Attempting to Suppress the Unwanted

Investigating the Long Term Effects, Using the Directed Forgetting Method

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Acknowledgements

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Abstract

        The purpose of this study was to investigate the effect of emotional arousal on memory. In part one the list wise directed forgetting (DF) method was used to investigate the long term effects of attempting to suppress emotionally arousing pictures. The participants were tested on two occasions, one week apart. The first test session replicated the findings in Payne & Corrigan (2007), with no DF effect being found. No DF effect was found on the second test, either, but a significant list difference was found, with lower means on list 2, than list 1. There were no group differences at any stage of the experiment. In addition the negative pictures were remembered better than the positive and neutral. Suppression of emotionally arousing stimuli may thus seem to be difficult. Part two was an attempt to assess memory quality, by asking participants to describe some of the pictures in detail. Memory for list 1 pictures, which were better remembered after a week, was less erroneous, than memory for list 2 pictures. Memory for positive pictures was less erroneous than for the negative and neutral. In addition an attempt to create memory errors was made, by presenting false titles of different valences. Valence did not matter. Error rates were the same for the negative, positive, and neutral title. Over all, memory errors were quite common. There was no group difference for this tendency either.

Introduction

We all have at one point in time had experiences that we wish we could forget. A stutter during an important presentation, fainting in the middle of a crowd, or saying something to someone we would rather have unsaid. Sadly, these memories tend to mark themselves in memory, and sometimes we are unable to make them go away, even though we try. Painful memories have an uncanny ability to seep into our dreams, and torment us in our daily lives. This tendency led the great William James to assert that emotional memories seem to "leave a scar upon the cerebral tissue" (James, 1890, p. 670, in Porter & Birt, 2001, p.102). Even so, negative events can be forgotten (Epstein & Bottoms, 2002; McNally, 2003). Freud (1856 – 1939) believed that our mind possesses unconscious defence mechanisms that are able to ban unwanted, negative memories from consciousness, what he called *repression*. Repression may be defined as a "motivational process that protects us by blocking the conscious recall of anxiety-arousing material" (Passer & Smith, 2007, p. 256). Decades of research on this phenomenon have challenged the existence of this mechanism, however (see Klausen, 2009, for a review). Nowadays most researchers speak of *suppression*: "the *conscious* attempts to expel disturbing material from awareness" (McNally, 2003, p. 169). If we put our mind to it, we may by our own effort manage not to think about previous, shameful incidents.

Various methods have been used in an attempt to pinpoint the assumed underlying mechanisms involved in forgetting unwanted memories. These include the *Think – no think*, (Anderson & Green, 2001; Depue, Banich & Curran, 2006), *Retrieval induced forgetting (RIF)* (Anderson, Bjork & Bjork, 1994), *Thought suppression* (Wegner, Schneider, Carter & White, 1987) and *Directed forgetting (DF)* (e.g. Basden & Basden, 1996; Bjork & Bjork, 2003) paradigms. The findings are mixed. Some studies using the think/no think -, directed forgetting - and RIF - paradigms have found that negative stimuli can be suppressed or inhibited (Anderson & Green, 2001; Anderson, Bjork & Bjork, 1994; Depue, Banich & Curran, 2006; Wessel & Merckelbach, 2006).Yet others have failed to find an effect using RIF and DF (Dehli & Brennen, 2009; Payne & Corrigan, 2007). In addition the suppression effect found with the think/no-think and RIF methods seems to be of limited duration (McLeod & Macrae, 2001; Nørby, Lange & Larsen, 2009). What, then, is it that enables us to forget unwanted memories? Under what conditions do we succeed, and when will we be unsuccessful? How easily do we forget? Does it matter *what* we attempt to forget, or do the memory mechanisms work in the same way regardless?

The directed forgetting method

One way of getting a possible answer to these questions is with the directed forgetting method (DF). *Directed forgetting* refers to the phenomenon of "impaired memory arising from an instruction to forget the unwanted material" (Anderson, 2005, cited in Geraerts & McNally, 2008, p. 615). In this paradigm participants are traditionally asked to study lists of words and then instructed to forget part of the stimulus material (e.g. Geraerts & McNally, 2008). There are two types of the DF method: the *item based* and the *list-wise* method. In the *item based* each stimulus is marked immediately after presentation as something to be remembered or forgotten, usually indicated with the letter R for remember or F for forget. In the *list-wise* method the stimuli is sorted into two lists. The entire first list is presented before half of the participants (the Forget group) are instructed to forget this list and only learn the second list, while the other half (Remember group) are instructed to remember both lists (Marks & Dulaney, 2001). The usual finding is that the Forget group recalls less of the to-be-forgotten (TBF) words in list 1, and more of the to-be-remembered (TBR) words in list 2 than the Remember group, on recall tasks. Conversely, the Remember group usually remembers more from list 1 than from list 2 (Conway, Harries, Noyes, Racsmány & Frankish, 2000; Geraerts & McNally, 2008), probably due to a proactive interference from the preceding list (Payne & Corrigan, 2007). This pattern has been labelled the directed forgetting effect, and is usually weaker in the list method than in the item method (Geraerts & McNally, 2008).

Another difference between the two methods is the observation that the DF effect is also found in recognition tasks with the item based method, but not the list-wise method. For this reason it is assumed that two different mechanisms underlie each method. The effects on the item based method are thought to stem from selective rehearsal of the stimulus. Receiving an instruction to forget immediately after the presentation of the stimulus might make the participants stop rehearsing the stimulus, and focus their efforts on learning the TBR items instead. This might lead to a disrupted encoding process for the TBF items, and the material is thus not properly stored in memory. Hence, there are no memory to be retrieved at either recall or recognition tasks (Bjork, 1970; Geraerts & McNally, 2007). In the list-wise method the material to be forgotten has been presented in full before the forget instruction, and the stimuli is thus assumed to have been properly encoded. Had it not been then no return of memory could occur at recognition tasks. The lack of memory on tests of recall is thus assumed to stem from *retrieval inhibition*. The return of memory on the recognition task could therefore stem from a change in retrieval abilities, possibly a "release" from inhibition (Basden & Basden, 1996). The return of forgotten material indicates that it is still stored in

memory, but access has been temporarily blocked, until a potent release cue is provided (Payne & Corrigan, 2007). Because the list-wise method is assumed to involve inhibition it seems suitable for studying the effect of attempting to suppress or forget unwanted memories. This study will thus utilize this method to further explore the conditions under which forgetting may occur or, alternatively, when forgetting is difficult. Henceforth, when the DF method is discussed it refers to the list-wise.

The DF effect has been found to depend on certain conditions to occur. One condition that has been identified is the learning of a second list (Gelfand & Bjork, 1985, cited in Pastötter & Bäuml, 2007). The DF effect is thought to stem from a redirecting of attention away from the items in the TBF list. The observed disruption in inhibition of list 1 items when attentional resources are depleted, working on additional tasks during list 2 learning, seems to support this hypothesis (Conway, et al., 2000). In relation to this: when Wegner Schneider, Carter and White (1987), in their thought suppression study, instructed their participants not to think about a white bear while performing a different task, the participants were unsuccessful unless they were given a distractor they could focus their attention on (a red Volkswagen; experiment 2). Without the distractor those instructed to suppress the thought of a white bear in the first part of the study experienced a "rebound effect" in part two of the study, when they were allowed to think of it again. They reported more thoughts of the bear, than a group who started by expressing thoughts about it (prior to a suppression period, experiment 1). It may thus seem like we are able to forget things we do not wish to think about if we manage to distract ourselves. Note however, that the thought to be suppressed in the Wegner et al. (1987) study was not emotional.

There is one issue that makes it difficult to draw a clear inference from the studies using directed forgetting method to how it may be possible to inhibit or suppress unwanted emotional memories, though. Traditionally these studies have used lists of words, and there is reason to doubt the ecological validity of using this form of stimulus material to describe autobiographical events. The generalizability of the traditional directed forgetting studies is thus questionable (e.g. Jocelyn & Oakes, 2005; Payne & Corrigan, 2007). Payne and Corrigan pointed out: "Though words like ["sex" and "death"] certainly convey emotional information, by themselves they produce very little emotion" (Payne & Corrigan, 2007, p. 782). In support of this Wessel and Merchelbach (2006) found that forgetting emotional words were no more difficult than forgetting neutral words.

Following their hypothesis that emotional words may not be suitable for studying forgetting of emotional events Payne and Corrigan (2007) used pictures as their stimulus material. They wanted to investigate whether intentionally forgetting emotional events was just as easy as forgetting mundane ones. They chose 32 emotional pictures (16 negative and 16 positive) and 32 neutral pictures, and divided them into 4 lists in total: two emotional and two neutral. Each picture was given a unique verbal title to enable verbal recall. The lists were presented as equal or unequal valence (neu – neu, neu – emo, emo – emo, emo – neu). When the first list was neutral (neu – neu or neu – emo) the standard directed forgetting effect occurred, with less items from list 1 being recalled by the forget group. When the first list was emotional on the other hand (emo – emo, emo – neu) no DF effect was found. In fact, the emotional pictures seemed to be favoured in memory and inhibition failed to occur. Payne and Corrigan (2007) argued that the previous findings of directed forgetting for emotional words might be because words only "elicit thoughts about emotional concepts, rather than elicit emotional *states*" *(*p.784*, italics mine), which might be essential to the difference between neutral and emotional stimuli (Payne & Corrigan, 2007). When something causes emotional arousal, we seem unable to suppress it.

Besides the issues with emotional arousal there are other reasons why using pictures are more expedient than using words. Words may convey meaning, and cause the participants to imagine a scene relating to that word. These scenes will be unique in each participant's mind, though, lacking standardization. In the sense they only remember the word (echoic representation, e.g. Passer & Smith, 2007), and no imagination of a visual scene occurs, it becomes difficult to generalize to autobiographical memory (AM), which is unquestionably visual in nature. Providing pictures eases generalization.

There is also reason to believe that our visual memory system is more accurate than verbal memory. Shephard (1967) tested peoples' memory accuracy for words, sentences and pictures. After having been presented for the test stimuli the participants were presented with a selection of the previously seen stimuli paired with a new stimulus, in a forced choice task, and asked the participants to identify the "old" stimulus. When the stimuli were pictures he found a 98% correct response rate when the participants were tested immediately after presentation. When tested after a week's delay, the group who saw the pictures was as accurate as the groups who studied verbal material (words and sentences) had been at the first test session, immediately after presentation (pictures 87% after 7 days; words 88.4% & sentences 89% on first test). In other words: after one week visual memory was as accurate as verbal memory had been shortly after presentation of the stimulus. This indicates a relatively

powerful and enduring impact of pictures on memory. Other studies have confirmed the long term accuracy of visual memory (Jiang, Song & Rigas, 2005; Voght & Magnussen, 2007).

It does not take the visual system long to register the gist of a visual scene (Oliva, 2005; Wolfe, 1998), i.e. the abstract meaning, such as whether it depicts a kitchen, a beach, or a supermarket (Rensink, 2000). Visual memory also has a high capacity for spatial context learning (Jiang, Song & Rigas, 2005). In studies using even thousands of pictures, people are able to recognize the ones they have seen in the past from the newly presented pictures (see Wolfe, 1998 for a review). It thus seems reasonable to assume that words may be inadequate for drawing inferences about AM.

