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The Psychophysiology of Self-Defining Memories

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The Psychophysiology of Self-Defining Memories

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Abstract

Throughout the past 15 years, researchers have explored self-defining memories within the larger category of autobiographical memories (Conway, Singer, & Tagini, 2004; Singer, 2005; Singer & Salovey, 2003; Wood & Conway, 2006). Other researchers have examined the physiological reactions to various stimuli, some related to autobiographical memory (Gross & Levenson, 1997; Levenson & Gottman, 1983; Philippot, Schaefer, & Herbette, 2003; Schaefer & Philippot, 2005; Schwartz, Weinberger, & Singer, 1981). The present study is the first experiment to investigate the relationship of physiological correlates to self-defining memories. This study had participants generate their own self-defining and autobiographical memories, and recall them, while attached to electrodes measuring heart rate and skin conductance one week later. The current study separated memories into four categories: positive and negative self-defining memories and positive and negative autobiographical memories. Change in skin conductance was greatest for negative self-defining memories. Further results showed that self-defining memories had more words and higher importance than did autobiographical memories pre-recall, and self-defining memories differed in intensity and emotion ratings from autobiographical memories post-recall.

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Humans are able to recall different memories of their personal experiences with varying amounts of detail and vividness. These memories elicit varying emotional reactions within individuals when they recall them. Conway, Singer, and Tagini (2004) explain that a self-defining memory is one kind of personal memory that is very vivid, has affective intensity, is linked to similar memories, has high levels of rehearsal, and is connected to an unresolved conflict or an ongoing concern. A self-defining memory is like a photograph; it is a detailed and specific insight into an episode of someone's life that helps define who he or she is. This type of memory may bring forth more intense emotions than other personal memories that do not have an effect as lasting or pivotal as does a self-defining memory. Previous research has shown that by priming a general mode of emotional information processing, the same level of emotional activity was activated as when the event actually occurred (Philippot, Schaefer, & Herbette, 2003). "I can smile at the old days. I was beautiful then. I remember the time I knew what happiness was. Let the memory live again" (Webber, Nunn, & Eliot, 1981). These lyrics illustrate the powerful effect that certain memories can have on people. During this song from *Cats*, Grizabella is flooded with emotion when she recalls her younger, more vivacious days. An audience can physically see the effects of this memory from her facial expressions, her body language, and the words she is singing, but to what degree are physiological reactions occurring when these emotions are re-experienced?

Autobiographical Memories

According to Conway et al. (2004), autobiographical memories are the result of goal processing, contain episodic details and sequences, and reflect knowledge about the self. They are a class of mental models created by an underlying knowledge base.

Conway and Pleydell-Pearce (2000) state that autobiographical memories can be sorted into three groups by amount of specificity: lifetime periods, general events, and event-specific knowledge (ESK). Depending on the detail of the recollection, a particular memory may operate at different levels of abstraction. In fact, autobiographical memories do not always allow a person to recollect specific experiences; the reliving of an experience will only happen if the memory is associated with episodic imagery and detail (Conway, 2001).

As Conway and Pleydell-Pearce (2000) suggest, their Self Memory System (SMS), which specifies the links between the goals of the "working self" and retrieval of long-term memories, provides a model for how new and stored memories become integrated into more conceptual structures of the long-term self, thus relating to the field of personality psychology. Autobiographical memory allows the self to provide accurate accounts of the working self's participation in goal pursuits, while simultaneously consolidating these activities to contribute to the coherence of the long-term self. The working self makes conceptual knowledge and memories more available if they are consistent with long-term goals (Conway, 2001).

This model relates to the concept of self-schemas in the sense that many memories tend to reflect dominant themes in a person's life (Brewer, 1988; Conway & Pleydell-Pearce, 2000). In fact, Howe, Courage, and Edison (2003; Nelson, 2003) say that the primary function of personal memory is to establish a life story, and one should use these memories as a narrative of one's own history. Individuals' goals that are rooted in Conway and Pleydell-Pearce's SMS should seldom contradict their existing autobiographical knowledge. For example, if someone's present goal were to receive a

high score on a test at school, it could be disruptive if the person only had access to memories of scoring poorly on previous tests or assignments. In this way, autobiographical knowledge works to ground the self by making unrealistic goals improbable, thus attempting to maintain a small discrepancy between the actual self and possible selves (Conway, 2001; Markus & Nurius, 1986).

Personal memory gleans experiences from the past and helps to answer the question "Who am I?" This type of memory, as defined by Brewer (1988), is a recollection of a specific episode of a person's past. Usually, those who experience remembrances of personal memory believe that these experiences happened to them. Brewer mentions that various people suffer from "despersonalization" and have trouble placing themselves in the experience. Autonoetic consciousness, or self-knowing, is necessary for remembering of personal events and helps people distinguish remembering from other types of awareness (Tulving, 1985). Amnesic patients have trouble remembering and relating current situations to past experiences, and therefore lack autonoetic consciousness. It would be interesting to investigate if those with Dissociative Identity Disorder would also have difficulty in recognizing themselves in a memory experienced by an alter self.

The previous three categories suggested by Conway and Pleydell-Pearce organize the information stored in personal memory. The broadest level, lifetime periods, groups memories together in a similar time frame, which can vary in length (Singer, 2005). For example, these memories might come from a person's four years of college or perhaps the first few years of being out in the workforce. The general events category, the next level of specificity of memories, groups together experiences with a similar theme in

smaller units of time. These time periods would include experiences that lasted a day or a week, and the themes might include romantic relationships, first experiences, or family trips. Event-specific knowledge (ESK), the third level, includes all of the details and the actual sensory imagery that a person can remember about events in his or her life.

In recent memory research, this sensory imagery, which is a large contributor to ESK, has been shown to be a predictor of memory specificity (Conway & Pleydell-Pearce, 2000). In other words, the more details we are able to recall about and relive from memories, the more likely we are to remember accurate autobiographical memories. When schemas and scripts stored in the knowledge base are activated and the ESK, in turn, is also activated, remembering occurs. Brown and Kulik (1977; see also Schaefer & Philippot, 2005) believe that people can have certain kinds of personal memories called "flashbulb memories," meaning they can remember events as though they are looking at an immediate snapshot of the event. These researchers argue that not only can people remember the exact details of an emotional experience but also that they can recall the conditions in which they found out about a major historical event, such as the assassination of John F. Kennedy. However, Ulric Neisser supports the idea that people make memories by connecting history to their own lives in a more reconstructive than veridical fashion (Neisser & Hyman, 2000). Humans frequently recall memories that hold significant meaning in their lives. After an emotional event, people pause to think about what had previously transpired and they rehearse the details, thus forming a memory that reflects both the event itself and also how it corresponds to their goals, interests, emotions, and motives (Anderson, 2005; Conway & Pleydell-Pearce, 2000; Neisser & Hyman, 2000). For example, Neisser would say that after a traumatizing event, such as

September 11th, people would need to process the details after the fact through the filter of their own self concerns in order to be able to recall the specific information from that occurrence.

Linton (1994), a prominent cognitive psychologist, mentioned that many studies have shown that people are more able to recall positive memories and events than negative ones, perhaps because the negative memories are accompanied by more emotion. Based on Neisser's theory of having to rehearse memories, it would be more difficult to specifically recall and focus on details of negative occurrences in one's life. Therefore, without rehearsal of these events, these negative memories might not be stored in a person's knowledge base of negative memories, creating an inaccessibility to negative emotional memories (Davis & Schwartz, 1987).

Philippot, Schaefer, and Herbette (2003; Conway & Pleydell-Pearce, 2000) have described two ways in which autobiographical memories are retrieved: *generative retrieval* and *direct retrieval*. In generative retrieval, people put in effort to reconstruct previous personal memories. They start out with a more abstract and general memory and elaborate on it so to recall more and more details of the memory. Sometimes people do not expand on the general memories to protect themselves from re-experiencing pains that may have been involved in previous experiences. Freud's work echoes this principle and says that there are many latent themes that exist in memories and often people repress various types of memories (Conway & Rubin, 2005). Philippot et al. introduced a strategic inhibition hypothesis that states that a specific retrieval mode of autobiographical memory should produce an inhibition of emotion during recall. Probing for the specific descriptions of these memories would involve an effortful search process,

whereas a general retrieval method without the details would probably not inhibit emotion. Linton (1994) also says that high emotionality doesn't necessarily yield accuracy in recall.

Direct retrieval, however, does not require much effort to obtain memories. This kind of retrieval is almost instantaneous, interrupts other ongoing activities, and yields a memory full of specific details, even if the memory doesn't encompass a complete event. With direct retrieval, a memory is activated automatically by certain cues in the environment. For this to occur, a pattern of activation from ESK must be established and should connect to the working goals of the person (Conway & Pleydell-Pearce, 2000; Philippot et al., 2003). Salaman (1970) described spontaneous or involuntary memories that are recalled that often bring about strong emotion and the sensation of reliving an experience from the past. These spontaneous memories, since they do not require effortful or strategic recall, allow full engagement of emotion and draw strongly on ESK (Conway, 2001).

