Evaluation of Methodologies for Testing the Sense of Self and Emotional Episodic Autobiographical Memory

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Abstract

Previous research suggests that episodic autobiographical memory (EAM), autonoetic consciousness and sense of self rely on one another. The basolateral amygdala (BLA) is thought to play a crucial role in EAM, because of its involvement in the consolidation of emotional memory. The goal of this research is to provide methodologies to eventually investigate the sense of self in human subjects with selective BLA damage and thus determine the role of the BLA in sense of self. In this exploratory study, we aimed to investigate whether the proposed methodologies (i.e. the Sense Of Self Scale (SOSS), the Behavioural and Experience checklist (BE-checklist), the autobiographical Implicit Association Test (aIAT) and the Mental Time Travel task (MTT)) are sufficiently valid and reliable for measuring the relation between sense of self, emotional EAM and their underlying concepts. We collected data from 52 Dutch female students, who performed the SOSS, the BE-checklist, the State and Trait Anxiety Inventory (STAI) and the aIAT online. In addition, 10 of the 52 participants performed the MTT task offline. Results show a good internal consistency of the SOSS and a relationship between SOSS scores, BE-checklist scores and STAI scores. Furthermore, we found a strong predictive value of negative emotional valence on weak sense of self. Both autonoetic consciousness and emotional intensity were found to have a significant correlation with (p)re-experiencing emotions. The results indicate a potential usability for the SOSS, the BE-checklist, the STAI and the MTT task to measure the link between sense of self, EAM and their underlying concepts. Thus, they provide other researchers with a possible conceptual and methodological framework to study the sense of self. However, more research is needed to determine causal relationships and to further improve this research paradigm.

Keywords: sense of self, emotional episodic autobiographical memory, autonoetic consciousness, trait anxiety, mental time travel.

Introduction

The purpose of this research is to develop a research protocol to study the link between sense of self and emotional episodic autobiographical memory (emotional EAM) in patients with Urbach Wiethe Disease (UWD). To test a possible relation between sense of self, emotional EAM and their underlying concepts, we investigated suitable methodologies and determined their validity.

UWD is an extremely rare genetic syndrome. To date, less than 100 cases are known worldwide (Van Honk, Terburg, Thornton, Stein & Morgan, 2016). The disease is characterized by hoarseness of voice from birth, and later easily damaged skin and poor wound healing (Urbach & Wiethe, 1929; Tranel & Hyman, 1990). An even rarer characteristic is the bilateral amygdala damage found in many patients with UWD. This damage is due to progressive calcifications in the brain. Terburg et al. (2012) established focal, bilateral damage in one of the subregions of the amygdala, the basolateral amygdala (BLA), while other amygdala subregions remain functionally intact, in a group of South African UWD patients. Globally, however, the location of these calcifications differ per UWD subject and are therefore not always selective to the amygdala, and are only selective to the BLA in the South African population (Van Honk et al., 2016). The BLA, given its rich connections to the hippocampus and the prefrontal cortex, is thought to play a crucial role in episodic and autobiographical memory (Botzung, Rubin, Miles, Cabeza & LaBar, 2010; van Honk et al., 2016; Richardson, Strange & Dolan, 2004; Yang & Wang, 2017)

Amygdala

The amygdalae are central to the functioning of several brain networks. Research has shown a dichotomy in function between the BLA and the centromedial amygdala (CMA) region (Van Honk et al., 2016). Aside from the different neuronal structures, which are subsequently cortical versus striatal, studies show different behavioural effects after lesions to

or pharmacological manipulations of the BLA or the CMA (Balleine & Killcross, 2006). Furthermore, the BLA projects sensory information onto the CMA and thereby regulates the execution of a fear response in which the CMA plays an important role. The BLA is also important for detecting salient (rewarding and threatening) information and is richly connected to all other sensory and memory systems in the brain (prefrontal cortex, hippocampus, thalamus; Yang & Wang, 2017). Research has shown that the BLA is involved in the interaction between episodic memory and the encoding of emotion (Cahill, Babinsky, Markowitsch, & McGaugh, 1995; Hurlemann et al., 2007; Markowitsch et al., 1994). In addition, a deficit in emotional empathy and difficulties judging the intensity of facial expressions can be observed in patients with BLA damage (Hurlemann et al., 2010). Results from Siebert et al. (2003) show that different emotions, like sadness and anger, were experienced as more intense by UWD patients. Moreover, they found that UWD patients were less likely to recognize and remember negative emotional stimuli. Research by Blake, Terburg, Balchin, van Honk and Solms (2019) found that UWD patients with bilateral BLA damage showed increased experience of positive emotions and a decreased experience of negative emotions in their dreams, their dream structure was also less complex. The BLA is activated in the REM phase, during which dreams are experienced. Less negative emotions could be the result of less negative emotion memory consolidation. The critical role of the BLA in the consolidation of emotional memories was already proposed by Hurlemann et al. (2007). Moreover, an experiment to test the ability to recall emotional stimuli showed that a UWD patient had, in comparison to controls, no increased memory of the emotional part of a story (Cahill et al, 1995). Interestingly, while both groups read the emotional part of the story, they had similar arousal levels. These findings also suggest that the BLA is not involved in the experience of emotion, but prominently in the consolidation of emotional memory.

Emotional episodic autobiographical memory

Emotional memory is connected to episodic autobiographical memory (EAM) (Hurlemann et al., 2007). The EAM is one of the five memory systems defined in the SPI-model by Tulving (1995) that are assumed to work serially, in parallel and independently. Furthermore, the memory systems are connected to three levels of awareness. Both the memory systems and levels of awareness are hierarchically ordered (Markowitch & Staniloiu, 2011) The five memory systems can be categorized by the information they entail, and the level of awareness one has over a memory system. The lower levels contain the simple memory systems: procedural memory and priming. These stand for, respectively, mechanical motor-based skills ("routines") and a higher probability of recognizing previously perceived informative input. Both levels act anoetically ("unconsciously"). Above those two levels are two memory systems that are connected to noetic ("conscious") awareness. One is the perceptual memory system, which stands for the conscious recognition of stimuli. However, the level of recognition in the perceptual memory system is still without semantic value. The semantic value is added in the next hierarchical system: the semantic memory system, also known as declarative memory (Vandekerckhove & Panksepp, 2011). The highest memory system is EAM, which depends on autonoetic ("self-conscious") awareness. It is autonoetic consciousness that gives rise to the feeling of identity, continuity and explicit self-awareness (Vandekerckhove & Panksepp, 2011). Furthermore, it can be directed retrospectively to the past, reflecting on memory and prospectively on the future (Markowitsch & Staniloiu, 2011).

Forming stable and long-term EAMs requires several information processing stages (e.g. retrieval, encoding and consolidation) (Markowitsch & Staniloiu, 2011). Studies using fMRI have shown that the hippocampus, as well as the parahippocampal and other medial temporal lobe regions are activated during the performance of episodic-autobiographical memory tasks (Dickerson & Eichenbaum, 2010). Additionally, the successful encoding and

consolidation of EAM has been shown to depend on several other brain structures, including the diencephalon and parts of the prefrontal cortex (Dickerson & Eichenbaum, 2010; Markowitsch & Staniloiu, 2011). Since emotion is considered to be intrinsic to EAM it is not surprising that certain parts of the limbic system, such as the amygdala and the thalamus, as well as the Papez circuit are involved in forming EAMs. These structures are especially important in assessing the emotional, biological and social relevance of the incoming sensory information.

The amygdala, as mentioned before, has been associated with binding sensory information to certain emotional cues which allows successful memory recollection of emotionally significant events (Markowitsch & Staniloiu, 2011; Piefke, Weiss, Zilles, Markowitsch, & Fink, 2003; Piefke, Weiss, Markowitsch, & Fink, 2005). Recent research further points to the amygdala's role in supporting the encoding and retrieval of autobiographical memories, because of its importance in social and self-referential processing (Ally, Hussey & Donahue, 2013). Ally et al. (2013) speculated that: "the amygdala likely charges AMs with emotional, social, and self-relevance. In heightened memory, this system may be hyperactive, allowing for many types of autobiographical information, including emotionally benign, to be more efficiently processed as self-relevant for encoding and storage". More specifically, research has shown that the BLA has a mediating effect on memory consolidation (Bass, Partain, & Manns, 2012; Paré, 2003). Given these findings, one can assume that the amygdala, and more specifically the BLA region, plays an integral role in encoding self-relevant information.

Sense of self

EAM seems to reflect the realization of a new stage in self-understanding and self-awareness (Nelson & Fivush, 2004). The EAM develops over time, with small children living in the here and now and having little to no EAM (Markowitsch & Staniloiu, 2011b).

Additionally, the emergence of EAM seems to support further self-development and conserves a consistent feeling of personal identity and a coherent awareness of the self's continuity over time (Markowitsch & Staniloiu, 2011b). Several authors have emphasized the importance of emotion for episodic autobiographical remembering (Irish, Lawlor, O'Mara, & Coen, 2008; Piefke, Weiss, Markowitsch, & Fink, 2005; Piefke, Weiss, Zilles, Markowitsch, & Fink, 2003). Bluck and Habernas (2000) considered the emotional and motivational memories linked to the self, to be the true autobiographical memories.

The sense of self seems to be an important part of the cohesion of EAM and autonoetic consciousness (Markowitsch & Staniloiu, 2011b). The connection between sense of self, consciousness and memory is dynamic and complicated. Markowitsch & Staniloiu (2011b) proposed a three level organization of the connection between different memory systems, types of consciousness and the self. In this theory, three types of self are distinguished: the proto-self (grounded in the sensory and motor dimension), the core self (cognitive self) and the extended self (autobiographical or narrative self). Markowitsch & Staniloiu (2011b) combined this theory with the different levels of consciousness and memory systems, and suggested that autonoetic consciousness and the EAM lead to the extended sense of self. As mentioned above, several studies have shown that the amygdala has an important part in forming emotionally relevant EAMs. Furthermore, some studies have indicated that the BLA may play an important role in the consolidation of these emotional EAMs (Bass et al., 2012; Blake, Terburg, Balchin, van Honk, & Solms, 2019; Paré, 2003; Piefke et al., 2003; Tyng, Amin, Saad, & Malik, 2017). Given the research suggesting that the EAM, autonoetic consciousness and sense of self rely on one another, further investigation into the effects BLA damage on the sense of self would further contribute to understanding these three constructs and their neural correlates.

Proposed methodologies

In this study, we propose three different methods to measure sense of self, emotional

episodic autobiographical memory and their interconnectedness: the Sense Of Self Scale (SOSS), the Mental Time Travel (MTT) task and the autobiographical Implicit Association Test (aIAT).

The SOSS

The SOSS measures whether one has a weak or strong sense of self. A weak sense of self has been characterized as feeling as if one does not know who they are, what they think or what their own opinions are (Flury & Ickes, 2007). The SOSS is a questionnaire on which participants have to score different statements related to their sense of self (Flury & Ickes, 2007). It is a methodology to directly and objectively measure how people evaluate their own thoughts and behaviour. Statements in the questionnaire are related to the participants' personal perspective and its variation over time and in space. A weak sense of self is also connected to instability, meaning that people with a weak sense of self appear to experience a sudden shift in preference, career plans, values, choice of friends and opinions. These are behaviours one does not expect in people with a strong sense of self. The Behavioural Experiences checklist (BE-checklist; Flury & Ickes, 2007) was added to the SOSS to measure whether people have recently engaged in behaviours or had experiences that are indicative of a weak sense of self.

The MTT task

The MTT task measures the quantity, the quality and the preferential content when freely remembering past events or making projections about the future (i.e. mental time travel). Autonoetic consciousness is thought to not only allow for re-experience of past events, but also the pre-experience of future events (Quoidbach, Hansenne, & Mottet, 2008). Autonoetic consciousness allows one to distinguish oneself from the social and biological environment (Gardiner, 2001; Markowitsch & Staniloiu, 2011b; van Schie, Chiu, Rombouts, Heiser, & Elzinga, 2019). In addition to the role the amygdala plays in reliving memories (Ally, Hussey, & Donahue, 2013; Greenberg et al., 2005; Markowitsch & Staniloiu, 2011a), recent research

suggests that the amygdala may also be involved in the stimulation of future emotional events (Sharot, Riccardi, Raio, & Phelps, 2007). This indicates that some of the neural structures involved in reliving past experiences, might also be important in the pre-experience of future events. Furthermore, factors that influence the phenomenal characteristics important for remembering (e.g. emotional valence and temporal distance from the present), seem to influence the phenomenal characteristics associated with future projections of oneself (D'Argembeau & Van der Linden, 2006). Reliving and pre-experiencing events and their connection to autonoetic consciousness, are assessed using the MTT task.

