

Development of the Involuntary Autobiographical Memory Questionnaire (IAMQ)

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A Thesis presented to the Graduate Faculty
of the College of William and Mary in Candidacy for the Degree of
Master of Art


Department of Psychology

The College of William and Mary
August, 2014

APPROVAL PAGE


This thesis is submitted in partial fulfillment of
the requirements for the degree of

Masters of Arts

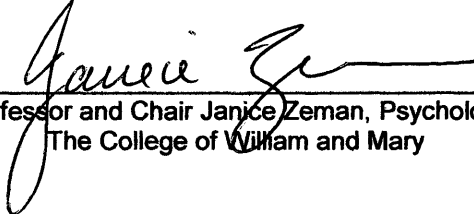


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ABSTRACT

Involuntary memories are experiences that come to mind without a deliberate attempt to retrieve this information. Although involuntary memories are a common and generally positive experience, vivid flashbacks and intrusive memories are major symptoms of various psychiatric disorders, such as Post-Traumatic stress Disorder (PTSD) and depression. The lifetime prevalence of experiencing a traumatic event is quite high, yet only a small proportion of individuals will experience repeated intrusive memories of this traumatic event. The current thesis focuses on developing a self-report instrument for measuring individual differences in experiencing involuntary memories (intrusive and non-intrusive memories). The goal of Study 1 is to develop the Involuntary Autobiographical Memory Questionnaire (IAMQ) and test its validity by comparing responses on this measure with scores on an intrusive memory response questionnaire and a depression questionnaire. A 17-item questionnaire was developed and tested on 785 participants. Principle Components factor analysis of the IAMQ revealed five factors: intrusiveness of involuntary memories (IN), emotional valence (EV), person focus (PF), specificity (SF), and multisensory object focus (MO). Significant positive correlations were found between the IN factor and each of the other four factors indicating intrusive memories were associated with greater emotional impact and specificity. In addition, the EV factor was significantly correlated with depression scores suggesting people who experienced higher levels of depressive symptoms were more likely to experience emotionally negative involuntary memories. The findings of Study 1 support the utility and validity of the IAMQ for measuring involuntary and intrusive memories. The goal of the second study was to compare responses on the IAMQ with responses to involuntary memories evoked by two laboratory tasks, Continuous Word Association Task (CWAT) and Traumatic Film Task (TFT). Significant relationships were found between the EV factor and mean emotional ratings of involuntary memories measured in both CWAT and TFT with 56 participants. In summary, the IAMQ was found to have adequate validity and clinical utility, and future research will examine further tests of its psychometrics and utility in clinical settings for symptom and intervention assessment.

COMPLIANCE PAGE

Research approved by

Protection of Human Subjects Committee

Protocol number(s): PHSC-2013-08-27-8897-ctball

Date(s) of approval: 09/10/2013

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ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my advisor, Professor Chris Ball for his patience, guidance and criticism throughout the investigation, and unending support in making this thesis possible. I am also indebted to Professors Janice Zeman and Sarah Bisconer, the members of my thesis committee, for their careful reading and criticism of the manuscript.

Additionally, I am also appreciative for my two great undergraduate research assistants, Rachel and Shelby, and all my supportive friends and family.

This thesis is dedicated to all the people who were there when I needed them.
“Soli Deo Gloria”

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Development of the Involuntary Autobiographical Memories Questionnaire (IAMQ)

Memory can take many forms and researchers classify memories on a variety of characteristics (refer to Figure 1). One important distinction relates to how long the experience or knowledge has been retained (i.e., short-term memory versus long-term memory). An additional important distinction relates to the type of information being stored, such as episodic versus semantic. Semantic memory is a more abstract level of learned knowledge that does not require conscious recollection of past experiences. This memory is not necessarily tied to specific events but organized into schemas and categories. Episodic memory, on the other hand, is memory of specific events or experiences containing temporal, spatial, emotional, and other contextual information. Autobiographical memory relates to experiences that have personal relevance and are primarily episodic. These memories are focused on the self and often linked with personal meanings and goals. A third distinction relates to how memories are retrieved into awareness as part of a voluntary premeditated act or without any voluntary act of retrieval (i.e., involuntary). The specific memories of interest to the current thesis are long-term autobiographical memories that reach awareness involuntarily. They are memories of a personal experience that comes to mind without a need for a premeditated deliberate search for this information. They are a common memory experience but one that has received very little research attention, except in the special cases of severe flashbacks associated with some psychological disorders, such as Post-traumatic Stress Disorder (PTSD) and depression (Brewin, Hunter, Carroll, & Tata, 1996; Ehlers & Steil, 1995; Holmes & Bourne, 2008).

Autobiographical Memories

Autobiographical memories allow us to construct our personal life history and to define who we are. Autobiographical memory encompasses not only factual knowledge about our past (semantic autobiographical memory), but also contains general event information about related experiences and detailed content of specific events (episodic autobiographical memory)

(Williams, Conway, & Cohen, 2008). Conway and Pleydell-Pearce (2000) described a hierarchical model of autobiographical memory that provides for three levels of memory representations based on the specificity of memory content with life time periods at the highest level, general events at the middle level, and event specific knowledge at the lowest level. Life time periods represent general, thematic knowledge about characteristics of a broad life period, such as a memory of one's early childhood or high school years. General events consist of repeated events linked by a common theme, such as the way your family has celebrated New Year's Day in the past, or consist of extended duration events, such as a summer vacation at the beach. Event specific knowledge contains more unique and detailed sensory-perceptual information of a specific event (usually less than 24 hours in duration), such as the memory of your most recent birthday celebration.

Autobiographical memories mainly serve three functions: directive, self, and social (Bluck, Alea, Habermas, & Rubin, 2005; Rasmussen & Berntsen, 2009; Williams, Conway, & Cohen, 2008). The directive function of autobiographical memories is involved in decision making and planning for present and future life courses based on knowledge learned in the past. The self-function, refers to self-continuity, and involves identifying, understanding, and preserving the sense of self. Lastly, the social function allows us to build and maintain meaningful relationships with others by sharing our life stories. We use these functions every day in our life. For example, when you and your friend go to a restaurant and make an order, you decide to have a sandwich because you did not like their salad last time when you visited the same restaurant. In this scenario, you used an autobiographical memory to guide your decision which is a directive function. You may also recommend to your friend not to have a salad and share your story from the last visit. This would be an example of using the social function of autobiographical memory. And knowing that past experiences with food are important to you is an example of accessing the self-function. Understanding these functions is important in

autobiographical memory studies because these functions could give us answers to why we remember what we remember when we do.

Involuntary Autobiographical Memories

Ebbinghaus first distinguished voluntary and involuntary memories in the late 19th century (Ebbinghaus, 1885/1964). Voluntary autobiographical memories involve premeditated, conscious, intentional recall of a past experience, whereas involuntary autobiographical memories occur unconsciously and spontaneously without deliberate retrieval (Berntsen, 1996)¹. For example, if you were asked “What is your best memory from the past couple of years?” you could voluntarily recall the memories from the last summer vacation and answer “It is my summer vacation to the beach last year.” On the other hand, if the memory of you sitting on the beach came to mind spontaneously without your conscious need to recall this information, then this would be an example of an involuntary memory.

Rasmussen and Berntsen (2009) investigated whether different types of memory retrieval serve different functions and suggested that involuntary autobiographical memories serve all three major functions of voluntary retrievals (self, directive, and social function) but to different degrees. Their results revealed that the self and social functions were used more than the directive function of involuntary memories. In their later study, Rasmussen and Berntsen (2011) examined the perceived functions of voluntary memories and involuntary memories by asking participants to choose what typically causes them to have either voluntary or involuntary memories. They found that voluntary memories were more likely to be accessed when one is sharing those voluntary memories with others or trying to solve a problem, whereas involuntary memories came to mind when one is daydreaming or in a period of boredom. These findings suggest that involuntary memories may serve different functions than voluntary memories. Studying the

¹ Most researchers use the short-hand term ‘involuntary memories’ for ‘involuntary autobiographical memories’.

different properties of involuntary memories should help us better understand the functions of involuntary memories.

Intrusive Autobiographical Memories

Intrusive autobiographical memories are involuntary memories that consist of repeated involuntary recall of the same event (Ehlers et al., 2002). Intrusive memories share much of the same features as involuntary memories. In terms of emotional valence, involuntary memories refer to both negative and positive memories, whereas intrusive memories refer to highly negative and stressful experiences as the word 'intrusive' describes unwanted memories (Berntsen, 2009; Krans et al., 2010). Due to the distressing nature of such intrusive memory recall, intrusive memories are commonly recognized as a symptom of psychiatric disorders like depression, anxiety, and PTSD. Brewin, Hunter, Carroll, and Tata (1996) found that 87% of depression sufferers reported an average of 2.6 different intrusive memories a day. Hackmann, Surawy, and Clark (1998) found that people with social anxiety disorder reported intrusive memories associated with anxiety provoking situations. A goal of the current research is to examine what characteristics distinguish people who experience such intrusive memories on a regular basis.

Properties of Involuntary Memories

Frequency of Occurrence

Berntsen (1996) first studied involuntary autobiographical memories using a naturalistic diary approach. She suggested that 3 to 20 involuntary memories occur during a typical day. In a later study, Rubin and Berntsen (2009) compared the frequency of involuntary memories with voluntary memories in daily life, and found the frequency of involuntary recall was similar to the frequency of voluntary recalls. Recently, Rasmussen and Berntsen (2011) found that involuntary memories were reported significantly more often than voluntary memories with an average of 22 involuntary memories reported during a normal day, while an average of seven voluntary memories were reported by the same participants. However, there were large individual

differences in the frequency of involuntary memories reported in these studies, and researchers have not speculated about a cause for these frequency differences. One of the goals of the current thesis is to examine individual differences in the frequencies of involuntary memory occurrence.

Cues

Conway and Pleydell-Pearce (2000) suggested that involuntary memories (direct retrievals) result from a fortuitous match between a cue in the environment and a related aspect of the memory's content. For example, an involuntary memory of an ocean swim may come to mind when cued by the taste of salt. Berntsen (1996) asked her participants to compare each of their involuntary memories with the retrieval situation at the time and to indicate whether there were any commonalities between the two. The results showed that almost all involuntary memories were experienced in response to one or more identifiable cues (commonalities) with activity, object, person, and sensory experience being the most frequent cues. However, other researchers have reported that cues do not necessarily need to be external and that many involuntary memories are triggered by more abstract cues, such as thoughts and feelings (Mace, 2004). And recent research, even suggests that involuntary memories can come to mind without any identifiable cue at all (Ball & Little, 2006; Berntsen, 2009). It is unclear how such involuntary memories are triggered, and the current research will examine if individual differences in their particular occurrence can help explain the role of cues in evoking involuntary memories.

Content

Visual Perspective

When an involuntary memory comes to mind, we sometimes observe ourselves in the scene (observer/3rd person perspective) but at other times we see the scene from our original perspective or through our own eyes (field/1st person perspective). Many studies have found that autobiographical memories are experienced more commonly with a field perspective and that these memories involve more emotional content (Berntsen & Rubin, 2006; Nigro & Neisser, 1983;

Robinson & Swanson, 1993; Rubin, Boals, & Berntsen, 2008; for reviews, see Mace, 2010). In a recent study, Mace, Atkinson, Moeckel, and Torres (2011) compared the perspectives that occur when experiencing involuntary memories and found that both types of perspective occur with involuntary memories just as they occur with voluntary memories. Researchers cannot explain why one perspective is preferred over the other for any memory retrieval, and also whether individuals have an overall preference for one perspective. This question becomes particularly intriguing for involuntary memories where the memory retrieval is not under voluntary control. Another goal of the current study is to examine whether one's preference for a visual perspective is associated with other aspects of involuntary memories, such as their emotional content and emotional impact when recalled.