David Pillemer (1998) believes that sensory images are important in defining autobiographical memories, and he includes in the definition of his "personal event memories" the idea that sensations contribute to the re-experiencing or reliving of the memory. In Proust's *Swann's Way*, the protagonist is triggered by the physical cue of the madeleine to spontaneously recall a childhood memory. The author provides an example of direct retrieval via the following scene:

> And as soon as I had recognized the taste of the piece of madeleine soaked in her decoction of lime-blossom which my aunt used to give me…immediately the old grey house upon the street, where her room was, rose up like a stage set to attach itself to the little pavilion opening on to the garden which had been built out behind it for my parents (the isolated segment which until that moment had been all that I could see); and with the house the town, from morning to night and in all

> weathers, the Square where I used to be sent before lunch, the streets along which I used to run errands, the country roads we took when it was fine…the whole of Combray and its surroundings, taking shape and solidity, sprang into being, town and gardens alike, from my cup of tea (1913, pp. 39-40)

The external cue of the taste of the madeleine triggered the remembrance of a childhood memory that was linked to the current sensations he was experiencing. This example involved implicitly thinking about the past in the present (Bluck & Alea, 2002). Also, this passage shows that the reactivation of cues, making a once available experience resurface, aids in the formation of complex memories (Johnson, 1992).

Autobiographical knowledge is extremely sensitive to external cues and can be primed by these triggers, either purposefully or unconsciously, to bring back memories (Brewer, 1988). The human long-term memory is limited in capacity (Dudai, 1997) and these cues often allow connections to previous experiences to reactivate when they are primed. When people recall memories including sensory perceptual episodic memories (EMs), they bring about a sense of self in the past. This view of sensory perceptual episodic memories classifies them as mental representations that are "small 'packets' of experience derived from conscious states that remain intimately connected to consciousness by instigating recollective experience during remembering" (Conway, 2001, p. 1383). Conway and Pleydell-Pearce (2000, p. 272) call this recollective experiencing of the past "autonoetic consciousness," and it is associated with, as Brewer states, a sense of self in the past, imagery, and reliving a previous event or occurrence. Thus, episodic memory is characterized in part by autonoesis since this type of memory ties to one's past, whereas semantic memory is not accompanied by a sense of re-experiencing the past (Nelson, 2003). These researchers speculate that since ESK is the

type of knowledge with the strongest connection to reliving the past, it is possible that it also triggers autonoetic consciousness.

Although external or environmental cues are often effective in bringing back old memories, verbal cues given by a friend, relative, acquaintance, or experimenter also can be useful in the recall of detailed memories (Linton, 1994). The more specific these cues are, the more specific the recalled memory will probably be. In the present study, participants provided their own cue words, with no direction as to how specific or vague they should be, in order to prime memories from their pasts. In a study done by Barnier, Hung, and Conway (2004), one of the findings was that participants took longer to recall memories primed by a neutral, rather than a positive or negative, cue word. This finding suggests that in order to remember any personal event memory, perhaps various types of cues and feelings can evoke the recollection of this kind of memory. However, a certain kind of autobiographical memory that is often recalled is pivotal in shaping who a person is.

Self-Defining Memories

Personality psychologists, such as Dan McAdams (2001), say that people construct their life stories from the memories that they accumulate during their lives. Self-defining memories are the experiences in our lives that shape us, define us, and make us the unique individuals we are. If the whole world shared all of the same experiences and placed the same value on them, it would be very difficult to distinguish among people. As Singer (2005) explains, there must be a balance between forgetting memories that prevent us from drawing general conclusions about ourselves from similar experiences and remembering the memories that matter most. He likens memory to a

camera that takes a very large number of photographs on a vacation. The owner of the camera, to truly show who he or she is, would discard many of the pictures that did not come out clearly or that were only interesting at the time of taking them but now do not hold much meaning. The owner of the camera might use a dozen or so selected images to represent this past experience. Singer uses the analogy of the camera to show the similar process of making and recalling self-defining memories, the most important autobiographical memories in a person's life.

Self-defining memories can always be characterized by five components: emotional intensity, vividness, repeated recall, focus on unresolved conflicts or lasting goals, and links to similar memories (Blagov & Singer, 2004; Singer, 2005; Singer & Salovey, 2003). This type of memory can be positive or negative but it always brings about strong emotions during recall. Singer and Moffitt (1991-1992) used a Self-Defining Memory Request form containing the five aforementioned components to more accurately induce self-defining memories, as opposed to other types of autobiographical memories. This form evoked self-defining memories that had stronger vividness, importance, and emotion ratings, distinguishing them from other autobiographical memories. Furthermore, another study by Singer, Rexhaj, and Baddeley (2007) demonstrated that both younger and older adults were able to generate vivid, important, and emotionally intense self-defining memories. Self-defining memories are also said to be easier to re-experience and imagine vividly in your mind's eye. These memories are so strong and hold such importance that when you remember them, you feel like you are reliving the past experience, much like the protagonist in Proust's work did when he momentarily re-experienced a scene of his childhood. Self-defining memories hold so

much meaning in one's life that the memory will come to mind during certain situations. The brain will begin to associate the memory with these situations until the memory is primed by the situations. This association is the reason why these important, specific memories are repeated in several related instances. These memories help us to discern what in our lives is most important and meaningful to us. People have a larger number of powerful and emotional memories about themes in their lives that really define them. Oftentimes failures resonate strongly with a person and can motivate him or her to strive to do better. However, sometimes it is the case that the negative experiences turn into memories that stick and signal an unresolved conflict. Another of Singer's (2005; Singer & Salovey, 2003) elements of self-defining memories signifies that these memories aid in the creation of life scripts and guide us to make conclusions in a situation that seems to have occurred in multiple previous situations. Many times self-defining memories contain similar outcomes and narrative themes. Also, it is possible that self-defining memories can propel someone to start something and build his or her life off of this one accomplished goal.

Steven Spielberg recently received the Cecil B. DeMille Award by the Hollywood Foreign Press Association during the 2009 Golden Globe Awards (McCartney, 2009). In his acceptance speech, Spielberg talked about one of his first most vivid childhood memories. He remembered that at the age of six he went to see the movie "The Greatest Show on Earth" by Cecil B. DeMille in 1952. A sequence of an enormous train wreck was featured in this film, and Spielberg left the movie wanting desperately to recreate the train wreck with his model trains. His parents warned him numerous times about ruining his train set, and each time this happened, Spielberg thought, "Am I going to get away

with this?" Eventually he decided to film the train wreck with a small camera and made his first movie. Although it was just a home video, recreating this crash brought back the same feelings he had felt in the movie theater. Taking this leap that started his career was a self-defining memory that followed him through almost 60 years of filmmaking. Each time Spielberg came up with a risky story, he would wonder if he could "get away with it." In his speech, Spielberg also mentioned that his films were milestones, somewhat like emotional triggers that made him think of his family. During the showing of a montage of his films at the awards ceremony, Spielberg reported that each movie made him think about if he had had children and what they were doing at that point in his life. Because of one powerful memory, Spielberg was driven to start his extremely successful career and made more self-defining memories for himself along the way.

Research on Self-Defining Memories

Thorne and McLean (2002), important researchers of self-defining memory, conducted research on gender differences for the level of emotionality of life-threatening events, which were considered to be self-defining memories for adolescents. They found that women's narratives were significantly longer than were men's narratives during a preliminary analysis, which was consistent with previous findings. Another result was that men tended to narrate their memories in a more stoic manner, whereas women included more emotion and compassion in their narratives. Although men and women differed in toughness and compassion, both genders showed equal amounts of vulnerability in the narratives of the self-defining memories of life-threatening events.

Blagov and Singer (2004) discuss the four dimensions of self-defining memories and the relationships of these categories to scores from the Weinberger Adjustment

Inventory of distress, self-restraint, and repressive defensiveness. The first dimension of self-defining memories according to these researchers is specificity, which refers to the memories' imagery and amount of detail. Many people have been found to use repression to defend themselves against painful or harmful emotions that can arise from self-defining memories, which limits the search for memories high in specificity. Other factors, such as tiredness and mood state, have also been shown to disrupt the recollection of specific emotional memories. Another dimension that Blagov and Singer included in their study is the meaning of these memories, or the integrative quality. Essentially, people use important memories as a reference to speculate about a current situation or goal and actively learn about themselves. Self-defining memories tend to contain meaningful content, the third dimension, and can show what kinds of situations or events a person is inclined to avoid or attain. The final dimension that Blagov and Singer examined is affect, or emotionality, of a memory, and evidence has supported the theory that affective memories depend on the relevance the memory has to the achievement of accomplishing a person's most valued goals (Conway, Singer, & Tagini, 2004; Moffitt & Singer, 1994; Singer, 1990).

In previous research, there had been speculations as to the fact that people's specificity in memory recall could be related to individual personality differences (Singer & Salovey, 1993). In Blagov and Singer's research on written narratives, they updated the coding system that differentiates between summary and specific memory narratives (Singer & Moffitt, 1991-1992) to make it fit better with Conway and Pleydell-Pearce's (2000) SMS model. One finding that came out of this study was that distress was inversely related to the number of positive specific memories, and this result was due

more to the emotionality than to the specificity of the memory. Also, participants who scored high in repressive defensiveness recalled fewer specific memories than did those who scored lower in repressive defensiveness. In addition, they found that individuals who had more integrative self-defining memories showed better adjustment than did individuals with less integrative self-defining memories. Finally, participants with higher distress scores showed more memories with themes of disrupted relationships than did those with lower distress scores, lending support to the theory that self-defining memories reflect important life goals and conflicts.