To reiterate: the DF effect has been observed for emotional words, but not emotional pictures. Since the aim is to pinpoint the underlying mechanisms for forgetting emotional *memories*, the best stimulus material would perhaps be *real* autobiographical memories (AMs)? Interestingly, the two studies that have used AMs in a list-wise DF experiment did find a DF effect (Barnier, et al., 2007; Jocelyn & Oakes, 2005). Barnier et al. (2007) asked their participants to generate AMs relating to specific cue words, and then used these memories in a standard list-wise method. However, they asked the participants to generate memories that were at least 1 month old (Barnier et al., 2007), and emotional characteristics of memory for the events may have declined sufficiently to enable DF inhibition. Jocelyn and Oakes (2005), however, used fairly new autobiographical material (diary entries for two consecutive weeks). Half of the participants received an instruction after the first week to forget all of the existing diary entries, and only concentrate on remembering the upcoming week's events, while the other half were told to remember both weeks. They found a DF effect for emotional events, with negative and positive, and both high and low salient memories, forgotten to an equal extent (experiment 1). This may indicate that negative memories are relatively easy to forget.

There is a slight methodological problem with using autobiographical material though. Because the events the participants reported in the Jocelyn and Oakes (2005) study were not "standardized" (they were to keep a diary for whatever took place in their lives), offering less control, it is difficult to generalize from this study (e.g. Barnier et al., 2007). The lack of standardization also makes it somewhat unclear exactly *how* arousing, or frequent (among the participants), the emotional events were. We usually don't experience very emotionally arousing events on a regular basis, and it may be that these events work differently than more low key, everyday events (e.g. Alexander et al. 2005; Berntsen, 2001; Porter & Birt, 2001; Payne & Corrigan, 2007). Barnier et al. (2007) did explore emotional events, and also scored

them on intensity, but they do not clearly specify if this variable was taken into account, leaving this factor potentially unexplored. Although the Jocelyn and Oakes (2005) and Barnier et al. (2007) studies clearly indicate that AMs can be forgotten, they may not be suited for clarifying how emotionality may mediate the forgetting process. However, in experiment 2, in the Jocelyn and Oakes (2005) study, the week to be forgotten included Valentines Day, and the events were scored as slightly higher on arousal than the previous week. In this experiment they did not find any DF effect for the high salience events. This may indicate that highly arousing events are harder to forget. However, since the salient events reported seemed to have been primarily positive in nature (Jocelyn & Oakes, 2005), and we may not be very motivated to forget positive memories[1] (e.g. Payne & Corrigan, 2007, Plutchik, 2001) the issue of negative events may still be an open issue.

Another problem with most studies using DF is that they have only tested the participants shortly after the presentation period (e.g. Barnier et al., 2007; Conway et al., 2000; Pastötter & Bäuml, 2007; Payne & Corrigan, 2007; Wessel & Merckelbach, 2006). Considering the annulment of suppression in studies using other methods to investigate related paradigms (c.f. MacLeod & Macrae, 2001; Nørby, Lange & Larsen, 2009), it stands to reason that some alteration of memory may be observed with the directed forgetting method too after a delay. Considering that no DF effect was observed for the emotional first list in the Payne and Corrigan (2007) study, it could be that inhibitory mechanisms need more time to suppress visual, emotionally arousing, stimuli. MacLeod and Macrae (2001) and Nørby, Lange and Larsen (2009) used words as their stimulus material, and it is possible that visual memory operates differently. Pictures are thought to be more suited to provoke an emotional activation than are words (Payne & Corrigan, 2007), and it seems like emotional activation may be a key factor in the DF effect.

If the DF paradigm is going to be used as a tool to investigate the long term effects of attempting to suppress (i.e. intentionally forget) emotionally salient autobiographical memories it has to be made more ecologically valid, first of all by replacing words with visual stimuli (as in Payne & Corrigan, 2007) in order to investigate the role of emotional arousal, and secondly by investigating the long term effects (this study). Although Jocelyn and Oakes (2005) tested the participants some time after the forget instruction, the lack of standardization makes it difficult to pinpoint the exact factors that mediated the DF effect in that study (e.g. Barnier et al., 2007). Although AMs are undeniably more ecologically valid than pictures that lack self referential qualities (i.e. the participants have not taken part in the

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[1] Positive emotions may signal approach behaviour, while negative emotions may signal avoidance.

activities they witness) using pictures is a necessary step towards an integrated understanding of how memory operates.

Memory quality

Another benefit from using pictures as the stimulus material is that it enables an investigation of the *quality* of the memory representations of the stimulus. The directed forgetting method have primarily measured peoples' verbal memory, or in cases where pictures are used; people's verbal memory of visual scenes (e.g. Payne & Corrigan, 2007). I.e. it indicates how good we are at remembering the gist/category name of a scene, but does not tell us if the scene itself, as it is portrayed in our mind, is correct or not. If the participants correctly remember the title "father and son" we don't know if they remember them in the correct setting, with the correct clothes, or the correct age. In addition, it is possible that visual memory may be altered by an attempt to suppress what we have seen. If so, memory quality for the pictures will not be the same for the Forget and the Remember group, on list 1.

The design of this study also enables an additional analysis: just how easy is it to create errors in someone's memory? This addition is inspired by the controversy surrounding repression and false memories. A *false memory* can be defined as: a "memory of an event that never took place" (Sivers, Schooler & Freyd, 2002). In the 80s and 90s a group of men and women claimed to have had repressed memories of being sexually abused in childhood, which they, years later, had supposedly recovered in therapy (McNally, 2003). The debate that ensued concerned whether or not these memories could inadvertently have been created in the therapy setting, by methods now considered to have been suggestive in nature, and in fact had been false memories (Loftus & Ketcham, 1994; McNally, 2003; Schacter, 2001). *Suggestibility* concerns "an individual's tendency to incorporate misleading information from external sources – other people, written materials or pictures, even the media – into personal recollections" (Schacter, 2001, p. 113). The therapists, on the other hand, rejected the notion of false memories arising in therapy (Schacter, 1996, p. 250).

Since then a great number of studies have demonstrated that planting false memories is possible. Elizabeth Loftus, a pioneer within false memory research, and colleagues have been able to alter memory in a variety of settings: from changing memory for details of a witnessed event (Loftus & Hoffman, 1989; Loftus & Palmer, 1974; Zhu, Chen, Loftus, Lin & Dong, 2009; Zhu et al., 2010), to even creating false autobiographical memories in the

participants (Loftus & Pickrell, 1995). Other researchers have replicated both the method[2] and the results (Chan, Thomas, Bulevich, 2009), even for assumed unpleasant and traumatic autobiographical events (Hyman, Husband & Billings, 1995; Porter, Yuille & Lehman, 1999). Most of the studies have presented a false narrative to coax the participants into believing they experienced the event, but also manipulated photographs have been employed (Wade, Garry, Read & Lindsay, 2002). Garry and Wade (2005), however, discovered that false narratives were better at creating false memories than false photographs were. This might indicate that memory for pictorial stimuli are relatively more accurate than verbal memory.

The body of past research have demonstrated that memory is rather malleable, and that even major alterations may be achieved with fairly simple methods. However, it is still unclear just how easily a memory error may be created. The previous studies have relied on providing the participants with already constructed notions of what may have happened, for their imagination to build on. Creating false autobiographical memories have additionally involved a certain amount of social pressure, in telling the participants that family members had confirmed that the events had occurred (e.g. Loftus & Pickrell, 1995; Hyman, Husband & Billings, 1995; Porter, Yuille & Lehman, 1999; Wade, Garry, Read & Lindsay, 2002; Garry & Wade, 2005). With a minimum of external information, and a minimum of social pressure, do errors still occur? Is it possible to make people believe they have seen pictures that have in fact never been presented to them, and to describe them in detail?

The present study

The purpose of the present study is thus twofold: part one is an investigation of the long term effects of a pictorial, emotionally arousing, version of the list wise directed forgetting method, using the Payne and Corrigan (2007) study as a starting point. Various issues have been altered in order to make the study as ecologically valid as possible. Part two of the study is an attempt to investigate the qualitative aspects of the memory representations, in addition to attempt to find out how easily memory errors may be created.

When it comes to the DF part of the experiment the most important change is adding a second test session, a week after presentation, in order to investigate the long term effects of

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[2] Using the 'standard' method, where the participants are asked to choose between an object they have seen in a picture and the object presented in the misleading narrative, in a forced choice recognition task. McCloskey and Zaragoza (1985) criticized this technique and proposed a new modified version, where participants were asked to choose between the seen object and an unrelated object not presented in either picture or narrative. They did not observe any misinformation effect. However, this method has again been criticized as not being sensitive enough (see Loftus, 1991, for a review).

attempting to suppress unwanted stimuli. This is done to see if memory for the negative pictures has changed in any way during the delay. Does an instruction to forget weaken the processing of the events in the long run, thus lessen the brains ability to retain the memories, or are negative events properly encoded, stored, and readily retrievable no matter what? Since the directed forgetting effect is not expected to occur at the first testing, could it be present after a week? Alternatively, if an effect is unexpectedly obtained at the initial testing, has it disappeared after a week?

Secondly, Payne and Corrigan (2007) used all emotional and all neutral lists. This gives an indication of the superiority of emotional events in memory over mundane events. However, this may be a somewhat artificial "situation", as we tend to experience several events of various emotional valences during our daily lives, and all these events will compete with each other for access to conscious recollection (e.g. Smith & Kosslyn, 2009). The present study thus includes negative, positive and neutral pictures in *both* lists (as in Barnier et al.'s, 2007, study, experiment 3), in an attempt to make the study more similar to daily life experiences. The primary interest is memory for the negative pictures compared to the positive and neutral ones.

Thirdly; this study only include pictures of humans in various, unique situations. The use of only situational pictures gives a better basis for generalizing to real life settings. Whenever someone attempts to suppress memories these may usually be social in nature. The participants will also be asked to describe some of the situations depicted in the pictures. This is to investigate whether pictures the participants have been told to forget, are more, or less, correct compared to pictures they are instructed to remember, after a certain delay. This might answer whether the inhibitory processes thought to result from an instruction to forget (e.g. Payne & Corrigan, 2007) might weaken the retrieval abilities for the forget-pictures in the time between the presentation stage and the second retrieval stage, compared to remember-pictures, and compared to the control (Remember) group, thus making memory more incorrect.

Unrelated to the Payne and Corrigan (2007) study, but to link the study to research on the creation of false memories, the present study will also attempt to find out if mildly influential suggestions are enough to create memory errors for false (not previously presented) picture titles. Of additional interest is whether this will be easier for titles indicating a benign (positive or neutral) situation, rather than a negative one. More precisely: will merely presenting a title be enough to make the participants attempt to describe the picture, as if they had seen it? Additionally, will the tendency to form memory errors differ

for the Forget and Remember groups? Presenting the same pictures to all participants enables this additional investigation. The titles are constructed to be mildly associated with the original pictures.