The aIAT

The aIAT can be used to investigate the autobiographical memory encoded in a respondent's mind or brain (Agosta & Sartori, 2013). It is an adapted version of the traditional IAT. In the traditional version, the strength of automated associations between two dimensions is measured. The classical example of this test is the implicit association between the dimension race (black/white) and the dimension pleasantness (pleasant/unpleasant; Greenwald et al., 1998). In this IAT, the dimension of pleasantness is an evaluative dimension and the dimension of race the target dimension. In the aIAT, evaluative dimensions are substituted by logical dimensions and the target dimension refers to the participants' episodic autobiographical memory. In this research, autobiographical memory was tested with the use of a mock emotional experience. This mock emotional experience was simulated by reading a first person narrative emotional story (Cahill, et al., 1994) and simultaneously looking at visualizations of every sentence. Similar to the mock crime study from Sartori et al. (2008), this experience is expected to become part of the participants' autobiographical memory. Research has shown that the self-related instructions of the aIAT activate a participant's concept of self and is explicitly involved in the test performance (Vargo, Petróczi, Shah & Naughton, 2014).

In this study, we aim to test whether the proposed methodologies are sufficiently valid and reliable for measuring the relation between sense of self, emotional episodic autobiographical memory and their underlying concepts. Higher scores on the MTT Quality task corresponds with a better ability to recall and/or imagine details of autobiographical events. Higher scores on the MTT Quantity task corresponds with a better ability to recall and/or imagine autobiographical events. A high SOSS and BE-checklist score coincides with a weak sense of self. Because the SOSS and BE-checklist measure the same construct, we expect to find a positive correlation between these two tests. Markowitsch & Staniloiu (2011b) proposed that autonoetic consciousness and the EAM lead to the extended sense of self. Therefore, we expect that high scores on the MTT Quantity task and on the MTT Quality task correspond with low scores on the SOSS/BE-checklist, and that low scores on the MTT Quantity task and on the MTT Quality task correspond with high scores on the SOSS/BE-checklist. We expect that the reaction times on the aIAT show a distinction between true autobiographical memory statements and false autobiographical statements. Furthermore, we expect to find that both MTT tasks and the aIAT measure concepts connected to EAM, resulting in a positive correlation between the MTT Quality and Quantity tasks and the aIAT. Therefore, we expect that we will also find a similar correlation between the aIAT and the SOSS/BE-checklist as with the MTT Quality and Quantity tasks and the SOSS/BE-checklist.

Methods

Participants

Dutch female undergraduate and graduate students between the ages of 19 and 27 participated in this study (N = 52, M = 22.23, SD = 1.28). All participants read and approved an informed consent before participating. There was a high homogeneity in the group based on education level, education type and age (Table 1). The participants were divided into two

groups: an online group (N = 42) and an offline group (N = 10). Participants were placed in the offline group based on proximity and accessibility to the research instructors. Participants in the offline group were accompanied by the instructor during the entire experiment. There was no significant difference in demographic data between the two groups. The subjects did not receive any reimbursement for their participation. Because all participants were native Dutch speakers, the entire experiment was carried out in Dutch. Recruitment criteria excluded women with a history of memory disorders, other mental health issues and brain injury.

Table 1

Demographics of Study Sample

Factor	Total sample (N=52)	Group 1b (N=10)
Age		
Mean ± SD	22.20 ± 1.27	22.30 ± 1.25
Min-Max	19-27	20-24
Education level		
% High school	1.9	-
% HBO	34.6	20
% WO	61.5	80
Education type		
% Medical	15.4	-
% Social	9.6	30
% Law	9.6	-
% Humanities	21.2	30
% Economics	7.7	-
% No current education	9.6	20
% Other	25.0	20

Note. N, number of non-missing values; SD, standard deviation; HBO, "higher professional education"; WO, "scientific education".

Materials and Procedures

The STAI

Participants filled out all following online questionnaires on online software Gorilla Experiment Builder. After filling in a short form with demographic questions, both the online and the offline group filled out the State and Trait Anxiety Inventory (STAI) questionnaire. The STAI is a 20-item questionnaire that attempts to measure anxiety either as an emotional momentary state or as a personality trait. We used the Dutch version of the STAI, called the 'Zelf-Beoordelingsvragenlijst' (ZBV). Questions were scored on a Likert scale ranging from 1 (almost never) till 4 (almost always). ZBV- trait scores range from a minimum of 20 (indicating almost no anxiety traits) with a maximum of 80 (indicating high anxiety traits). The ZBV reports a high reliability (with a Cronbach's alpha of .88, p <.001; Van der Ploeg, 1980). The STAI was used to control for anxiety disorders and to exploratively investigate trait anxiety.

The SOSS

After filling out the STAI, both groups proceeded with filling out the SOSS. This questionnaire gives an indication of a strong or weak sense of self and consists of twelve statements. For example, one statement is: "I sometimes wonder if people can actually see me". All sentences were translated to Dutch (Appendix A). Participants rated these statements with a Likert-type scale ranging from 1 (not characteristic) to 4 (very characteristic). Out of twelve statements, three are reversely stated to increase internal validity. The SOSS reports a high internal consistency, with a Cronbach's alpha of .86 and a high test-retest reliability (r = .83, p < .001; Flury & Ickes, 2007). Scores range from a minimum of 12 points (indicating a strong sense of self) to a maximum of 48 points (indicating a weak sense of self).

As part of the SOSS, the BE-checklist was added to this experiment to assess whether participants had recently engaged in behaviour or had experiences that indicate a strong or a weak sense of self (Flury & Ickes, 2007). It consists of a 15-item checklist that can be answered

with ‘true’ or ‘false’. All items were translated to Dutch (Appendix B). Eight of these items indicate a strong sense of self (e.g. “I put my own personal stamp on everything I do”) and seven items indicate a weak sense of self (e.g. “I bought an item of clothing within the past six months that wasn’t at all right for me”). Previous research showed a medium internal consistency score for the BE-checklist, with a Cronbach’s alpha of .55 (Flury & Ickes, 2007). This is likely due to the variety of behaviours measured. Nevertheless, this same research showed a relatively high correlation between the BE-checklist and the SOSS ($r = .53$, $p < .01$). Total BE-checklist scores range from a minimum of 0 points (indicating behaviour corresponding to a strong sense of self) to a maximum of 15 points (indicating behaviour corresponding to a weak sense of self).

The MTT task

After completing the STAI, the SOSS and the BE-checklist, the offline group diverged from the online group by temporarily stopping the online experiment. An instructor carried out the MTT task, after which the participant resumed the online experiment on Gorilla Experiment Builder. The Mental Time Travel (MTT) task is adapted from Quoidbach et al. (2008). The MTT task consists of three sub-tests that together make up a coherent picture of the participants ability to recall and project emotional memories (see Appendix C for a full overview of the script and used forms). The three sub-tests studied the quantity, emotional valence and quality, respectively.

The MTT Quantity task. To test quantity, participants were asked to recall or project as many emotional events as they could within three minutes. This was done using six different temporal windows (last week, next week, last year, next year, last 5 to 10 years, next 5 to 10 years). Participants were free to choose for themselves what they wanted to tell to the interviewer. All participants gave permission to have their answers recorded for later analyses. For analysis, the amount of positive and negative events was summed across the different

temporal windows, which were divided into past events (last week, last year, last 5 to 10 years) and future events (next week, next year, next 5 to 10 years). The summed amount of past and future events was further divided in positive and negative events. The events were also categorised based on their content in one of nine different broad subject-matter categories: 1) health and physical appearance, 2) family, 3) romance and sex, 4) social relationships, 5) money and material goods, 6) work, 7) leisure, 8) reflexivity and 9) other. In total, this part of the MTT task provided information regarding the quantity of past/future events, positive/negative events and certain subject-matters.

The MTT Preferential task. To study emotional valence, we asked participants to complete a set of six sentences with short self-related stories. For the purpose of this experiment, we translated all sentences to Dutch (Appendix C). The participants were asked to come up with three past events and three future events, further subdivided into 1 positive, 1 negative and 1 neutral event. We presented the participants with a form on which they could read the sentence, the period in time (past/future) the sentence should be associated with and the hedonic tone (positive/negative/neutral). Sentences used are shown in Table 2. Every story was rated by one pair of independent judges with the use of a 7-point scale (-3 extremely negative to +3 extremely positive). The scores per sentence were aggregated into a mean score per temporal direction. In total, 4 judges formed 4 different pair combinations and rated a total of 60 stories.

The MTT Quality task. The quality of the MTT was measured using a subjective questionnaire that investigated the phenomenal characteristics of memories or projections. Participants were asked to remember 3 events from the past and imagine 3 events from the future (last week, last year, last 5 to 10 years and next week, next year, next 5 to 10 years). They were handed a form on which they could, first, write down a brief description of the event and second, rate their subjective experience of the event using a 7-point scale. They rated their

experience on 10 different items: 1) visual detail, 2) sounds, 3) smell/taste, 4) clarity of location, 5) clarity of the spatial arrangement of objects, 6) clarity of the spatial arrangement of people, 7) clarity of the time of day, 8) feeling of experiencing emotions as if the event was actually happening (a measure for emotional valence), 9) emotional intensity of the event and 10) feelings of re- (or pre-, in case of future event) experiencing the event. Following the procedure of Quoidbach et al. (2008) we averaged the first 6 items into a general quality of memory/projection measure. The other 4 items, respectively, measured, temporal information, pre/re-experience of emotion, emotional intensity and autonoetic consciousness.

Table 2

Sentences used during the emotional valence part of the MTT task

Emotional valence	Time period	
	Past	Future
Positive	*I was walking down the street*	*I'm lying on the beach*
Negative	*I was looking at myself in the mirror*	*I'm listening to music*
Neutral	*I was standing in the kitchen*	*I'm on the bus*

The aIAT

The aIAT was used to measure emotional EAM encoding in both participant groups. This study used an adapted version of the mock crime experiment by Sartori et al. (2008). In the original experiment, participants were randomly divided into the innocent and guilty group. The guilty group was instructed to enact the crime of stealing a CD containing an upcoming examination, while the innocent group only read a short article about the theft. Interestingly, the results of the aIAT showed a strong association between guilty and true sentences in the

guilty group. A strong association between the innocent and true sentences was also found for the innocent group. Suggesting that the participant can correctly be classified by their results on the aIAT (Sartori et al., 2008).

Participants categorized four categories of stimuli: two from the logical dimension (true/false) and two from the target concept dimension (happened/did not happen). The logical dimension consisted of statements that are obviously true for the participant group (e.g. 'I am a woman') or obviously false (e.g. 'I am retired'). The target concept dimension was based on an emotional story. All participants read an emotional story and envisioned the story actually happening to them. The goal was to create an artificially constructed emotional memory. Participants were presented with this emotional story shortly before taking the aIAT. They were asked to read the story as if they were experiencing it themselves. This was a written story with visualizations per sentence about a mother whose son is involved in a traffic accident. The story was used in earlier studies on emotional memory (Cahill, et al., 1994). A Dutch translation of this story was used (Appendix D). The target concept dimension consisted of statements that are congruent with the storyline (e.g. 'A brain scan was made') or incongruent with the storyline (e.g. 'His hands were chopped off') (Appendix E).

Similar to the research of Marini et al. (2012), the aIAT consisted of 5 blocks: 3 discrimination blocks and 2 categorization blocks (Table 3):

- In block 1 (20 trials, logical discrimination), participants classified factual statements as true or false. They were asked to press the C key if the factual sentence was true for them and the M key if the factual sentence was false for them.
- In block 2 (20 trials, episodic discrimination), participants classified sentences referring to the emotional story as happened or didn't happen. They were asked to press the C key if they thought that the sentence was congruent with the story (happened) and the M key if they thought it was incongruent (didn't happen).