Abstract knowledge from the self-defining memories becomes integrated with other self-related semantic memories to create the life story schema (Blagov & Singer, 2004). A self-defining memory does not always remain a self-defining memory; throughout the course of an individual's life, personal goals change and conflicts are resolved. As a person ages, the life story schema becomes more crucial in terms of using present goals and concerns to influence and motivate the working self. Singer, Rexhaj, and Baddeley (2007) compared self-defining memories of people aged 50 and over to the memories of college aged students. Previous research had demonstrated that most of the studies on self-defining memories had been conducted among adolescents and young adults, and since self-defining memories play a vital role in adults' narrative identities, these researchers thought it essential to include adults in the samples. In this study, memories of young adults and older adults were compared on the basis of the four dimensions from Blagov and Singer's (2004) research: specificity, meaning-making, affect, and context. This research endeavor also examined whether or not the older adults

would have similar ratings to the younger sample on affective quality, vividness, and importance.

There was not much difference between the content of the memories of the older versus the younger participants; however, there were significant findings in the other three areas. Older adults recalled fewer specific memories than did their younger counterparts, possibly signifying that the older participants had more time to integrate their memories and have more a more coherent identity. It is likely that the younger generation hadn't had ample time to make conclusions about themselves based on their self-defining memories. The older adults reported recalling more positive memories than did the college students. This difference could reveal that the older participants had more time to learn to deal with negative experiences and focus on the positive ones than had college-age individuals. Using the memory integration scoring system by Blagov and Singer (2002), the researchers found that younger adults had fewer meaning-making statements than did the older adults. Perhaps the younger adults had not been distanced enough from their self-defining memories to glean meaning that could be applied to life goals. It seems that with age, people have a chance to reflect on what is most important to them in their lives and refer to these self-defining memories to create a meaningful life story.

Wood and Conway (2006) investigated the impact of self-defining events, the meaning-making of these events, and how this impact accounts for emotions recalled for these self-defining memories. One finding of this study was that memories that had a lot of impact also were found to have high levels of meaning-making. Another result from this research was that participants recalled having more positive emotions regarding a

high-impact memory than they did at the time the event actually occurred. It is possible that after reflecting on these memories and deciding that they were consistent with their identity, these individuals were able to view a more negative event as a learning experience. For them, time could have allowed participants to feel that they benefitted from the event and allowed them to attribute more meaning to the experience. Also, older individuals show higher levels of generativity than their younger counterparts and they often are trying to determine how to draw on experience-based wisdom in order to contribute to the following generation in a positive way.

Physiological Research Linked to Autobiographical Memories

In order to explore how physiological processes may reflect the influence of recollecting different kinds of autobiographical memories, it would be valuable to review previous research on the connection between emotions and physiological correlates. For example, Gross and Levenson (1997) examined the acute physiological effects of hiding feelings while watching a film. Participants first watched a video to get used to the laboratory environment and then proceeded to view three types of films: amusement, neutral, and sadness. The participants' emotional states were measured at three points throughout the experiment: pre-film, immediately after the pre-film report (baseline), and during-film. There was a no-suppression condition in which participants were instructed to watch the film carefully, but were told they could stop if they found the movie too distressing. In the suppression condition, however, they were told they could stop if the movie was too distressing, but they were also instructed to watch the film as if they didn't want anyone else to see what they were feeling. Nine physiological measures were recorded, including cardiac interbeat interval and skin conductance level, on a 12-channel

polygraph. Change scores were created for the two measures that were singled out by subtracting pre-film scores from during-film scores.

Participants in the suppression condition showed greater decreases in cardiac interbeat interval, demonstrating faster heart rates, and greater increases in skin conductance than did participants in the no-suppression condition. The amusement and sadness videos had an effect on physiological reactions of suppressed participants, but the neutral films did not. During the amusement films, suppression participants experienced a decrease in heart rate, and during the sadness films they underwent an increase in skin conductance. The individuals who were told to inhibit their feelings experienced a greater change in physiological state than did those who were not told to suppress their feelings, probably due to anticipation of emotion inhibition. The greater physiological activity in participants who suppressed their feelings probably was a mechanism preparing them for emotion suppression. Participants in the suppression group were able to dramatically decrease, but not entirely hide, their expressive behavior. This finding shows that for both positive and negative emotions, emotions can be controlled but only to a certain point.

Lacey, Bateman, and VanLehn (1952) conducted some of the classic research on the relationship between physiological responses to stress and subjective emotionality. In the first experiment, participants were subjected to four sequential stressors: mental arithmetic, hyperventilation, taxing word association, and the cold pressor test. The physiological responses were continuously measured in this study and consisted of heart rate, variability of heart rate, and palmar conductance (sweat activity on the palms). Participants tended to respond with the same type of physiological activation in the

different stress conditions. In the second experiment, some of the participants from the first experiment took the Rorschach Inkblot Test. Color on this test is often used as an indicator of emotionality, and was utilized in the same fashion in this study. When the autonomic responses were compared to the results of the color test, there were no significant results. However, when response specificity was taken into account, the two components of emotion and specific physiological responses became significantly correlated.

Obrist (1963) used some of the same stimuli that Lacey et al. (1952) used, such as the cold pressor, white noise, and the difficult mental mathematical problems, which required little environmental intake, and also added three new stimuli that had never before been included in this area of research: viewing slides of colorful landscapes, hearing a short somewhat funny essay, and finding hidden faces in a black and white drawing. In contrast, the three new stimuli required participants to pay close attention to environmental input. There were several physiological measurements taken in this study, including heart rate and skin resistance. After the stimuli were presented to the participants, always in the same order, each person had to rate how pleasant or unpleasant the stimuli were. The cardiovascular activity was measured over two one minute periods, once before the onset of the stimulus and again at the start of the presentation of each stimulus. In terms of heart rate, Obrist's hypotheses were supported: for the stimuli that needed only minimal attention to environmental input, there was an acceleration in heart rate, with the exception of the white noise stimulus, but for the other three stimuli that required more attention to environmental input, there was a decrease in heart rate.

In addition to using sensory stimuli, such as imagery, as Obrist did, other researchers included exercise as stimulus for the observation of cardiovascular activity (Schwartz, Weinberger, & Singer, 1981). Participants were asked to generate images from the past or the future that would evoke the various emotion states, and then later had to vividly recall these instances while also imagining that they were walking up and down the step in front of them. In the control condition, participants were instructed to imagine themselves walking up and down the step, not recalling other emotional images. Blood pressure and heart rate measurements were taken at six points during the experiment. Results showed that the different imagery conditions affected the cardiovascular activity patterns. The diastolic blood pressure, the blood pressure of the arteries between heart beats, increased most dramatically in the anger condition. For heart rate, however, anger and fear produced significantly larger increases; the happiness condition had the smallest amount of acceleration of heart rate of the four emotion states. Also, exercising while evoking an angry emotion drastically increased the participants' heart rates. Participants reported that they were more able to create states of fear, anger, and happiness while exercising, but found it difficult to generate states of relaxation and sadness.

Physiological Research Among Various Age Groups

Physiological research has been conducted drawing on various age groups for participants. Levenson, Carstensen, Friesen, and Ekman (1991) studied the effects of emotion and facial expression in elderly people on physiological reactions. This study only examined people aged 70 or older; however, the data were compared to the results of younger participants from a different study. Some of the emotions that were included in the study by Schwartz et al. (1981) were included in this investigation, and had

previously been shown to generate different patterns of associated autonomic nervous system (ANS) activity. Heart rate and skin conductance were measured via electrodes connected to six-channel polygraphs, and were observed in within-subjects trials throughout the experiment in the form of change scores. For one task, participants were instructed to mold their faces into various positions. In another task, participants were asked to recall memories that brought back strong emotions related to the example they were given. Findings showed that heart rate accelerated most in emotions of anger and sadness, which means that there were autonomic differences among emotions in old age. These results were similar for the younger participants; however, the magnitudes of these physiological changes were smaller for the elderly. The only gender difference in this study demonstrated that in the recollection task, women were more able than were men to remember affective memories.

Levenson and Gottman (1983), another pair of researchers who used non-college students as participants, performed a naturalistic investigation of married couples' interactions to observe physiological and emotional patterns between distressed and non-distressed spouses. Physiological responses were measured by an eight-channel polygraph and a smaller computer, and included heart rate, via electrodes on the chest, and skin conductance level, via electrodes on two fingers of one hand, among the four physiological measures. The experiment began with a five minute baseline, a period where the participants sat still attached to the machinery. Then the couple was to have a conversation and after 15 minutes, they were shown a video. From the questionnaire that followed the film, the experimenter chose a marital problem both spouses had listed and then the couple talked about this topic. This second conversation was carried out in the

same manner as the first, beginning with a baseline and ending with a video. Each spouse then watched the videotapes of the previous conversations separately at a later session. After the videos, the spouses filled out a questionnaire with affect ratings.

