity are happier than people with lower levels (Fredrickson, 2001). Thus, they experience more positive emotions. Because this research did not focus on personality traits of the participants, this bias cannot be excluded.

Content. Furthermore, it was expected that people experience more intensive emotions, depending on the content of the memory (H5) and that there is a difference in the intensity of emotions between positive and negative memories, depending on the content of the memory (H6). The last two analyses has shown that there was a significant difference between the content categories in the intensity of emotions. The results indicated that, in comparison to the other categories, “free time activities” and “health” had a significant difference in mean scores.

The other categories formed one homogeneous group and showed no significant differences. To sum up, these results suggest that content can influence the intensity of emotions. More specific, the results suggest that when humans are remembering free time activities of their past, they feel more positive emotions and when they are remembering their health problems, they feel more negative emotions. That means that the fifth hypothesis was supported. In addition to that, the sixth hypothesis was supported because a difference in the intensity of emotions between positive and negative memories was found. Participants felt more intensive positive emotions when they thought about their health, social relations and free time activities. On the contrary, they felt more intensive negative emotions when they thought about a specific period of their life, their property and education.

These information indicate why there are differences in the intensity of emotions regarding the seven categories of the content. For example, the findings suggest that the category "free time activity" was associated with more positive emotions than the other six categories. People seem to associate this term with positive memories, which trigger positive emotions automatically. According to previous research, enjoyable leisure activities were associated with higher levels of positive psychosocial states, lower levels of depression and negative affect. Moreover, people who reported doing more leisure activities, gained beneficial effect regarding their physical health (e.g. lower blood pressure, cortisol level and body mass index) (Pressman, Matthews, Cohen, Martire, Scheier, Baum & Schulz, 2009). When people were remembering incidents (e.g. illness and accidents) from the category "health", they reported more negative emotions. The results show that this category was associated with more negative emotions than the other six categories. An explanation for this could be that people tend to remember negative events regarding their health, because it is easier to recall health issues which are associated with intensive negative emotions. Furthermore, the coding scheme presented in table 2 shows that the category "free time activities" summarizes only positive events and "health" only negative events. Besides, it is common sense that people do not have the tendency to feel positive about their health issues. That is why it is understandable that participants experienced coherent emotions regarding these two categories. These findings can be used to support interventions with the focus on enhancement of positive emotions by using positive memories.

Emotions. Together, these findings suggest that intensive emotions can be related to vivid memories, especially in the context of free time activities, social relations and health.

Strengths and limitations

First, this research provides a big sample size representing the Dutch population with more than 6000 memories. As a matter of fact, people without an access to the online survey got the chance to take part in the study because computers with Internet access have been provided. Therefore, a large number of people could be reached in order to collect the data for the research. Moreover, the participants could choose the time and length of their participation because they could fill in the questionnaires at any time at home. Besides, the data were collected in a familiar environment of the participants, which increases the ecological validity of the results because the study has been conducted in a real-world scenario (Paljic, 2017). Finally, the memories were coded by two raters, which resulted in good inter-rater reliability (Blagov & Singer, 2004). Even though the current research was part of a longitudinal study, there were less disadvantages of the design because this research had focused on the first measurement (t1).

On the other hand, there are some limitations. First, the focus of the study was to investigate the relationship between the variables. In that case, no conclusions of causality can be made. Second, the sample represents the Dutch population, but with a higher number of elderly people. That means the results can be generalized only for older people. Because the participants filled in the questionnaires at home without being observed by a researcher, the self-reported data cannot be verified and many could have been biased by unknown influences (USC Libraries, 2018). In fact, there are some bias that could occur during the research.

First, participants could have problems with remembering experiences that occurred at a particular time in the past, also known as "selective memory" (USC Libraries, 2018). Another bias that could have been occurred is called "telescoping". The telescoping bias refers to the displacement of one remembered event that has occurred at one particular time, but is perceived as it has occurred at another time (Janssen, Chessa & Murre, 2006). For example, events could have been perceived as being more distant or more recent than they actually are. If these two biases have occurred in the present study, then they would have influenced the time factor and make the data unreliable.

Moreover, the collected data of the present study could be influenced by mental health problems or mood congruence. The mood congruence states that people have less problems to remember events that match their current mood. For example, depressed patients tend to remember negative childhood memories and have a better memory for negative events in general (Peak Wellbeing, 2016). However, that also means, if people are in a good mood, they tend to remember positive memories. This shows that mood, which was not measured in the present study, can influence the remembered event valence. Other studies investigated the effects of the

mood congruence theory. For instance, Tesoriero and Rickard (2014) examined the effect of mood congruence on the short-term recollection of positive and negative information about song narratives. Their findings strongly supported this effect. In the current study, participants remembered more positive than negative memories. According to the mood congruence theory, this could mean, that the current sample was mostly in a good mood during the first measurement. Due to that, the participants remembered more positive events and felt positive during the recall.