The rationale for combining the list-wise DF method with a study on memory errors is, as previously mentioned, the assumption that this method involves retrieval inhibition of the studied material (e.g. Basden & Basden, 1996), and would thus allow an investigation into the nature of material one has been explicitly instructed to forget, and assumed to have become inhibited. As it is further assumed that both picture lists have been equally processed, the possibility that the forget list is unavailable in memory because it had never been encoded, can be excluded. By combining this method with a measure of the quality of details in memory could give an indication of how trying to forget something might affect memory for it, compared to the things one have tried to remember. Do people in the forget condition have more correct memories for the pictures they had been instructed to forget, because they have been "locked in" somehow, or do they contain more errors, due to weakened memory traces? Consequently, are the pictures they were told to remember recalled more correctly, because they do not have to compete with other memories? Which group is more likely to accept the false probes? Does the feeling of having forgotten something make the forget group more likely to believe that the false titles had been presented? Considering that no DF effect is expected on the first test session, the answers to these questions hinge on the results at the second testing.

The erroneous descriptions given to the false titles (and also the true, original titles) in the present study are here referred to as *memory errors* rather than false memories. Some studies using "technical" methods to create memory errors, such as the DRM-paradigm, have claimed that the errors represent false memories (e.g. Watson, McDermot & Balota, 2004). It is an open question, however, whether the term false memory should be reserved for false *autobiographical memories*, since a dilution of the term may make theoretical discussions somewhat confusing. This is not to say that the phenomena are not linked in any way. Every false memory will at some point have started with a mere memory error.

Predictions

As in the Payne and Corrigan (2007) study the directed forgetting effect is not expected to occur at the first testing. Concerning the second testing is seems reasonable to assume that memory for the two lists remain stable during the 1 week delay, considering the advantage of emotional stimuli in memory. Since negative material seems to be better

remembered (e.g. Payne & Corrigan, 2007), it may further be assumed that negative pictures will be harder to forget than neutral and positive pictures, even after the delay. Alternatively there may be a decrease in mean values of equal strength in both lists, across all valences, in accordance with general forgetting (e.g. Ebbinghaus' forgetting curve, in Smith & Kosslyn, 2009). The latter hypothesis seems more likely considering the study does not involve people's AMs, which may be more memorable (e.g. Barnier et al., 2007) than pictures one has merely looked at for a brief period of time.

Memory quality is expected to be related to the results on the DF task. Provided that the DF effect appears on the second testing it seems plausible that memory for list 1 pictures will be more accurate in the remember group, while list 2 pictures will be more accurate in the forget group. If no group differences are found in the DF task on test 2, no group difference should be found in the memory quality part.

Additionally, creating false responses for the titles indicating a negative scene ought to be more difficult than for the positive and neutral titles. The negative pictures are assumed to be more memorable, due to their relatively higher arousal (cf. table 1 below; additionally the negative pictures were remembered better than the positive pictures in the Payne & Corrigan, 2007 study, even though they were of similar arousal), and the participants should realize that they had not seen a picture depicting that particular scene. It is further assumed that the participants will show a tendency of misattributing the false titles with the original pictures that they are based on. *Misattribution* happens when information in memory is attributed to the wrong source. It could be that we remember the details of an event correctly, but we may mix up the dates for when it happened. We may also mistakenly believe that visual images in our mind – which may have been created from something we have heard, seen, read in a book, or dreamt up – have actually taken place (Schacter, 2001). Misattribution is sometimes called source monitoring error (e.g. Lindsay, 1990), or source confusion (Passer & Smith, 2007). The latter term will be used here.

Main experiment

This study used coloured photographs in a list-wise directed forgetting experiment to explore the long term impact of emotional arousal on memory. The pictures were divided into two separate lists, list A and list B[3], matched on valence and arousal. The pictures depicted humans in a social setting, and each picture was given a unique verbal title to enable verbal recall. The titles were designed to capture the gist of the contents of the picture, without at the same time giving away too much information. The titles were $1 - 3$ words in length. A picture showing a man and a woman having a conversation, over a cup of coffee, was simply titled "man and woman" (see appendix for complete list). The participants were presented with both lists, but presentation order was randomized.
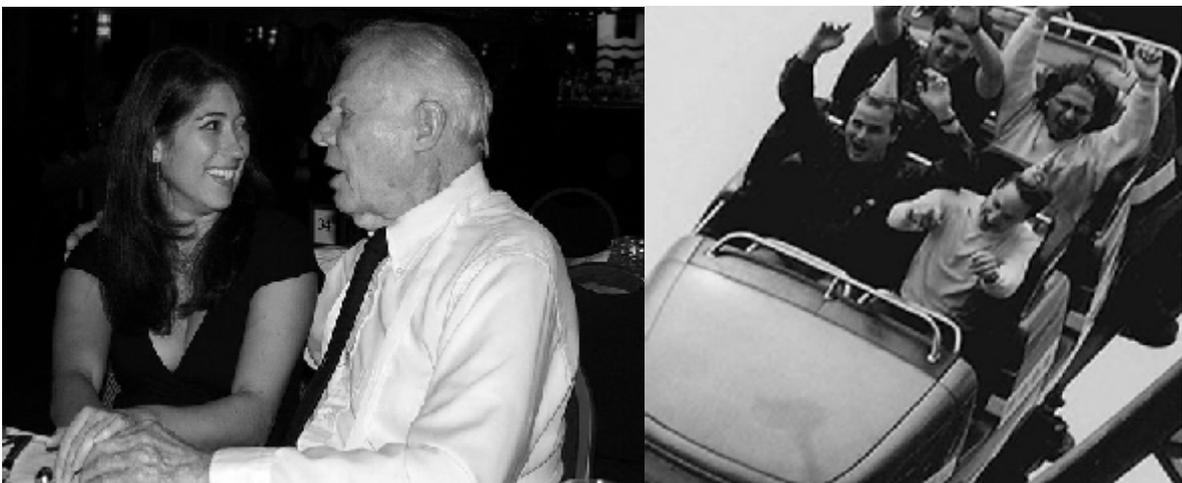

Illustration photos of the type of picture the participants were asked to describe. Pictures are not part of the database used in the study. Credits from left to right: Sara Atkins and Joe Mabel (pictures have been altered). Licensed under the © Creative Commons Attribution 3.0 Licence.

The participants were randomly allocated to one of two conditions, Forget or Remember. After the presentation of the first list the Forget group received an instruction to forget this list, because it was only practice, and instructed to only remember the second one. The Remember group was instructed to remember both the list they had just seen and the next list to be presented. Memory for the verbal titles of the pictures was tested on two occasions,

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[3] Presentation order of list A and list B were counterbalanced. List A or B refers to the two separate picture lists, while List 1 and 2 refers to the presentation order in the DF experiment, i.e. whether the list was presented before or after the mid-test instruction. Both list A and list B were presented as list 1 or list 2.

shortly after presentation and again after a week, to investigate the long term effects of the suppression attempt.

In order to explore the qualitative properties of the memory representations some of the pictures from both lists (1 of each valence), were selected to be more thoroughly described. First the participants were given a recall task, where they were presented with a title and asked to describe the picture that had been presented with that title, as detailed as possible. They were casually encouraged to try to visualize the original picture before describing it, since this might aid their recall. The descriptions were then matched to the original picture to check for possible deviations. In case the participants failed to include all of the details they remembered in the recall task a response booklet was provided afterwards, containing open, non-leading questions probing for more specific details. The main reason for this addition to the DF study was to further investigate the quality of the memory representations of the presented pictures, and whether this would be different for people who have attempted to suppress part of the study material compared those told to remember all of it.

The design of this study also enabled an additional analysis concerning the creation of memory errors. Three additional titles, indicating a negative, positive and a neutral scene, were constructed, and presented with the true titles. The false titles were mildly associated with some of the pictures that had been presented before. As well as being the basis for an investigation into quality of visual memory, the original pictures also served to lend some credibility to the false titles. Presenting titles participants had actually seen could make it easier to make them believe that they had seen a picture with that title. It should be noted that this study may contain too few pictures in the sample to make broad generalizations, but could nonetheless be considered a first attempt to investigate these issues.

Method

Participants

The participants were 58 (38 female and 20 male) undergraduate students in psychology, at the University of Oslo, who all volunteered for the study. They received no compensation for participating. The participants were divided into a Forget condition (the experimental group) and a Remember condition (the control group), with 29 in each. The participants were aged 19 – 31 years, with a mean age of 22 years. The participants were not recruited by gender, and assignment to either category was purely random.

Materials

All pictures were selected from the International Affective Picture System (IAPS) database[4], which have been standardized, on valence and emotional arousal. Arousal and valence are scored on a likert scale ranging from 1-9 (1 = very low; 9 = very high arousal; 1 = very negative, 9 = very positive valence) (Lang, Bradley & Cuthbert, 2008). The valence and arousal categories have been found to correlate positively with measures of physiological activation (Bradley, Greenwald, Petry & Lang, 1992). 6 negative, 6 positive and 6 neutral pictures were selected, 18 in total[5], and divided into two separate lists. The negative, positive and neutral images in each list were matched on both valence and arousal (see table 1).

Table 1

Valence and arousal for picture lists

	List A		List B	
	Valence	Arousal	Valence	Arousal
Negative	2.36	6.04	2.35	6.1
Positive	7.53	4.77	7.6	4.9
Neutral	5.14	3.72	5.04	3.76

A unique title was constructed for each picture (1-3 words) in order to separate them from each other, and to enable verbal recall. For instance: a picture showing people on a roller coaster were given the title "roller coaster", and a picture of two children holding a kitten each were given the title "children and cats". The titles indicated plurality of a category, such as 'children' if there were more than one, but did not otherwise indicate any number of people or objects. As in the Payne and Corrigan (2007) study if the participants could not remember the correct title they were instructed to either indicate an approximate title or describe the picture.

Care was also taken to ensure that the pictures could not potentially overload the participants' memory, i.e. that the pictures were too detailed and complex. Only pictures depicting a minimum of two people (to ensure *some* complexity), but no more than 7 central persons (in accordance with "Miller's (1956) magical number 7 ± 2", cited in Passer & Smith,

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[4] We were permitted to use the pictures from the IAPS database in this research, but we were not permitted to publish the pictures in the paper. The original pictures are thus described in the appendix, while the pictures actually shown in this paper are for illustration purposes.

[5] A separate study ran parallel to this that also used pictures from the IAPS database, and in addition recruited from the same sample of students. The pool of possible pictures to select for this study was thus restricted, since it was imperative that the participants had not potentially been exposed to the pictures previously.

2007), were chosen to be presented at stage one. For the second, description stage of the experiment only pictures with 2 - 3 individuals were chosen, again to lessen strain on memory, and motivation.

Design and procedure

The participants were told that they were taking part in a study on long term memory for images. They were instructed to remember the picture titles and details in the pictures for a later memory task. Pictures and titles were presented on a computer monitor using E-prime 2.0 (Psychology Software Tools, Inc.). The pictures measured 22.5 by 28.2 cm, and the participants were seated 60 - 80 cm from the computer monitor. The presentation of the pictures was randomized within each list, and the presentation order of the two picture lists was pre-randomized to exclude 'list memorability' as a confounding variable. The title of the picture was presented by itself for 2 seconds, in black letters on a white computer screen, before the title was presented in combination with the picture for another 3.5 seconds. The title was presented on top of the picture. Each picture presentation was followed by a 1000 ms inter stimulus interval. During this time a black fixation point was presented on a white screen at the location of the appearance of the next title, to focus attention. The pre-presentation of the titles was done to make sure that a seemingly lack of memory was not due to the participants failing to register the title. The Payne and Corrigan (2007) study presented the pictures, in combination with the titles for 2.5 seconds, but pilot testing of this experiment indicated that this was not enough time to register any details in the pictures, and might potentially cause the participants to fail to register the title. The presentation time was thus extended in order to increase the likelihood that poor memory reflected a problem in retrieval, and not encoding failure.