In terms of affect ratings, wives were found to rate the video of the conflict conversation more negatively than husbands did. Physiological linkage between spouses was stronger during the high-conflict portion of the experiment (the conversation about a marital issue) than during the low-conflict part (the natural, free-flowing conversation). Also, during the free conversation, wives in dissatisfied marriages reported more negative emotions, and during the conversation regarding the conflict, they reported feeling less positive emotion. Husbands in dissatisfied marriages had lower skin conductance levels during the baseline before the interaction, but had a higher heart rate during the interaction.

Application of Physiological Research to Memory

Schaefer et al. (2003) discovered that the schematic and the propositional emotional processing modes activated different portions of the brain. The schematic system relates to the activation of a schema and the bodily responses, or "hot" emotional processing, that accompany it. The propositional system deals with the processing of declarative knowledge, "cold" processing of emotion, and is not enough to elicit emotional reactions. In this experiment, participants performed a task with an emotional imagery aspect and a sentence repetition aspect. For the schematic mode, questions about each of the ten imagined scenarios holistically appraised the situation, whereas for the propositional mode, questions were more analytical with respect to certain elements of the scenarios. In addition to a positron emission tomography scanning (PET Scan),

heart rate via electrodes on the chest was measured. Participants felt more intense emotions in the schematic processing mode for all four emotional conditions than they did in the propositional processing mode. Similarly, heart rates were higher in the schematic processing mode than in the propositional processing mode.

More research has recently been conducted on physiological data for the recollection of emotional autobiographical memories (Philippot, Schaefer, & Herbette, 2003; Schaefer & Philippot, 2005). In one experiment, physiological measures, such as blood flow, electrodermal activity, and skin conductance, were measured by way of electrodes (Schaefer & Philippot, 2005). Participants had to recall a positive, negative, or neutral memory as quickly as possible and then describe it orally for one minute. They then had to report the intensity of the emotions they had felt during the recollection and fill out a questionnaire assessing the characteristics of the autobiographical memories. Results presented evidence that the recollection of emotional autobiographical memories brought about autonomic changes. For both heart rate and skin conductance, the combination of means of positive and negative memories was higher than those of neutral memories; however, these physiological changes were the same between positive and negative emotion conditions. On the autobiographical memory characteristics questionnaire, participants had higher scores for clarity, remembered feelings, and remembered thoughts when they recalled emotional rather than neutral memories. In a comparison between positive and negative emotional memories, the positive memories elicited higher scores for temporal and sensory elements than negative memories did. The theory that emotional memories are more vivid but not more specific than neutral memories was supported in this study.

Another study, though it did not include physiological data, examines the relationship between intensity of emotion and the voluntary activation of autobiographical memories (Philippot, Schaefer, & Herbette, 2003). Two hypotheses are proposed: the specificity hypothesis, which says that intensity of emotion is positively related to the specificity of autobiographical memories, and the strategic inhibition hypothesis, which states that recalling these memories specifically requires the inhibition of emotion. In the first part of the experiment, participants were instructed to retrieve either specific or general personal memories before using mental imagery to draw out emotion. This approach was aimed to prime emotional information processing in a general or specific processing mode. Results to the first part demonstrated that more emotion intensity was reported after general priming than after no priming or specific priming of the autobiographical memories, thus supporting the strategic inhibition hypothesis. Also, participants rated intensity of the memories as lower during the mental imagery recall with a specific priming condition than they did with a general priming condition. However, in the general priming condition, intensity was the same from the first recording of the memory to the mental imagery recall. People do seem to repress emotions when specifically and generatively recalling emotional memories.

The second part of this study used a wider array of emotions and used film clips as an external emotional stimulus. The strategic inhibition hypothesis was again supported, since the general autobiographical memory priming elicited more intense feelings with respect to the films than the specific priming condition did. Both parts of the study lend more evidence to the strategic inhibition hypothesis than to the specificity hypothesis. The results from this experiment contrast with the previously accepted

principle that the more specifically emotional memories are activated, the more intense the emotions will be. Self-defining memories, although specific in imagery, are also linked to general networks of thematically similar memories. In this sense, they are specific exemplars of a more general category of experience. Similar to the general autobiographical memories of the Philippot et al. study, self-defining memories are likely to engage emotions more than is true of a more isolated specific memory.

The Present Study

The present study is the first empirical investigation of the physiological correlates of self-defining memories. Some previous studies have involved memory specificity and/or intensity, and others have included physiological data with regard to autobiographical memory. The present study combines the work of personality and cognitive studies to examine the differences in physiological reactions, in terms of heart rate and skin conductance level, between self-defining memories and autobiographical memories. Here, self-defining memories are autobiographical memories that should be more intense when they are recalled. Autobiographical memories are ones that can be remembered specifically but not as emotionally as self-defining memories. They are also memories that do not share a more developed network of associations to themes or conflicts that reside in the long-term self.

The main hypothesis for this study was that self-defining memories would produce greater changes in heart rate and skin conductance than would autobiographical memories upon recollection. Self-defining memories were expected to receive stronger ratings of importance, vividness, and emotional intensity along with corresponding greater physiological activation than would be produced by autobiographical memories.

Furthermore, it was also hypothesized that negative self-defining memories would elicit the greatest difference of physiological reactions from the baseline measurements among the four categories of memory involved: positive self-defining memories, negative self-defining memories, positive autobiographical memories, and negative autobiographical memories.

Method

Participants

The participants were 55 Connecticut College students, primarily from the Psychology 101 subject pool. Of these participants, 13 were men and 34 were women aged between 17-22 years (M = 19.15, SD = 1.22). Participants were 40.4% freshmen, 42.6% sophomores, 6.4% juniors, and 10.6% seniors. In terms of race, participants were 74.5% European American/White, 10.6% African American, and 2.1% Hispanic/Latina; 10.6% identified with another race. Eight participants' data were eliminated due to errors during the second session of the experiment or inappropriate ratings during recall. Thus, data from 47 participants were used. These students received course credit for their participation. All participants read and signed an informed consent document before partaking in the study, and all participants were given a debriefing form upon completion.

Materials

Informed Consent. This form stated the purpose of the experiment, notified the participant of the credit he/she would receive and that he/she was permitted to withdraw from the experiment at any point, and contained the participant's signature and the date (see Appendix A).

Demographics Questionnaire. This questionnaire asked about each participant's class year, age, gender, and race/ethnic background (see Appendix B).

PowerPoint Presentation: Distinction between Self-Defining Memories and Autobiographical Memories. This presentation was given during the first session of the experiment (see Appendix C). The experimenter utilized these slides to define self-defining and autobiographical memories for the participants and to ensure that they could distinguish between the two types of memories.

Example of How to Fill Out Memory Sheets. This was a sheet filled out by the experimenter prior to the first session to demonstrate how the Memory Request Forms were to be completed (see Appendix D).

Session One Information Sheet. This was a summary of the characteristics of self-defining and autobiographical memories, and provided examples of each type of memory, both positive and negative (see Appendix E). On the other side of this sheet was a list of tasks the participant needed to perform before the second session.

Memory Request Form (Hess, 2008). The Memory Request Form was emailed to the participants immediately following their first session (see Appendix F). On this form, the participants included their code number to maintain confidentiality. Each participant was instructed to recall and write down descriptions of 12 memories: six self-defining memories, of which three were positive and three were negative, and six autobiographical memories, of which three were positive and three were negative. With the description of each memory, each participant provided three ratings, ranging from 1 to 5: how important the memory was to him/her, how positive it made him/her feel currently, and how negative it made him/her feel currently. Finally, participants provided a memory cue

word for each memory to help them to recall the memories in the second session of the experiment.

Session Two Script. This script consisted of instructions for the second session, and was read aloud by the experimenter before the collection of physiological data began (see Appendix G).

Experiment Order. This sheet was in front of the experimenter during physiological data collection, and provided information on when to give memory cues, display the distracter photograph, and mark each time interval on the computer (see Appendix H).

Distracter Task (Hess, 2008). This task consisted of scenic photographs taken by the experimenter that were shown in a PowerPoint presentation during the second session. The purpose of these photographs was to aid participants in fully releasing their previous memory before receiving the next cue word.

Debriefing Form. This form gave a recap of what the participants did during the course of this experiment and informed them of the hypotheses (see Appendix I). Participants were provided with the citations of other related articles and with the telephone number of counseling services in case they felt distressed from recalling powerful memories.

Instruments

Heart rate and galvanic skin response data were collected using a BIOPAC MP35 data acquisition unit interfaced with a Dell D610 laptop computer running BSL Pro data acquisition software. A second computer was used to show the distracter photographs.