Another fact is that more than a half of the sample (65.3%) was 55 years old and older. Another explanation for the results of the current study could be that there is an age difference. Older people tend to let negative memories fade faster than positive ones (Charles, Mather & Carstensen, 2003; Memory key, n.d.). Due to the fact that older people are able to regulate their emotions more effectively than younger people, it is possible for them to lower negative emotions and maintain positive emotions. Research has shown that the amygdala of older adults is activated equally by positive and negative stimuli, whereas the amygdala of younger people is activated more by negative stimuli (Memory key, n.d.). Besides, they experience fewer negative emotions in comparison to younger people, but they are able to show more emotionally pleasant autobiographical information as a result of emotion regulation, cognitive abilities and motivation (Mather & Carstensen, 2005). In addition to that, people use different strategies to regulate their emotions while remembering positive and negative autobiographical memories, including suppression (trying to blunt or hide negative emotions) and reappraisal (trying to adopt a new perspective on unpleasant memories) (Nauert, 2012).

Further research

Future research should not only focus on the memories and emotions of the general population, but also on people with mental health issues. The research sample should be divided into two groups: one group diagnosed with a mental disorder (e.g. PTSD, depression or anxiety disorder) and the other, without mental disorders. These two categories will help to analyze the differences between the emotional memories of people with and without mental health problems. Hence, it is suggested to conduct a study with an experimental pretest - posttest design, which would benefit the data collection and the data integrity. This is why data should be collected online at two measurement moments (pre- and post-test) to ensure that as many people as possible can be reached in order to get more knowledge about causal effects. Moreover, a pretest - posttest design means also that a real time factor could be measured, instead of using self-reported time estimates of the participants. In addition to that,

physiological measurements could be used to measure emotional arousal to ensure that more reliable data is collected. Besides, further research should address the whole Dutch population including younger generations to ensure the variety of data. Social media like Facebook, Twitter and Instagram can be useful to reach the younger generations. The older generations without an access to the online survey will get a pen-and-paper version of the survey or will be provided with a computer including Internet access, so that the participants can complete the surveys at home. Hence, they get the chance to choose for one of these options. While taking part in the online survey, people will be asked to provide only positive memories, in order to test whether positive emotions improve well-being and increase life satisfaction as it is describes by the broaden-and-build theory. Last but not least, future research should include questionnaires about personality characteristics, current situation and the mood before and after memory recall, in order to find particular patterns and to be able to pay attention to biases caused by personality, mood congruence or a mental disorder.

Implications

On the one hand, this study contributes to the literature on autobiographical memory and intensive emotions. The present research can help to understand how memories relate to positive and negative emotions over time. On the other hand, the reader of this paper can gain more insight into which memories evoke the most intensive positive and negative emotions. For example, this research suggests that memories especially about free time activities evoke the most intensive positive emotions. Also memories about positive social relations and good health evoke positive emotions during recall. However, memories about health harming events and health issues seem to cause the opposite. All in all, interventions should focus on the recollection of the positive aspects of life in order to increase life satisfaction. These information could be useful for mental health professionals because they can use them for future interventions preventing mental health problems in the general population or for developing new techniques for treatment of mental disorders by using positive psychology.

Conclusion

To sum up, the present research focused on the relationship between memories and emotions of the Dutch population and aimed to answer the question "*Which memory characteristics are related to positive and negative emotions?".* The findings provide insight into the strengths of positive memories. Positive emotions seem to last longer than negative emotions over time. These emotions are enhanced by the vividness of a memory. Especially, positive emotions are experienced more intensive during the recollection. Last but not least, participants experienced

more intensive positive emotions when they remembered events of free time activities. However, they felt more intensive negative emotions when they remembered their health issues or thought about their property and education. Taken together, this research suggest that intensive emotions relate to vivid memories, especially to events concerning free time activities and health issues.

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Appendices

Appendix A:

Relevant questions used in the survey to access information about each remembered memory

"When we describe to other people who we are, we often tell something about our past. We would like to ask you to describe some personal memories that show who you are. These are memories that are very characteristic for you as a person. What type of memories are we asking about? They are personal memories that are important to you. They vividly come to your mind. They evoke strong positive or negative feelings. You will often have thoughts about them. We would like to ask you to describe three memories of this type which are at least 1 year old." (Blagov & Singer, 2004)

Variables	**Questions**
Memory	"Please, describe the memory as detailed as possible. Can you explain why this memory is important for you?"
Time	"How many years ago happened the remembered event?"
Vividness	"How vivid is this memory for you?"
Positive emotions	"How positive do you feel about this memory?"
Negative emotions	"How negative do you feel about this memory?"

Appendix B:

Criteria for the interpretation of Spearman's correlational coefficients (Hinkle, Wiersma & Jurs, 2003)

Size of Correlation	Interpretation
.90 to 1.00 (−.90 to −1.00)	Very high positive (negative) correlation
.70 to .90 (−.70 to −.90)	High positive (negative) correlation
.50 to .70 (−.50 to −.70)	Moderate positive (negative) correlation
.30 to .50 (−.30 to −.50)	Low positive (negative) correlation
.00 to .30 (.00 to −.30)	Negligible correlation