After studying the first list the group in the forget condition (the Forget group) received an on-screen instruction that the first list was only a practice trial, and that they should forget the list they had just seen and only remember the second list. The group in the Remember condition (the Control group) was told after the first list that they were halfway in the experiment, and that the second list would be presented shortly. The participants were instructed to 'press any key' in order to continue the experiment. After the presentation of the pictures was completed a filler task was introduced, asking the participants to write down as many names of countries that they knew of. The filler task lasted two minutes, and upon its completion they were asked to list all the picture titles that they could remember from both lists. For the Forget group this included the list they had been instructed to forget.

The total time for the presentation phase was 15 minutes. After the task was completed a time for the second stage of the experiment was scheduled before the participants were excused, after receiving instructions not to discuss the experiment with anyone, to avoid external interference on memory (e.g. French, Gerry & Mori, 2008).

In the second stage, 1-2 weeks later, ($M = 7.7$ days, Range: 7 (76%) - 15) the participants were first told to write down as many titles as they could remember from the first stage, as part of the directed forgetting part of the experiment.

Afterwards, as part of the study on the quality of the memory representations, they were presented with a *recall task* where 6 previously presented picture titles were presented one at a time on a computer screen (using E-prime 2.0), in addition to the 3 false titles[6] (1 indicating a negative picture, 1 positive and 1 neutral). The presentation was randomized by the computer program. The participants were then instructed to describe the pictures belonging to the title as detailed as they could, on the computer. After receiving information about the steps of the experiment they were casually encouraged to "Close your eyes for half a minute or so, after being presented with the title and just try to imagine the picture the title belongs to. This may make it easier to remember details, and aid you in describing the pictures". The experimenter then left the room, to minimize external pressure and the risk of experimenter bias. The participants were left alone in a closed off cubicle.

After the completion of the *recall* task they were given a response booklet with questions that asked for more specific details, such as: "how many people (and animals) are present?", "describe looks, clothes and central objects" and "briefly describe the situation". The questionnaire was included in case these details had been left out of the descriptions in the recall task, and the questions could also serve as a probe. This could therefore be considered a *cued recall* task, although the questions did not offer any clues as to what the correct answer might be. The experimenter again left the room, and the participants were free to take the time they needed to complete the questionnaire. The memory error part of the experiment lasted approximately 1 hour +/- 30 min. After the completion of the experiment the participants were debriefed about the purpose of the study and the deception with the false titles. They were also informed about the malleable nature of memory, and how common it is to make memory errors. They were then thanked for their participation, and excused.

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[6] The new, false titles were constructed to be weakly related to pictures shown in the first phase (but not presented in the second phase), but no picture with that exact title had been shown. Considering the small sample of pictures in this study it was decided that distinct pictures, that did not resemble any of the original titles, might make the participants realize the titles were false, thus lead to a floor effect.

Coding of responses

"Name all titles"- task (Part 1: DF). After the distracter task in the first (picture presentation) phase and again at the beginning of the second phase the participants were asked to write down the titles of as many pictures as they could remember. If they could not remember the exact title a tentative title or a description sufficed. These were coded as *partial*, and if they remembered the *correct* title it was coded as such. A second *correct* category was established during coding for titles that changed the semantics, but were otherwise correct. When the participants changed part of the title from singular to plural, or vice versa, i.e. if the title was 'doctor*s* and patient', and the participant wrote 'doctor and patient', it was coded as a *correct minus*. Although the title had been altered, the alteration did not seem to be to such a degree that it should be deemed merely "partially remembered". The titles were then further plotted according to valence, and whether they appeared in the first or second list. However, after an initial data analysis it was decided to collapse all 3 categories into one, since 60 – 90% of the responses in the correct minus and partial categories clustered around 0, with at least 90% of the participants scoring less than 1, in any category.

Recall and cued recall (Part 2: Memory errors). For the recall tasks during the second phase the descriptions were coded into 6 distinct categories. Descriptions containing no errors, regardless of length of the description, were coded as *correctly remembered*. If the participants indicated that they could not remember any picture suggested by the false titles, or if they described the original picture, but explicitly stated the title of that picture (i.e. stated that "bakers" had been labelled "chefs"), the responses were coded as *correctly rejected*. If they described an original picture as belonging to the false title, e.g. describing the "gangster" picture to the title "robbers", without mentioning the original title, the response was coded as (source) *confused*. Responses where the core details of the picture were described correctly, but which also contained erroneous details were coded as *partial*. Some participants chose not to describe pictures they could not remember and these non-responses were coded as *forgotten*. If the participants made an erroneous description of a title, but stated that they had a distinct feeling they were just making it up, the picture was also coded as *forgotten*. Only statements claimed to be true were of interest in this study.

Descriptions not pointing to any picture that had been presented, in any form, or describing situations relating to the false titles, ended up in the *false* category. In addition, if participants described a scene originating from the cues in the original title, but which clearly indicated a new scene, i.e. the picture they imagined were not the correct one, the response

also ended up in the *false* category. For example: the original picture titled "children and cats" depicted 'a boy and a girl sitting on a lawn, holding a kitten each'. If the participant described it as being 'one girl, sitting on a floor inside a house, with several cats around', the scene they "remembered" were clearly not the one they had actually seen.

  Errors of omission in the description of people/objects were not considered in this study, e.g. if someone had a blue sweater, but the participant failed to include this detail, it was not coded as an error. If the participant claimed the sweater was pink, however, this was considered to be an error (*Error of commission*). However, if two people were central in the picture, and only one was reported, the 'number of people present' was coded as an error, since the scene of the picture could be considered substantially altered.

Results

Part 1: Directed forgetting:

Although it could be claimed that three pictures of each valence category, a total of nine pictures in each lists, might be considered too few, preliminary analyses indicated that there was no ceiling effect. The majority had 1-2 correct recalls of each valence category, and very few remembered all of the titles on any list (≤ 2 participants).

Graph 1

*Mean correct recalls of list 1 and 2, at both test sessions, collapsed on group:*
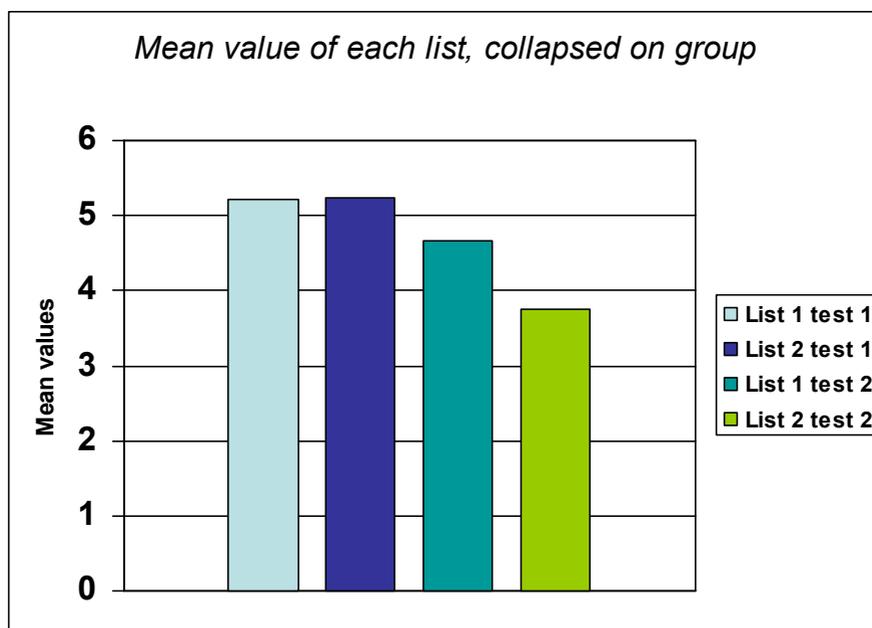
1. test session (immediately after pictures presentation). As expected, the first test, shortly after the picture presentation phase, did not reveal any main or interaction effects. Both lists were equal, and there was no difference between the Forget and Remember groups, replicating the findings in Payne and Corrigan (2007). Further the negative pictures were remembered better than the positive and the neutral pictures, in accordance with previous research (e.g. Barnier et al., 2007; Payne & Corrigan, 2007). For the Forget group recall for the negative pictures was superior compared to the other valences. Despite the lack of significant difference between the positive and neutral pictures, the scoring pattern did reflect the differences in arousal. Although not significant, the Remember group had a slightly higher recall rate on the neutral images than the positive ones, a finding that was not expected, considering that the positive pictures were more arousing.

A 2 (List 1 vs. 2) X 2 (Group: Forget vs. remember) ANOVA was conducted on the data collected at the first test session. There was no significant main effect of list or group, nor did the standard interaction between list and group occur, i.e. there was no directed forgetting effect. Mean scores for both lists, for both groups, were practically identical.

Graph 2

Mean values on list 1 and 2 for the Remember and Forget groups, at test 1:
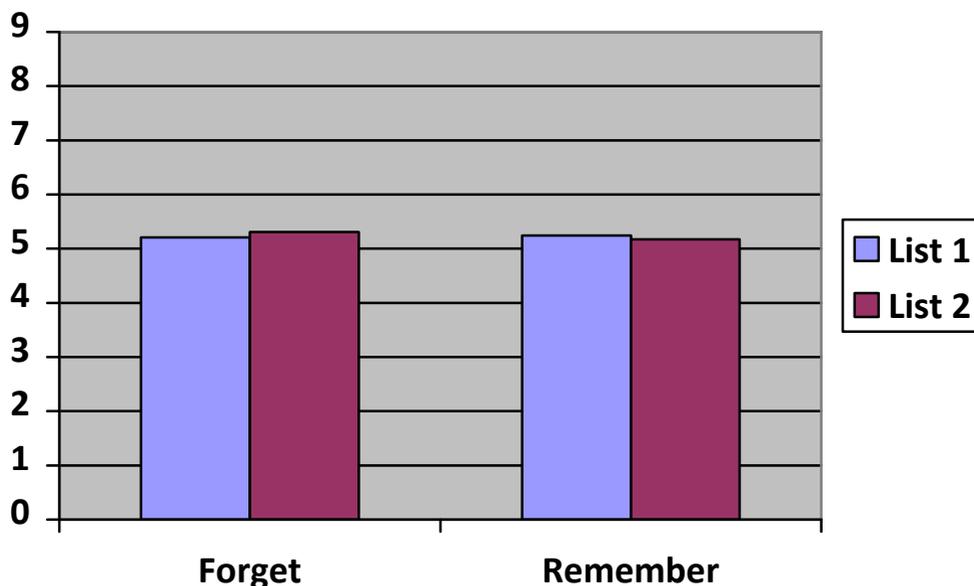
Investigating the differences in valence within each list a 2 (group: Forget vs. Remember) x 2 (List: 1 vs. 2.) X 3 (Valence: Negative vs. neutral vs. positive) mixed within – between ANOVA revealed a main effect of valence only, $F(2, 55) = 9,491$, $p < .001$, with more negative pictures recalled than positive and neutral. There was also an interaction between valence and condition group $F(2, 55) = 3,351$, $p = 0.042$, with better memory for the emotional pictures in the Forget group, and the Remember group scoring higher on the neutral pictures.