Procedure

Participants signed up on a sheet entitled "Physiological Responses to Memories" posted on a bulletin board in the college's psychology building, Bill Hall, and attended a first session of about ten participants in each session. They filled out the consent form and the demographics questionnaire and then received the PowerPoint presentation on self-defining memories and how to distinguish between self-defining memories and autobiographical memories. The experimenter briefly explained the memory task the participants were to undergo in the second session, including a description of the physiological measurement procedures. The participants received instructions about their tasks for the coming week of choosing 12 memories, three positive and three negative self-defining memories and three positive and three negative less meaningful autobiographical memories, rating these memories on importance, how positive they were, and how negative they were, and picking cue words that would help them recall their memories. They then signed up for an individual second session, which would take place a week later, and were instructed to email the brief descriptions of the memories, the ratings, and the cue words to the experimenter over the course of the week. The experimenter distributed a summary of the PowerPoint presentation and of the task instructions before the participants left the session. Participants recorded this information on the Memory Request Form, which was emailed to them immediately following the first session. When the participant came in one week later for the second session, he or she was connected to the electrodes and was seated comfortably in an armchair in front of the computer with the distracter photographs. The experimenter sat to the right of the participant and could reach both computers from the seat. EL507 electrodes, which

measured skin conductance, were placed on the palmar side of the left middle and index fingers. These were covered with electrical tape to prevent them from falling off during the session. EL503 electrodes, which measured heart rate, were attached to different colored wires: the white wire was placed on the right forearm, the black wire was placed on the inner right ankle, the red wire was placed on the inner left ankle. The experimenter gave instructions and explained the experimental process using a script. The experimenter had a trial of the participant's memories in a random order prepared before this session by using an online data randomizer. A baseline of physiological data was recorded on the computer with the BIOPAC program running and the participant heard the randomized cue words to prompt the recollection of his/her memories. After 15 seconds of baseline data, the experimenter explained that she was about to say the cue word and that the participant should make sure to remember to nod when he or she found the memory. The participant held onto the image of the memory for one minute. After about 30 seconds, the experimenter reminded the participant to continue to relive the memory. After the minute was up, the experimenter instructed him or her to release the memory. The experimenter then asked the participant to verbally give intensity, positive, and negative ratings based on how the recollection of the memory made him or her feel. The participant viewed a distracter task in the form of a scenic photograph for 30 seconds. After this interval of time, another 15 seconds of baseline data were recorded. The experimenter prepared the participant for the next cue, who was reminded to alert the experimenter by nodding when he or she thought of the memory. These steps were repeated until all of the memories were recalled. When the participant finished recalling his or her memories, he or she was given the debriefing form.

Results

Results for Pre-Memory Recall Data

A 2 (emotion) x 2 (memory type) x 2 (gender) within subjects multivariate analysis of variance (MANOVA) was conducted to examine possible differences between positive and negative self-defining and autobiographical memories, with gender as the between factor and word count, pre-recall positive ratings, negative ratings, and importance ratings as the dependent variables. Due to no significant gender differences, gender was omitted from the subsequent analyses, Wilks's Lambda = .846, F (4, 42) = 1.91, p = .126.

There was a main effect for positive and negative memories, regardless of whether the memories were self-defining or autobiographical, Wilks's Lambda = .076, F (4, 42) = 1.29, $p < .001$. Follow-up univariate analyses revealed significantly different importance ratings, such that positive memories were given higher importance ratings than were negative memories, F (1, 45) = 22.83, $p < .001$. In terms of positive ratings, as might be expected, positive memories were rated significantly more positive than were negative memories, F (1, 45) = 489.62, $p < .001$. These analyses also showed that negative memories were assigned more negative ratings than were positive memories, F (1, 45) = 282.50, $p < .001$. However, there was not a significant difference in word count for positive and negative memories, F (1, 45) = 2.19, p = .146 (see Table 1).

Multivariate analyses also showed a significant main effect for self-defining versus autobiographical memories, regardless of their emotion, Wilks's Lambda = .244, F (4, 42) = 32.47, $p < .001$. Further univariate tests demonstrated that participants used more words in their descriptions of self-defining memories than in those of

autobiographical memories, F (1, 45) = 42.26, $p < .001$. In addition, self-defining memories were rated higher in importance than were autobiographical memories, F (1, 45) = 123.48, $p < .001$. Autobiographical memories were assigned lower positive ratings, F (1, 45) = 4.31, $p = .044$, and lower negative ratings, F (1, 45) = 45.79, $p < .001$, than were self-defining memories. There was no main effect from the MANOVA for gender nor were there significant interactions between gender and the other two factors, emotion and memory type. However, there was a significant interaction between the emotion and type of the memories, Wilks's Lambda = .552, F (4, 42) = 8.54, $p < .001$. Univariate analyses revealed that the interaction had a significant effect on negative ratings of memories, F (1, 45) = 31.88, $p < .001$. There were no other significant effects on the other dependent variables. Simple effects tests showed that negative self-defining memories were given higher negative ratings than were negative autobiographical memories, F (1, 45) = 104.62, $p < .05$. Also, positive self-defining memories were assigned lower negative ratings than were negative self-defining memories, F (1, 45) = 620.41, $p < .05$. Finally, similarly to self-defining memories, positive autobiographical memories were rated less negative than negative autobiographical memories, F (1, 45) = 238.31, $p < .05$. There was no significant difference in negative ratings between positive self-defining and positive autobiographical memories. Means and standard deviations can be found in Table 1.

Table 1

Means and Standard Deviations of Word Count, Importance Ratings, and Pre-Memory Recall Emotion Ratings for Self-Defining and Autobiographical Memories (n = 47)

	SDM				AM			
	Positive		Negative		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Word Count	97.43	43.18	100.73	50.37	69.25	36.19	76.66	40.84
Importance	4.31	0.54	3.96	0.62	3.08	0.92	2.53	0.68
Positive	4.38	0.70	1.49	0.64	3.92	0.88	1.50	0.53
Negative	1.38	0.61	4.01	0.68	1.30	0.37	2.93	0.85
	SDM		AM		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total Word Count	99.08	43.53	72.95	36.87	83.34	37.34	88.70	42.45
Total Importance	4.13	0.44	2.81	0.66	3.70	0.56	3.24	0.46
Total Positive	2.93	0.46	2.71	0.53	4.15	0.62	1.49	0.46
Total Negative	2.70	0.45	2.12	0.47	1.34	0.42	3.47	0.64

Results for Post-Memory Recall Data

A 2 (emotion) x 2 (memory type) within subjects MANOVA, with post-recall positive, negative, and intensity ratings as the dependent variables, was performed to investigate possible relationships between post-recall emotion ratings and self-defining and autobiographical memories. There was a main effect for positive and negative

memories, regardless of whether they were self-defining or autobiographical, Wilks's Lambda = .073, F (3, 44) = 1.87, $p < .001$. Follow-up univariate analyses suggested a significant difference in positive ratings, such that positive memories were rated more positive than were negative memories, F (1, 46) = 549.85, $p < .001$. In terms of negative ratings, negative memories were rated significantly more negative than were positive memories, F (1, 46) = 510.02, $p < .001$. There was not a significant difference between positive and negative memories and intensity ratings, F (1, 46) = 1.59, $p = .213$.

Multivariate analyses also showed a significant main effect for self-defining versus autobiographical memories, regardless of their emotion, Wilks's Lambda = .267, F (3, 44) = 40.25, $p < .001$. Further univariate tests demonstrated that self-defining memories had higher negative ratings than did autobiographical memories, F (1, 46) = 56.23, $p < .001$. In addition, as they were predicted to do, participants reported higher intensity ratings for self-defining memories than for autobiographical memories, F (1, 46) = 88.93, $p < .001$. There was no significant difference for positive ratings between the two types of memories, F (1, 46) = 1.64, $p = .207$. However, in the MANOVA, there was a significant interaction between the emotion ratings and type of memories, Wilks's Lambda = .447, F (3, 44) = 18.18, $p < .001$. Univariate analyses revealed that the interaction had a significant effect on positive ratings of memories, F (1, 46) = 19.35, $p < .001$, negative ratings, F (1, 46) = 44.97, $p < .001$, and intensity ratings, F (1, 46) = 8.59, $p = .005$.

Simple effects tests showed that negative self-defining memories were given lower positive ratings than were negative autobiographical memories, F (1, 46) = 4.04, $p < .05$. Also, positive self-defining memories were assigned higher positive ratings than

were positive autobiographical memories, F (1, 46) = 17.02, $p < .05$. Other findings with respect to positive ratings were that positive self-defining and autobiographical memories were rated more positive than were negative memories of both kinds, F (1, 46) = 803.74, $p < .05$ and F (1, 46) = 493.50, $p < .05$, respectively. Simple effects tests that examined the interaction effect on negative ratings found that negative self-defining memories were rated more negative than were negative autobiographical memories, F (1, 46) = 110.97, $p < .05$. Also, the negative versions of both self-defining and autobiographical memories were given higher negative ratings than were the positive memories, F (1, 46) = 1030.33, $p < .05$ and F (1, 46) = 514.37, $p < .05$, respectively. More simple effects tests were conducted to explore the interactions between groups with respect to intensity ratings. Self-defining memories, both positive and negative, were reported to be more intense than either emotional type of autobiographical memory, F (1, 46) = 105.10, $p < .05$ and F (1, 46) = 37.6, $p < .05$, respectively. Also, negative self-defining memories were rated more intense than were positive self-defining memories, F (1, 46) = 8.82, $p < .05$. Means and standard deviations can be found in Table 2.