Focus of Content

Arguably, most of our personal experiences are assumed to focus on ourselves because of the inherent role they play in our self-identity and self-goals, as clearly outlined by the self-memory model of autobiographical memory (Conway & Pleydell-Pearce, 2000). However, this does not rule out the possibility that the focus of specific memories could be primarily focused on others, and may be even focused on non-human or inanimate objects. To the best of our knowledge, the focus of involuntary memories has not been examined in previous research. The focus of memory content relates to the function of the memory retrieval and these preferences could tell us more about the causes and functions of involuntary memories.

Sensory Contents

Hall and Berntsen (2008) suggested that involuntary memories are often accompanied with strong sensory (primarily visual) imagery and emotional re-living. However, other sensory aspects such as smell, sound, and taste could also be part of involuntary memories. Moreover, physical reactions, such as palpitation, feeling restless, and sweating, that are found to be

associated with negative emotional memories (Berntsen & Rubin, 2006), may be more common for people who experience intrusive memories.

Specificity

Memory specificity distinguishes the memories of specific events (e.g., 21st birthday) from the memories of general events (e.g., past birthdays). Researchers have reported that involuntary memories when compared with voluntary retrievals tend to involve more specific experiences than general events (Berntsen, 2009; Watson, Berntsen, Kuyken, & Watkins, 2013). Numerous clinical studies have reported a tendency for many clinical and sub-clinical populations to show a specificity effect when voluntarily retrieving autobiographical memories (see recent review by Williams et al., 2007). For example, depressed individuals are more likely to recall general memories when provided cue words for retrieving memories. For this reason, the current thesis will examine individual differences in the specificity of involuntary memories.

Personal Importance

Previous research suggests that involuntary memories are more likely to involve important life events (Berntsen, 1996; Bernsten, 2009). Given the functions of autobiographical memories, this result is not surprising. However, this finding could also result from a demand characteristic of previous research because participants most often used daily diaries to record their involuntary memories. They may only be recording the memories involving important events because they are more memorable or because the participant wants to report interesting personal experiences. The current thesis involves the use of a self-report questionnaire and may be more resistant to this demand characteristic problem.

Emotional Content and Impact

Emotional content and impact can be explained in terms of intensity and valence. Berntsen (2009) reported that involuntary memories are usually of low emotional intensity with positive valence, unlike intrusive memories which generally have higher intensity with negative

valence. Higher emotional intensity of memory content is related to stronger vividness (involve more sensory contents), more rehearsal and reliving, and higher personal importance (Berntsen & Rubin, 2006). These findings suggest that emotionality of memory content links to many other properties of involuntary autobiographical memories. Intrusive memories can also have a major impact on the emotional state of an individual, specifically flashbacks associated with PTSD (Clohessy & Ehlers, 1999; Ehlers & Steil, 1995). The current study will examine individual differences in the emotional content and impact of past involuntary memories, and how these individual differences may relate to past intrusive memory experiences and the participant's current mental health.

Methodologies for Studying Involuntary Memories

Diaries

The most popular methodology for examining involuntary memories has been the daily diary procedure pioneered by Bernstein (1996). Much of what we currently know about involuntary memories has come from the use of this methodology (Ball & Little, 2006; Berntsen, 1996, 1998; Mace, 2004; Mace, Atkinson, Moeckel, & Torres, 2011). This methodology involves the recoding of involuntary memories as soon after they happen as is possible. Although this methodology has excellent ecological validity with participants reporting real involuntary memories, this methodology does not allow researchers opportunities for experimental manipulations. This methodology also takes considerable time to collect a relatively small number of involuntary memories that are only relevant to that specific time in the participant's life. Although there are some limitations with the diary methodology, what we know so far about the characteristics and functions of autobiographical memories has for the most part come from these diary recording.

Laboratory tasks

There have been some recent attempts to elicit involuntary memories in a laboratory setting. Mace (2007) used voluntary memory retrievals to cue involuntary memory retrievals but the number of involuntary memories collected was quite small with this procedure. There are also concerns about the actual involuntary nature of these retrievals. Schlagman and Kvalivishi (2008) asked participants to perform a repetitive simple task while word phrases were concurrently displayed on the screen. Their participants indicated when involuntary memories occurred during the 60 minutes of data collection. Again, the number of involuntary memories reported was small and experimental manipulations are limited. Ball (2007) developed the Continuous Word Association Task (CWAT) which uses continuous free associations to evoke involuntary memories. The CWAT requires participants to provide a free association to a word cue prompt, and then each free association becomes the new prompt for the next free association (Ball, 2007). The sequence of associations generated by participants are primarily semantic (e.g., popcorn to movies, tree to leaves), but quite often an autobiographic memory comes to mind spontaneously during the sequence. Ball argued that these autobiographical memories are not the product of deliberate voluntary retrievals, and therefore they are instances of involuntary memories. Ball (2007) reported that participants reported experiencing involuntary memories on almost 90% of CWAT trials. Other researchers have found similar results while also revealing significant relationships between CWAT measures and personality dimensions (Jones & Steel, 2012; 2014).

A laboratory procedure that focuses specifically on intrusive memories is the Traumatic Film Task (TFT). The traumatic film methodology was first introduced in the 1960s and it has been extended in many ways since then (see review for Holmes & Bourne, 2008). Participants watch an emotionally arousing trauma-related film (e.g., car accident), and then are asked to report memory intrusions about the film contents immediately after viewing the film or during the next few days that follow the viewing. Experimental manipulations can be achieved with this

methodology by manipulating the viewing conditions or the tasks performed during or after viewing (Brewin & Saunders, 2001; Davies et al., 2012; DeRose et al., 2012).

Self-report Measures of Voluntary Autobiographical Memories

Self-report questionnaires are one of the most popular methods for psychologists to understand human behavior. Researchers have developed self-report instruments to examine the phenomenological characteristics of voluntarily retrieved autobiographical memories. The Memory Characteristic Questionnaire (MCQ) was developed by Johnson, Foley, Suengas, and Raye (1988) to compare the characteristics of the autobiographical recall of a real event with the similar characteristics for an imagined event. As a reality monitoring measurement, the MCQ asks participants to rate the degree of sensory details (sound, smell, and taste), perceptual details (realism, location, and setting), temporal details (time, year, season, day, and hour), and details of before and after the event of the recalled memories.

More recently, the Autobiographical Memory Questionnaire (AMQ) was developed by Rubin, Schrauf, and Greenberg (2003) to describe the different features of autobiographical memories. The AMQ shares some of the same basic components of the MCQ, but the AMQ is shorter in length and has an additional emphasis on the recollection (reliving of original events) of such memories. In studies using the AMQ, participants are given a set of cue words to recall autobiographical memories, and then asked to rate each recalled memory on a number of scales. Although the total number of items included in the AMQ will differ based on the purpose of the study, the questions cover five basic properties of autobiographical memories: sensory components (images, field/observer, setting, sounds, and smells), emotional components (valence, intensity, reaction, and mood change), language and narrative component (story, pieces, and life story), properties of memories (previous rehearsal, involuntary recall, specific, merged/extended, age of memory, cued by, and trauma related), and metacognitive judgments of recollection and belief (reliving and belief) (Rubin, Boals, & Berntsen, 2008).

Questionnaire developed by Sutin and Robins (2007) is called the Memory Experiences Questionnaire (MEQ). The MEQ includes 10 dimensions of autobiographical memories: vividness (clarity and intensity), coherence (logical story and specific event-knowledge information), accessibility (ease of retrieval), time perspective (perceived clarity and lapse of time), sensory details (non-visual sensory details), visual perspective (first person versus third person), emotional intensity (at encoding and retrieval), sharing (memory shared with other people), distancing (distance from the past self), and valence (perceived valence of the event and the emotional experience at encoding).

These self-report questionnaires have been used in various studies to compare different aspects of autobiographical memories, and many of their items have been used as rating scales in diary studies of involuntary memories. To the best of our knowledge, however, there was no questionnaire solely focused on involuntary memories. The first goal of the current thesis is to develop a new questionnaire for examining individual differences in the experiencing of involuntary memories and to examine its factor structure. A second goal involves examining the relationships between involuntary memory experiences and responses to intrusive memories. The third goal of this thesis is to test the utility of this newly developed questionnaire by examining the relationships between the questionnaire's factors and a clinical measure of depression, because involuntary, and especially intrusive, memories are a common problem for depressed individuals. The final goal of this thesis is to test the validity of the questionnaire by comparing factor scores from the questionnaire with measures obtained from laboratory tasks designed to evoke involuntary memories (CWAT) and intrusive memories (TFT).

Study 1

Development of the Involuntary Autobiographical Memory Questionnaire (IAMQ)

The Involuntary Autobiographical Memory Questionnaire (IAMQ) was developed by the author and is a 17-item self-report questionnaire asking respondents about their past involuntary

autobiographical memories. The IAMQ covers the multidimensional nature of involuntary autobiographical memories and includes measures of frequency, cues, contents, types, and emotion related aspects. The items of the IAMQ were drawn from diary investigations of involuntary memories and self-report questionnaires of voluntary memories. Unlike past diary studies of involuntary memories, where ratings are provided for each memory daily for weeks, the IAMQ asks participants to provide their ratings based on their general memory of past involuntary memories. Rather than averaging their entries in a diary, we requested participants to recount their typical involuntary memory experience. For example, instead of counting the number of involuntary memories experienced each day for a lengthy period of recording (Rasmussen & Berntsen, 2011), the IAMQ requires the participant to estimate their relative frequency.

Measurement of Intrusive Memories

An intrusive memory questionnaire (INMQ) was used in the current study to investigate the relationship between emotional aspects of involuntary memory experience and emotional response to intrusive memories. The INMQ requires participants to describe a specific intrusive memory of a distressing event that they experience and then provide ratings of their emotional response (distress, dissociation, and feeling of control) to this intrusive memory. These questions were adapted from the items of the Response to Intrusions Questionnaire (RIQ) developed by Clohessy and Ehlers (1999) who found correlations between the RIQ, particularly the dissociation items (feeling numb and detached) and the severity of PTSD symptoms. In addition, the negative interpretations of intrusive memories were associated with less controllability over the occurrence of such memories. Considering these significant relationships, the INMQ assesses the degree of distress, the frequency of feeling dissociation, and the level of perceived control over the occurrence of an intrusive memory.

Involuntary Memories, Intrusive Memories, and Depression

People who suffer from a depressive disorder experience intrusive memories as much as PTSD patients (Reynolds & Brewin, 1999). Several previous studies have shown that many features of intrusive memories, such as vividness, negative emotionality, level of distress, physical sensations, and avoidance behavior, are commonly reported by depression patients (Newby & Moulds, 2011). To examine the relationships between involuntary memories and intrusive memories with depression, the Center for Epidemiologic Studies-Depression scale (CES-D; Radloff 1977) was used in the current study. The CES-D is in the public domain and it is a well-known self-report depression inventory suitable for measuring an individual's level of depressive symptoms in the general population. Scores on the CES-D are expected to correlate with factor scores obtained from the IAMQ, as well as with items from the INMQ.

Method

Participants

Seven hundred and ten undergraduate students at the College of William and Mary completed a set of questionnaires as a part of the Psychology Department's Fall 2013 mass testing (a course requirement for introductory psychology students). The measures used in the current thesis were randomly located in amongst this set of questionnaires. Four hundred and five participants were female with a mean age of 18.67 years ($SD = 1.52$ years) and 305 participants were male with a mean age of 18.90 years ($SD = 1.07$ years).