In order to further investigate the interaction a split file analysis was performed, making paired comparisons of the valences within each group separately, in order to look at the effect of inhibitory mechanisms on memory performance for each valence[7]. The analysis showed that the significant main effect of valence occurred in the Forget group only, $F(2, 27) = 7.727$, $p = .002$, remembering more negative pictures ($M = 2,121$, $SD = .115$) than neutral ($M = 1.534$, $SD = .136$) and positive ($M = 1.603$, $SD = .106$). There were no other main effects or interaction effects. Paired comparisons of the various valences revealed a significant main effect of valence between negative and positive images for both groups (Forget: $F(1, 28) = 13.376$, $p = .001$; Remember: $F(1, 28) = 5.143$, $p = .031$), but the negative vs. neutral was only significant for the Forget group ($F(1, 28) = 13.928$, $p < .01$). Stated in different terms: for the Forget group the negative pictures > positive pictures = neutral pictures, but for the Remember group, negative ($M = 1.862$, $SD = .099$) = neutral ($M = 1.793$, $SD = .104$), which again = positive ($M = 1.552$, $SD = .152$), and negative > positive. No significant differences were found between positive and neutral images for either group (p's > .05). Independent samples t-tests on each of the valence categories in both lists revealed no statistical differences between the Forget and Remember groups, on either valence (all ps > .05).

2. test session (1 week after picture presentation). While the lists had been identical on the first testing they were not at test 2. More pictures were remembered from list 1 than list 2. Again no group differences were found at any variable.

As on the first test a 2 (List: 1 vs. 2) x 2 (group: Forget vs. Remember) ANOVA was conducted, to see if the directed forgetting effect had appeared after the one week inter trial interval. While the list-factor did not reach significance in the first testing, it did come out as a main effect in the second test session, $F(2, 56) = 12.576$, $p = .001$, with more pictures being remembered from list 1 than list 2 (see graph 1). This pattern could be expected for the Remember group, but not for the Forget group too, cf. the directed forgetting effect.

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[7] Considering the low number of pictures of each valence a Bonferroni correction was not carried out in the analyses, in line with Barnier et al. 2007.

A 2 (List: 1 vs. 2) x 2 (Group: Forget vs. Remember) x 3 (valence: negative, neutral & positive) ANOVA revealed a main effect of valence (F (2, 55) = 4.749, p = .013), with again more negative pictures being remembered (M = 1.552, SD = .074) than neutral (M = 1.328, SD = .095) and positive (M = 1.336, SD = .068) overall, further supporting the notion of negative stimuli having a greater impact on memory. There were no further main or interaction effects.

Graph 3

Mean values on list 1 and 2 for the Remember and Forget groups, at test 2:
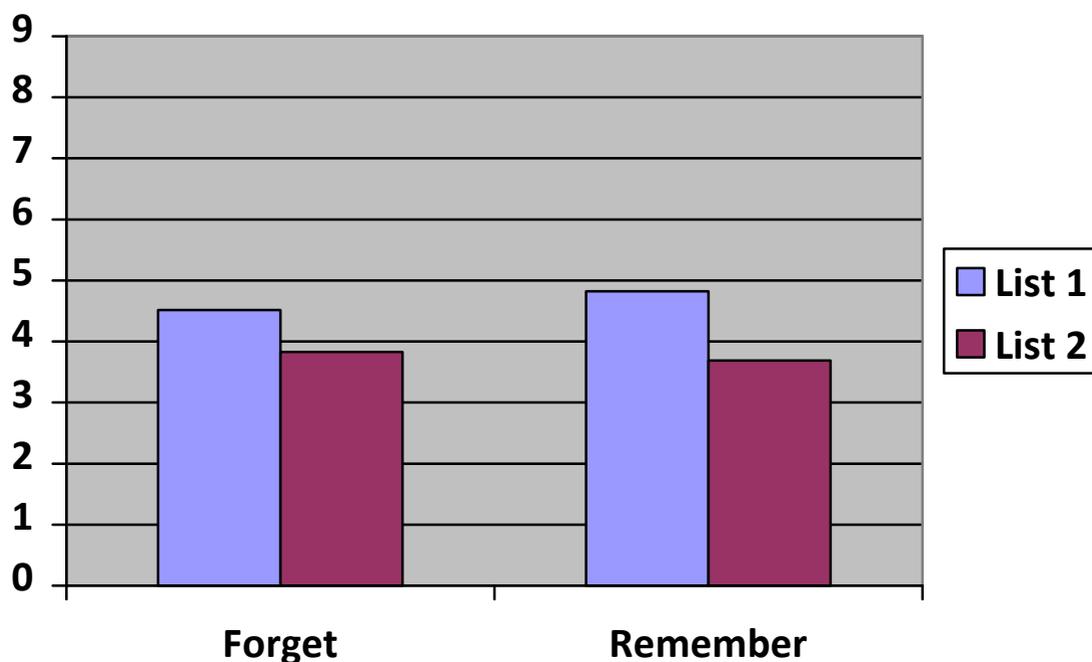
In order to investigate whether the valences were treated differently between the groups a split file within - between ANOVA was conducted, investigating each group separately. Paired comparisons revealed that negative pictures were preferred over neutral pictures, in the Forget group only (F (1, 28) = 6.633, p = .016). The negative (M = 1.552, SD = .112) was further statistically equal to the positive (M = 1.397, SD = 0.97), which again was equal to the neutral pictures (M = 1.224, SD = .112), with the order of the scorings reflecting the arousal differences in the valence categories (negative = positive = neutral, negative > neutral).

The unexplainable high scoring for the neutral pictures on test 1 for the Remember group was not apparent on test 2. In fact all valences were now statistically similar (Negative: $M = 1.552$, $SD = .097$; Neutral: $M = 1.431$, $SD = .135$; Positive: $M = 1.276$, $SD = .095$; all ps > .05. The pattern on the 1. test, with neutral higher than positive remained, though. As with the first test session, independent samples t-tests revealed no significant group differences on either valence category (all ps > .05) on either of the lists, despite minor idiosyncrasies in relative difference between the valences within each group.

Time: We all know memory fades with time (e.g. Ebbinghaus, 1885-1964, in Smith & Kosslyn, 2009). However, for list 1 only recall for the negative pictures in the Forget group changed significantly over the 1 week delay ($F(1, 28) = 12.6$, $p = .001$). In other words, the Forget group had a significantly lower scoring on the negative pictures in list one on the second testing. All other group x valence scores on list 1 remained stable across the 1 week delay. The Forget group had a slightly higher mean value ($M = 2.21$, $SD = .152$) than the remember group ($M = 1.9$, $SD = .125$) in the first session, but dropped to almost equal values on the second test session ($M = 1.69$, $SD = .132$ vs. $M = 1.72$, $SD = .148$) for forget and remember respectively). Interestingly, the second list showed a significant change over time, in both groups for all valences (all ps ≤ .025). This could indicate a possible hypermnesia (cf. Erdelyi & Becker, 1974) for the pictures in list 1, while the pictures in list 2, although the same as list 1 on first testing, were somehow weakened during the inter test interval.

Part 2: Memory error

Recall that no significant group differences were found in the directed forgetting experiment, which may have affected the results in this part of the study. Nevertheless it should still be possible to explore just how easily memory errors may be created.

For the original pictures (pictures the participants had actually seen) only the *correct*, *partial* and *false* categories were included in the analyses. The confused category contained too few participants to be included, since this led to a violation of the requirements for the statistical method used. In addition, the forget category was not of theoretical interest, and were thus excluded. The partial category was included in the analyses because it is a relative indication of the erroneous quality of memory, but the main interest of this study was the entirely correct or entirely false descriptions, and the partial category will thus not be commented upon.

On the *cued recall* task the participants were given a response booklet, were they were presented with questions asking for more specific details, such as number of people, and details in clothing and surrounding objects. The questions did not suggest any answers, or offer any misleading information. For the new, false titles only the *correctly rejected*, *confused* and *false* categories were used in the analyses.

Original pictures: There was a tendency towards the two groups being relatively equal in their tendency to give a false or correct description to the original pictures. Only for the neutral picture in list 1 on the recall task, and the positive picture on list 2 in the cued recall task, did the analysis reach significance. All other analyses were non-significant. Apart from the two significant pictures, the rest of the analyses were collapsed on group to look at the category distribution for all responses.

In the *recall* task there were more false descriptions of the negative picture and fewest for the positive, on list 1. The positive picture had the least amount of false responses on list 2 also, with the negative and neutral being almost equal, with about a third of the responses being false. The positive was also more correct on both lists; compared to negative and neutral, which again was almost equally correct (table 2). The number of *false* responses increased from recall to *cued recall* on the first list, but declined on the second list for the negative and neutral pictures. The number of *correct* responses decreased from recall to cued recall on both lists. This latter tendency probably reflects an increase in errors on the correct responses on the recall task, thus having been coded as partially correct on the cued recall.

Table 2
Percentage distribution false & correct on the recall & Cued recall tasks for original pictures, collapsed on group:

| | False | | Correct | |
| | Recall / Cued recall | | Recall / Cued recall | |
	List 1	List 2	List 1	List 2
Negative	17.1/ 26.2	31.1/ 26.1	31.1/ 26.2	37.8/ 29.8
Neutral	9.5/ 11.1	36.1/ 23.3	40.5/ 20	36.1/ 27.9
Positive	6.7/ 12.8	9.5/ 12.8	55.6/ 36.2	52.4/ 29.8

*Recall: Negative N = 35; Neutral N = 42; Positive N = 45*

Cued recall: Negative N = 46; Neutral N = 43; Positive N = 47

(Note that the percentage does not sum up to 100%. This is because the partial category was excluded from further comments, but still used in the analyses.)

A crosstabs chi square analysis revealed a significant result on the neutral picture ($N = 42$) in list 1 ($p = .011$), on the recall task, with the Remember group having more correct responses than the Forget group, and the Forget group having more false responses (graph 4).