- In block 3 (60 trials, congruent categorization), participants categorized both factual statements and sentences referring to the emotional story. They were asked to press the C key to classify both the true factual statements and congruent sentences. The M key was instructed to be used to classify the false factual statements and incongruent sentences.
- In block 4 (40 trials, reversed episodic discrimination), participants classified only the sentences referring to the emotional story. In contrast to block 2, they were now asked to press the C key if they thought the sentence was incongruent with the story (didn't happen) and the M key if they thought it was congruent (happened).
- In block 5 (60 trials, incongruent categorization), participants categorized both factual statements and sentences referring to the emotional story. In contrast to block 4, they were now asked for the C key if they thought the sentence was incongruent with the story (didn't happen) and the M key if they thought it was congruent (happened). Similar to block 4, they were instructed to press the C key for true factual statements and the M key for false factual statements.

Table 3

Experimental design of the aIAT categorization task

Discrimination	Trials	Stimuli
Block 1: logical discrimination	20	10x true factual statements 10x false factual statements
Block 2: episodic discrimination	20	10x true story statements 10x false story statements

Discrimination	Trials	Stimuli	
Block 4: reversed episodic discrimination	40		20x true story statements 20x false story statements
Categorization			
Block 3: congruent categorization	60	15x true factual statements 15x false factual statements	15x true story statements 15x false story statements
Block 5: incongruent categorization	60	15x true factual statements 15x false factual statements	15x true story statements 15x false story statements

Analysis

Data was analysed using the software systems Microsoft Excel and SPSS (version 25). We used an alpha level of .05 for all statistical tests. Data of participants was divided into three groups: group 1, group 1a and group 1b. Group 1 consisted of STAI, SOSS and BE-checklist data of all participants ($N = 52$). Assumptions were checked and validated for all variables in group 1. Group 1a consisted of the STAI, the SOSS, the BE-checklist and the aIAT data of 39 participants. A total of 13 participants were excluded. Of these excluded participants, 12 were excluded based on a below chance correctness score on categorizing the aIAT statements, suggesting that they did not fully understand the task. Assumptions were validated for all variables in group 1a, except for normality of the variable 'Reaction time false autobiographical statements in block 5' ($W(40) = 0.93$, $p = 0.015$). An outlier analysis showed one outlier within this variable, which was deleted to validate the assumption of normality. Group 1b consisted of the STAI, the SOSS, the BE-checklist and the MTT task scores of all participants in the

offline experimental group ($N = 10$). The assumption of normality was violated in 5 variables within this group (Average quality past, Preferential past positive, Preferential past neutral, Preferential future positive and Preferential future neutral). However, given the explorative nature of our research and the small sample size, we chose to include all participants in the analysis.

Firstly, internal validity and reliability were assessed for the STAI, the SOSS and the BE-checklist with the use of Cronbach's alpha. Two explorative repeated measures ANOVAs were conducted to investigate the effects of time and emotion on the MTT Quantity task and the MTT Preferential task. The MTT Quantity task ANOVA was a 2x2 ANOVA in which the main effect of time (past/future), main effect of emotion (positive/negative) and their interaction effect were investigated. The MTT Preferential task ANOVA was a 3x2 ANOVA in which the main effect of time (past/future), main effect of emotion (positive/neutral/negative) and their interaction effect were investigated. The interjudge reliability of the MTT Preferential task was controlled for by using Cohen's kappa coefficient.

Secondly, our hypothesis regarding the measured constructs were tested. To test our hypothesis that the SOSS and the BE-checklist measure the same construct (sense of self), total scores of the SOSS and the BE-checklist were correlated using Pearson's correlation. To investigate our hypothesis that the aIAT can be used to distinguish true autobiographical memory statements, based on an emotional story, from false autobiographical statements, a 2x2 repeated measures ANOVA and a paired samples T-test were conducted. The ANOVA was conducted to investigate the main effect of congruence (congruent/incongruent), main effect of correctness (true/false) and their interaction effect. The D-scores of the aIAT (difference of mean scores congruent and incongruent divided by the inclusive standard deviation) were determined for both false and true autobiographical statements. The D-scores in the two groups (false and true) were compared with a paired samples T-test. Our hypothesis

that mental time travelling plays a role in forming a sense of self, was tested by conducting a regression analysis. In this analysis, the five predictors for our dependent variable sense of self (SOSS scores), were MTT Preferential task scores, MTT Quantity task negative scores, MTT Quantity task positive scores, MTT Quality task past scores and MTT Quality future scores.

Lastly, explorative correlations and regressions were conducted to investigate possible relations between sense of self (the SOSS), behavioural sense of self (the BE-checklist) and anxiety (the STAI).

Results

Descriptives group 1

Our general participant group consisted of the combination of both the offline and the online group (N = 52). The 10 offline participants compared to the 42 offline participants demonstrated significantly less anxiety, $t(50) = -2.36$, $p = .22$, and better behavioural sense of self, $t(50) = -2.82$, $p = .007$.

The STAI

The STAI consists of 20 Likert-scale items (from 1 “almost never” through 4 “almost always”). The minimum possible score was 20, indicating no anxiety, and the maximum possible score was 80, indicating a lot of anxiety. In the present sample, there was a mean score of 39.96 and a standard deviation of 9.11. The empirical range was 24-59.

The SOSS

The SOSS consists of 12 items with a Likert-scale (from 1 “very uncharacteristic” through 4 “very characteristic”). The minimum possible score was 12 points, representing a strong sense of self, and the maximum possible score was 48 points, representing a weak sense of self. In our sample, there was a mean score of 25.40 and a standard deviation of 5.41. The empirical range was 14-37.

The BE-checklist

The BE-checklist consists of 15 dichotomous items (true/false). The minimum possible score was 0, indicating a strong behavioural sense of self, and the maximum possible score was 15, indicating a weak behavioural sense of self. In this present sample, there was a mean score of 5.37 with a standard deviation of 1.82. The empirical range was 2-10.

Analyses group 1

The internal consistency of the STAI, the SOSS and the BE-checklist was assessed using Cronbach's alpha. The alpha of the STAI in the present data was .91. This alpha indicates an excellent internal consistency. The SOSS had a Cronbach's alpha of .76. This alpha indicates an acceptable internal consistency. The BE-checklist had a Cronbach's alpha of .20. This alpha indicates an unacceptable internal consistency.

Behavioural sense of self and sense of self was significantly correlated, $r(50) = 0.43$, $p = .01$. Sense of self and anxiety was also found to be moderately and significantly correlated, $r(50)=.65$, $p < .01$. Behavioural sense of self and anxiety were found to be weakly and significantly correlated, $r(50) = .32$, $p < .05$. In sum, participants with higher level of anxiety seemed to show a stronger sense of self.

To substantiate this relationship, an independent-samples t-test was conducted to compare sense of self in low anxiety and high anxiety conditions. We divided all participants ($N = 52$) into two groups using their total STAI scores with a cutoff point of 40. This cutoff point was chosen based on the mean STAI score ($M = 39.96$). Group 1(>= 40, $N = 25$) had a mean SOSS score of 28.52 and a standard deviation of 4.98. Group 2 (< 40, $N = 27$) had a mean score of 22.52 and a standard deviation of 4.08. There was a significant difference in the scores for sense of self for the two groups, $t(50) = 4.77$, $p < .0001$. Participants with a high trait anxiety had a lower sense of self than participants with a low trait anxiety.

A multiple linear regression model was calculated to predict SOSS scores based on BE-checklist scores and STAI scores (Figure 1). A significant regression equation was found, R^2 = .473, $F(2,49) = 22.031$, $p < .0001$. Participants' predicted SOSS scores were equal to 7.967 + .336 (STAI scores, $p < .0001$) and + .746 (BE-checklist scores, $p = .027$). Therefore, both behavioural sense of self and trait anxiety were significant predictors of sense of self.

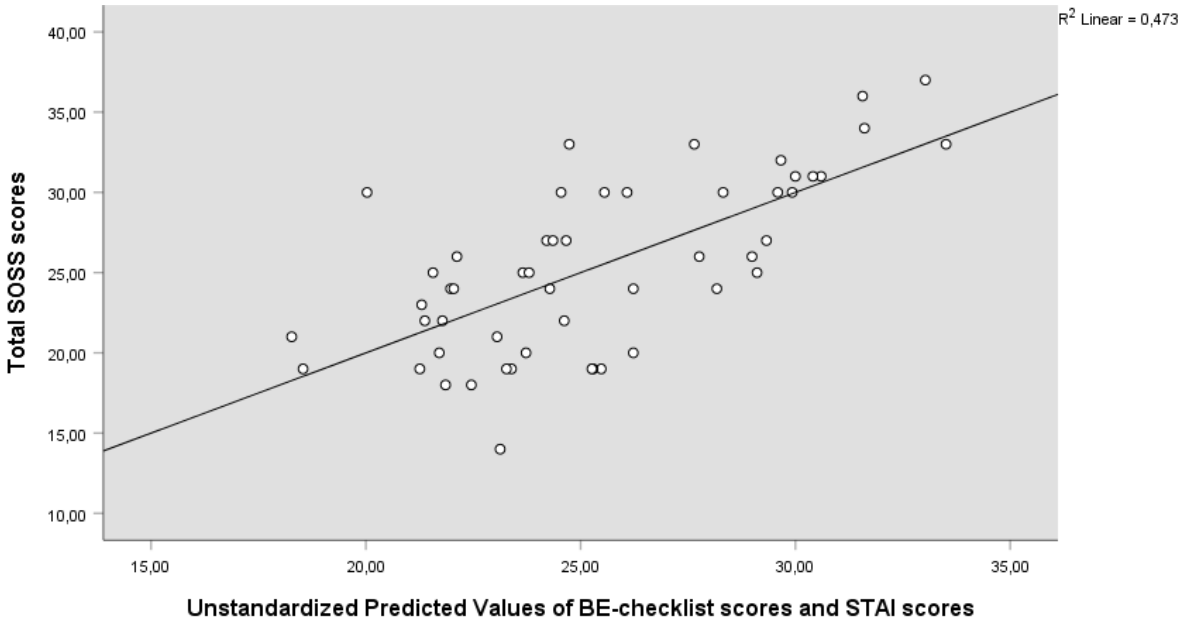

Figure 1. Predicted value of SOSS based on the unstandardized predicted values of the multiple linear regression analysis.

To further investigate the correlations between the SOSS, the BE-checklist and the STAI, we ran additional exploratory regression analyses. A linear regression model was calculated to predict SOSS scores based on STAI scores. A significant regression equation was found, R^2 = .417, $F(1,50) = 35.82$, $p < .0001$. Participants' predicted SOSS scores were equal to 10.061 + 0.384. Therefore, trait anxiety was a significant predictor of sense of self.

STAI scores were also a significant predictor for BE-checklist scores, $R^2 = .103$, $F(1,50) = 5.75$, $p = .02$. Participants' predicted BE-checklist scores were equal to 2.809 + 0.064. Trait anxiety was a significant predictor of behavioural sense of self.

A multiple linear regression model was calculated to explore the possible predictive value of BE-checklist and SOSS scores for STAI scores. The overall model was significant, $R^2 = .420$, $F(2,49) = 17{,}712$, $p < .0001$. However, the BE-checklist was not a significant coefficient ($p = .670$). Participants' predicted STAI scores were equal to 11.904 + 1.050. Therefore, sense of self is significantly predictive of trait anxiety.

Descriptives group 1a

The group that performed the aIAT, excluding all outliers, consisted of $N = 39$ participants. The mean reaction time on the congruent block with true autobiographical memory statements was 1028.12 msec, with a standard deviation of 170.69 msec. The mean reaction time on the congruent block with false autobiographical memory statements was 1015.38 msec, with a standard deviation of 148.11 msec. On the incongruent block, the mean reaction time in the true autobiographical memory statements condition was 1754.81 msec, with a standard deviation of 528.29 msec. The mean reaction time in the incongruent block in the false autobiographical memory statements condition was 1754.80, with a standard deviation of 549.64.