Measures

Involuntary Autobiographical Memory Questionnaire (IAMQ)

The IAMQ is a 17-item self-report questionnaire developed to measure individual differences in involuntary autobiographical memory experiences (see Table 1). Involuntary autobiographical memories are defined in the questionnaire as personal experiences that unconsciously and spontaneously come to mind without any deliberate retrieval of the past event from memory and are typically triggered by identifiable environmental cues. An example of an

involuntary autobiographical memory was provided in the instructions to help participants better understand the difference between involuntary and voluntary memories. The example described: “A time when a specific incident from high school came to mind when you were not planning to recall this information. This is in contrast to a voluntary retrieval of the same information in response to a question you were asked or as part of a story you were telling.” The instructions asked participants to respond with respect to their general experiences of involuntary autobiographical memories from their past.

The 17 items are displayed in Table 1. Items 1 and 17 relate to the frequency of involuntary memory occurrence (1 = *many times a day*, 2 = *daily*, 3 = *every few days*, 4 = *weekly*, 5 = *monthly*, to 6 = *yearly*) and the frequency of a repeated involuntary autobiographical memories that relate to the same event (i.e., intrusive memory) (1 = *never* to 7 = *very often*). Items 2, 3, 11, and 15 relate to the general characteristics of their past involuntary memories: vividness (1 = *not vivid at all* to 7 = *very detailed and vivid*), identifiable cue (1 = *rarely* to 7 = *always*), specificity of event (1 = *mainly specific* to 7 = *mainly general*), and personal importance (1 = *rarely* to 7 = *always*). Items 4, 5, 6, and 7 examine the sensory content of their involuntary memories: visual images, other sensory aspects (i.e., smell and sound), physical actions, and the emotional reactions (1 = *rarely involved* to 7 = *always involved*). Items 12, 13, and 14 relate to the emotional content of their involuntary memories (1 = *mainly negative* to 7 = *mainly positive*), emotional impact of memories (1 = *not much at all* to 7 = *quite a lot*), and the feeling after the recall of the involuntary memories (1 = *mainly negative* to 7 = *mainly positive*). Items 8, 9, 10, and 16 relate to focus of content (self, others, inanimate object) (1 = *rarely focused on* to 7 = *always focused on*) and the visual perspective of these memories (1 = *mainly first person* to 7 = *mainly third person*).

Intrusive Memory Questionnaire (INMQ)

The INMQ is a 3-item questionnaire (see Table 2) based on items from the Response to Intrusions Questionnaire developed by Clohessy and Ehlers (1999) to specifically examine intrusive memories. An intrusive memory was defined in the instructions for this questionnaire as “A personal experience involving an involuntary autobiographical memory that has come to mind repeatedly and always involves the same event.” The instruction directed participants to provide a brief description of a specific intrusive memory for a distressing event that they had personally experienced. Based on the intrusive memory recalled, participants then rated how distressing this memory was (1 = *not at all* to 7 = *very much*), whether they felt detached or numb after this memory came to mind (1 = *never* to 7 = *very often*), and how much control they felt they had over the occurrence of this memory (1 = *none at all* to 7 = *quite a lot*).

Center for Epidemiologic Studies Depression Scale (CES-D)

The CES-D is a 20-item self-report questionnaire that measures depression symptomology in the general population, and was first reported by Radloff (1977). For each of the items, participants indicate how often they have felt or behaved in certain ways associated with depressive symptoms during the past week using a 4-point ordinal scale: rarely or none of the time (less than 1 day); some or a little of the time (1-2 days); occasionally or a moderate amount of the time (3-4 days); most or all of the time (5-7 days). Items 4, 8, 12, and 16 are positive statements (e.g., I felt I was just as good as other people), while the other 16 items are negative statements (e.g., I was bothered by things that usually don't bother me). The positive items were reverse scored and the sum of the 20 items gave a total depression score that ranged from 0 to 60 ($M = 13.08$, $SD = 9.42$). Individuals with scores of 16 points or more are considered to have depressive symptoms (Radloff, 1977). Thirty percent of the 650 participants who completed this questionnaire were experienced depressive symptoms using this criterion. The CES-D was found to have good internal consistency in this study with a Cronbach's $\alpha = .90$.

Procedure

The IAMQ, INMQ, and CES-D questionnaires were provided online to participants as part of a battery of 24 tests included in the mass testing of participants. The informed consent was provided on the first page of the survey.

Results

IAMQ Analysis

Descriptive statistics for all 17 items are provided in Table 1 and correlations between individual items are provided in Table 3.

Frequency of Occurrence

Most people reported experiencing involuntary memories at least once every few days ($M = 3.58$, $SD = 1.38$), but there were some participants who experienced them many times a day while others reported they hardly ever experienced them. The frequency of involuntary memories (item 1) was negatively correlated with their personal importance (item 15), $r(676) = -.08$, $p = .03$. If experiencing involuntary memories frequently, the memories that do come to mind are more likely to be of personally important events. A negative correlation was found between the frequency of involuntary memories and the frequency of prior rehearsal (item 17), $r(676) = -.34$, $p < .001$. This again probably relates to the previous finding in that individuals who experience involuntary memories frequently, tend to recall memories of well-rehearsed important events when they do have such involuntary retrievals. Not surprisingly, personally important memories are more frequently rehearsed, $r(676) = .28$, $p < .001$.

Cues

Consistent with previous studies, many people (76%) could regularly identify cues for the majority of their past involuntary memories ($M = 4.46$, $SD = 1.63$) and this finding is consistent with diary studies of involuntary memories (Ball & Little, 2006; Berntsen, 1996, 2009; Mace, 2004). The presence of identifiable cues (item 3) was negatively correlated with the memory specificity (item 11), $r(676) = -.17$, $p < .001$, and positively correlated with the personal

importance (item 15), $r(676) = .19, p < .001$. Participants were more likely to identify cues for their involuntary memories when such memories were of specific and important personal life events.

Content

Visual Perspective

More participants reported that they experienced their past involuntary memories in mainly a first person perspective (57%) than participants who experienced their memories primarily in a third person perspective (25%) ($M = 3.17, SD = 1.81$). The visual perspective (item 16) was positively correlated with the focus of memory content on the self (item 8), $r(676) = .091, p = .018$, and negatively correlated with a focus on other people (item 9), $r(676) = -.082, p = .033$. This item also correlated positively with the specificity (item 11), $r(676) = .11, p = .003$. Involuntary memories of general events were more often experienced in third person perspective and focused on the self, whereas involuntary memories of specific events were more likely experienced in first person perspective and focused on other people.

Focus

Compared to focus on self ($M = 3.99, SD = 1.52$) or focus on other people ($M = 4.01, SD = 1.43$), participants were less likely to have their involuntary memories focused on inanimate object that were part of the event ($M = 3.07, SD = 1.47$). As expected, the focus on self (item 8) was negatively correlated with the focus on other people (item 9), $r(676) = -.35, p < .001$. However, the focus on inanimate object (item 11) was positively correlated with both the focus on self, $r(676) = .087, p = .024$, and the focus on other people, $r(676) = .15, p < .001$. This result suggests that the presence of an inanimate object in the memory occurred with the presence of the individual and others, and would appear to suggest an object used by people (e.g., a car).

Sensory Content

Nearly 85% of participants reported that their involuntary memories frequently involved visual images, 57% reported their memories frequently contained other sensory aspects (smells, sounds), 67% reported a high frequency of physical actions, and 79% reported emotional reactions were a common part of their involuntary memories. As would be expected, visual images (item 4), other sensory aspects (item 5), physical actions (item 6), and emotional reactions (item 7) were all positively correlated with the overall vividness (item 2) of involuntary memories.

Specificity

More than half of the participants (57%) reported that their involuntary memories were frequently of specific events. The specificity (item 11) was negatively correlated with the vividness (item 2), $r(676) = -.16, p < .001$, the visual images content (item 4), $r(676) = -.15, p < .001$, the emotional reactions content (item 7), $r(676) = -.12, p = .002$, and positively correlated with valence of emotional content (item 12), $r(676) = .15, p < .001$. Involuntary memories of specific events were highly vivid, often involve visual image and emotional reactions as part of memories, and the emotional content of those memories was mainly negative.

Importance

Seventy two percent of participants rated their involuntary memories as often referring to important life events. The personal importance (item 15) of involuntary memories was not correlated with the focus on self, $p > .05$, but was positively correlated with a focus on other people, $r(676) = .20, p < .001$, and a focus on an inanimate object, $r(676) = .11, p = .005$. This is contrary to the findings from diary studies that report these important life event memories to generally be personally relevant positive events (e.g., celebration, first date), again suggesting that the IAMQ is perhaps revealing a different view of involuntary memories than prior research that focused on daily recordings of involuntary memories.

Emotional Content and Impact

Consistent with previous studies, involuntary memories tend to be more emotionally positive (44%) than emotionally negative (22%). In addition, more participants reported that the recall of involuntary memories made them feel positive (40%) than negative (23%). Moreover, 71% of participants reported a moderate to strong impact of their involuntary memories on their emotional state. The emotional content (item 12) was positively correlated with the feeling after recall (item 14), $r(676) = .71, p < .001$, whereas the intensity of emotional impact (item 13) was negatively correlated with the feeling after recall, $r(676) = -.18, p < .001$. When involuntary memories involved emotionally positive content, the feeling after the recall of such memories was also positive. Strong impact of involuntary memories on one's emotional state was associated with feeling mainly negative after recall of involuntary memories.

Gender Differences

Significant gender differences were found for some items of the IAMQ. Women were more likely to report their involuntary memories involved visual images ($M = 5.02, SD = 1.52$) and emotional reactions ($M = 4.88, SD = 1.57$) when compared to men (visual images $M = 4.75, SD = 1.52$; emotional reaction $M = 4.49, SD = 1.60$), $t(674) = -2.26, p = .024$ and $t(674) = -3.12, p = .002$ respectively. On the other hand, men were more likely to have their involuntary memories focus on inanimate object ($M = 3.2, SD = 1.52$) than women ($M = 2.97, SD = 1.43$), $t(674) = 2.09, p = .037$.

Exploratory Factor Analysis of IAMQ

Exploratory Factor Analysis of the IAMQ was conducted using Principal Component Analysis (PCA) with oblique rotation (Oblimin with Kaiser Normalization). Examination of the scree plot of eigenvalues revealed five factors. After excluding factor loadings less than .40, factor 1 was identified with five items (6, 7, 13, 15, and 17), factor 2 with two items (12 and 14), factor 3 with two items (8 and 9), factor 4 with six items (1, 2, 3, 4, 11, and 16), and factor 5 with two items (5 and 10). The factor loadings are displayed in Table 4.

Factor 1 appears to distinguish intrusive memories (repeated involuntary memories of the same event) from the more common daily involuntary memory. This factor is labeled “Intrusiveness” (IN) and a high score on this factor reflects the strong presence of intrusive memories in an individuals’ experience of involuntary memories. These intrusive memories are important life events that come to mind repeatedly and involve a strong component of physical actions in their content. Intrusive memories also have strong emotional content and are emotionally impactful when they are recalled.

Factor 2 distinguishes the emotional valence of the involuntary memories (negative vs. positive) (item 12) and the valence of their emotional impact on (item 14). This factor is labeled “Emotional Valence” (EV) and a high EV score indicates that the emotional contents of the memories were mostly positive and had a positive effect on emotional state, while low scores reflect negative involuntary memories with a negative effect on emotional state.