Table 2

Means and Standard Deviations of Intensity Ratings and Post-Memory Recall Emotion Ratings for Self-Defining and Autobiographical Memories (n = 47)

	SDM				AM			
	Positive		Negative		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Intensity	3.43	0.92	3.74	0.78	2.79	0.94	2.67	0.76
Positive	4.06	0.72	1.38	0.49	3.67	0.80	1.57	0.62
Negative	1.30	0.40	3.89	0.77	1.21	0.29	3.04	0.79

	SDM		AM		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total Intensity	3.59	0.76	2.73	0.76	3.11	0.85	3.21	0.64
Total Positive	2.72	0.44	2.62	0.59	3.86	0.66	1.48	0.47
Total Negative	2.59	0.46	2.12	0.47	1.26	0.29	3.46	0.69

Results for Physiological Data

A 2 (emotion) x 2 (memory type) within subjects MANOVA was executed to explore any possible relationships between positive or negative self-defining or autobiographical memories and physiological reactions, with average difference scores in heart rate and skin conductance as the dependent variables. Raw heart rate and skin conductance scores were computed into difference scores by taking each one and subtracting the baseline value of the same physiological measure. There was no significant main effect for emotion, Wilks's Lambda = .993, F (2, 45) = .16, p = .856, nor

was there a main effect for memory type, Wilks's Lambda = .973, F (2, 45) = .62, p = .541. The interaction between negative, positive, autobiographical, and self-defining memories approached significance, Wilks's Lambda = .887, F (2, 45) = 2.87, p = .067.

Further univariate analyses yielded an interaction between emotion and memory type and change in skin conductance nearing significance, F (1, 46) = 3.80, p = .057. Simple effects tests showed that change in skin conductance was greater for negative self-defining memories than for negative autobiographical memories, F (1, 46) = 5.28, p < .05. This finding supports the hypothesis that negative self-defining memories would be accompanied by the greatest physiological change. Although the interaction with heart rate was not significant, F (1, 46) = 1.89, p = .176, the means reflect a trend toward significance. There were no significant main effects found in the univariate tests. Means and standard deviations can be found in Table 3.

Table 3

Means and Standard Deviations of Average Changes in Heart Rate (HR) and Skin Conductance Level (SCL) for Self-Defining and Autobiographical Memories (n = 47)

	SDM				AM			
	Positive		Negative		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Change HR	0.685	5.605	0.904	5.094	0.852	5.370	0.318	5.493
Change SCL	0.003	0.059	0.009	0.062	0.005	0.070	-0.002	0.066
	SDM		AM		Positive		Negative	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total Change HR	0.795	5.166	0.585	5.277	0.768	5.247	0.611	5.204
Total Change SCL	0.006	0.058	0.001	0.065	0.004	0.062	0.003	0.061

Note. Heart rate was measured in beats per minute (BPM) and skin conductance was measured in delta micro Mho.

Correlations for Physiological Data and Self-Report of Intensity and Emotion

To explore the relationship between the average difference in heart rate and skin conductance for the four types of memories (positive self-defining, negative self-defining, positive autobiographical, and negative autobiographical) and the post-memory recall self-report ratings (intensity, positive, and negative), Pearson correlations were executed. None of the correlations for change in heart rate and the self-report ratings was significant. For change in skin conductance, correlations with reported positive and negative ratings were not significant; however, the relationship between change in skin conductance for negative self-defining memories and self-reported intensity ratings for the same type of memory was significant, $r = .369$, $p = .011$. This finding demonstrates

that participants who reported their negative self-defining memories to be more intense at recall also experienced a greater change in skin conductance.

Discussion

The present study was the first reported experiment to examine physiological correlates with respect to self-defining memories. The goal of this study was to explore the corresponding physiological responses to self-defining memories and less emotionally-engaging autobiographical memories, with particular emphasis on changes in heart rate and skin conductance during memory recall. An effort was made to generate memories that differed in meaning and in intensity. To do this, participants received instruction in how to differentiate between the two types of personal memories and then were given a week to identify and record these self-defining and autobiographical memories. The following week, physiological data were collected after participants received oral prompts to recall and re-imagine each memory. In this study, participants were generally able to remember and recall memories with differing degrees of emotion and intensity corresponding to each type of memory request. In other words, self-defining memories were generally given higher intensity ratings; positive memories were given higher positive ratings; and negative memories were given higher negative ratings immediately following recall. These findings replicate the work of Singer and Moffitt (1991-1992) in that self-defining memories were recalled with more vividness and were given stronger emotion ratings than were autobiographical memories.

Clearly, participants may have come up with self-defining memories that were more emotional and autobiographical memories that were less emotional because they were instructed to do so. It is possible that the differences in self-report ratings were due

to the demand characteristics of the experiment. The varied ratings might have occurred due to the fact that participants were informed that self-defining memories should have higher intensity ratings. The possibility of the self-report ratings being self-fulfilling is lower for the self-reported intensity ratings in the physiological portion of the experiment. Some participants supposedly could feel higher intensities for some autobiographical memories. Therefore, despite the demand characteristics, there was still variation about how people felt about the two types of memories. Most participants did rate self-defining memories as more intense, even though the memories were cued randomly and were no longer associated with the previous memory categories. This demonstrates the depth of emotional power for self-defining memories.

As predicted, the greatest change in physiological responses was found in skin conductance level with the recall of negative self-defining memories. For negative self-defining and autobiographical memories, changes in heart rate were in the predicted direction (higher for negative self-defining than negative autobiographical memories), but were not significant. The significant correlation between the average difference of skin conductance scores for negative self-defining memories and the self-reported intensity rating has an important implication in this study. This finding shows that not only was there a significant difference in self-reported intensity of negative self-defining and autobiographical memories, but there were also physiological responses that varied with the intensity of these memories. This result lends more support to differences between self-defining and autobiographical memories. The physiological aspect of the experiment supports the distinction between the two types of memories, and argues against demand characteristics further because skin conductance and heart rate were not in conscious

control of the participants. Lastly, the hypothesis that negative self-defining memories, more than the other three categories of memories, would elicit the most change in physiological responses was supported by current findings.

The skin conductance results for negative self-defining memories in this study parallel the earlier findings of Gross and Levenson (1997). Their research on emotion suppression examined skin conductance, or electrical resistance of the skin, as a physiological measure. Their finding that during the sadness film inductions participants underwent an increase in skin conductance provided evidence that negative emotion produces this arousal in skin conductance. The present study extends Gross and Levenson's finding so that negative emotion causing skin conductance arousal is applicable to self-defining memories characterized by negative emotion. A possible explanation as to why negative emotions might have brought about these physiological reactions is the view that negative self-defining memories present a threat to the self. Thorne, McLean, and Lawrence (2004) found that memories involving more tension might be more likely to provide information in meaning-making. A threat to the self from these self-defining memories might show people insights and life lessons, as these researchers suggested, but also might raise the arousal level of participants during the course of recollection.

Levenson and Gottman (1983) measured skin conductance in their research on physiological connections and emotional exchanges between married couples. The purpose of examining skin conductance in the fingers, which was also done in the present study, was to measure the activity of the sweat glands that are thought to be connected to emotionality. In previous research, negative emotions, especially fear and anger, have

been shown to be linked to physiological activation. Change in skin conductance is evolutionarily connected to feelings of anxiety or fear, in that physiologically, animals regulate themselves in situations of "fight" and "flight" by sweating.

Limitations

The biggest limitation of this study was the small number of men who participated. Due to this problem, it was extremely difficult to obtain any gender difference in any of the statistical analyses that were run. At Connecticut College in the psychology department, it is much easier to obtain participants who are women since the women involved in the major or minor outnumber the men by a 10 to 1 ratio.

The other limitations of the present study related directly to the experiment itself. A few participants provided inappropriate memories, such as choosing memories that were too recent to be self-defining memories. During the session in which participants had to recall their memories, it was difficult for some people to engage with and relive the memories. Some participants had trouble finding some of their memories associated with certain cue words, and occasionally needed the experimenter to provide more detail about these memories. The artificial circumstances of the experiment might have increased the difficulty to recall memories on the spot. Some participants had trouble remembering the memories they had written down, whereas others were not able to feel the appropriate intensity for a self-defining memory. In some cases, participants recalled autobiographical memories as more intense than some self-defining memories following recall. Also, participants may have felt uncomfortable during the experiment when they were hooked up to the electrodes and this discomfort might have contributed to the fact that some people found it difficult to engage. This part of the experiment also was

conducted in a very small room with no windows and a desktop filled with two computer monitors and scattered wires, so feelings of discomfort may have been compounded by these circumstances. In addition, the BIOPAC machinery might have lacked some sensitivity, and there is a possibility that the physiological measures did not fully test the hypotheses of this study. Also, the experimenter was a relative novice with this type of equipment, and a person with more knowledge of the machinery might have been able to adjust these sensitivity settings to obtain a more accurate test.

One must also ask if the physiological responses were influenced by the added effort of concentration in recalling the memories, and not only because participants were remembering self-defining memories. In other words, the additional cognitive demands exacted by a more complex memory could explain the differential physiological responses. However, the significant correlation between memory intensity and the physiological response in this study lends evidence to the counterargument. Since the self-report intensity ratings were higher with change in skin conductance for negative self-defining memories, the physiological reactions were at least in part influenced by the intensity of the memories.

Further Research

In the future this study could be replicated with more men in the subject pool, but also among older participants. Since research has examined self-defining memories among people of different age groups (Singer, Rexhaj, & Baddeley, 2007), it would be interesting to conduct this experiment among older adults as well. Older adults might have more well-rehearsed memories and also might engage in the recollection task with an added level of seriousness and conviction. This study could be expanded further by

including more physiological measurements, such as blood pressure, in addition to heart rate and skin conductance. Also, more complicated machinery, such as an EEG (electroencephalograph), which could be used to measure brain wave changes, an MRI (Magnetic Resonance Imaging), or a PET (Positron Emission Tomography) Scan could be utilized for a more in-depth examination of physiological responses during self-defining and autobiographical memory recall.