Analyses group 1a

A two-way repeated measure ANOVA was conducted to compare reaction time between congruence and correctness of autobiographical memory statements. There was a significant effect of congruence on reaction time, $F(1,38) = 100.09$, $p < .0001$, $\eta_p^2 = .705$. This effect indicated that reaction times in the incongruent condition were significantly slower than in the congruent condition.

A paired-samples t-test was conducted to compare the aIAT D-score in false and true conditions. There was no significant difference in the scores for false (M = .928, SD = .477) and true (M = .901, SD = .443) conditions, $t(39)$=.60, p = .550. Therefore, participants differed similarly on reaction times when categorizing true and false autobiographical statements between the congruent condition as they did on the incongruent condition.

Descriptives group 1b

The STAI

The participants (N = 10) had a mean STAI score of 34.11, with a standard deviation of 6.90. The empirical range was 24-45.

The SOSS

On the SOSS-scores, there was a mean score of 23.20, with a standard deviation of 4.57. The empirical range was 18-30.

The BE-checklist

There was a mean BE-checklist score of 4.00, with a standard deviation of 1.41. The empirical range was 2-7.

The MTT Quality task

Overall, the participants had a total MTT Quality task score of 4.56. The average quality score of past events was 4.92, with a standard deviation of 1.22. The average quality score of future events was 4.21, with a standard deviation of 1.05. The overall quality score had a mean of 4.56, with a standard deviation of 1.14. In Table 4, mean scores per item are shown.

Table 4

Mean score per item on the MTT Quality task

Variable	Past		Future		Total	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Visual details	5.60	1.47	4.23	0.98	4.92	1.40
Sounds	4.07	1.68	4.14	0.96	4.11	1.33
Taste/smell	2.77	1.40	4.24	0.94	3.50	1.38
Location	6.57	0.57	4.44	1.03	5.50	1.36
Spatial arrangement of objects	6.07	0.73	4.27	1.06	5.17	1.28
Spatial arrangement of people	6.00	0.97	4.21	1.09	5.11	1.36
Time of day	5.57	1.23	4.15	1.21	4.86	1.39
(P)re- experiencing emotions	4.77	1.12	4.12	1.20	4.44	1.18
Intensity of emotions	3.83	1.37	4.14	1.07	3.99	1.21
Autonoetic consciousness	3.93	1.70	4.16	0.98	4.05	1.36

The MTT Quantity task

The participants remembered a total of 442 events from the past, 317 of which were positive events and 125 of which were negative events. The participants projected a total of 361 events into the future, 294 of which were positive events and 67 of which were negative events. In Table 5, the total amount subdivided into categories is shown.

Table 5

The total amount of positive and negative events remembered from the past and projected into the future, subdivided into categories

Variable	Past		Future	
	Positive	Negative	Positive	Negative
Health and physical appearance	11	6	13	2
Family	30	22	36	10
Romance and sex	15	9	25	3
Social relationships	72	15	43	7
Money and material goods	8	2	18	1
Work	44	8	50	8
Leisure	52	0	33	1
Reflexivity	29	31	23	28
Other	56	32	53	7

The MTT Preferential task

The participants had an overall emotional valence score of 0.03, with a standard deviation of 0.59. The average emotional valence score of past events was 0.08, with a standard deviation of 0.55. The average emotional valence score of future events was -0.02, with a standard deviation of 0.63. In Table 6, the emotional valence scores divided into positive, negative and neutral conditions is shown.

Interjudge reliability of the four pairs of judges differed slightly between pairs judge1*judge3 (with a Cohen's kappa of .47), judge2*judge4 (with a Cohen's kappa of .41) and judge3*judge4 (with a Cohen's kappa of .52). These three pairs had a moderate reliability. Pair judge1*judge2 had a substantial reliability, with a Cohen's kappa of .80.

Table 6

Emotional valence scores in the past and future, divided into positive, negative and neutral conditions

Variable	Past		Future	
	Mean	Std. Deviation	Mean	Std. Deviation
Positive	2.05	0.44	2.05	0.64
Negative	-2.25	0.54	-2.05	0.64
Neutral	0.45	0.69	-0.05	0.60

Analyses group 1b

The MTT Quality task

Using a paired samples t-test, we found that the average quality of future events and the average quality of past events were strongly and positively correlated, $r(10) = .67$, $p = .033$. There was an almost significant difference between the average quality of future events and the average quality of past events, $t(9) = 2.20$, $p = .055$. This suggests that the quality of past events was almost different from the quality of future events.

Furthermore, there was a strong significant correlation between (p)re-experiencing emotions and intensity, $r(10) = .77$, $p < .01$. As well as a strong significant correlation between (p)re-experiencing emotions and autonoetic consciousness, $r(10) = .93$, $p < .01$.

The MTT Quantity task

A two-way repeated measure ANOVA was conducted to compare emotional valence scores between time and emotion. There was a significant effect of emotion on emotional valence scores, $F(1,9) = 40.18$, $p < .0001$, $\eta_p^2 = .817$. This may be due to a positive bias for positive events. The average number of positive events was 61.10 and the average number of negative events was 19.20. There was an almost significant effect of time on emotional valence

scores, $F(1,9) = 4.68$, $p = .059$, $\eta_p^2 = .342$. This suggests that emotional valence is almost different in the past than it is in the future condition.

The MTT Preferential task

A two-way repeated measure ANOVA was conducted to compare preferential scores between time and emotion. Sphericity was assumed for both variables. There was a significant effect of emotion on preferential scores, $F(2,18) = 188.32$, $p < .0001$, $\eta_p^2 = .954$. There was an almost significant interaction effect of time*emotion on preferential scores, $F(2,18) = 3.47$, $p = .053$, $\eta_p^2 = .278$.

We found a strong and significant correlation between preferential scores and sense of self, $r(10) = -.76$, $p < .05$.

A linear regression model was calculated to predict SOSS scores based on MTT preferential scores (Figure 2). A significant regression equation was found, $R^2 = .756$, $F(1,8) = 10.684$, $p = .011$. Participants' predicted SOSS scores were equal to 23.488 - 11.535. Therefore, emotional valence was a significant predictor of sense of self.

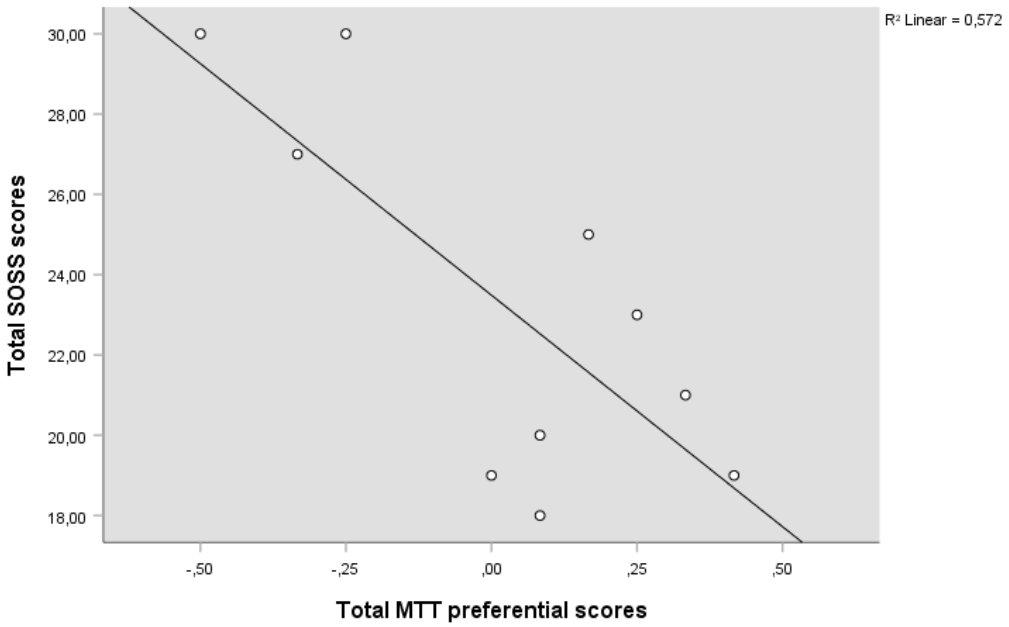

Figure 2. Total SOSS scores predicted by total MTT Preferential task scores.

For a more extensive overview of analysis, please refer to Appendices F (reliability statistics), G (aIAT statistics) and H (MTT task correlation statistics).

Discussion

This study was performed to find and validate experimental methods to investigate the link between sense of self and emotional autobiographical episodic memory. The data showed interesting results regarding the reliability of the SOSS, the STAI and the BE-checklist, the concepts measured within the MTT and relations between the different methodologies and their concepts. The aIAT did not yield significant results. This suggests that reading an emotional story is not sufficient for creating autobiographical memories. Therefore, we could not assess autobiographical memory encoding and its possible link with sense of self.

Results showed that both the SOSS and the STAI had good internal consistency. The BE-checklist results showed an unacceptable consistency. This could have several explanations, for example the many different and divergent behaviours measured in the questionnaire (Flury & Ickes, 2007). Nevertheless, because of the small sample size, internal consistency reliability of all tests should be further investigated

Results showed a significant difference in the MTT Quantity task, an emotional valence effect in the preferential task and multiple correlations between variables in the MTT Quality task.

In the MTT Quantity task, participants recalled more positive events than negative events, indicating a slight positivity bias. This is not an unknown effect; most individuals show decreased memory for failure than for success and perceive themselves as better than others perceive them (Taylor & Brown, 1988; Silverman, 1964). Moreover, individuals who have low self-esteem or are moderately depressed show a reduced positivity bias (Ruehlman, West & Pasahow, 1985). The positivity bias has several practical functions; it increases happiness

(Freedman, 1978), intellectual functioning (Greenwald, 1980) and motivation (Felson, 1984).

In addition, there was a significant effect of emotion on preferential scores. This confirmed expectations because of the nature of the task: participants were asked to write down either a positive, negative or neutral story. This undoubtedly steered their answers towards a particular emotional valence. In this way, this finding validates the emotional aspect of the MTT Preferential task.

Lastly, we found multiple correlations between certain items of the MTT Quality task. The data showed a strong correlation between (p)re-experiencing emotions and autonoetic consciousness. This could indicate a link between autonoetic consciousness and emotional encoding. Previous research shows that healthy people are able to remember having experienced a particular emotion, while in a state of autonoetic awareness. Furthermore, they can recollect specific information that made this particular event emotional, such as the sensory, perceptual or contextual details of the episodic memory (Neumann, Philippot & Danion, 2007). In addition, research by Piolino et al. (2009) stated that visual details and emotional experience are critical phenomenological characteristics of EAM retrieval. The emotional loading of an EAM is closely connected to the self-relevance and personal meaning of that EAM (Markowitsch & Staniloiu, 2011; Medford et al., 2016). This connection between the emotional loading of an EAM and its self-relevance and personal meaning could be reflected by the correlation found between (p)re-experiencing emotions and autonoetic consciousness. Furthermore, a correlation between (p)re-experiencing emotions and intensity of emotions was found. This indicated that emotional encoding of a memory (partly) relies on the intensity of the emotion. The amygdala plays a crucial part in the processing, encoding and consolidation of emotional memories (Ally, Hussey, & Donahue, 2013; Dolcos et al., 2017; Tyng, Amin, Saad, & Malik, 2017). Research by Van Stegeren et al. (2005) showed that amygdala activity increased with the emotional intensity of pictures. This suggests that the

emotional intensity of an event influences the emotional encoding. Furthermore, previous research found that the general effect of emotions on autobiographical memory properties (e.g. sensory, perceptual and emotional information) is due to the intensity of the emotion (Talarico, LaBar & Rubin, 2004). The correlation between (p)re-experiencing emotion and emotion intensity provides further evidence for the connection found between emotion intensity and emotional encoding.

In line with our expectations, a moderate correlation between the SOSS and the BE-checklist was found, suggesting that both questionnaires measure similar or connected constructs. An alternative explanation of this correlation could be causal: suggesting low sense of self behaviours cause a low sense of self. This explanation is supported by the significant predictionary value of BE-checklist scores on SOSS scores.