Factor 3 distinguishes the focus of recall in terms of 1st person focus (focus on self as a center of event) versus 3rd person focus (focus on other people in the event). This factor is labeled, “Person Focus” (PF). High PF scores indicate involuntary memories were more focused on self, while low scores reflect focusing on other people.

Factor 4, labeled as “Specificity of Memories” (SM), distinguishes between specific and general memories. A high score on SM means that more of the involuntary memories recalled are of specific events. Specific memories involve very detailed and vivid contents with identifiable cues and visual images as a major part of these memories. In addition, specific memories are high in frequency and commonly recalled with a 1st person perspective. On the other hand, general memories are commonly recalled in 3rd person perspective, are not so vivid, and unidentifiable cues are common with these memories.

Factor 5 highlights whether the involuntary memories contain non-visual sensory aspects, and also distinguishes between a human versus object focus of the content. This factor is labeled,

“Multisensory Object Focus” (MO) and a high score on MO means that involuntary memories tended to be recalled involving multisensory aspects with a focus on inanimate objects.

Factor scores were calculated for all participants using the multiple regression procedure. The correlations between the five factors are provided in Table 5. IN and MO correlated positively with all other four factors, although EV, PF, and SM factors are not correlated with each other.

Gender Differences

An independent sample t-test revealed a significant gender difference for the SM scores, $t(674) = -2.14, p = .032$. Male participants were more likely to experience involuntary memories of a general nature ($M = -.10, SD = 0.97$) than female participants ($M = .07, SD = 1.02$). There was also a significant effect for gender with the MO scores, $t(674) = -2.48, p = .01$. Compared to female participants ($M = -.08, SD = .96$), male participants ($M = 0.11, SD = 1.04$) were more likely to experience involuntary memories as involving multisensory content with an object focus.

INMQ Analysis

Descriptive statistics for this questionnaire are shown in Table 2. The INMQ requires participants to provide a brief description of a specific intrusive memory. Nearly 24% of these descriptions involved death, illness, or injury to people and pets that were close to the participant. About 19% of the descriptions were about relationship breakups with loved ones or friends. Another 17% of the descriptions involved failed outcomes such as getting a low grade on an exam, getting rejected from a college, or losing a sporting competition. A further 9% of descriptions involved car accidents and 7% were family related issues such as their parents' divorce or having a major argument. Another 15% of descriptions were from various other events including embarrassing social situations, sexual/child abuses, other types of accident, and nightmares. Some of the descriptions were either ambiguous or described a positive event (i.e., ‘the day I got my dog’, ‘the days at grandma’s house’, ‘Christmas party’, ‘birthday’, and ‘having

big family dinner’), but these respondents were not excluded from the data analysis because they still provided high distress ratings. For instance, a participant might have their worst ‘Christmas party’ or an argument with family member while ‘having big family dinner’. Seven percent of participants choose not to provide a description (some people indicated that they do not want to share their memories) and the data from these participants were excluded only if their distress ratings are also missing. About 2% ($n = 12$) of participants who reported that they have never experienced intrusive memories were excluded from further data analysis.

Significant correlations were found between all three items (refer to Table 5). Distress (INMQ-distress) was correlated positively with disassociation (INMQ-dissociation), $r(663) = .50$, $p < .001$, and negatively correlated with perceived control (INMQ-control), $r(663) = -.24$, $p < .001$. INMQ-dissociation was correlated negatively with INMQ-control, $r(663) = -.21$, $p < .001$. A high level of distress experienced from an intrusive memory was associated with stronger feelings of detachment and less control over the occurrence of these intrusive memories.

Gender Differences

A significant gender difference was found for the distress relating to these intrusive memories, $t(661) = -3.98$, $p < .001$, with men ($M = 4.72$, $SD = 1.79$) reporting less distress than women ($M = 5.26$, $SD = 1.68$). There were no other significant gender differences, $p > .05$.

Relationship to IAMQ

Four out of the five factor scores from the IAMQ revealed significant correlations with scores on items from the INMQ (refer to Table 5 for summary of correlations). Higher levels of distress associated with an intrusive memory was related to higher levels of involuntary memory intrusiveness in the past (IN), $r(663) = .32$, $p < .001$. The negative emotional content and impact of past involuntary memories (EV), $r(663) = -.10$, $p = .012$, and the specificity of event type recalled involuntarily (SM), $r(663) = .14$, $p < .001$, were also related to distress from this particular intrusive memory.

Stronger feelings of detachment and dissociation was also associated with higher IN scores, $r(663) = .30, p < .001$, negative EV, $r(663) = -.12, p = .002$, and experiencing involuntary memories involving non-visual sensory aspects and inanimate object focus (MO), $r(663) = .16, p < .001$. Participants who perceived less control over the occurrence of their specific intrusive memory reported involuntary memories to be more frequently intrusive (IN), $r(663) = -.21, p < .001$, with more negative emotional contents and impact (EV), $r(663) = .17, p < .001$, and more specific events (SM), $r(663) = -.10, p = .009$.

Depression Scale (CES-D)

Relationship to IAMQ

A positive skew was found for the CES-D scores and this skew was removed using a square root transformation. The transformed scores were tested for correlations with the five IAMQ factors (refer to Table 5). Participants who had higher CES-D scores of depression rated their involuntary autobiographic memories as more intrusive (IN), $r(650) = .15, p < .001$, and the emotional content and impact of these involuntary memories (EV) as more negative, $r(650) = -.21, p < .001$. Participants with higher depression scores also rated their involuntary memories as more likely to contain non-visual sensory aspects and a focus on inanimate objects that were part of the event (MO), $r(650) = .13, p = .001$, which suggests these depressive symptoms could relate to a past traumatic event memory, such as a car accident or related injury.

Relationship to INMQ

Participants who scored higher on depression measure rated their specific intrusive memory as more distressing, $r(638) = .21, p < .001$, felt more detached, $r(638) = .29, p < .001$, and felt less control over its occurrence, $r(638) = -.18, p < .001$.

Discussion

The goal of Study 1 was to develop a self-report questionnaire that measures an individual's past experiences with involuntary memories. Involuntary memories are commonly

reported as generally positive experiences; however, for some individuals their involuntary memories tend to be the repeated memory of a negative event (intrusive memory) that has a negative emotional impact when recalled. In fact, such memory intrusions are often a diagnostic symptom for a range of psychological disorders, such as PTSD and depression (refer to DSM-5; American Psychiatric Association, 2013). The IAMQ consists of 17 items based on previous diary studies of involuntary memories and clinical studies of intrusive memories.

The frequency rates provided by many participants when using the IAMQ seem at odds with frequency rates reported by previous researchers using diary studies (Ball & Little, 2006; Berntsen, 1996, 1998; Mace, Atkinson, Moeckel, & Torres, 2011). The average frequency rate measured with the IAMQ was once every few days or a week, whereas most diary studies reported that involuntary memories occurs on an average of two or more times a day. Previous research has relied on either asking participants to provide estimated numbers of involuntary memories they experienced daily or to record their involuntary memories as they came to their mind and count the total number of involuntary memories reported for a day. This may have led to a demand characteristic for these studies because often participants only completed their participation after they had recorded a set number of involuntary memories or recorded for a specific length of time. On the other hand, the IAMQ relies on retrospective assessments of a longer time period from the past and allows responses of frequencies that were not included or relevant in other research (e.g., yearly). This may encourage participants to give more accurate estimates of involuntary memory frequency. But Berntsen (2009) claims that involuntary memories are rapidly forgotten if not recorded immediately as they happen, and perhaps relying on a participant's memory for this elusive memory phenomenon does not provide accurate estimates of their frequency. One way to resolve this discrepancy would be to conduct a diary study after collecting IAMQ data from a group of participants. This way the frequencies reported in the diaries could be checked with the responses provided for the IAMQ.

As we expected, personally important life events were more likely rehearsed and related to higher frequency rates of involuntary memories. For instance, people might have forgotten that they had such experiences if those involuntary memories were not of specific and important life events. It is also possible that those involuntary memory experiences themselves were not memorable, or people simply did not pay attention to those experiences. This is another reason we cannot rule out the inaccuracies inherent to retrospective assessments. Combining diary recording with the IAMQ would also help resolve this issue.

Although most participants could identify cues that triggered their involuntary memories, some participants (7%) also rated that they have rarely identified cues for their past involuntary memories. This percentage is consistent with frequency rates provided by participants in diary studies (Ball & Little, 2006; Berntsen, 2009; Mace, 2004). Since involuntary memories are assumed to result from associative processes (Berntsen, 2009), it seems unusual for an involuntary memory to be retrieved without a cue to involuntarily trigger such a memory retrieval. Ball and Little (2006) suggested that a diffuse attention state as the possible explanation for those no-cue involuntary memories. A diffuse attention state refers to when people are not focused on any particular features of current environment, and thus allow more involuntary memories to occur. More diffused attention level was found among participants who could not identify a cue that triggered the memories compared to participants who could identify a cue. Although, in our study, we were not able to confirm whether the cues that triggered certain involuntary memories were also the content of those memories due to the lack of incorporating a question regarding this topic, several studies have shown that the features of involuntary memories retrieved are matched with the features of environment at the time of retrieval (Berntsen, 2009). Following Berntsen (1996) and Berntsen and Hall (2004) studies, asking commonalities between the cues and the content of involuntary memories retrieved might allow us to explain why certain involuntary memories have no identifiable cue. Perhaps, no-cue involuntary memories are less vivid and of

general events, in which no distinctive features are presented in the memories. This proposition is supported by our correlation results that revealed highly vivid involuntary memories of specific and important life events were associated with a greater tendency to identify cues for their retrieval.

We expected to find a correlation between the visual perspective and the focus of memory content, but none of the three items regarding the focus were correlated with the visual perspective item. However, a possible relationship between the visual perspective and the person focus could be found in relation to the specificity of involuntary memories. Participants who rated their involuntary memories were experienced in mainly first person and participants who rated their focuses as primarily on other people reported that their involuntary memories tend to be recollection of specific events.

Consistent with previous studies, involuntary memories were more likely specific events than general events. Involuntary memories of specific events were highly vivid with visual image and emotional reactions often part of those memories. Visual images were the most dominant content of involuntary memories, whereas other sensory aspects such as smells and sounds were the most infrequent content of the involuntary memories. Emotional reaction was also common content of involuntary memories of specific events, and its relation to the high frequency rates supports the emotional intensity bias in favor of retrieving emotionally intense memories, often more distinctive and memorable, than neutral memories (Berntsen, 2009). The involuntary memories of specific events were also associated with the emotional negativity of the memory content. Women were more likely to report that their involuntary memories involve visual images and emotional reactions than were men, supporting the notion that perhaps women are more visually and emotionally sensitive than men. Previous studies have found that women recall more voluntary memories of emotional events and more vivid memories of the past than men (Davis, 1999; Fivush & Buckner, 2003; Morse, Woodward, & Zweigenhaft, 1993). Women also tended

to use more emotional words and refer to their own and others emotional state when they describe their past memories compared to men (Bloise, 2007). Although more studies focusing on gender and involuntary memories are necessary, our findings were in line with previous findings of gender and autobiographical memories in general.

The majority of participants rated their involuntary memories as important life events. Involuntary memories not only favor important life events that are frequently rehearsed, but they also favor emotional events. There was a clear dominance of emotionally positive involuntary memories over emotionally negative involuntary memories; positive memories were twice more likely to be retrieved than negative memories. This finding is consistent with many previous studies showing the general pattern of proportion that a half of positive and a quarter each of negative and neutral involuntary memories (Berntsen, 2009). Berntsen (2009) explained this positivity bias in relation to a person's mood state and fading affect bias, in which people are generally in positive moods and emotionally negative memories fade out quickly, and thus positive memories are more likely to be available and recalled. As we expected, involuntary memories influenced the person's emotional state. Participants who rated the content of their involuntary memories as mainly negative and participants who rated that their involuntary memories had stronger impact on their emotional state were more likely to experience a negative effect on their emotional state after recalling involuntary memories.