Graph 4

Number distribution on false and correct category for each group, on neutral picture, list 1, recall:
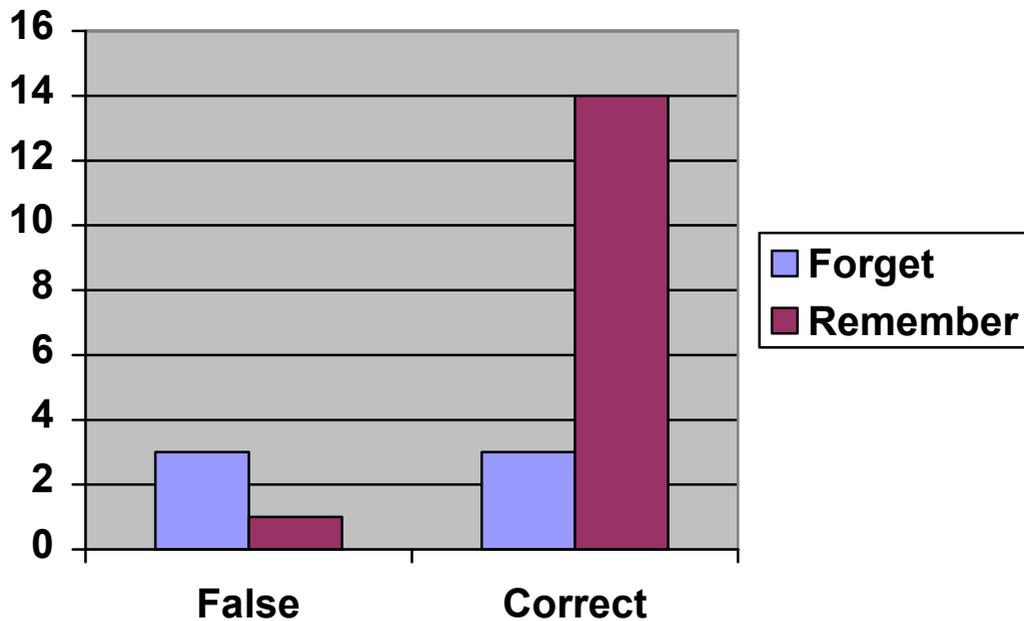
Note that only 4 people gave a false response, and the group difference here could be arbitrary.

On the positive picture ($N = 47$) on list 2 ($p = .023$), on the cued recall task, the Remember group was more likely to give a partial account (40.4% vs. 17% of all responses), while the Forget group was more likely to give a correct response. The Forget group was also more likely to give a false description, than the Remember group (graph 5).

Graph 5

Number distribution on false and correct category for each group, on positive picture, list 2, cued recall:
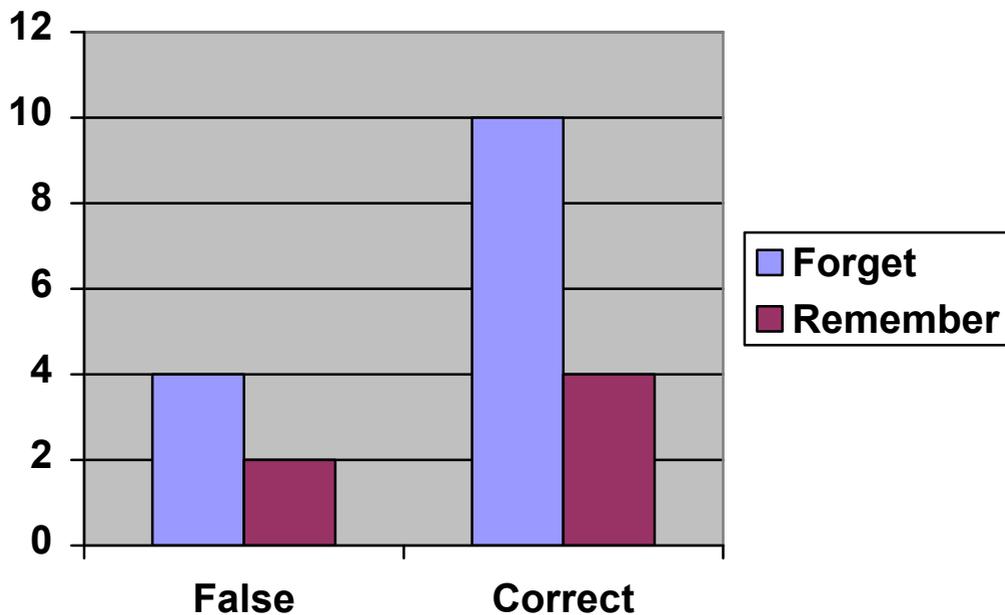
False titles: Three titles, indicating a negative ("Robbers"), a neutral ("Bakers") and a positive ("Couple on the beach") scenery were presented in a randomized fashion together with the titles of the original pictures, to see if this would suffice to produce errors in memory. A substantial number of the descriptions were false. Contrary to expectations source confusions were rare. The valences were almost equal in their tendency to be falsely described, indicating that memory errors is just as likely for negative stimuli, as more benign ones. Errors increased from the recall to the cued recall task, but more so for the positive titles, than the negative and neutral. The tendency to reject the false titles decreased for the positive and neutral, while it increased for the negative title. Source confusions for the negative picture decreased while it remained fairly stable for the other pictures (table 3). No significant group differences were found.

Table 3

Recall / Cued recall - Percentage distribution scoring categories for false titles:

	Negative	Positive	Neutral	Mean:
False	31 / 32.8	34.5 / 50	32.8 / 39.7	32.8 / 40.8
Rejected	56.9 / 60.3	62.1 / 44.8	56.9 / 50	58.6 / 51.7
Confused	12.1 / 6.9	3.4 / 5.2	10.3 / 10.3	8.6 / 7.5

In order to see if the Forget group was more or less likely to accept the false titles, a chi square analysis was conducted to compare the two groups in each of the coding categories, on both recall and cued recall: *false*, correctly *rejected* and *confused*. The confused category ended up being removed from the final analysis since there were too few subjects in the category to fulfil the requirements of the analysis. There were no significant group differences on either of the false titles (negative $N = 51$, neutral $N = 52$, positive $N = 56$[8]), or the coding categories, on either recall or cued recall tasks. In other words: both groups were equally likely to give a false description as to correctly reject the titles.

Percentage of participants giving all correct or false on all the false titles: While errors were quite prominent in the data material, very few participants gave false descriptions to all of the false titles. Almost three times as many correctly rejected all of the false titles while the majority had a mixture of all categories, on the recall task. On the cued recall task more participants now had false on all categories, and slightly fewer rejected all.

A manual count of the data set revealed that of the 58 participants 5 had false descriptions to all three false titles (8.6%) on the *recall* task. 14 correctly rejected all titles (24.1%). The majority (39/67.2%) had a mixture of false, correctly rejected and confused responses to the false titles. None had confused responses on all the original titles. On the *cued recall* part, which followed immediately after the recall task, 9 out of 58 (15.5%) now had false responses to all of the false titles, an increase in approximately 6.9% from the recall task. 12 correctly rejected all titles (20.7%) a drop in 3.4%. 63.8% (37) had a mixture of false, correctly rejected and confused responses to the false titles, a drop in 3.4%. It appears the amount of memory errors increased slightly in the short period from the recall task until the cued recall task.

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[8] The missing number (58-N) for each group belongs in the confused category.

Discussion

Part 1: Directed forgetting

The first test session of this study replicated the findings from Payne and Corrigan (2007), with no directed forgetting effect being found. In addition the negative pictures were remembered better than the positive and neutral pictures, supporting the general finding that negative, emotional stimuli are rather difficult to forget[9] (e.g. Alexander et al., 2005; McNally, 2003; Payne & Corrigan, 2007; Porter & Birt, 2001). The Forget group did not behave in the way that were expected in standard directed forgetting experiments (e.g. Geraerts & McNally, 2008), but responded in very much the same manner as the Remember group. The mean values of recall on both lists were virtually identical, indicating that inhibition of visual stimuli is rather difficult at shorter intervals.

No DF effect was found on the second testing either. Contrary to expectations the two lists did *not* remain similar in mean values at the second testing (by either remaining stable or declining at equal strength). While the mean values for the first list remained (statistically) stable during the 1 week delay (except for the negative pictures in the Forget group) the mean values for list two declined. In other words, although they appeared to be identical on the first testing the underlying qualities of the memory representations must have been different. The Forget group did not show the expected pattern, of significantly lower scorings on the first list than the second list, at the second test either. In fact, the scoring pattern was similar to the one typically seen for the Remember group at standard directed forgetting studies (e.g. Payne & Corrigan, 2007), and was also equal to the Remember group's scoring for this study.

To reiterate the initial critiques of the DF paradigm: The experiments that have been done so far have usually tested memory shortly after the presentation of the stimulus material. It could thus be claimed that the standard experiments have been a test of suppression/ inhibitory abilities in working memory. In this case DF for emotionally arousing stimuli seems difficult, if not impossible, which is demonstrated by the near identical scoring for the Forget and Remember groups. Secondly, it may seem that using word lists may not create the level of arousal that occurs in more naturalistic settings. When the stimuli are more arousing, as in the Payne and Corrigan (2007) and the present study, inhibition seems improbable. How often do we manage to walk out of a situation that made us really uncomfortable, tell ourselves not to think about it anymore, and completely forget the event within mere minutes or hours? Most likely, we are unable to. Events that cause strong emotions stay with us for at

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[9] Positive memories may "form highly vivid and persistent memories" (Berntsen, 2001, p. 136) too, but we may be less motivated to forget them.

least a short amount of time (as the Payne & Corrigan, 2007, and test 1 of the present study indicates) whether we like it or not, and may even intrude when we least want them to (Berntsen, 2001). More mundane (neutral) events, however, may be more easily put out of mind (e.g. Payne & Corrigan, 2007; but see Berntsen, 2001), simply because they may not be important for survival (e.g. Plutchik, 2001). In support of this, the second experiment of the Jocelyn and Oakes (2005) study that did not find a DF effect for more high salient AMs. Lastly, it may seem as though the 'inhibitory patterns', theorized to be placed over the memory representation at encoding, leading to worse recall (Racsmány & Conway, 2006), may not be effective for arousing stimuli. This is indicated by both the stable values on the TBF list after the delay, and the identical scoring of both groups.

Considering that the Forget group had a higher scoring (though not significant) than the Remember group on the negative picture in list 1, it may be that suppression of negative pictures is harder than suppressing positive and neutral pictures, at least in short term. The Forget group also had higher scoring on the positive picture, but the difference was minute, and could be due to the Remember group's relatively poor memory for the positive pictures. The higher values in the Forget group could indicate that when people attempt to suppress emotional stimuli in general, and negative pictures in particular, they experience a temporary rebound similar to the "white bear" effect when they afterwards are asked to recall what they had been told to suppress (cf. Wegner, et al., 1987). After all, the Forget group is traditionally expected to show *lower* values than the Remember group, not higher, however small the difference may be. How long this rebound effect might exist is unclear, but we can assume it is for less than a week, since the scores on the negative picture for the Forget group was quite similar to the Remember group at test 2. Additionally, the valences were equal for the Remember group at test two, while the negative was still significantly larger than the neutral, in the Forget group.

The identical scores on test 2 could indicate a regression towards the mean (e.g. Howitt & Cramer, 2008, p. 153), and a stabilization of memory (e.g. Ebbinhaus' forgetting curve, in Smith & Kosslyn, 2009). On the other hand, it cannot be determined from these data whether the inhibition of the negative pictures had started during the delay, maybe having resulted in a further drop in mean values for the negative pictures had the inter test interval been longer. However, one might claim that the pictures weren't arousing enough (compared to self experienced events) to form long lasting memories, hence they were most likely subjected to "ordinary" forgetting (cf. Ebbinghaus, in Smith & Kosslyn, 2009; e.g. Clancy & McNally, 2005/06). Note that the mean values on the rest of the variables (all valences for

both groups) in list 1 decreased over the interval, the decrease was just not statistically significant for the rest of them. The significant drop in the mean values of the negative pictures for the Forget group could thus be due to a statistical artefact, considering that there were no significant differences between the Forget and Remember groups.