Conclusion

Research on self-defining memories has been explored and conducted for the past fifteen years or so. Researchers have extended samples to include a range of ages, from college-age adults to older adults, and have applied their research cross-culturally and in a variety of clinical samples. This project replicated earlier findings with regard to the affective intensity and importance of self-defining memories, and extended the previous research on self-defining memories to the field of psychophysiology.

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Appendix A: Informed Consent

I have been fully informed about my task as a participant in this research study by Rachel Hess. I understand that I have the right to withdraw from this study at any time and do not have to answer certain questions if I so desire. I understand that my participation in this study will be kept strictly confidential and that I will not be asked to place my name or any other identifying information on any data sheets I may be asked to fill out. I also understand that this study is not meant to gather data about individuals, rather my responses will be combined with other participants' data for the purpose of statistical analysis. I consent to the use of my data for the potential publication of this study. There are no known risks to the participation in this study.

I understand that I will be connected to electrodes in a small room in order to measure my heart rate and skin conductance. I understand that these electrodes will not cause me any pain. It is clear that I will have to recall twelve memories which I came up with prior to being hooked up to the electrodes. I understand that thinking of memories, both negative and positive, may not be an easy task. It is clear that the study will take approximately 75 minutes, 30 minutes in one session and 45 minutes in a second session, to complete for which I will receive course credit.

I also understand that this project has been approved by the Psychology Department Institutional Review Board (IRB) at Connecticut College. If I have any concerns and/or questions about the approval of this study by the IRB, I may contact the Chair of the Connecticut College IRB, Ann Sloan Devlin at asdev@conncoll.edu (860) 439-2333. In addition, I am aware that if I have any questions regarding this experiment or my participation in this study, I can contact Rachel Hess at achel.hess@conncoll.edu, (860) 439-3452, or Jefferson Singer at jasin@conncoll.edu, (860) 439-2343.

Informed Consent

I am at least 18 years of age, and I have read the statement above. Having been so informed, I consent to participate in Rachel's study on the psychophysiology of memories.

Signature _____

Date _____

Printed Name _____

Appendix B: Demographics Questionnaire

Please answer the following questions about yourself.

1. Class year (circle): Freshman/1st year Sophomore Junior Senior

2. Age _____

3. Gender: _____

4. Would you describe yourself as:
___ European American/White
___ Asian American
___ African American/Black
___ Native American/American Indian
___ Hispanic/Latina
___ Other _____

Appendix C: PowerPoint Presentation: Distinction between Self-Defining Memories and Autobiographical Memories

WELCOME TO MY STUDY ON THE PSYCHOPHYSIOLOGY OF MEMORIES!!!!

SESSION 1

Please sign in, have a seat, and fill out the Informed Consent form and the Demographics Questionnaire.

We will begin shortly.

SELF-DEFINING MEMORIES

- Highly personal
- Evokes strong emotion when recalled
- Vivid with a lot of detail, like a photograph
- Specific and meaningful
- Links to similar memories
- At least one-year old
  - Become part of you

Blagov & Singer (2004).

SELF-DEFINING MEMORIES

- If you were to compile a photo album of your life with only a few pictures, these memories would be those photos
- Define who you are
- Can be positive or negative
- Helps to explain who you are and what makes you distinct
- If you just met someone, you might use an SDM memory to help them know who you are

Example of a Self-Defining Memory

- "I can remember receiving a grant during my senior year of college to study in Japan. I reread the congratulatory letter several times before I actually registered the information. I called my parents and my grandparents to tell them the news. I could barely contain my excitement. I hung the letter up on my bulletin board in my room. I couldn't sit still. I grabbed my keys, coat, and wallet, ran to my friend's room to tell her the news, and then we went out to a celebratory sushi dinner at Koto in Groton. I still think of this memory as an important example of how hard work and dedication can pay off."

Another example

- "I started taking swimming lessons when I was seven years old. On the first day of lessons, I was practicing dunking my head and I swallowed too much water. I was gagging and coughing and I didn't know what was going to happen to me. I started to panic. My mom had to come over to the pool to calm me down. Ever since that day I feel extremely anxious in new situations and this memory reminds me of how I don't like to try new things."

AUTOBIOGRAPHICAL MEMORIES

- Memories that don't matter as much as SDM
- Less pivotal
- Don't necessarily help to define who you are
- Can use to recall things in your life and may be specific
- Don't feel they've played a role in who you are
- Can be positive or negative but unlikely to have same intensity as SDM

Example of an Autobiographical Memory

- "When I was 11, I was going up to my apartment in my building after the school bus dropped me off. The doorman got the elevator for me and I got in by myself. On the way up to the 12th floor, the elevator came to a sudden halt in between the 7th floor and the 8th floor. I got very nervous and I started sweating, but I was able to calm myself down after a few minutes. I hit the help button in the elevator, someone's voice came on the intercom, and he got the elevator to work again soon after. This experience hasn't prevented me from riding elevators, but I do remember the memory clearly."
- Didn't have an effect for this person but could be a SDM for another

Another example

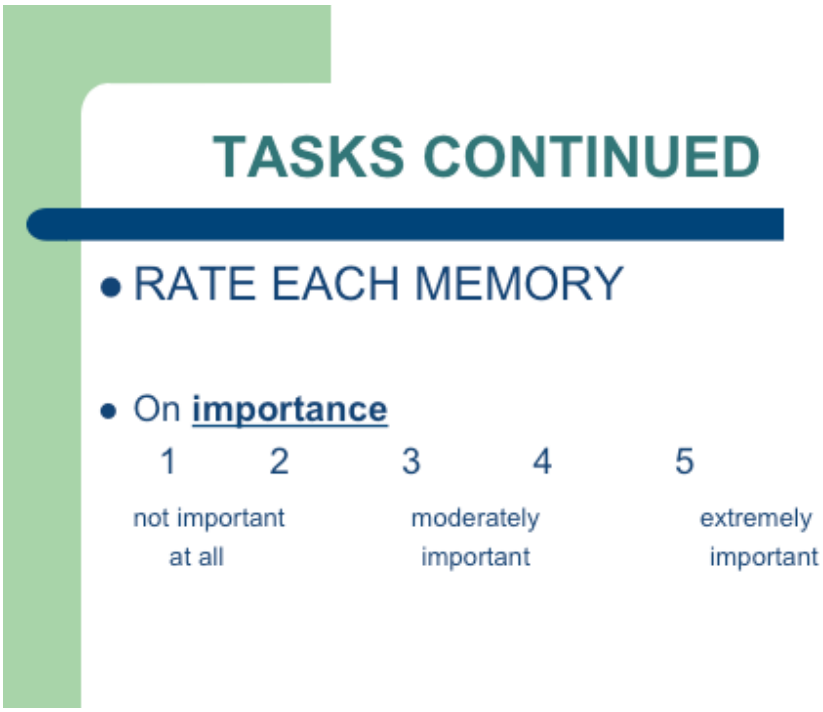
- "I can remember the one day in elementary school when the math teacher was droning on and on about something having to do with fractions. Extremely bored, I looked out the window and I saw the first snowflakes of the season starting to fall. Seeing the snow made me feel a little bit happier, even though I was so bored in class."

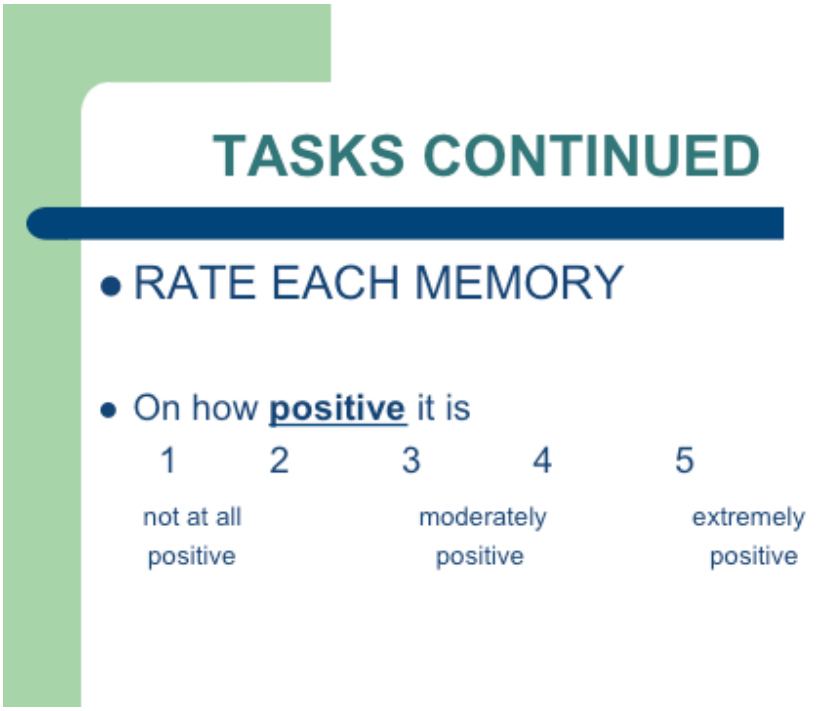
TASKS FOR SESSION 2

- You will receive a memory request form via email
- Recall and write down 12 memories
  - 6 SDM, 6 AM
- For each memory request (e.g. pos. SDM), you will recall a memory that fits this category, describe in a few sentences, and choose a cue word that will help you retrieve the memory at a later date. You'll rate the memory on how you feel about it and it's importance.