Exploratory factor analysis of the IAMQ revealed the following five factors: intrusiveness of involuntary memories (IN), emotional valence (EV), person focus (PF), specificity of memories (SM), and multisensory and objective focus (MO). The IN factor appears to measure the degree of intrusiveness of the involuntary memories. The EV factor distinguishes whether the emotional content and impact of the involuntary memories are mainly negative or mainly positive. The PF factor distinguishes 1st person focused involuntary memories from 3rd person focused involuntary memories. The SM factor tells whether the involuntary memories

were of specific events or of general events. The MO factor measures the involvement of non-visual sensory aspects and object focus of the involuntary memories' content. Each of five factor scores was then compared with the INMQ measures (distress, dissociation, and control) and depression scores.

Relationship between IAMQ and INMQ

Intrusiveness of Involuntary Memories (IN)

Participants who scored high on the IN (intrusiveness) factor experienced involuntary memories primarily in the form of intrusive memories of the same event that came to mind repeatedly and involved physical actions and emotional reactions pertaining to important personal life events. These memories had a strong emotional impact on their state of mind when retrieved. Since the term 'intrusive memories' are commonly used for emotionally negative involuntary memories, it was odd to see a positive correlation between the IN factor and the EV factor which suggested that intrusive memories tend to involve more positive content and to make them feel mainly positive after recall. It is possible that greater availability and accessibility of positive memories due to positivity bias influenced this result. Indeed, the proportion of positive involuntary memories was twice as large as negative memories. However, validation of the IN factor as a general measure of intrusive memory experiences was obtained by its correlations with items on the INMQ. Participants with high scores on the IN factor rated their specific intrusive memory as highly distressing, frequently felt detached or numb after recall, and had less control over the occurrence of this particular intrusive memory.

Emotional Valence (EV)

It is not surprising that the EV factor was strongly correlated with all three items in the INMQ, as the INMQ measures relate to a specific intrusive memory of distressing event. Participants who rated their general involuntary memories as emotionally more negative and indicated that those memories made them feel mainly negative also rated their specific intrusive

memory as more distressing, felt dissociation after recall more often, and had less control over the occurrence of the memory.

Person Focus (PF)

The PF factor was positively correlated with the IN factor, suggesting involuntary memories of important life events tend to be focused more on self than other people. Interestingly, when individual items (items 8, 9, 10 regarding the focus of memories and item 15 regarding personal importance of memories) were compared, involuntary memories of important life events were not necessarily focused on self. Instead, those memories were more likely to be focused on other people or an object in the retrieval context. Perhaps, intrusive memories referring to important life events are more likely to involve the interaction between people. When we asked participants to describe a specific intrusive memory of the most distressing event, the majority of descriptions were about death, illness, or injury of family members or friends and relationship breakups.

Specificity of Memories (SM)

Participants who scored higher on the SM factor experienced involuntary memories less frequently. These memories were of specific events and very vivid with visual images as a major part of the memories. In addition, these memories were retrieved with first person perspective and the cues triggering those memories were generally identifiable. This factor was correlated with the level of distress and controllability of intrusive memory measured by the INMQ. Participants who had more specific involuntary memories rated their intrusive memory more distressing and had low control over the occurrence.

Multisensory Object Focus (MO)

The MO factor was positively correlated with all other four factors. Participants who experienced most of their involuntary memories in the form of intrusive memories reported that the content of their memories often involved non-visual sensory aspects and the focus was on

inanimate objects. Emotionally positive, self-focused, and specific involuntary memories were associated with the non-visual sensory aspects and inanimate object focus of the involuntary memories. Since the item measuring inanimate object focus has never been studied in previous studies, replication of this investigation is necessary to fully understand this finding.

Relationship to Depression

Since intrusive memories are a common symptom of clinical disorders, it is not surprising that both the scores on the IN factor from the IAMQ and all three of the INMQ measures correlated with depression scores. These findings are consistent with the findings of Newby and Moulds (2011) in which depressed individuals experienced greater distress and negative emotion following intrusive memories than non-depressed individuals.

Participants who rated their involuntary memories as mainly negative also endorsed more items of depression. Due to the nature of correlation analysis, it is also possible that participants who reported more depressive symptoms were more likely to rate their involuntary memories as negative. The first statement may suggest that experiencing negative involuntary memories is a key vulnerability factor for depression, whereas the latter suggest that a negative interpretation bias may exist among depressed people. This bidirectional relationship was expected as previous studies have found that depressed people have a harder time accessing positive memories (Williams, 1992) and their negative memories do not fade out as quickly as non-depressed people (Walker et al., 2003). Negative feelings after recall of involuntary memories involving negative contents could lead one to become depressed. Likewise the more depressed you are, the more likely you will have negative involuntary memories. Based on Clark and Teasdale's (1982) finding of depression patients recording more negative voluntary memories when they were in a depressed mood state than in a positive mood state, Berntsen (2009) suggested the depressed individual reporting more negative involuntary memories is more likely due to a mood-state dependent effect rather than greater availability of negative (less happy) life events.

It was surprising that the SM factor was not correlated with the depression measure, because in a recent study, Watson, Berntsen, Kuyken, and Watkins (2013) found that depressed participants experienced less specific involuntary memories compared to never-depressed participants. Considering the fact that women are more likely to be depressed than men, a significant gender difference found for the SM factor, in which men were more likely to experience less specific involuntary memories than women, also seems inconsistent with Watson et al.'s findings. In terms of vividness (one of the items that loads on the SM factor), Werner-Seidler and Moulds (2011) found no differences in negative autobiographical memories between depressed and never-depressed individuals, whereas positive memories were reported as less vivid among depressed individuals than never-depressed individuals. Therefore, the lack of significant correlation between the SM factor and depression might be due to the emotional valence of the memories. However, a further evaluation is necessary because we could not confirm whether the emotional valence had an effect on this relationship based on current results because the correlation between the EV factor and the SM factor was not significant.

The MO factor was also positively correlated with the depression measure in which higher depression scores were associated with experiencing object focused involuntary memories with non-visual sensory content such as smells and sounds. This might suggest that the nature of involuntary memories experienced by depressed individuals is more likely to be multimodal compared to non-depressed individuals. A significant gender difference was also found for the MO factor. Men were more likely to experience involuntary memories involving multisensory aspects and inanimate object focus than women. Again, considering the fact that women are more susceptible to depression than men, this finding is somewhat perplexing because a higher score on the MO factor was associated with a higher depression score suggesting that men tend to experience involuntary memories with features that are closely related to depression. However, male participants rated their specific intrusive memories less distressing compared to female

participants. Perhaps, this could be the reason why men are less likely to develop depression even though they experience more depression related features of involuntary memories.

Overall, the findings of this study suggest that certain features of involuntary memories might play a key role in experiencing depressive symptoms. We could further test the clinical utility of the IAMQ and the INMQ measures involving other psychiatric disorders. For example, the number of involuntary memories has been found to be positively correlated with the severity of schizophrenia (Holmes & Steel, 2004; Jones and Steel, 2012) and it would be interesting to determine whether schizophrenics experience involuntary memories and intrusive memories involving features distinguishable by the IAMQ and INMQ. Previous research has investigated involuntary memories in PTSD patients and found a correlation between the emotional negativity of memories (both involuntary and voluntary) and the level of PTSD symptoms (Rubin, Boals, & Berntsen, 2008). We could further support this finding by collecting IAMQ and INMQ data from PTSD patients.

Study 2

In Study 1, a new self-report questionnaire that measures individual differences in the experiencing of involuntary memories (IAMQ) was developed, and the factor structure of the IAMQ was analyzed. The goal of Study 2 was to validate this newly developed questionnaire by comparing the factor scores from the IAMQ with measures obtained from two laboratory tasks used to evoke involuntary memories. This comparison will allow us to investigate the relationships between self-report responses regarding real-life involuntary memories with involuntary memories elicited in the laboratory, and hence allow us to validate both types of methodologies.

Involuntary memories are difficult to elicit in laboratory settings because of the spontaneous and unconscious nature of involuntary memories. The Continuous Word Association Task (CWAT) is a new methodology designed to elicit involuntary memories using free

associations under controlled conditions (Ball, 2007). A typical word association task requires participants to provide the first thing that immediately comes to their mind when they are given a word cue prompt, and this task has a long history of use in the field of psychology. The CWAT builds on this method and requires participants to continue making associations where each new association is based on the preceding association. For example, when an experimenter gives “ocean” as a word cue prompt, a participant may say “salt” as the first thing that comes to their mind when they hear “ocean”. The second word association should then be prompted by “salt”. If a participant says “pepper”, then the next word association should be prompted by “pepper” and the same process would be repeated thereafter for a set amount of time determined by the experimenter. Just like the example provided, most associations are usually in the form of semantic associations, but occasionally autobiographical memories come to mind during these sequences of free associations. This is not surprising given the close relationships between semantic memories and episodic memories. In fact, researchers now refer to semantic autobiographical memories that describes personal content that has been so often associated with semantic content that it is now similar to a semantic memory (e.g., your high school teacher’s name). The CWAT also allows the experimenter to collect involuntary memory data without letting participants know the goal of the CWAT task because the first few trials of the CWAT procedure are run before the associations are analyzed for autobiographical memory content.

During the CWAT, the participant is asked to make free associations to a target word (e.g., ‘tree’, ‘coffee’, or ‘popcorn’) while their responses are recorded. The recorded responses are then played or read back to the participant and he or she is instructed to stop the playback of associations if the participant experienced an involuntary memory. The majority of participants (86%) in the study conducted by Ball (2007) reported involuntary memories while they were providing the chains of free associations. In a similar study, Brewin and Soni (2011) used the CWAT to examine gender, psychosis proneness, and cue valence effects on involuntary

memories. Participants in this study received either six positive prompt words (e.g., “win”, “affection”, and “joy”) or six negative prompt words (e.g., “misery”, “failure”, and “sin”). Brewin and Soni found that participants reported higher proportions overall of positive and neutral involuntary memories than negative involuntary memories and this result is consistent with previous diary research (Berntsen, 2009). They also found a significant word cue valence effect with the proportion of negative memories larger when negative cue words were provided. They did not find any gender differences in the involuntary memories reported. However, trait dissociation and psychosis-proneness scores were associated with the total number of involuntary memories triggered by negative cue words.

Study 2 utilizes two positive and two negative cue words based on the cue words used by Griffith et al. (2012) in a study of voluntary retrievals of autobiographical memories. We predict a relationship between the total number of involuntary memories recalled in the CWAT and the frequency of involuntary memory experiences reported from the IAMQ. We also predict more positive involuntary memories than emotionally negative memories will be collected using the CWAT, but that the emotional ratings of the CWAT induced memories will correlate with the emotional content of memories reported using the IAMQ. Likewise, we would expect the specificity of memories elicited by the CWAT to be consistent with the relative frequency of specific involuntary memories recorded by the IAMQ.