To sum up: no directed forgetting effect was found at either the first or second test. While both lists were identical at the first test, they were not at test 2. The first list pictures remained stable over the delay, the second list pictures had declined significantly. Additionally, negative pictures had higher mean values than positive and neutral pictures. With this in mind, what may explain these findings?

Competition between lists: It has been found that in order for directed forgetting to occur, with inhibition of the first list in the Forget group, the second list needs to be able to draw attention, and serve as a competitor to the first list. When attention is depleted during learning of the second list, directed forgetting does not appear, and it has been suggested that the DF effect depends on the possibility of shifting attentional focus, which then causes inhibition of the TBF list (Conway et al., 2000). Attention is necessary for memory encoding; what has not been properly attended to, will not be properly encoded or stored in memory (Smith & Kosslyn, 2009). Emotional stimuli has the ability to grab attention (Öhman, Flykt & Esteves, 2001), and it is possible that since both lists were arousing the first list was able to grab attention to such an extent that the second was unable to divert attention away from the first, thus no inhibition could occur. It could be that in order to achieve a DF effect for emotionally arousing stimuli the second list stimuli need to be emotionally "stronger" than the first. When the first list, or both lists, are low in arousal, as with neutral pictures (e.g. Payne & Corrigan, 2007) or words (e.g. Wessel & Merchelbarch, 2006), shifting attention to the second list may be easier.

To draw a parallel to forgetting an unwanted, emotional memory: it may be that this will only be successful if there are other emotional events (valence may be insignificant) that are *more* arousing, and thus capable of distracting attention from the unwanted memory (e.g. Conway et al., 2000; Experiment 2 in Wegner et al. 1974). If no such event exists, it may be that forgetting becomes difficult, and the memory remains strong and enduring.

Interference: The traditional DF pattern[10] has been thought to involve proactive interference for the Remember group when learning the second list, while the Forget group is released from this interference by the forget instruction (e.g. Bjork, 1970; Payne & Corrigan, 2007). Since the lists were identical at the first test, it is doubtful that any interference hampered the *learning* of the second list, thus it cannot explain the lower test 2 scorings. The lower means cannot reflect inhibition either, since both groups were instructed to remember list two (the 'forget' instruction is thought to initiate inhibition, cf. Barnier, et al. 2007) and both groups scored in the same way. It may be that the theorized interference impaired the second list's ability to form long lasting memory traces (e.g. Bjork, 1970); hence memory was weakened during the delay. Of course, it could be a combination of both interference and lack of competition: a highly memorable first list that "confiscates" attentional resources, and a second list incapable of competing with the first, once these resources have been allocated. Note that this would affect the long term memory of the pictures, since the lists were processed and encoded to an equal extent into working memory. It is also possible that the first list occupied working memory, causing a processing "overload" which made it harder to form long term traces of the second list (e.g. Passer & Smith, 2007).

Although the two lists were identical at list 1, and presumably identical in memory, the underlying memory characteristics must have been different. These findings seem to support the notion that a one-time testing of a phenomenon such as inhibition does not provide a full picture of the memory representations of the stimuli. The findings of the present study are in line with studies investigating long term effects of other methods used to study inhibition or suppression, which have also found a lack of long term effects of suppression attempts (McLeod & Macrae, 2001; Nørby, Lange & Larsen, 2009).

Attentional redirection: The finding that DF requires shift in attention (cf. Conway et al., 2000) may indicate that worse recall does not involve inhibition, but may be due to a defective processing of whichever list receives less attention. In studies using low arousing stimuli this will be the first list for the Forget group, which is explicitly instructed to shift focus to list two, and a "weak" list 1 is unable to prevent this shift. The second list may receive less attention in the Remember group because they are focussed on keeping the first list in memory while learning the second list (interference). In this respect, trying to keep information in memory may lead to divided attention for the second list, and encoding suffers. This may also explain why the Remember group has better memory for the first list on

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[10] With the Forget group having higher recall for list 2 than list 1 stimuli, and the Remember group having better recall for list 1 over list 2 stimuli (Geraerts & McNally, 2008).

traditional DF studies (e.g. Conway et al. 2000), at least when low arousal stimuli are used, because attention is not overloaded at that point. When the first list is too emotional attention may be immediately drawn to it (e.g. Öhman, Flykt & Esteves, 2001), and while arousal may enhance memory for list 2 at short term, making the lists equal (e.g. Payne & Corrigan, 2007; this study), less resources may be allocated to forming long lasting memory traces of it.

For the Forget group it may also be that inhibition attempts of emotionally arousing stimuli draws upon the attentional resources to such an extent that it both abolishes short term inhibition (e.g. experiment 4, Conway et al., 2000) and further weakens long term storage of list 2 (Conway, et al., 2000). However, this latter hypothesis does not account for the near identical values of the Remember group and the Forget group, unless the different theorized attentional overload mechanisms for each group has similar results. The hypothesized attentional redirection also does not explain why DF effect seems to be lifted at recognition tasks. However, Benjamin (2006) discovered a trend towards a DF effect on list 2 in a recognition test, possibly indicating that the second list is in fact not encoded in equal strength, for both groups.

Previous studies compared to the present: So why is it that DF effects are observed with emotional words (Conway et al. 2000; Wessel & Merchelbach, 2006) and AMs (Barnier et al., 2007, experiment 3; Jocelyn & Oakes, 2005), but not pictures (Payne & Corrigan, 2007; this study)? The likely explanation is that pictures lead to higher emotional activation causing better memory consolidation, thus better memory for the items (Smith & Kosslyn, 2009, pp. 348-352). Barnier et al. (2007) used AMs that were more than a month old, and it is possible that even though the events were arousing at the time of occurrence, and are remembered as having been arousing, they may not have been able to activate strong enough emotional reactions at the time of the study to prevent inhibition from taking place. It could thus be, as Payne and Corrigan (2007) speculated when words are concerned, that older AMs include knowledge of emotions at the time, but may not evoke an emotional *state* (at retrieval), and the latter may not be as easily inhibited. While Jocelyn and Oakes (2005) used recent autobiographical memories the forget group received the forget instruction at least a day after the event took place, which may have caused enough emotional decline for the instruction to be effective. It is also possible that the memories in their study were too low on emotional arousal in the first place. Maybe emotional events can only be inhibited after its potential to evoke emotional activation at retrieval has diminished. Previous studies may have been based on low arousal, while the present study, and the study of Payne and Corrigan (2007), would

be equal to receiving a forget instruction shortly after an emotionally salient event had taken place. In this situation, inhibition seems improbable.

The fact that the DF effect was not observed even after a week may indicate that inhibitory patterns were not encoded simultaneously with the stimulus material, as the episodic inhibition view, theorized by Racsmány and Conway (2006) suggests (see also Conway et al., 2000). When a stimulus is arousing it may be that these "commands" would have to be initiated at a different point in time, possibly during a later retrieval attempt. Arousal level at retrieval may then again mediate the effect of this later suppression/inhibition attempt. In other words: for the participants in this study to have been able to inhibit memory for the TBF pictures, they would have had to receive a forget instruction at a later point in time, after the emotional qualities of the memories had decreased to a sufficient degree for inhibition to become possible. In support of this, Jocelyn and Oakes (2005, experiment 2) did not find a DF effect for the highly salient events, even though the forget instructions were given some time after the events had taken place. It is possible that the arousing qualities of those events had not decreased sufficiently.

In relation to forgetting traumatic events: traumas might not be suppressed unless the emotionally arousing qualities have declined. To the extent that the events "leave scars upon the cerebral tissue" (cf. William James) inhibition seems unlikely (e.g. Berntsen, 2001). This is in line with previous studies on traumatic memories where it has been found that the more traumatic the event the better it is remembered (Alexander et al., 2005). Alternatively a more potent distractor may be required (e.g. Wegner et al., 1987). Future studies should attempt to find the arousal threshold for when suppression is possible, and when it is not.

However, there is a possibility that the recall task at the end of the presentation phase may have lifted the inhibitory mechanisms that would otherwise have been in operation during the inter test interval. Racsmány and Conway (2006) postulated that "the pattern of activation/inhibition over representations in the memory can be altered for at least some time after encoding" (p. 48). It is possible that if the initial recall task had been excluded, and the participants received an instruction to forget or remember the pictures during the delay, then the DF effect would have occurred at the second testing.

The present study does not render previous DF studies useless. It merely suggests that the effect is mediated by emotional arousal to such a degree that DF (i.e. intentional forgetting) may not work when the TBF items still cause emotional activation. The results of previous studies may thus be limited to stimuli or memories of lesser arousing qualities and generalizations to more emotionally arousing memories may thus be restricted.

Part 2: Memory errors

In part two of the experiment the quality of the memory representations of the pictures was investigated, with a recall and a cued recall task. No clear predictions were made for this part of the study, as it was mostly exploratory in nature. It was anticipated, however, that the results in this part of the study would be linked to the results on the DF study. This was confirmed. No group differences were found, except for the neutral picture on list 1 on the recall task, and the positive picture on list 2 on the cued recall task. Although interesting, the positive and neutral pictures were not the main concern of this paper, and this apparent group difference will thus not be discussed further. Since none of the other variables showed any group differences the following discussion concerns the over all tendencies for all participants, collapsed by group.

There were fewer false descriptions for the pictures in list 1, which were better remembered, than for the pictures in list 2. Contrary to expectations, memory for the negative pictures in list 1 had a higher rate of false responses than the positive and the neutral pictures. The error rate on the positive valence was slightly higher on list 2, but it was still lower than for the negative and the neutral, at either list. On the latter two valences the number of false descriptions was substantially higher on list 2. Their error rates were also quite similar.

The amount of errors increased for most of the variables from the recall task to the *cued recall* task, except for the negative and neutral on list 2. Additionally the number of correct descriptions decreased for all of the valences on both lists. This could possibly indicate the appearance of errors in the initially correct memories. In other words: it may be that correct recall descriptions included errors on the subsequent cued recall task, hence being coded as partially correct. No expectations were made concerning differences between the recall and cued recall task, but the increase in erroneous responses was somewhat surprising, considering the lack of external pressure, and the fact that the cued recall task took place mere minutes after the recall task.

For the *false titles* it was expected that the negative title would produce less false descriptions than the positive and neutral. This expectation was based on the assumption that the negative original pictures would be so memorable that the participants would realize that they had not seen a picture of the scene indicated by the false title. However, valence did not seem to make a difference. The participants were just as likely to give a false response to the title indicating a negative picture as to the positive and neutral titles, with about a third of the descriptions being false. There were no significant group differences for this tendency.

The lack of observed inhibition, or suppression, in the Forget group made it impossible to answer one of the research questions: What happens to the quality of stimuli that have been suppressed, and then later attempted retrieved? Nevertheless it may still be possible to draw some inferences about memory quality.

Memory stability: First of all, memory errors were less likely for the first list, for which memory remained fairly stable over the 1 week delay on the DF task, than for list 2, which showed a significant decline in mean values. This may indicate that emotionally arousing pictorial stimuli are not just relatively enduring in memory; they are also relatively accurate, when properly encoded. They are not fault free, however (e.g. Smith & Kosslyn, 2009), as indicated by the error rates. Rather counterintuitive, the highest false rate on list 1 was for the negative picture, and the lowest for the positive picture.