In addition to analyses for the validation of the measurement and validation of hypotheses, explorative analyses were conducted. We found an interesting significant correlation of SOSS scores and STAI scores and a difference in SOSS scores between a low trait anxiety group and high trait anxiety group. The data showed that low trait anxiety correlated with a high sense of self and high trait anxiety correlated with a low sense of self. This suggests that people with higher trait anxiety have a weaker sense of self. Previous research has shown that people with high trait anxiety are often self-preoccupied and have self-focused, negative thought patterns (Smith, Ingram & Brehm, 1983). Those negative thought patterns reflect mostly in the form of self-doubt, self-derogation, concern about performance and anticipation of harm or loss of self-esteem. This could be an explanation for the correlation between high trait anxiety and weak sense of self.

In addition, the exploratory analyses showed strong interdependence between anxiety and sense of self. Trait anxiety negatively predicted both sense of self and behavioural sense

of self.. The interconnectedness wherein high trait anxiety predicts a weaker sense of self reveals an important relationship which warrants further research.

Because the MTT Quantity and MTT Quality tasks measured the ability to perform mental time travel, we expected these tasks to have a relationship with sense of self. The mediating concepts of this relationship could be EAM and autonoetic consciousness (Markowitsch & Staniloiu, 2011). However, no relationship between these concepts was found.

The MTT Preferential task measured emotional valence and showed a significant relation with sense of self. A regression analysis showed that a slight preference for negatively charged memories and projections is a predictor for a weak sense of self. Previous research into the relation between personality, measured with the 'Big Five' personality questionnaire, and sense of self, measured with the SOSS, showed that higher scores on the trait neuroticism predicted a higher score on the SOSS. This indicates that more neuroticism causes a weaker sense of self (Flury & Ickes, 2007). Furthermore, neuroticism has also been shown to cause a significantly more negative valence on the MTT Preferential task (Quoidbach, Hansenne, & Mottet, 2008). Considering previous research, the predicting effect of negative valence of the MTT Preferential task on the SOSS could be moderated or mediated by the personality trait neuroticism.

In addition, previous research has shown that neuroticism and high trait anxiety are strongly correlated, suggesting that they measure extremely similar constructs (Eysenk & Eysenk, 1987). High trait anxiety relates to a negative bias in information processing (Elwood, Wolitzky-Taylor & Olatunji, 2012). Research by Thomsen et al. (2016) showed that this negative bias extends to negative interpretations in life stories. This means that high trait anxiety predicts more negative valence life stories. As mentioned before, the current study found that both high trait anxiety and a tendency for negatively charged memories/projections are predictors for a weak sense of self. Although the current study found no significant

correlation between trait anxiety and a tendency for negatively charged memories/projection, their mutual predictive value on sense of self and the similarity of neuroticism and trait anxiety indicate a connection between the two concepts. A suggestion for future research is to investigate this connection. Understanding both the interconnectivity of trait anxiety, neuroticism and negatively charged memories/projections as well as their influence on the sense of self could further the understanding of the constructs underlying sense of self.

Limitations

This experiment was conducted during the peak of the COVID-19 pandemic. This limited our research, especially the experimental phase. For example, we could not test participants in a controlled lab setting. This might have influenced the data. Participants were asked to perform the experiment in a non-distracting environment, but it is possible that not all of them complied with these instructions. Additionally, a controlled environment might have prevented the exclusion of data due to misunderstandings of the task.

Furthermore, our relatively small participant group might be the cause for the absence of some predicted results. Our participant group was small, especially for the MTT task. This increases the chance of a type I and type II error. Furthermore, most participants were University students, a skewed representation of the population, possibly resulting in a measurement bias.

Previous research has shown that the aIAT can be used to accurately determine whether a memory was autobiographical or not (Agosta & Sartori, 2013;Marini, Agosta, Mazzoni, Dalla Barba, & Sartori, 2012; Vargo, Petróczi, Shah, & Naughton, 2014; Takarangi, Strange & Houghton, 2015). However, the aIAT, when used with statements about an emotional story rather than one's own autobiographical memories, did not seem to assess autobiographical memory. Furthermore, Lanciano, Curci, Mastandrea and Sartori (2013) hypothesized that the aIAT is an implicit memory task, which would mean that task performance is driven by feelings

of familiarity. This familiarity causes people to make an automatic assessment to determine the truth or falseness of events. Previous research has shown that familiarity can influence aIAT results (Takarangi, Strange & Houghton, 2015). The results of the current suggest that this familiarity effect was not present in this participant group, which is most likely due to the artificially constructed memory.

A suggestion for future research is to collect participants' autobiographical memories beforehand and use the participants' own memories in the aIAT task. Due to the current circumstances and time constraints , we were not able to do so. Furthermore, the number of participants may have influenced the results of a study. It is therefore important for future research to include more participants.

The MTT task is a relatively new experiment that has not yet received a great deal of attention. Therefore, we propose more thorough research on this task, evaluating more profoundly what constructs it actually measures. Another suggestion to improve the validity of the MTT task is to add measures in order to control for potentially extraneous variables, like verbal fluency.

Future research should also include a personality questionnaire to better understand the relation between negative valence of the MTT task and its predictive value on the SOSS. Moreover, it might give more insights into the relation between higher trait anxiety and weaker sense of self.

Conclusion

This research aimed to investigate and validate methodologies to measure sense of self, EAM, underlying concepts and their connections.

Results show a good internal consistency of the SOSS and a relationship between SOSS scores, BE-checklist scores and STAI scores. Furthermore, we found a strong predictive value

of negative emotional valence on low sense of self. Both autonoetic consciousness and emotional intensity were found to have a significant correlation with (p)re-experiencing emotions.

Evidence was provided for the SOSS and BE-checklist being good measurements for indicating a weak or strong sense of self in participants. Relations between different mental time traveling aspects indicated a link between autonoetic consciousness and emotional encoding and indicated a dependency of emotional encoding on the intensity of emotions. Although a general positive bias was found, the relationship between low sense of self and negative emotional valence suggested a slightly negative bias in individuals with a weak sense of self. This relationship might be mediated or moderated by the strongly connected constructs trait anxiety and neuroticism. The strong relations we showed between trait anxiety, sense of self and behavioural sense of self, suggest that the inclusion of personality characteristics in future research is of the essence. However, more research is needed to determine causal relationships and to further improve this research paradigm.

The goal of this research was to take a first step in investigating methods that can be used in future research with UWD patients to investigate the role of the BLA in autobiographical episodic memory and sense of self. The development of such models is of the essence because research into the sense of self in UWD patients could add to the understanding of the neural correlates of the self and connected constructs.

In sum, this study strongly suggests a potential usability for questionnaires and tasks that can be used to measure the link between sense of self, EAM and their underlying concepts. It provides other researchers with a possible conceptual and methodological framework to study the sense of self. And in this way, it brings us closer to unravelling the complex sense of self, EAM, connected concepts and their neural substrates.

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Appendix A
Translated Sense of Self Scale (Dutch)

1. Ik zou willen dat mijn gevoelens meer consistent zijn.
2. Ik vind het moeilijk om mijn persoonlijkheid, interesses en meningen te begrijpen.
3. Ik denk vaak na over de kwetsbaarheid van mijn bestaan.
4. Ik heb een redelijk idee van mijn langetermijndoelen in het leven.
5. Ik vraag me soms af of mensen mij wel echt kunnen zien.
6. De gedachten en gevoelens van andere mensen zijn waardevoller dan mijn eigen gedachten en gevoelens.
7. Ik weet precies wie ik ben en waar ik voor sta.
8. Ik vind het vervelend dat ik mijn persoonlijkheid niet duidelijk kan omschrijven.
9. Ik weet niet of ik mijn eigen gedachten en gevoelens kan begrijpen of vertrouwen.
10. ‘Wie ben ik?’ is een vraag die ik mijzelf regelmatig stel.
11. Ik heb anderen nodig om te begrijpen wat ik denk en hoe ik me voel.
12. Ik ben zeker van mijzelf en blijf bij mijn eigen principes, zelfs als de groep waarmee ik ben een andere mening heeft.

Appendix B

Translated Behavioural Experience Checklist (Dutch)

1. Ik houd een dagboek bij.
2. In de laatste maand heb ik mijn eigen mening in het openbaar verdedigd.
3. Ik heb een stappenplan om mijn carrièredoelen te behalen.
4. Ik heb recent het gevoel gehad dat ik onzichtbaar ben in sociale situaties.
5. Ik heb recent moeite gehad met het doen van grote aankopen, omdat ik niet wist of ik het leuk zou vinden of niet.
6. Ik heb in het afgelopen jaar een petitie of een politiek standpunt ondertekend.
7. Ik heb in de afgelopen zes maanden een kledingstuk gekocht dat helemaal niet bij mij past.
8. Ik heb in de laatste tijd, wanneer ik in de spiegel keek, soms gedacht dat ik mezelf niet meer herkende.
9. De inrichting en decoratie van mijn kamer reflecteren mijn persoonlijkheid.
10. In de afgelopen maand heb ik mijzelf de vraag ‘Wie ben ik?’ in ieder geval 1 keer gesteld.
11. Ik druk een persoonlijke stempel op alles wat ik doe.
12. In de afgelopen maand heb ik vrienden en familie gevraagd wat ze denken over een kwestie om mijn eigen mening te vormen.
13. Wanneer ik mijn persoonlijkheid beschrijf aan anderen gebruik ik expres vage en algemene termen, voor het geval dat mijn persoonlijkheid kort daarna zou veranderen.
14. In de afgelopen maand heb ik een discussie gehad over een kwestie waar ik een sterke mening over heb.
15. Ik heb in het afgelopen half jaar een groep vrienden laten weten dat ik niet meeging in hun planning tijdens een avondje uit (ik heb ze laten weten dat ik mijn avond liever op een andere manier besteed dan dat zij hadden gepland).

Appendix C

MTT Script and forms (Dutch)

Draaiboek MTT

Pre-assessment

Zorg dat alles klaar ligt voordat de participant er is, zodat jullie direct kunnen beginnen.

Benodigdheden:

- Laptop
- Gorilla.sc (link)
- Pennen
- Opname apparatuur
- Formulieren onderdeel 2 en 3
- Toestemmingsformulier

Het onderzoek bestaat uit 5 delen:

1. Welkom
2. Demografische vragenlijst; SOSS; Checklist experience/behaviour
3. MTT
4. IAT
5. Afsluiten

Welkom

Benodigdheden: Laptop, internet, Gorilla.sc

Participanten worden verwelkomd door de onderzoeker. Dit houdt in dat de onderzoeker zichzelf voorstelt en de participant begeleidt naar een kamer met bureau waar het onderzoek in alle rust kan worden afgenomen. De participant krijgt een plaats aangeboden tegenover de onderzoeker. Daarna bespreekt de onderzoeker kort het onderzoek en toestemmingsformulier, en geeft de participant de kans om vragen te stellen. Tot slot vraagt de onderzoeker de participant om het toestemmingsformulier (elektronisch) te ondertekenen.

> *"Welkom, fijn dat je mee wilt doen aan dit onderzoek. Mijn naam is … en ik neem vandaag het onderzoek bij jou af. Zou je daar plaats willen nemen?*
>
> *Allereerst, fijn dat je mee wilt doen met ons pilot onderzoek. Het doel van deze pilot is onderzoeken of bepaalde methoden geschikt zijn om zelfbewustzijn te meten. Het onderzoek bestaat uit verschillende delen. Je gaat zo direct beginnen met het invullen van een aantal vragenlijsten. Daarna volgt een interview en tot slot een experimentele taak. Het zal in totaal ongeveer 1,5 tot 2 uur duren.*
>
> *Het is belangrijk om te weten dat dit onderzoek volledig vrijwillig is en dat je op ieder moment mag stoppen, zonder dat je daar een reden voor hoeft te geven. Verder*

worden je gegevens anoniem opgeslagen, wat inhoud dat niemand jouw antwoorden aan jou kan terugkoppelen.

Heb je nog vragen over het onderzoek of hoe er met jouw data omgegaan wordt? Heb je verder nog vragen of wil je nog iets kwijt? Zou je het toestemmingsformulier dan willen doorlezen en ondertekenen?".