The Traumatic Film Task (TFT) is another experimental method designed to elicit distressing involuntary memories although it focuses on involuntary memories that relate to the same event (i.e. viewing the traumatic film). The participants are shown a distressing film (e.g., car accidents) and then asked to record in diaries any involuntary memories that result in the days that immediately follow the viewing of the film. The TFT was developed by researchers to simulate the intrusive memories of individuals suffering from flashbacks from traumatic experiences and has been used extensively in recent years (Brewin & Saunders, 2001; Deeprose,

Zhang, Dejong, Dalgleish, & Holmes, 2012; Krans, Naring, & Becker, 2009; Krans, Naring, Holmes, & Becker, 2009). For example, Brewin and Saunders (2001) tested the role of attention in the formation of these intrusive memories by using a dual task condition in which participants had to tap a sequence of key presses during the film viewing. They found the attention demands of this dual task arrangement significantly decreased the number of memory intrusions recorded by participants. Previous studies have used different types of traumatic films. Some studies have used real-life footage (e.g., Krans, Naring, Holmes, & Becker, 2009; Regambal & Alden, 2009), whereas others have used excerpts from the commercial films or movies available in the public domain (e.g., Deeproose, Zhang, Dejong, Dalgleish, & Holmes, 2012; Krans, Naring, & Becker, 2009). The content of those films include road traffic accidents, natural disaster, war, terror, rape, torture, etc. For the current study, we selected “threat or shock” advertisements that present the consequences of unsafe driving practices in the form of road traffic accidents. These television ads are produced by government agencies to encourage safe driving practices, such as avoiding speeding and drink driving. Beside the fact that road traffic accident films were most commonly used in previous studies, another reason for selecting these films was the fact that motor vehicle accidents are one of the most common traumatic events that can cause PTSD (Ehlers, Mayou & Bryant, 1998), and thus we assumed that these films would successfully elicit involuntary memories in our study.

We predict that the frequency and content of involuntary memories elicited by the TFT procedure will relate to factor scores obtained from the IAMQ in a similar fashion as predicted for the CWAT. In particular, we expect to find a relationship between emotional ratings on involuntary memories about the film content and scores on the emotional valence (EV) factor from the IAMQ. Assuming that the content of intrusive memories is emotionally negative, a significant correlation is expected between the EV factor and the degree to which the laboratory evoked intrusive memories are found distressing. The design of Study 2 also allows us to be the

first researchers to compare involuntary memories recorded using two different laboratory procedures. We expect there to be significant relationships between the involuntary memories reported in these ways (e.g., frequencies of involuntary memories and emotional impact), but we also suspect there will be differences in the involuntary memories reported in these ways. The TFT is assumed to evoke more intrusive memories and this is why the INMQ was also included from Study 1. The INMQ measures self-report responses to a specific negative, intrusive memory and we would expect these scores to perhaps better correlate with the involuntary memories recorded using the TFT when compared with the memories recorded using the CWAT. This would be a significant finding because there is considerable debate on the differences between intrusive memories and involuntary memories with some researchers suggesting there are no differences whereas others see intrusive memories as special cases of involuntary memories (Berntsen, 2009).

Method

Participants

A random sample of 56 participants from the original sample described in Study 1 participated in the experimental phase of Study 2. The sample consisted of 35 women with a mean age of 18.74 years ($SD = 1.01$ years) and 21 men with a mean age of 18.81 years ($SD = 1.40$ years). Participants completed this component for additional course credit, and participants provided informed consent before participating in this study.

Measures

Continuous Word Association Task (CWAT)

The CWAT was developed by Ball (2007) to elicit involuntary autobiographical memories in a laboratory setting. The computer screen displays a word prompt (Guilty, Cheer, Ugly, and Peaceful) and instructs the participant to say out loud the first thing that comes to mind associated with this word cue. These cue prompts came from a previous study by Griffith et al.

(2012) and were specifically chosen on the expectation that emotional words would enhance the involuntary retrieval of emotional memories. The participant was then asked to form a new association with their response to the cue word, and to continue forming new associations to each new response until stopped by a signal from the computer. An example of associations provided by one participant for the cue prompt “guilty” were: ‘stealing’, ‘thief’, ‘criminal’, ‘jail’, ‘society’, ‘justice’, ‘judges’, ‘lawyers’, ‘grad school’, ‘career’, ‘college’, ‘salary’, and ‘inequality’. The time given for making these free associations was 30 seconds, and participants were asked to close their eyes while providing their associations. The computer provided an auditory signal when it was time for the participants to stop and move on to the next word cue. The experimenter wrote down all of the participant's associations, and after the fourth trial, went back through the associations provided by the participant. The participant was asked to notify the experimenter if an autobiographical memory came to mind at any time during the sequence of associations while the experimenter read back the associations. An autobiographical memory was defined to participants as the following: “Most of the associations that you provide will be of a semantic form, like salt is to pepper. However, on some occasions while you were giving your associations a personal experience may have come to mind. This is very common when providing continuous associations like this and we are very interested in these autobiographical memories.” Each time the participant reported an autobiographical memory, the participant was also required to describe the event and rate its emotional content using the response scale of -3 (very negative) to +3 (very positive). The experimenter also recorded the number of involuntary autobiographical memories reported by the participants, and their specific locations in the sequence of associations.

Traumatic Film Task (TFT)

Participants viewed five television commercials which present graphic images of the consequences of unsafe driving practices. The consequences displayed in these commercials involved graphic depictions of physical injury or death to a driver, passenger, or pedestrian. Film

1 involved a 30-second motorcycle safety commercial where a car driver's lack of attention results in his car being hit with force by a motorcyclist. Film 2 involves a 60 second ad that depicts a graphic emergency room scene after a fatal accident that results from a driver driving under the influence of alcohol. Film 3 is a 60 second ad that shows a fatigued driver crashing his minivan into a truck coming from the other side of the road. Film 4 is a 60 second ad that depicts a rear seat passenger being thrown into other passengers in a serious car accident because he was not wearing a seatbelt. The fifth film is a 60 second ad that shows a speeding car hitting another car with such force it hits and kills a pedestrian walking in front of this car. The total duration of the five films was 4 minutes and 30 seconds. Each participant sat alone in a small dark testing room while viewing the film. Immediately after viewing the five television ads, the participant were asked to remain in the testing room and relax with their eyes closed for a 4 minute period. During this time participants were instructed to avoid thinking about the TV ads that they had just viewed. The computer provided an auditory signal when the 4 minutes has passed. The experimenter recorded the frequency of reported involuntary memories about the films just viewed and the emotional responses to the involuntary memories (0 = not at all distressing, 7 = very much distressing) reported by participants during this 4 minute period. Participants were then given instructions on how to complete a 7-day diary on their memory intrusions that related to these films. In this diary, participants recorded descriptions of any memory intrusions about the film contents that occurred during the following 7 days after the film viewing, and rated how distressing each intrusion was using a scale of 0 (not at all distressing) to 5 (very distressing).

IAMQ and INMQ

These measures were described in Study 1 and were taken from the mass testing phase of Study 1.

Procedure

Each participant completed the informed consent form and then was directed to the testing room. In the testing room, a desktop computer with a LCD monitor and a keyboard were equipped on a desk attached to the wall. There were a chair in front of the monitor for participants to sit on and another chair on the back corner of room for the experimenter. All participants started with the CWAT. Verbal instructions for the CWAT were given, and written instructions were also presented on the monitor for participants to read. The participants completed a few practice trials to familiarize themselves with the word association task. Participants completed four trials of the CWAT and then the experimenter went back through associations with participants to identify involuntary autobiographical memory experiences that may have occurred. Participants then viewed five film clips for the TFT. During a 4-minute period after film viewing, participants had a break with their eyes closed. After the break, participants were then asked to provide details of any involuntary memories of the ads that may have come to their awareness during the break. Participants were then given diaries to complete for next 7 days and instructed to record any spontaneous memory intrusions of the film at the moment they entered into their consciousness awareness. Participants returned their diary to the experimenter 7 days later. Participants were then provided debriefing information about the study as an attachment via email.

Results

Continuous Word Association Task (CWAT)

On average, participants provided 10.96 word associations ($SD = 2.98$) per trial in the 30 seconds allotted for each trial of the CWAT. The minimum number of associations provided by any participant for one trial was 5 and a maximum number of 18.5 associations. The first involuntary autobiographical memory to appear in the sequence of associations occurred on average after 4.66 associations ($SD = 1.72$). Because each participant reported a different number of associations and involuntary memories per trial, the proportion of involuntary memories to overall associations was calculated. On average, 12% of word associations ($SD = 6\%$) involved

involuntary memories and the mean rating of their emotional content was 1.76 ($SD = .51$). Only 26% of involuntary memories involved negative content ($SD = 28\%$) and the mean rating of negative emotional content for these involuntary memories was -1.78 ($SD = .76$).

Correlations between CWAT measures are provided in Table 6. The average number of total associations provided by participant on four trials was positively correlated with the timing of the first involuntary memory, $r(56) = -.32, p = .02$, and was negatively correlated with the mean emotional rating, $r(56) = -.44, p < .001$. The proportion of involuntary memories reported was negatively correlated with the timing of the 1st involuntary memory, $r(56) = -.28, p < .01$. There were no significant gender differences on any of the CWAT measures, $p > .05$.

Relationship to IAMQ

Correlations between all self-report measures and laboratory task measures are provided in Table 7. The timing of the first involuntary memory correlated negatively with the EV factor scores. Participants who experienced the first involuntary memory later in the sequence of word associations (1stIM) tend to rate the contents of their past involuntary memories and their emotional impact as more negative, $r(54) = -.34, p = .01$. The mean emotional rating of involuntary memories was positively correlated with the EV scores. Participants who rated their involuntary memories more positive when elicited by the CWAT also rated their real-life involuntary memory experiences (IAMQ) as more positive, $r(54) = .38, p < .001$. The degree of emotional response to negative involuntary memories elicited by the CWAT also positively correlated with scores on the MO. Participants who had a higher emotional intensity of their negative involuntary memories in the laboratory setting tended to have involuntary memories involving multisensory contents and inanimate object focus, $r(36) = -.41, p = .01$.

Relationship to INMQ

None of the CWAT measures were correlated with INMQ measures, $p > .05$

Traumatic Film Task (TFT) Analysis

An average of 4.85 ($SD = 6.14$) involuntary memories of film contents were reported immediately after film viewing (immediate intrusions), and a mean of 5.29 ($SD = 5.07$) involuntary memories were reported over the following 7 days after film viewing (delayed intrusions). Average emotional impact rating for immediate intrusions was 4.17 ($SD = 1.70$). For delayed intrusions, the average emotional impact ratings was 1.71 ($SD = 1.17$).

A significant positive correlation was found between the immediate and delayed emotional responses, $r(48) = .29$, $p = .047$ (see Table 6).

Gender differences

There was a significant gender effect, $t(47) = -2.66$, $p = .011$, with men experiencing their immediate involuntary memories as less distressing ($M = 3.56$, $SD = 1.63$) than women ($M = 4.71$, $SD = 1.31$).

Relationship to IAMQ

The emotional impact rating for immediate involuntary memories was correlated positively with EV and negatively with PF. Participants who reported higher level of distress after experiencing memory intrusions immediately after film viewing tend to rate their experience of general, real-life involuntary memories as more positive, $r(44) = .29$, $p = .04$, and more likely to focus on other people in the event than on themselves, $r(48) = -.37$, $p < .001$.

Relationship to INMQ

The emotional rating of immediate memory intrusions was also positively correlated with INMQ-distress. Participant who rated their immediate intrusions to be more emotionally distressing also rated their specific real-life intrusive memory as more distressing, $r(48) = .32$, $p = .03$. In addition, the number of delayed memory intrusions positively correlated with INMQ-distress. A more number of delayed memory intrusions was associated with the higher levels of distress that participants reported towards their specific real-life intrusive memory, $r(53) = .36$, $p < .001$.