TASKS CONTINUED

- **MEMORY CUES**
- Find words that help you remember these memories
- Think about the elevator example. A good cue word might be "elevator"
- Think about the seeing the first snowfall example. A good cue word might be "snow"
- These words will help you recall these memories vividly next week


TASKS CONTINUED
RATE EACH MEMORY
On importance
1 2 3 4 5
not important at all
moderately important
extremely important


TASKS CONTINUED
RATE EACH MEMORY
On how positive it is
1 2 3 4 5
not at all positive
moderately positive
extremely positive

TASKS CONTINUED

- RATE EACH MEMORY

- On how **negative** it is

1	2	3	4	5
not at all negative		moderately negative		extremely negative

IN SUM:FOR NEXT WEEK

- Recall and write down:
  - 6 Self-Defining Memories
    - 3 positive, 3 negative
  - 6 Autobiographical Memories
    - 3 positive, 3 negative
- Rate each memory on importance, how positive it is, and how negative it is
- Choose a cue word for each memory
- **PLEASE EMAIL COMPLETED MEMORY REQUEST FORM TO ME!**

Appendix D: How to Fill Out Memory Sheets

Code Number: _____1____

Autobiographical Memory-Negative 1

Please type a brief description of this memory in italics in the space below.

When I was 11, I was going up to my apartment in my building after the school bus dropped me off. The doorman got the elevator and I got in by myself. On the way up to the 12th floor, the elevator came to a sudden halt in between the 7th and the 8th floor. I got very nervous and I started sweating, but I was able to calm myself down after a few minutes. I hit the help button in the elevator, someone's voice came on the intercom, and he got the elevator to work again soon after. This experience hasn't prevented me from riding elevators, but I do remember the memory clearly.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: ___2___

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: ___1___

1	2	3	4	5
not at all positive		moderately positive		extremely positive

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: ___4___

1	2	3	4	5
not at all negative		moderately negative		extremely negative

Cue Word: _____elevator_____

Appendix E: Session One Information Sheet

SELF-DEFINING MEMORIES
-defines who you are
-very personal
-specific (lots of detail) and meaningful
-at least one-year old
-evokes strong emotion when recalled
-can be positive or negative

Example-Positive: "I can remember receiving a grant during my senior year of college to study in Japan. I reread the congratulatory letter several times before I actually registered the information. I called my parents and grandparents to tell them the news. I could barely contain my excitement. I hung the letter up on my bulletin board in my room. I couldn't sit still. I grabbed my keys, coat, and wallet, ran to my friend's room to tell her the news, and then we went out to a celebratory sushi dinner at Koto in Groton. I still think of this memory as an important example of how hard work and dedication can pay off."

Example-Negative: "I started taking swimming lessons when I was seven years old. On the first day of lessons, I was practicing dunking my head and I swallowed too much water. I was gagging and coughing and I didn't know what was going to happen to me. I started to panic. My mom had to come over to the pool to calm me down. Ever since that day I feel extremely anxious in new situations and this memory reminds me of how I don't like to try new things."

AUTOBIOGRAPHICAL MEMORIES
-don't matter as much as self-defining memories
-don't necessarily help to define who you are
-can be positive or negative
-unlikely to have the same intensity as self-defining memories

Example-Positive: "I can remember the one day in school when the calculus teacher was droning on and on about something having to do with derivatives. Extremely bored, I looked out the window and I saw the first snowflakes of the season starting to fall. Seeing the snow made me feel a little bit happier, even though I was so bored in class."

Example-Negative: "When I was 11, I was going up to my apartment in my building after the school bus dropped me off. The doorman got the elevator for me and I got in by myself. On the way up to the 12th floor, the elevator came to a sudden halt in between the 7th floor and the 8th floor. I got very nervous and I started sweating, but I was able to calm myself down after a few minutes. I hit the help button in the elevator, someone's voice came on the intercom, and he got the elevator to work again soon after. This experience hasn't prevented me from riding elevators, but I do remember the memory clearly."

TO-DO FOR NEXT WEEK

1. Recall and write down 12 memories: 6 self-defining memories and 6 autobiographical memories. Three of each type of memory should be positive and the other three of each type of memory should be negative.

Using the Memory Request forms:

a. Provide a brief description of each memory. You just need to get the memory across, so a few sentences or a paragraph of a vividly recalled memory will be fine.

b. Rate each memory on how important it is.

c. Rate each memory on how positive it currently makes you feel.

d. Rate each memory on how negative it currently makes you feel.

e. Provide a memory cue word for each memory.

Send an email with the Memory Request forms to rachel.hess@conncoll.edu **by no later than a day before your second session**

Appendix F: Memory Request Form

Code Number: _____

Self-Defining Memory-Positive 1

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Self-Defining Memory-Positive 2

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Self-Defining Memory-Positive 3

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Self-Defining Memory-Negative 1

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Self-Defining Memory-Negative 2

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Self-Defining Memory-Negative 3

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Positive 1

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Positive 2

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Positive 3

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Negative 1

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Negative 2

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Autobiographical Memory-Negative 3

Please type a brief description of this memory in italics in the space below.

Importance Rating

Please rate this memory on how important it is to you.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Positive Rating

Please rate this memory on how positive it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Negative Rating

Please rate this memory on how negative it currently makes you feel.

Your rating: _____

1	2	3	4	5
not important at all		moderately important		extremely important

Cue Word: _____

Appendix G: Session Two Script

Electrodes:
-rectangular – left index and middle fingers
-circular – **white** = right forearm, **black** = right leg, **red** = left leg

After hooking up participant to electrodes:

You had the previous week to come up with memories of differing importance in your life, and today is an opportunity to really throw yourself back into those experiences and to relieve them and re-experience them in your mind's eye. You might be aware that drawing on memories is a technique that actors often use to find the feelings and motivations of a character.

For each memory that you're going to recall, do your best to be open to the images and feelings that it evokes in you, but keep in mind that you should now try to force feelings when they aren't there. Simply allow yourself to be as open as possible to the thoughts and emotions that each memory may inspire, and importantly, let the self-defining memories fill you.

Throughout this session, it is extremely important that you stay as still as possible, seeing as if you move a lot, this may ruin the data.

I'm going to now explain the process of the experiment. You are going to sit there for several seconds just to get some data without any cues. I will then read to you one of the memory cues that you gave to me via email. Please nod when you have the memory. I will remind you to nod when you have the memory each time you have to recall your memory. You will hold onto and re-experience the memory for one minute and I will encourage you to keep reliving the memory during this time. I will then instruct you to release the memory and I will ask you for three ratings: the intensity of the memory now, how positive it made you just feel, and how negative it made you just feel. Then you will have 30 seconds to relax and look at a soothing picture. This process will repeat until you have recalled all 12 memories. Do you have any questions?

Ok, then we'll start now.

Appendix H: Experiment Order

1. (F9) 15 second baseline

2. “I will now give you your memory cue. Please be sure to nod when you have the memory.”

3. Nod (F9)

4. After 30 seconds, “please continue to re-live the memory.”

5. “Release the memory.” (F9)

6. Intensity rating, positive rating, negative rating

7. Distracter (F9)

8. 15 second baseline (F9)

   15 second baseline
   1 minute hold memory
   30 second distracter

Appendix I: Debriefing Form

Thank you for participating in my study on the psychophysiology of memory!
This study was designed to investigate the physiological responses to self-defining memories and to autobiographical memories that aren't as important. Heart rate and skin conductance were examined when participants were asked, after hearing cue words, to recall these memories. You were hooked up to electrodes to obtain physiological measurements when they recall their memories. Previous research (e.g., Philippot, Schaefer, and Herbette (2003)) has shown that by priming a general mode of emotional information processing, the same level of emotional activity in a mental imagery trial was activated as when the event actually occurred. I am interested to see how priming memories of varying importance will affect people's physiological and emotional responses.

If you have questions regarding this study, you may contact Rachel Hess at rachel.hess@conncoll.edu. The Institutional Review Board (IRB) at Connecticut College approved this study, and any additional questions regarding the experiment can be directed to Ann Sloan Devlin, chair of the IRB (asdev@conncoll.edu). If you find yourself distressed from recalling memories which may have been very powerful, you should feel free to call Counseling Services at (860) 439-4587.

If you'd like to read a few interesting articles on this topic, check out the following:

Philippot, P., Schaefer, A., & Herbette, G. (2003). Consequences of specific processing of emotional information: Impact of general versus specific autobiographical memory priming on emotion elicitation. *Emotion, 3*, 270-283.

Blagov, P.S., & Singer, J.A. (2004). Four dimensions of self-defining memories (specificity, meaning, content, and affect) and their relationships to self-restraint, distress, and repressive defensiveness. *Journal of Personality, 72*, 481-511.

Conway, M.A., Singer, J.A., & Tagini, A. (2004). The self and autobiographical memory: Correspondence and coherence. *Social Cognition, 22*, 491-529.