Demographic questions, Sense Of Self Scale (SOSS) en Checklist of self-expressive behaviours and experiences

Benodigdheden: Laptop, Internet, Gorilla.sc

De online participanten krijgen geen participant nummer. De participant die het MTT onderdeel doen wel. De participant nummers lopen op van 1 tot 10. Geef de participant de laptop waar het experiment IAT_Amygdala geopend klaar staat. (Als het goed is staat deze al open en kan de participant op volgende drukken en beginnen). Vertel de participant dat dit onderdeel uit demografische vragen bestaat en twee vragenlijsten.

"Het eerste onderdeel bestaat uit een aantal demografische vragen en 2 vragenlijsten. Een van de demografische vragen gaat over je participant nummer. Jouw participant nummer is … . Geef een seintje wanneer je het vragenlijsten onderdeel hebt afgerond. Als je een vraag niet snapt of verheldering wilt kun je dat altijd vragen. Heb je nog vragen? Dan kan je nu beginnen, succes!"

Mental Time Travel (MTT) task

Benodigdheden: Recorder, Timer, Pen, Formulieren onderdeel 2, Formulieren onderdeel 3.

Nadat de SOSS is afgenomen gaan we door met de Mental Time Travel taak. Deze bestaat uit drie onderdelen. In het eerste onderdeel gaat het om de hoeveelheid herinneringen of toekomstige gebeurtenissen de participant kan herinneren/inbeelden binnen een bepaalde tijd.

"We gaan nu beginnen met de volgende taak. Deze zal in 3 onderdelen worden afgenomen en zal ongeveer … minuten/uur duren. Alle antwoorden tijdens dit onderdeel zullen worden opgenomen. Uiteraard worden de opnames alleen gebruikt voor het verwerken van de resultaten en daarna verwijderd."

Onderdeel 1

"Tijdens het eerste onderdeel ga ik je vragen om je persoonlijke gebeurtenissen van 6 tijdsperiodes in te beelden. De bedoeling is dat je bij iedere periode ***zoveel mogelijk*** *herinneringen of toekomstige gebeurtenissen ophaalt binnen 3 minuten. De gebeurtenissen waar je over verteld, mogen zo belangrijk of onbelangrijk zijn als je zelf wilt, met andere woorden je mag vertellen wat je wilt. Het is alleen wel de bedoeling dat toekomstige gebeurtenissen waar je over vertelt daadwerkelijk gaan gebeuren óf gebeurtenissen zijn waarvan het aannemelijk is dat ze gaan gebeuren. Is dit onderdeel duidelijk of heb je nog vragen?"*

> *Je krijgt nu van mij 3 minuten. Probeer **zoveel mogelijk** specifieke emotionele ervaringen of gebeurtenissen te bedenken van de **afgelopen week** en aan mij te vertellen. Ben je er klaar voor? Dan start ik nu de timer."*

Na 3 minuten geef je aan dat de tijd voorbij is en dat jullie doorgaan naar de volgende tijdsperiode.

Herhaal dit voor de tijdsperiodes:

1. volgende week
2. afgelopen jaar
3. aankomend jaar
4. afgelopen 5 tot 10 jaar
5. aankomende 5 tot 10 jaar.

Wanneer de participant bij alle 6 de tijdsperiodes 3 minuten de tijd heeft gehad om zoveel mogelijk herinneringen/projecties te delen, ga je door met het volgende onderdeel.

> *"Dankjewel, we gaan nu door naar het volgende onderdeel van deze taak. Wil je gelijk door met het volgende onderdeel of wil je eerst een korte pauze?*

Onderdeel 2

Dit is een 'sentence-completion task'. Het is dus de bedoeling dat de participant aan de hand van een zin een herinnering/projectie deelt.

> *"Bij dit onderdeel is het de bedoeling dat je aan de hand van één zin een kort verhaal schrijft die aan jouzelf is gerelateerd. Het is de bedoeling dat je het verhaal koppelt aan een gebeurtenis in jouw verleden of aan een gebeurtenis die nog kan of gaat gebeuren. Daarnaast moet elk verhaal aan een negatieve, positieve of neutrale gebeurtenis gekoppeld worden. Je krijgt van mij zes zinnen. Het is dus de bedoeling dat je uiteindelijk 1 negatief, 1 positief en 1 neutraal verhaal gebaseerd op een gebeurtenis in het verleden en 1 negatief, 1 positief en 1 neutraal verhaal gebaseerd op een gebeurtenis die nog kan of gaat gebeuren met mij deelt. Een verhaaltje hoeft niet langer dan 10 tot 15 zinnen te zijn. Is dit duidelijk? Heb je nog vragen?"*

Elke keer geef je de participant het formulier dat bij de zin hoort met daarop de betreffende zin en ruimte om een antwoord op uit te schrijven.

> *Het eerste verhaal begint met de volgende zin: **Ik keek naar mezelf in de spiegel…** Koppel het verhaal aan een **negatieve** gebeurtenis in je **verleden**. Het maakt nu niet uit hoe lang geleden. Hier is het formulier.*
>
> *Dankjewel, het tweede verhaal begint met de volgende zin: **Ik liep door de straat…** Koppel dit verhaal aan een **positieve** gebeurtenis in je **verleden**.*
>
> *Dankjewel, de derde zin is: **Ik stond in de keuken…** Koppel dit verhaal aan een **neutrale** gebeurtenis in je **verleden**.*
>
> *Dankjewel, nu gaan we door met verhalen over gebeurtenissen die nog kunnen of gaan gebeuren. De zin is: **Ik luister naar muziek…** Koppel dit verhaal aan een **negatieve** gebeurtenis die **nog moet of kan gebeuren.***

> *Dankjewel, de volgende zin is:* ***Ik lig op het strand…*** *Koppel het verhaal aan een* ***positieve*** *gebeurtenis die* ***nog moet of kan gebeuren****.*
>
> *Dankjewel, tot slot dit is de laatste zin:* ***Ik zit in de bus…*** *Koppel dit verhaal aan een* ***neutrale*** *gebeurtenis die* ***nog moet of kan gebeuren****."*

Wanneer de participant alle verhaaltjes heeft geschreven ga je door naar het volgende onderdeel.

> *"Dankjewel, we gaan nu door naar het laatste onderdeel van deze taak. Wil je gelijk door met het volgende onderdeel of wil je eerst een korte pauze?*

Onderdeel 3

Het doel van dit onderdeel is om kwaliteit van herinneringen of projecties in de toekomst te beoordelen. We doen dit door de participant te vragen een specifieke en gedetailleerde herinnering/projectie in te beelden. Deze wordt vervolgens door de participant kort opgeschreven en beoordeeld op het beoordelingsformulier.

> *"Dan zijn we nu aangekomen bij het laatste onderdeel van deze taak. We vragen je om je een persoonlijke gebeurtenis in te beelden voor 6 verschillende tijdsperiodes. Deze gebeurtenis kan hetzelfde zijn als een gebeurtenis die je in de taak hiervoor hebt beschreven. Het is de bedoeling dat je de gebeurtenis zo gedetailleerd mogelijk voor je ziet. Elke keer als je je een gebeurtenis herinnert of een aankomende gebeurtenis voor jezelf hebt bedacht, vraag ik je om deze kort op te schrijven en de herinnering/projectie vervolgens te beoordelen op het formulier. Heb je nog vragen?"*

Elke participant krijgt per herinnering/projectie een blad met daarop ruimte om de gebeurtenis op te schrijven en de beoordelingsvragen met daaronder een 7-punt Likert schaal.

Voer dit uit voor de volgende tijdsperiodes:

1. vorige week
2. volgende week
3. afgelopen jaar
4. aankomend jaar
5. afgelopen 5 tot 10 jaar
6. aankomende 5 tot 10 jaar.

> *"Dankjewel, dan zijn we nu aangekomen bij het einde van deze taak. Ik stel voor dat we heel even een korte pauze inlassen en dat we daarna door gaan met het volgende onderdeel."*

Experiment (IAT)

<u>Benodigdheden:</u> Laptop, Internet, Gorilla.sc

Het laatste deel van dit onderzoek is een Implicit Association Task. Deze wordt gedaan in Gorilla. Deze participanten hebben al het eerste deel van het online onderzoek doorlopen. Na de MTT kunnen ze volgende drukken waar ze gebleven waren en door met de IAT. De instructie van de IAT komen op het scherm te staan.

"Dit is het laatste onderdeel van het onderzoek en duurt ongeveer 20 minuten. Je kunt nu op volgende drukken.

Is het zo duidelijk of heb je nog vragen? Dan kun je beginnen door op de spatiebalk te drukken, succes!".

Afsluiting

"Ontzettend bedankt voor het meedoen aan ons onderzoek. Heb je nog vragen over een van de onderdelen? Wil je op de hoogte gehouden worden van het onderzoek?"

Formulier 1 (example)

MTT onderdeel 2

Datum: ……

Participant nummer: ……

Schrijf de zin om een verhaaltje te schrijven gekoppeld aan een gebeurtenis in jouw verleden/toekomst.

<u>Schrijf een verhaaltje gekoppeld aan negatieve gebeurtenis in jouw verleden.</u>

Ik keek naar mezelf in de spiegel …..……

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

Formulier 2 (example)

MTT onderdeel 3

Datum: ……..

Participant Nummer: ……..

Geef een korte beschrijving van een gebeurtenis die **aankomend jaar** gaat gebeuren.

……
……
……
……
……
……
……
……
……
……

Appendix D

aIAT storyline and statements

Sentence 1

“Stel je voor dat je op een woensdagochtend met je zoontje vertrekt van huis. Je neemt hem mee naar de werkplek van zijn vader.”

[Boy with backpack] (2020). Retrieved from https://www.verywellfamily.com/graduation-gifts-for-preschool-2764677

Sentence 2

“Jouw man werkt als een technicus in het Utrecht Medisch Centrum (UMC). Jij en je zoontje moeten een drukke straat kruisen en kijken goed om je heen voordat jullie oversteken.”

[UMC Utrecht] (2020). Retrieved from https://students.uu.nl/sites/default/files/images/gebouw-umc-1800x1200p-5.jpg

Sentence 3

“Hoewel je heel goed oplette, raakt je zoontje ernstig gewond bij een vreselijk ongeluk.”

[Car accident] (2018). Retrieved from https://www.omroepbrabant.nl/nieuws/2694950/verkeerde-inhaalmanoeuvre-vermoedelijk-oorzaak-dodelijk-ongeluk-zundert

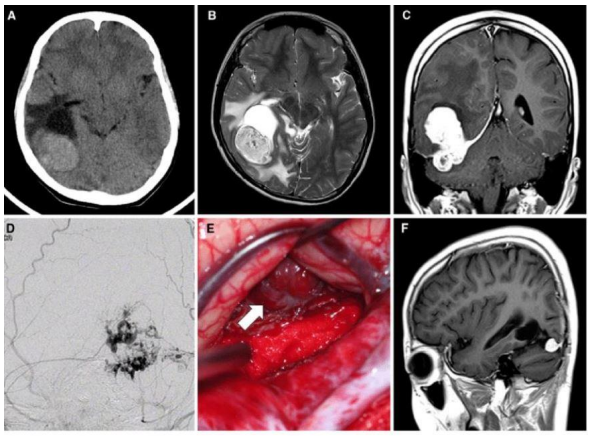
Sentence 4

“In het ziekenhuis wordt je zoontje met spoed naar de eerste hulp gebracht.”

[Emergency room] (2018). Retrieved from http://www.carthagehospital.com/emergency-facility-description/

Sentence 5

“Er wordt een foto gemaakt van zijn hersenen met een hersenscan apparaat. De foto laat een ernstige bloeding zien.”



[Brain scan] (2012). Retrieved from https://www.researchgate.net/figure/mages-from-a-13-year-old-boy-case-II-a-Brain-CT-scan-reveals-a-mass-in-the-right_fig2_224868281

Sentence 6

“De hele ochtend lang worstelt het chirurgisch team om zijn leven te redden.”

[Operation room] (2012). Retrieved from https://www.researchgate.net/figure/mages-from-a-13-year-old-boy-case-II-a-Brain-CT-scan-reveals-a-mass-in-the-right_fig2_224868281

Sentence 7

“Het lukte de specialistische chirurgen om de afgehakte voeten van de jongen opnieuw te bevestigen.”