Relationship to CWAT

The numbers of memory intrusions reported in immediately and delayed after film viewing were positively correlated with the timing of the first involuntary memory reported in the sequence of word associations. Participants who reported a greater number of immediate memory intrusions about the film contents tended to experience the first involuntary memory later in the sequence, $r(55) = .34, p < .01$. Participants who reported a greater number of delayed memory intrusions about the film contents also tended to experience the first involuntary memory later in the sequence of word associations, $r(55) = .30, p < .01$.

Discussion

Study 2 demonstrated that involuntary autobiographical memories can occur when participants are asked to continuously create free associations after a given cue prompt (CWAT) and that watching traumatic films can also elicit involuntary memories (TFT). Although everyone experiences involuntary memories, the frequency and emotional impact of their occurrences can differ quite dramatically from one individual to another. Only 26% of the involuntary memories elicited by the CWAT involved emotionally negative contents which again supported Berntsen's (1996) finding that emotionally positive involuntary memories are more commonly experienced than negative memories. Participants who recalled their first involuntary memory earlier in the associations provided fewer word associations overall and a greater proportion of involuntary memories. This result suggests that the first involuntary memory may have led to another involuntary memory, and so on. This explanation is in line with Mace's (2010) concept of chained involuntary remembering where one involuntary memory (or a voluntary retrieval) can trigger additional involuntary recalls. Participants who experienced more negative real-life involuntary memories took a longer time to elicit involuntary memory using the CWAT. Taking a longer time to elicit involuntary memory in the CWAT was also associated with a negative emotional rating of such memory. Perhaps, these findings suggest that participants who

experienced more negative involuntary memories were in the habit of suppressing negative memories. A significant relationship was obtained for the emotional valence of memories retrieved in a laboratory with those reported using a self-report questionnaire. These findings help validate the use of both methodologies for recording involuntary memories. This may suggest that how people experience their real-life involuntary memories would predict how they experience laboratory elicited involuntary memories. And the prediction of opposite direction can also be suggested. Although we expected some correlation between the INMQ and the CWAT based on the assumption that intrusive memories are a subset of involuntary memories, the results of Study 2 do not support this conclusion.

The TFT purports to simulate intrusive memories experiences in a laboratory setting, and we found some support for the validity of this approach. In the TFT, on average, around five memory intrusions were reported for both immediate and delayed recordings. Immediate memories were the total number of intrusive memories came to mind during the 4-minutes break after film viewing, whereas delayed memories were the total number of intrusive memories reported during the week after film viewing. It is difficult to directly compare our frequency data with previous diary studies which measured the frequency rates of involuntary memories on a daily basis. Although the frequency rates we obtained for delayed intrusive memories (five intrusive memories per week gave less than one intrusive memories per day) seems lower than a typical rates (two to five involuntary memories per day) reported in previous diary studies of general involuntary memory experience (Berntsen, 1996; Rasmussen & Berntsen, 2011; Rubin & Berntsen, 2009). This rate seems reasonable since we restricted participants to record only intrusive memories that related to a specific film event. For instance, in Homles, Brewin, and Hennessy (2004) study, participants reported around five intrusions over a week following the film viewing. The majority of participants rated moderate to high distress for immediate intrusions, whereas rated low to moderate distress for delayed intrusions. This finding supports

the fading affect bias which refers to the diminished emotional intensity of the memories in the lapse of time (Ritchie et al., 2009; Walker & Skowronski, 2009). In a study of the fading affect bias in autobiographical memories, Ritchie et al. (2009) found three other possible affect biases and they are fixed affect (emotional intensity maintained), flourishing affect (emotional intensity increased), and flexible affect (emotional valence reversed). They also found that the fading affect was dominant for negative events (51%), whereas the fixed affect was dominant for positive events (49%). Since the involuntary memories we measured in the TFT were of negative events, our finding also supports this fading affect dominancy for the memories of negative events. Although emotional intensity reduced over time in general, participants who reported higher distress for immediate intrusions also reported higher distress for delayed intrusions, suggesting the immediate impact of intrusive memories can be maintained over time.

As we expected, the TFT measures showed relationships with scores from the IAMQ and the INMQ. Participants who rated higher distress on laboratory elicited intrusive memories also rated higher distress on real-life involuntary memories measured with the IAMQ and more emotional responses to a real-life intrusive memory measured by the INMQ. This finding is in line with research by Schlagman and Kvavilashvili (2008) who found no differences between real-life involuntary memories and laboratory elicited involuntary memories in terms of memory characteristics. In addition, participants in our study who rated higher distress on a real-life intrusive memory also had a greater number of delayed memory intrusions. Considering the significant correlation we found between the distress ratings on a real-life intrusive memory and the level of depressive symptoms in the Study 1 and the association between other characteristics of intrusive memories and depression found in many previous studies (Brewin et al., 1996; Williams & Moulds, 2007), this result might suggest that the greater total number of delayed memory intrusions could also be a possible risk factor for developing depression. In fact, Meiser-Stedman, Dalgleish, Yule, and Smith (2012) have shown that the higher intrusive memory

frequency was associated with more depressive symptoms experienced (i.e., more scared, sad, angry, ashamed, and helpless feeling) during non-traumatic negative life events. Moreover, in line with our findings using the INMQ, we found a significant gender effect on distress with men rating their immediate intrusive memories as less distressing than those rated by women. Again, this finding supports that women are more emotionally sensitive than men that may have consequences for the gender bias in the prevalence of emotion and anxiety related disorders (Fujita, Diener, & Sandvik, 1991; Kornstein, 1997).

The comparison between the CWAT and the TFT found that participants who took a longer time to retrieve their first involuntary memory while providing continuous word associations reported more memory intrusions about the film contents both immediately after the film viewing and during the 7-day period (delayed memory intrusions reported in diary). This result seems paradoxical to our previous findings where we described a suppression effect with people reporting more negative involuntary memories providing later reporting of involuntary memories using the CWAT procedure. This finding suggests a possible difference between involuntary memories evoked in the CWAT with those evoked using the TFT. However, participants who had less negative involuntary memories in the CWAT had more intrusive memories during the 7 days after the TFT film viewing, suggesting the methods have more in common than different.

General discussion

The primary goal of the current thesis was to develop a new self-report questionnaire that can measure individual differences in involuntary autobiographical memory experiences. The variation in responses to involuntary memories reported in the IAMQ and the INMQ highlights these individual differences. These differences were also correlated with higher depression scores. Individuals who scored higher on depression measure experienced their involuntary memories as more intrusive and emotionally negative, and responded to real-life intrusive memories in less

adaptive ways (more distress, less control, and more dissociation). The data regarding real-life involuntary memories obtained using the IAMQ and the INMQ were compared with the data from laboratory elicited involuntary memories obtained from the CWAT and the TFT. Individuals who reported more distress from their real-life intrusive memories were also more likely to experience an impactful, intrusive memory elicited in the laboratory setting. Overall, our findings support the validity of the CWAT and the TFT as experimental analogues for studying real-life involuntary and intrusive memories. One limitation with the results of Study 2 is the small sample size, especially when some participants do not report any negative involuntary memories using the CWAT procedure. A larger database may help when searching for relationships between these lab-based measures and those provided by self-report measures like the IAMQ.

The IAMQ and INMQ measures appear to be adequate measures of involuntary memories and intrusive memory responses. They could be improved in future research by adding more items that relate to other aspects of involuntary memories and intrusive memories that were not distinguished in the current research. For example, the IAMQ only asked participants to indicate the presence of an identifiable cue for involuntary memories experienced, and did not distinguish the types of cue (i.e., internal versus external; abstract versus sensory/perceptual). This would be an interesting item to include in a revised IAMQ, because Mace (2004) suggests that abstract cues (internal and external) are more common than sensory/perceptual cues, and this speculation runs contrary to the traditional “Proustian” view of involuntary memories.

An additional question that could be added to the IAMQ relates to the typical age of their involuntary memories (i.e., recent versus remote) because this factor has been found to relate to the perspective of involuntary memories. Previous studies have found that the memories remembered in first person perspective (see the event with your own eyes) more likely involve recent events (shorter retention interval calculated by subtracting participant’s age at original

event from current age), whereas the memories remembered in third person perspective (see yourself in the event) are more likely of remote events (Berntsen & Rubin, 2006). The role of perspective in the frequency and experiencing of involuntary memories has possible important implications for the treatment of intrusive memories.

Future investigations should test the CWAT and the TFT in terms of the emotional valence and impact of the event or stimuli. Assessing the participant's ratings of the emotional valence of cue words and film content could help explain individual differences in the involuntary memories elicited by both procedures. We could also test which emotional cue words trigger more involuntary memories. Schlagman and Kvavilashvili (2008) have found that involuntary memories are more likely to be triggered by negative cues and suggested that this is based on the evolutionary perspective that negative cues are more survival related. For the TFT, we could also include different types of traumatic films to provide better measure of individual differences in experiencing memory intrusions. For example, Krans, Naring, Holmes, and Becker (2009) have used a scene showing the aftermath of real-life road traffic accidents that has been shown to successfully induce intrusive memories in laboratory setting. Comparisons of real-life footage versus television advertisements could have important implications for the TFT procedure and for applications of "shock ads" for behavioral change interventions.

During the break after the trauma film viewing, we instructed participants to try not to think about the film's contents in order to prevent any voluntarily retrievals. Rassin et al. (1997) investigated the effect of suppression on the number of intrusive thoughts after film viewing and found that the suppression group had more intrusive thoughts than a group who did not get this specific instruction, suggesting that suppression enhanced the participants' memory for the film (see also Wenzlaff & Wegner, 2000 for a recent review of other suppression effects). It would therefore be interesting to look at the effects of suppression instructions on involuntary memories evoked by the TFT and CWAT procedures.

Future research could examine developmental trends in involuntary memories using the IAMQ. For example, Jacques and Levine (2007) investigated age difference in voluntary recall of autobiographical memories and found that young participants (a mean age of 26) recalled memories with more episodic details, whereas old participants (a mean age of 78) recalled memories with more semantic details. Schlagman et al. (2009) also compared the effects of age on involuntary and voluntary memories, and found that older adults (a mean age of 75) rated their involuntary memories more positively than young adults (a mean age of 21), and this positivity effect was not found with voluntary memories. Providing older participants the IAMQ would allow us to test for more detailed differences in involuntary memories across the life span.

In line with several previous studies, the laboratory elicited involuntary memories were similar to the naturalistic involuntary memories in terms of frequency, emotional valence and impact. This result suggests the validity of using the IAMQ and the INMQ (retrospective self-report measures) to index the characteristics of involuntary and intrusive memories. Based on the significant correlation result found between the questionnaires we developed and depression measures, replication of this investigation in a clinical sample of depressed patient in particular will represent an important extension. As briefly mentioned in the introduction, training on cognitive memory tasks to decrease the number of occurrence of negative involuntary memories and finding ways to detach negative emotions from the memory might be of interest when developing interventions to treat PTSD, for example. If we can change or manipulate the elicitation and processing of involuntary memories, we may be able to change an individual's control over and emotional response to distressing intrusive memories.