[Legs support] (2016). Retrieved from https://www.researchgate.net/figure/Apply-SCD-and-feet-support-during-operation_fig1_305986804

Sentence 8

“Na de operatie blijft zijn vader wachten naast het bed van de jongen, terwijl jij de ruimte verlaat om de kleuterschool van je andere kind te bellen. Je voelt je radeloos. Je pakt je telefoon en typt het nummer van de kleuterschool in om te zeggen dat je je dochtertje snel zal komen ophalen.”

[Boy operation] (2020). Retrieved from https://www.telemundo47.com/noticias/salud/coronavirus/un-nino-sano-de-nueva-york-termino-en-un-respirador-despues-de-sufrir-un-paro-cardiaco/2051178/

Sentence 9

“Nadat je nog een laatste blik werpt op je gewonde zoon, loop je het ziekenhuis uit. Je belt een taxi op het moment dat je bij bushalte nummer negen aankomt.”

[Taxi] (2020). Retrieved from https://www.taxidegroen.nl/theatertaxi

Appendix E

aIAT statements

Autobiographical true statements

1. De hersenscan liet een bloeding zien
2. Mijn zoon raakte gewond
3. Zijn voeten waren afgehakt
4. Ik had goed gekeken voor we overstaken
5. Ik belde de taxi bij bushalte 9

Autobiographical false statements

1. De hersenscan liet een tumor zien
2. Mijn dochter raakte gewond
3. Zijn handen waren afgehakt
4. Ik belde de taxi bij bushalte 12
5. Ik had niet gekeken voor we overstaken

Obviously true statements

1. Ik ben een vrouw
2. Ik doe een test
3. Ik ben in Nederland
4. Ik ben een mens
5. Het is 2020

Obviously false statements

1. Ik ben een man
2. Het sneeuwt
3. Het is 1999
4. Ik ben in China
5. Ik ben president

Appendix F

Reliability statistics

```
RELIABILITY

 /VARIABLES=angst1r angst2 angst3r angst4 angst5 angst6r angst7r angst8
angst9 angst10r angst11
  angst12 angst13r angst14r angst15r angst16r angst17 angst18 angst19r
angst20
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /SUMMARY=TOTAL.
```

Reliability

Notes		
Output Created		28-JUN-2020 18:06:45
Comments		
Input	Data	\\Client\C$\Users\HP\Documents\SPSS AMYGDALA SNS\SPSSALLDATA.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=angst1r angst2 angst3r angst4 angst5 angst6r angst7r angst8 angst9 angst10r angst11 angst12 angst13r angst14r angst15r angst16r angst17 angst18 angst19r angst20 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00,02

	Elapsed Time	00:00:00,05

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	52	100,0
	Excluded[a]	0	,0
	Total	52	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,906	20

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
angst1r	38,2692	78,083	,446	,904
angst2	37,7115	76,837	,474	,904
angst3r	38,1154	75,790	,552	,902
angst4	38,0000	75,529	,515	,903
angst5	38,1346	73,413	,621	,900
angst6r	37,5769	75,112	,489	,903
angst7r	37,9615	74,665	,583	,901
angst8	38,1923	74,747	,609	,900
angst9	37,2692	75,965	,397	,907
angst10r	38,2308	74,691	,656	,899
angst11	38,1154	74,261	,585	,901
angst12	37,8269	74,264	,592	,901
angst13r	38,4038	77,069	,553	,902
angst14r	38,2500	75,407	,648	,900
angst15r	37,5769	74,759	,483	,904
angst16r	38,2500	76,270	,538	,902
angst17	37,5000	74,843	,539	,902
angst18	38,0192	74,215	,659	,899
angst19r	37,8077	76,511	,351	,908
angst20	38,0577	72,722	,732	,897

```
RELIABILITY
 /VARIABLES=SOSS1 SOSS2 SOSS3 SOSS4R SOSS5 SOSS6 SOSS7R SOSS8 SOSS9 SOSS10
SOSS11 SOSS12R
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /SUMMARY=TOTAL.
```

Reliability

Notes		
Output Created		28-JUN-2020 18:07:07
Comments		
Input	Data	\\Client\C$\Users\HP\Documents\SPSS AMYGDALA SNS\SPSSALLDATA.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=SOSS1 SOSS2 SOSS3 SOSS4R SOSS5 SOSS6 SOSS7R SOSS8 SOSS9 SOSS10 SOSS11 SOSS12R /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00,05
	Elapsed Time	00:00:00,05

Scale: ALL VARIABLES

Case Processing Summary			
		N	%
Cases	Valid	52	100,0
	Excluded[a]	0	,0
	Total	52	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,760	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SOSS1	22,94	24,840	,327	,754
SOSS2	23,67	23,950	,607	,720
SOSS3	23,27	25,769	,263	,760
SOSS4R	23,02	26,568	,222	,763
SOSS5	23,40	25,030	,409	,742
SOSS6	23,06	26,134	,276	,757
SOSS7R	23,15	25,741	,537	,735
SOSS8	23,52	24,215	,518	,729
SOSS9	23,42	24,367	,541	,727
SOSS10	23,27	23,730	,476	,733
SOSS11	23,40	25,422	,360	,747
SOSS12R	23,31	26,178	,335	,750

```
RELIABILITY
 /VARIABLES=BE_1 BE_2 BE_3 BE_4r BE_5r BE_6 BE_7r BE_8r BE_9 BE_10r BE_12r
BE_13r BE_11 BE_14 BE_15
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created		28-JUN-2020 18:07:24
Comments		
Input	Data	\\Client\C$\Users\HP\Documents\SPSS AMYGDALA SNS\SPSSALLDATA.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
	Matrix Input	

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=BE_1 BE_2 BE_3 BE_4r BE_5r BE_6 BE_7r BE_8r BE_9 BE_10r BE_12r BE_13r BE_11 BE_14 BE_15 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,05

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	52	100,0
	Excluded[a]	0	,0
	Total	52	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,204	15

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
BE_1	4,5192	3,117	,035	,201
BE_2	5,2308	3,083	,077	,187
BE_3	4,6538	3,250	-,100	,262
BE_4r	5,0000	2,745	,195	,123
BE_5r	5,0769	3,053	,021	,210
BE_6	5,1346	2,903	,146	,154
BE_7r	4,9808	3,000	,032	,206
BE_8r	5,1923	2,943	,158	,154

BE_9	5,1923	3,452	-,214	,290
BE_10r	4,9231	2,700	,209	,113
BE_12r	4,6731	3,283	-,121	,273
BE_13r	5,3462	3,133	,292	,166
BE_11	4,8462	2,564	,295	,063
BE_14	5,2500	3,054	,122	,173
BE_15	5,0962	3,226	-,082	,253

```
GLM RT_3T RT_3F RT_5T RT_5F
 /WSFACTOR=congruence 2 Polynomial autobiographical 2 Polynomial
 /METHOD=SSTYPE(3)
 /PRINT=DESCRIPTIVE ETASQ
 /CRITERIA=ALPHA(.05)
 /WSDESIGN=congruence autobiographical congruence*autobiographical.
```

Appendix G
aIAT statistics

General Linear Model

Notes		
Output Created		28-JUN-2020 18:15:51
Comments		
Input	Active Dataset	DataSet3
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	51
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM RT_3T RT_3F RT_5T RT_5F /WSFACTOR=congruence 2 Polynomial autobiographical 2 Polynomial /METHOD=SSTYPE(3) /PRINT=DESCRIPTIVE ETASQ /CRITERIA=ALPHA(.05) /WSDESIGN=congruence autobiographical congruence*autobiographical .
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

Within-Subjects Factors		
Measure: MEASURE_1		
congruence	autobiographical	Dependent Variable
1	1	RT_3T
	2	RT_3F
2	1	RT_5T
	2	RT_5F

Descriptive Statistics

	Mean	Std. Deviation	N
RT_3T	1028,11983521 2677100	170,686170691 044500	39
RT_3F	1015,38057325 8075200	148,107044307 778520	39
RT_5T	1754,81254937 0686400	528,285147688 734400	39
RT_5F	1754,80442559 0306700	549,640569614 270500	39

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df
congruence	Pillai's Trace	,725	100,090[b]	1,000	38,000
	Wilks' Lambda	,275	100,090[b]	1,000	38,000
	Hotelling's Trace	2,634	100,090[b]	1,000	38,000
	Roy's Largest Root	2,634	100,090[b]	1,000	38,000
autobiographical	Pillai's Trace	,001	,042[b]	1,000	38,000
	Wilks' Lambda	,999	,042[b]	1,000	38,000
	Hotelling's Trace	,001	,042[b]	1,000	38,000
	Roy's Largest Root	,001	,042[b]	1,000	38,000
congruence * autobiographical	Pillai's Trace	,001	,040[b]	1,000	38,000
	Wilks' Lambda	,999	,040[b]	1,000	38,000
	Hotelling's Trace	,001	,040[b]	1,000	38,000
	Roy's Largest Root	,001	,040[b]	1,000	38,000

Multivariate Tests[a]

Effect		Sig.	Partial Eta Squared
congruence	Pillai's Trace	,000	,725
	Wilks' Lambda	,000	,725
	Hotelling's Trace	,000	,725
	Roy's Largest Root	,000	,725
autobiographical	Pillai's Trace	,838	,001
	Wilks' Lambda	,838	,001
	Hotelling's Trace	,838	,001
	Roy's Largest Root	,838	,001
congruence * autobiographical	Pillai's Trace	,843	,001
	Wilks' Lambda	,843	,001
	Hotelling's Trace	,843	,001
	Roy's Largest Root	,843	,001

a. Design: Intercept
Within Subjects Design: congruence + autobiographical + congruence * autobiographical

b. Exact statistic

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]
					Greenhouse-Geisser
congruence	1,000	,000	0	.	1,000
autobiographical	1,000	,000	0	.	1,000
congruence * autobiographical	1,000	,000	0	.	1,000

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Epsilon	
	Huynh-Feldt	Lower-bound
congruence	1,000	1,000
autobiographical	1,000	1,000
congruence * autobiographical	1,000	1,000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.[a]

a. Design: Intercept
Within Subjects Design: congruence + autobiographical + congruence * autobiographical

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
congruence	Sphericity Assumed	20957603,419	1	20957603,419
	Greenhouse-Geisser	20957603,419	1,000	20957603,419
	Huynh-Feldt	20957603,419	1,000	20957603,419
	Lower-bound	20957603,419	1,000	20957603,419
Error(congruence)	Sphericity Assumed	7956710,345	38	209387,114
	Greenhouse-Geisser	7956710,345	38,000	209387,114
	Huynh-Feldt	7956710,345	38,000	209387,114
	Lower-bound	7956710,345	38,000	209387,114
autobiographical	Sphericity Assumed	1584,334	1	1584,334
	Greenhouse-Geisser	1584,334	1,000	1584,334
	Huynh-Feldt	1584,334	1,000	1584,334
	Lower-bound	1584,334	1,000	1584,334
Error(autobiographical)	Sphericity Assumed	1422680,893	38	37438,971
	Greenhouse-Geisser	1422680,893	38,000	37438,971
	Huynh-Feldt	1422680,893	38,000	37438,971
	Lower-bound	1422680,893	38,000	37438,971

congruence * autobiographical	Sphericity Assumed	1580,298	1	1580,298
	Greenhouse-Geisser	1580,298	1,000	1580,298
	Huynh-Feldt	1580,298	1,000	1580,298
	Lower-bound	1580,298	1,000	1580,298
Error(congruence*autobiographical)	Sphericity Assumed	1505338,575	38	39614,173
	Greenhouse-Geisser	1505338,575	38,000	39614,173
	Huynh-Feldt	1505338,575	38,000	39614,173
	Lower-bound	1505338,575	38,000	39614,173

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		F	Sig.	Partial Eta Squared
congruence	Sphericity Assumed	100,090	,000	,725
	Greenhouse-Geisser	100,090	,000	,725
	Huynh-Feldt	100,090	,000	,725
	Lower-bound	100,090	,000	,725
Error(congruence)	Sphericity Assumed			
	Greenhouse-Geisser			
	Huynh-Feldt			
	Lower-bound			
autobiographical	Sphericity Assumed	,042	,838	,001
	Greenhouse-Geisser	,042	,838	,001
	Huynh-Feldt	,042	,838	,001
	Lower-bound	,042	,838	,001
Error(autobiographical)	Sphericity Assumed			
	Greenhouse-Geisser			
	Huynh-Feldt			
	Lower-bound			
congruence * autobiographical	Sphericity Assumed	,040	,843	,001
	Greenhouse-Geisser	,040	,843	,001
	Huynh-Feldt	,040	,843	,001
	Lower-bound	,040	,843	,001
Error(congruence*autobiographical)	Sphericity Assumed			
	Greenhouse-Geisser			
	Huynh-Feldt			
	Lower-bound			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	congruence	autobiographical	Type III Sum of Squares	df
congruence	Linear		20957603,419	1
Error(congruence)	Linear		7956710,345	38

autobiographical		Linear	1584,334	1
Error(autobiographical)		Linear	1422680,893	38
congruence * autobiographical	Linear	Linear	1580,298	1
Error(congruence*autobiographical)	Linear	Linear	1505338,575	38

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	congruence	autobiographical	Mean Square	F	Sig.
congruence	Linear		20957603,419	100,090	,000
Error(congruence)	Linear		209387,114		
autobiographical		Linear	1584,334	,042	,838
Error(autobiographical)		Linear	37438,971		
congruence * autobiographical	Linear	Linear	1580,298	,040	,843
Error(congruence*autobiographical)	Linear	Linear	39614,173		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	congruence	autobiographical	Partial Eta Squared
congruence	Linear		,725
Error(congruence)	Linear		
autobiographical		Linear	,001
Error(autobiographical)		Linear	
congruence * autobiographical	Linear	Linear	,001
Error(congruence*autobiographical)	Linear	Linear	

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	300661848,573	1	300661848,573	869,419	,000	,958
Error	13141128,090	38	345819,160			

```
T-TEST PAIRS=DscoreT WITH DscoreF (PAIRED)
 /CRITERIA=CI(.9500)
 /MISSING=ANALYSIS.
```

Appendix H

MTT correlation statistics

T-Test

Notes		
Output Created		28-JUN-2020 18:16:06
Comments		
Input	Active Dataset	DataSet3
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	51
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=DscoreT WITH DscoreF (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	D-scoreT	,901420074685302	39	,443229240503143	,070973479994199
	D-scoreF	,928209645332401	39	,476570823074384	,076312406056272

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	D-scoreT & D-scoreF	39	,820	,000

Paired Samples Test				
	Paired Differences			
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference

					Lower
Pair 1	D-scoreT - D-scoreF	-,026789570647099	,277617685742728	,044454407481624	-,116782813713050

Paired Samples Test					
		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	D-scoreT - D-scoreF	,063203672418853	-,603	38	,550

```
DATASET ACTIVATE DataSet1.
CORRELATIONS
 /VARIABLES=TOT_angst TOT_SOSS BEtotal_sum MTT_Quant_Past_pos
MTT_Quant_Past_neg MTT_Quant_Fut_pos
  MTT_Quant_Fut_neg Preferential_Total_average Qualityofrepresentation
Temporalinformation
  Preexperiencingemoties Intensity Autonoeticconsciousness
 /PRINT=TWOTAIL NOSIG
 /STATISTICS DESCRIPTIVES
 /MISSING=PAIRWISE.
```

Correlations

Notes		
Output Created		28-JUN-2020 18:21:06
Comments		
Input	Data	\\Client\C$\Users\HP\Documents\SPSS AMYGDALA SNS\MTT_SPSSdataMETCATEGOR.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		CORRELATIONS /VARIABLES=TOT_angst TOT_SOSS BEtotal_sum

		MTT_Quant_Past_pos MTT_Quant_Past_neg MTT_Quant_Fut_pos MTT_Quant_Fut_neg Preferential_Total_average Qualityofrepresentation Temporalinformation Preexperiencingemoties Intensity Autonoeticconsciousness /PRINT=TWOTAIL NOSIG /STATISTICS DESCRIPTIVES /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00,06
	Elapsed Time	00:00:00,06

[DataSet1] \\Client\C$\Users\HP\Documents\SPSS AMYGDALA SNS\MTT_SPSSdataMETCATEGOR.sav

Descriptive Statistics

	Mean	Std. Deviation	N
TOT_angst	34,10	6,903	10
TOT_SOSS	23,20	4,566	10
BEtotal_sum	4,00	1,414	10
MTT_Quant_Past_pos	31,70	15,959	10
MTT_Quant_Past_neg	12,50	6,721	10
MTT_Quant_Fut_pos	29,40	6,653	10
MTT_Quant_Fut_neg	6,70	3,889	10
Preferential_Total_average	,0250	,29930	10
Quality of representation	4,7333	,80072	10
Temporal information	4,5625	,78696	10
Pre/experiencing emoties	4,5125	1,17983	10
Intensity	3,5167	1,04660	10
Autonoetic consciousness	3,7375	1,18407	10

Correlations

		TOT_angst	TOT_SOSS	BEtotal_sum	MTT_Quant_Past_pos	MTT_Quant_Past_neg
TOT_angst	Pearson Correlation	1	,373	,250	-,221	,471
	Sig. (2-tailed)		,288	,485	,540	,170
	N	10	10	10	10	10
TOT_SOSS	Pearson Correlation	,373	1	-,155	,175	,387
	Sig. (2-tailed)	,288		,669	,629	,269

	N	10	10	10	10	10
BEtotal_sum	Pearson Correlation	,250	-,155	1	-,231	,257
	Sig. (2-tailed)	,485	,669		,520	,473
	N	10	10	10	10	10
MTT_Quant_Past_pos	Pearson Correlation	-,221	,175	-,231	1	-,052
	Sig. (2-tailed)	,540	,629	,520		,886
	N	10	10	10	10	10
MTT_Quant_Past_neg	Pearson Correlation	,471	,387	,257	-,052	1
	Sig. (2-tailed)	,170	,269	,473	,886	
	N	10	10	10	10	10
MTT_Quant_Fut_pos	Pearson Correlation	,028	-,255	,295	,529	,363
	Sig. (2-tailed)	,939	,476	,408	,116	,303
	N	10	10	10	10	10
MTT_Quant_Fut_neg	Pearson Correlation	,436	,630	,020	,308	,810**
	Sig. (2-tailed)	,208	,051	,956	,386	,005
	N	10	10	10	10	10
Preferential_Total_average	Pearson Correlation	-,243	-,756*	,328	-,173	-,209
	Sig. (2-tailed)	,498	,011	,355	,633	,561
	N	10	10	10	10	10
Quality of representation	Pearson Correlation	-,360	-,301	,387	,382	,088
	Sig. (2-tailed)	,306	,398	,269	,276	,808
	N	10	10	10	10	10
Temporal information	Pearson Correlation	,151	-,358	,216	-,523	-,017
	Sig. (2-tailed)	,677	,309	,548	,121	,963
	N	10	10	10	10	10
Pre/experiencing emoties	Pearson Correlation	,208	-,419	,078	,276	,277
	Sig. (2-tailed)	,563	,228	,831	,440	,438
	N	10	10	10	10	10
Intensity	Pearson Correlation	,451	-,071	,000	,006	,502
	Sig. (2-tailed)	,191	,846	1,000	,987	,140
	N	10	10	10	10	10
Autonoetic consciousness	Pearson Correlation	,256	-,432	,321	,302	,363
	Sig. (2-tailed)	,476	,213	,366	,397	,303
	N	10	10	10	10	10

Correlations

		MTT_Quant_Fut_pos	MTT_Quant_Fut_neg	Preferential_Total_average	Quality of representation	Temporal information
TOT_angst	Pearson Correlation	,028	,436	-,243	-,360	,151
	Sig. (2-tailed)	,939	,208	,498	,306	,677
	N	10	10	10	10	10
TOT_SOSS	Pearson Correlation	-,255	,630	-,756*	-,301	-,358
	Sig. (2-tailed)	,476	,051	,011	,398	,309
	N	10	10	10	10	10
BEtotal_sum	Pearson Correlation	,295	,020	,328	,387	,216
	Sig. (2-tailed)	,408	,956	,355	,269	,548
	N	10	10	10	10	10
MTT_Quant_Past_pos	Pearson Correlation	,529	,308	-,173	,382	-,523
	Sig. (2-tailed)	,116	,386	,633	,276	,121
	N	10	10	10	10	10
MTT_Quant_Past_neg	Pearson Correlation	,363	,810**	-,209	,088	-,017
	Sig. (2-tailed)	,303	,005	,561	,808	,963
	N	10	10	10	10	10
MTT_Quant_Fut_pos	Pearson Correlation	1	,336	,404	,347	-,170
	Sig. (2-tailed)		,343	,247	,326	,639
	N	10	10	10	10	10
MTT_Quant_Fut_neg	Pearson Correlation	,336	1	-,605	,078	-,055
	Sig. (2-tailed)	,343		,064	,831	,880
	N	10	10	10	10	10
Preferential_Total_average	Pearson Correlation	,404	-,605	1	,204	,022
	Sig. (2-tailed)	,247	,064		,572	,952
	N	10	10	10	10	10
Quality of representation	Pearson Correlation	,347	,078	,204	1	,168
	Sig. (2-tailed)	,326	,831	,572		,642
	N	10	10	10	10	10
Temporal information	Pearson Correlation	-,170	-,055	,022	,168	1
	Sig. (2-tailed)	,639	,880	,952	,642	
	N	10	10	10	10	10
Pre/experiencing emoties	Pearson Correlation	,706*	,355	,172	,317	,405
	Sig. (2-tailed)	,023	,314	,635	,372	,246
	N	10	10	10	10	10

Intensity	Pearson Correlation	,597	,520	,097	-,162	,239
	Sig. (2-tailed)	,068	,123	,790	,655	,505
	N	10	10	10	10	10
Autonoetic consciousness	Pearson Correlation	,738*	,332	,245	,518	,336
	Sig. (2-tailed)	,015	,349	,495	,125	,343
	N	10	10	10	10	10

Correlations

		Pre/experiencing emoties	Intensity	Autonoetic consciousness
TOT_angst	Pearson Correlation	,208	,451	,256
	Sig. (2-tailed)	,563	,191	,476
	N	10	10	10
TOT_SOSS	Pearson Correlation	-,419	-,071	-,432
	Sig. (2-tailed)	,228	,846	,213
	N	10	10	10
BEtotal_sum	Pearson Correlation	,078	,000	,321
	Sig. (2-tailed)	,831	1,000	,366
	N	10	10	10
MTT_Quant_Past_pos	Pearson Correlation	,276	,006	,302
	Sig. (2-tailed)	,440	,987	,397
	N	10	10	10
MTT_Quant_Past_neg	Pearson Correlation	,277	,502	,363
	Sig. (2-tailed)	,438	,140	,303
	N	10	10	10
MTT_Quant_Fut_pos	Pearson Correlation	,706*	,597	,738*
	Sig. (2-tailed)	,023	,068	,015
	N	10	10	10
MTT_Quant_Fut_neg	Pearson Correlation	,355	,520	,332
	Sig. (2-tailed)	,314	,123	,349
	N	10	10	10
Preferential_Total_average	Pearson Correlation	,172	,097	,245
	Sig. (2-tailed)	,635	,790	,495
	N	10	10	10
Quality of representation	Pearson Correlation	,317	-,162	,518
	Sig. (2-tailed)	,372	,655	,125
	N	10	10	10
Temporal information	Pearson Correlation	,405	,239	,336
	Sig. (2-tailed)	,246	,505	,343
	N	10	10	10
Pre/experiencing emoties	Pearson Correlation	1	,770**	,925**
	Sig. (2-tailed)		,009	,000
	N	10	10	10
Intensity	Pearson Correlation	,770**	1	,589
	Sig. (2-tailed)	,009		,073

	N	10	10	10
Autonoetic consciousness	Pearson Correlation	,925**	,589	1
	Sig. (2-tailed)	,000	,073	
	N	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).