Appendix

Table 1

Descriptive Statistics for the Involuntary Autobiographical Memory Questionnaire (IAMQ)

Item	<i>M</i>	<i>SD</i>
1. How frequently do you experience involuntary autobiographical memories?	3.58	1.38
2. In general, how vivid were the memories that come to mind?	4.75	1.45
3. How often could you have identified a cue in the environment or a cue you generated yourself that may have triggered this involuntary recall?	4.46	1.63
4. How common were visual images a part of these involuntary memory recalls?	4.91	1.52
5. How common were other sensory aspects (smells, sounds) part of these involuntary memory recalls?	3.76	1.65
6. How common were physical actions part of these involuntary memory recalls?	4.02	1.63
7. How common were emotional reactions part of these involuntary recalls?	4.71	1.59
8. How often did the content of these involuntary memories primarily focus on you and solely you?	3.99	1.52
9. How often did the content of these involuntary memories primarily focus on other people?	4.01	1.43
10. How often did the content of these involuntary memories focus on inanimate objects that were part of the event?	3.07	1.47
11. Do your past involuntary autobiographical memories tend to be general recollections of events (e.g., past thanksgivings) or recollections of specific events (e.g., last Thanksgiving's dinner)?	3.24	1.69
12. In general, how would you rate the emotional content of these involuntary memories?	4.36	1.45
13. In general, how would you rate the impact of these involuntary memories on your emotional state after they come to mind?	4.17	1.56
14. In general, how does the recall of these memories make you feel?	4.26	1.38
15. How often do these past memories refer to important life events?	4.20	1.42
16. When memories of past experiences come to mind, they can feel as though you are seeing the event unfold through you own eyes (first person) or feel as though you are watching a video of the event from another person's perspective (third person). What visual perspective is common to your past involuntary autobiographical memories?	3.17	1.81
17. How common is it for involuntary autobiographical memories to repeatedly come to mind that relate to the same event from your past?	4.40	1.35

Note. Item 1 was measured on a 6-point scale from 1 = many times a day to 6 = yearly. All other items were measured on a 7-point scale.

Table 2

Descriptive Statistics for the Intrusive Memory Questionnaire (INMQ)

Item	<i>M</i>	<i>SD</i>
Please provide a brief description of the event (e.g., car accident, bad loss, failed test)		
1. How distressing to you is this specific intrusive memory?	4.97	1.80
2. Do you ever feel detached or numb after this memory comes to mind?	3.67	1.93
3. How much control do you feel you have over the occurrence of this particular involuntary memory?	4.03	1.74

Note. All items measured on a 7-point scale from 1 to 7.

Table 3

Correlations for Individual Items in the IAMQ

Item	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Frequency	1															
2. Vividness	-.334**	1														
3. Cue	-.237**	.330**	1													
4. Visual images	-.232**	.453**	.376**	1												
5. Other sensory	-.232**	.256**	.317**	.263**	1											
6. Physical actions	-.212**	.301**	.291**	.296**	.310**	1										
7. Emotional reactions	-.261**	.351**	.322**	.369**	.227**	.429**	1									
8. Focus on self	-.082*	.127**	.172**	.179**	.012	.150**	.194**	1								
9. Focus on others	-.183**	.171**	.171**	.137**	.204**	.218**	.190**	-.345**	1							
10. Focus on objects	-.067	.114**	.141**	.058	.179**	.152**	.022	.087*	.150**	1						
11. Specific vs. General	.142**	-.164**	-.165**	-.154**	.000	-.064	-.118**	.018	-.028	.063	1					
12. Emotional content	.000	.025	.119**	.117**	.146**	.020	-.039	-.129**	.175**	.106**	.145**	1				
13. Impact on mood	-.257**	.254**	.130**	.161**	.234**	.285**	.417**	.032	.245**	.044	-.080*	-.040	1			
14. Feeling after recall	.039	.005	.114**	.118**	.133**	.031	-.090*	-.051	.090*	.101**	.136**	.714**	-.177**	1		
15. Importance of event	-.083*	.205**	.194**	.159**	.151**	.256**	.261**	.070	.201**	.107**	.039	.147**	.314**	.119**	1	
16. 1st vs. 3rd person perspective	.043	-.009	.016	-.042	-.023	.053	-.003	.091*	-.082*	.067	.112**	.033	-.043	.027	.066	1
17. Repetitiveness	-.342**	.354**	.290**	.275**	.221**	.275**	.388**	.119**	.156**	.067	-.122**	-.021	.371**	-.051	.282**	.016

Note. * $p < .05$; ** $p < .01$

Table 4
Factor Analysis Result of the IAMQ

Item	IN	EV	PF	SM	MO
1. Frequency	-0.22	0.08	0.05	-0.40	-0.23
2. Vividness	0.30	0.06	0.13	0.45	0.19
3. Cue presence	0.12	0.21	0.21	0.41	0.30
4. Visual image	0.20	0.28	0.25	0.53	0.07
5. Other sensory	0.13	0.14	-0.10	0.17	0.51
6. Physical action	0.45	0.00	0.09	0.06	0.31
7. Emotional reaction	0.67	-0.06	0.14	0.19	-0.03
8. Focus on self	0.08	-0.08	0.82	0.00	0.04
9. Focus on others	0.30	0.10	-0.69	0.07	0.30
10. Focus on objects	-0.21	-0.06	-0.03	-0.19	0.90
11. Specific vs. General	0.09	0.16	0.03	-0.67	0.11
12. Emotional content	-0.02	0.89	-0.14	-0.05	-0.03
13. Impact on mood	0.78	-0.21	-0.20	-0.04	-0.03
14. Feeling after recall	-0.14	0.91	-0.01	-0.02	-0.02
15. Importance of event	0.73	0.21	-0.02	-0.28	-0.09
16. 1 st vs. 3 rd person perspective	0.12	-0.00	0.33	-0.48	0.18
17. Repetitiveness	0.60	-0.05	0.06	0.18	0.01

Note. Factor loadings less than .40 were not shown in this table. Factor 4 and 5 loadings were reversed. IN = Intrusiveness (factor 1), EV = Emotional Valence (factor 2), PF = Person Focus (factor 3), SM = Specificity of Memory (factor 4), MO = Multisensory Object focus (factor 5)

Table 5
Correlations for Mass Testing

Variable	1	2	3	4	5	6	7	8	<i>M</i>	<i>SD</i>
1. IN	1									
2. EV	.100**	1								
3. PF	.087*	.012	1							
4. SM	.240**	-.019	.012	1						
5. MO	.323**	.186**	.102**	.131**	1					
6. CES-D	.149**	-.213**	.027	.041	.132**	1			3.37	1.31
7. INMQdistress	.351**	-.084*	.010	.156**	.105**	.217**	1		4.97	1.80
8. INMQdissociation	.320**	-.111**	-.014	.078*	.179**	.299**	.514**	1	3.67	1.93
9. INMQcontrol	-.173**	.170**	-.016	-.076*	.022	-.165**	-.192**	-.185**	4.03	1.74

Note. IN = Intrusiveness (factor 1), EV = Emotional Valence (factor 2), PF = Person Focus (factor 3), SM = Specificity of Memory (factor 4), MO = Multisensory Object focus (factor 5), CES-D = square root transformed depression score, INMQdistress = distress rating of intrusive memory, INMQdissociation = dissociation rating of intrusive memory, INMQcontrol = control over occurrence of intrusive memory.

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

Table 6
Correlation for Laboratory Tasks

Variable	1	2	3	4	5	6	7	8	9	<i>M</i>	<i>SD</i>
CWAT											
1.meanWA	1									10.96	2.98
2.1stIM	.315*	1								4.66	1.72
3.IM%	.061	-.281*	1							11.82	6.05
4.meanER	-.443**	-.100	-.016	1						1.76	.515
5.negIM%	-.186	-.096	-.036	-.026	1					26.20	28.32
6.negER	.163	.182	-.094	-.308	-.023	1				-1.78	.759
TFT											
7.immedIM	.141	.341*	-.099	.134	-.127	-.179	1			4.89	6.11
8.immedER	.145	-.023	.008	-.179	-.180	-.038	.2	1		4.34	1.50
9.delayIM	.163	.301*	.025	-.313*	.027	-.048	.142	.169	1	5.29	5.07
10.delayER	-.256	-.178	.193	.057	.045	-.344*	.048	.289*	.074	1.71	1.17

Note. CWAT = Continuous Word Association Task, meanWA = mean number of word associations provided, 1stIM = timing of 1st involuntary memory, IM% = proportion of the number of involuntary memory to the total number of word associations, meanER = mean emotional rating (including both positive and negative), negIM% = proportion of negative involuntary memory, negER = mean emotional rating of negative memory, TFT = Traumatic Film Task, immedIM = number of intrusive memory immediately after film viewing, immedER = mean emotional response to immediate intrusive memory, delayIM = number of intrusive memory reported in a 7-day diary, delayER = mean emotional response to delayed intrusive memory.

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

Table 7
Correlations between Mass Testing and Laboratory Tasks

Variable	IN	EV	PF	SM	MO	INMQdistress	INMQdissociation	INMQcontrol
CWAT								
meanWA	-.160	-.116	.095	.004	-.210	-.023	-.186	-.212
1stIM	-.066	-.339*	.037	.177	-.056	.134	.086	.119
IM%	.213	.098	-.011	-.003	.103	-.123	-.009	-.239
meanER	.140	.380**	-.103	-.111	.253	-.168	-.128	.164
negIM%	.164	-.129	.195	.097	.016	.113	.114	.129
negER	.052	-.295	.088	-.044	-.405*	-.043	-.132	-.189
TFT								
immedIM	-.125	-.107	.012	.106	.041	.166	.156	-.096
immedER	.081	.294*	-.372**	-.006	.082	.317*	.217	-.048
delayIM	.149	-.265	.203	.268	-.025	.357**	.130	-.134
delayER	.056	.252	-.268	-.021	-.021	.096	.053	.007

Note. IN = Intrusiveness (factor 1), EV = Emotional Valence (factor 2), PF = Person Focus (factor 3), SM = Specificity of Memory (factor 4), MO = Multisensory Object focus (factor 5), INMQdistress = distress rating of intrusive memory, INMQdissociation = dissociation rating of intrusive memory, INMQcontrol = control over occurrence of intrusive memory, CWAT = Continuous Word Association Task, meanWA = mean number of word associations provided, 1stIM = timing of 1st involuntary memory, IM% = proportion of the number of involuntary memory to the total number of word associations, meanER = mean emotional rating (including both positive and negative), negIM% = proportion of negative involuntary memory, negER = mean emotional rating of negative memory, TFT = Traumatic Film Task, immedIM = number of intrusive memory immediately after film viewing, immedER = mean emotional response to immediate intrusive memory, delayIM = number of intrusive memory reported in a 7-day diary, delayer = mean emotional response to delayed intrusive memory.

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

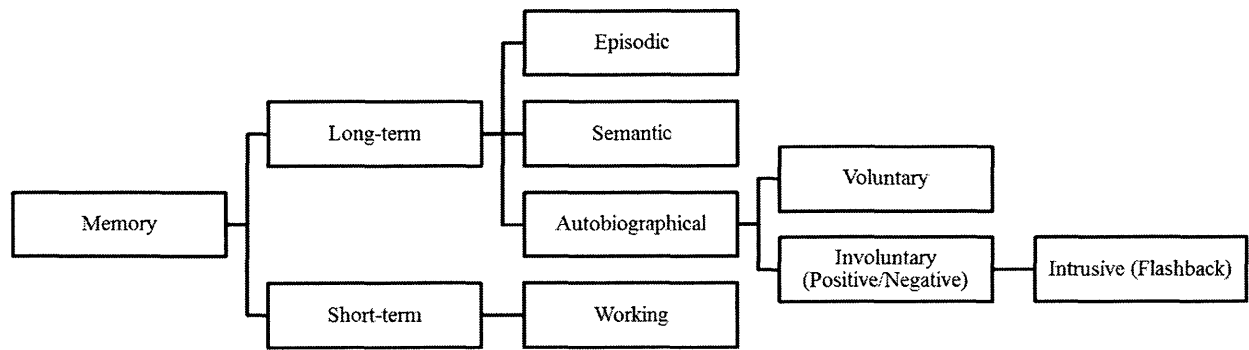


Figure 1. A Diagram of Memory Sub-divisions.

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