Interestingly the positive pictures were least erroneous on *both* lists. The false rates for the neutral and negative images were a lot higher on the second list, and the error rate came close to the error rate for the false titles on the recall task (c.f. tables 2 and 3). This may indicate that when memory fades errors become more likely (e.g. Loftus, 1992). It is possible that when memory appears vague there may be an increased tendency to describe the first thing one recalls that seems familiar (e.g. Garry & Polaschek, 2000), rather than continue to search for the correct memory. It is however possible that because the participants had a relatively poor memory for list 2, they may have treated the original list 2 titles as "false titles", which may explain the similar error rate.

The rate of memory errors increased slightly from the recall to the cued recall task, except for the negative and the neutral pictures on list 2. It is unclear why only these two variables showed a decrease in amount of errors. One possibility could be that the participants chose to refrain from describing a picture they were unsure of, at the cued recall task, thus the responses were later coded as forgotten. These pictures did after all have a surprisingly high error rate at the recall task. The tendency of both higher and lower rate of false responses could also be due to "the testing effect", where repeated attempts at recalling information increases likelihood of both increased error and accuracy rate (McDermott, 2006). Concerning the increase in errors, it might have been caused by the erroneous mental images, which were cued by the false titles, appearing to be more familiar. When processing of erroneous information increases in fluency, it may more likely to be perceived as true (e.g. Garry & Wade, 2005). Research suggests that memories return to a labile state upon reactivation,

leaving the memory traces vulnerable to alterations (see Nader, 2003, for a discussion). Which mechanism might explain the rise in errors in this study is unclear.

Bear in mind that no visual suggestions were provided, nor were any detailed narrative descriptions of the false titles given. Thus any distortion in visual memory, arising from the generation of false scenes in the minds of the participants, happened then and there, without any direct external pressure, except for a casual request to spend a short time (30-60 seconds) to imagine the picture belonging to the title. The logical response would have been to misattribute the mildly related previously presented picture to the false title, but the descriptions provided by the participants indicated a quite different visual scene to anything they had actually witnessed. In response to the title "Robbers", which were mildly related to the original picture titled "Gangsters" (see appendix) showing a close up of three men (two blacks, one white) pointing a pistol at the camera, one participant described:

> *Three men with black balaclavas, running. They're outside, in the picture, asphalted street, gloomy surroundings. There may have been someone being robbed, but I cannot remember. The clearest is the image of the three masked men running with a rifle (my translation).*

The over all results seem to indicate that even mildly suggestive influences may be enough to significantly alter memory. Recall that a description of an original title were coded as false only when it was considered altered to such a degree that it no longer resembled the original picture. For the false titles only descriptions that could not be linked to any original picture (i.e. source confusion), either through description or by stating the title of the original picture, were considered false. Thus by merely presenting an associative title entirely new visual scenes were created in the minds of the participants, even though the title could be related to a previously seen picture. It may seem like memory is easier to manipulate than initially expected.

However, there are other factors beside memory malleability that may explain the results in the present study:

Source confusion: This was predicted to be the most prominent response to the false titles, rather than giving entirely false descriptions. In this study source confusion would be if the participants described the original pictures, of which the false titles were based, when probed with the false titles. However, source confusion errors were rare (table 3). It's possible

that the participants actually remembered the original picture and its title, concluded that the false title did not refer to that specific picture, rejected it, and then proceeded to describe the first mental image that felt familiar (e.g. Garry & Polaschek, 2000). The responses of some of the participants during debriefing may support this hypothesis. However this seems to have been the case for only a minority of the participants.

Social factors in the testing situation: Although steps were made to minimize influencing factors one cannot preclude the possibility of the "good participant effect", i.e. the participants attempting to please the experimenter (Bordens & Abbott, 2005). When presented with titles they could not remember, they may have chosen to describe whatever came to mind, in order to not appear like a "bad" participant. On the other hand, the fact that this study was led by a student (maybe lacking authority) may have made them feel less compelled to produce accurate descriptions, or to withhold false ones, compared to, for instance, a police interrogation. However, during debriefing, when the students were informed about the real purpose of the study and told which titles had been false probes, almost all seemed surprised by the errors they had made. The majority indicated that they initially believed that they had not seen the picture before, but then started to doubt their memory, and eventually ended up describing a mental image they believed to have been the picture they had seen. There is thus reason to believe that they attempted to perform the tasks conscientiously, and made their best effort to give correct answers. The main cause of accepting the false probes, as indicated by the majority of the participants, seem to be initial self doubt in their own memory, followed by a hesitant acceptance of the visual image that "popped up" during mental imagery, and which seemed somewhat familiar.

The participants were instructed to indicate whether they were certain or uncertain of the descriptions they provided to the titles, but since not everyone complied with this instruction this factor could not be explored further. However, of those that did include an evaluation almost all seemed to be uncertain of the false descriptions they provided.

The effects of warning: Suggestibility influences have been found to drop when the participants are warned that they have been exposed to erroneous information (Lindsay, 1990). The fact that the participants were not instructed to withhold responses if they could not remember the title may thus have influenced the tendency to accept vague visual images that would otherwise have been rejected. After all, we live in a very visual world, where television and internet makes pictures and videos readily available for consumption. We may

therefore all at one point in time have seen other visual stimuli that resembled scenes suggested by the titles that were used as false probes in this study. It is therefore no surprise that the false titles may have become misattributed to these already stored "visions". The surprise is the ease with which this was done.

Limitations of the present study: The results in this study seem to indicate that even though people remember the correct verbal label of a visual scene, it does not necessarily mean that the scene they see in their minds eye corresponds very well with what they actually saw. However, there are some limitations in connecting this study to the DF study. This part of the experiment contained only a selection of the pictures that were presented, and it is quite likely that the pictures that were chosen were not remembered by some of the participants, i.e. the titles were treated in the same way as the new, "false" titles, hence they ended up getting those wrong. The amount of false descriptions could mirror this. It is also possible that the participants had excellent memory for the pictures that were *not* selected, thus this study may present a skewed representation of memory quality, in favour of false memory representations.

Regardless, it seems that even negative emotional memories may be easily tempered with. Granted, the pictures in the present study cannot be put on par with traumatic autobiographical events. However, one may speculate whether the false mental images that had intruded into the memories of the participants would have been able to take hold and, with time, they could have been lured into believing that they had actually witnessed the event first hand. On the other hand, it might require more "effort" on behalf of both researcher and participant to create false AMs. The studies cited in the present study employed social pressure, a false narrative, and also required that the participants spent some time trying to reminisce (e.g. Loftus & Pickrell, 1995; Wade, Garry, Read & Lindsay, 2002; Garry & Wade, 2005). AMs possess certain qualities, such as "fundamental significance for the self, for emotions, and for the experience of personhood", (Conway & Pleydell-Pearce, 2000, p. 261), not found in pictures that have been viewed on a computer screen. Nevertheless, if it is possible to create a memory for a scene not previously witnessed by merely offering an associative title, it could potentially have implications for real life court cases, and therapy practices that still rely on mental imagery techniques. If proper care is not taken, memory errors may cause severe problems for both patients and innocent people (e.g. Loftus & Ketcham, 1994; Magnussen, 2004; www.discovery.com, 2010).

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Appendix:

Pictures from IAPS database:
Pictures selected for 'Part 2: Memory errors' marked with asterix.
Pictures associated with false title marked by hash tag.

Number in database	Given name	Valence	Description: *Scene, then persons left to right*
6242#	"Gangstere"	Negative	- Close up, waist up, in front of a fence - White man, black t-shirt, glasses, caps - Black man, bear chest, blue & white bandana, points pistol at camera - Black man black t-shirt
6315*	"Slag"	Negative	- Close up, waist up, car in background - White man, dark hair, red t-shirt. Right hand in a strangle grip around woman's neck, left arm in motion to slap woman - White woman, blue & white armless t-shirt. Head turned left, pained facial expression
9250*	"Leger og pasient"	Negative	- Semi-close up, from knees up, outside, asphalt & wooden wall in background, two people partially visible on right - Asian man, white doctor's coat, glasses, carries torso of: - Asian, female patient: injured, very bloody top, unconscious, dark skirt - Asian man, white doctor's coat, yellow ribbon left arm. Carries legs of patient. White shirt, dark trousers, glasses - They seem to be in a hurry
9414	"Mann med gevær"	Negative	- Outside, buildings in background, green hedge in front, dirt road - A hand holding a rifle, barely visible - Black man face down on dirt road, white t-shirt, yellow trousers, left hand raised towards: - White man pointing rifle at black man. Multicoloured, chequered sweater, blue jeans, brown shoes. Short, blond hair.
9429	"Redsel"	Negative	- Outside in a street. Front person waist up, people in background in full figure. - Frightened women and children running. White, blonde women, dark jackets. Girls 8-12 years old, crying, school uniform, red ties. - Policeman with back turned
9433	"Død mann"	Negative	- Outside; grey, paved street. - Dark skinned man lying on street, visible from knees to head. Blue jeans, red t-shirt. Blood around his head, presumed dead. - Older man, blue jeans, red t-shirt, holding bike, looking at dead man

			- Woman, blue t-shirt, white skirt, head not visible, faced dead man. - Two dogs, light brown. One appears to be licking the blood.
2272	"Gutt"	Neutral	- Large, red wall with the word "Oui" in large, white letters. - Black boy, 8-12 years, white t-shirt, blue shorts. - 3 girls walks past on right at pavement, one looks at boy
2390*	"Mann og kvinne"	Neutral	- Inside, red, brick wall with lit fireplace in background. Close up, man and woman sitting at table - White woman, white shirt, blue stethoscope around neck, white tea cup in right hand, short, blond hair, black ear rings - White man, short, dark hair, blue and white chequered shirt. Turned towards woman, away from camera
2396*	"Par i trapp"	Neutral	- Inside, large blue and grey staircase, white railing on left, elder couple walking down stairs, towards camera - Asian man, black cap, black & grey jacket, light blue jeans, animal cage right hand. Black bag over left shoulder - Asian woman, red-ish hair, light brown jacket, black trousers, blue bag on left arm - Gloomy, facial expressions
2579#	"Kokker"	Neutral	- Back alley of shopping street, Asian looking - Two people making dumplings in the street, bamboo steamers, table - Asian man/woman, white jacket & apron, dark trousers - Asian man, white jacket and hat - Two people barely visible on the left
2595	"Kvinner samtaler"	Neutral	- Close up, waist up, sitting outside a white house - Back woman, half long black, wavy hair. White and light blue, striped shirt, with elbow-long sleeves. - Black woman, half-long black, straight hair. Sleeveless white and blue striped shirt with buttoned front. Beer in left hand. - Brown bag between them.
7506	"Gamblere"	Neutral	- Inside a gambling casino, people barely visible in background, two men behind central figures, half visible. - white man in tuxedo, glasses, turned away from camera - white man, blue and white chequered jacket, placing a bet - Half visible man, light blue jacket, blue tie, placing bet - White woman, long, blonde hair, yellow jacket, black shirt underneath
2091*	"Barn og katter"	Positive	- Outside, on a lawn, trees in background, sunny. Children 8-12 sitting on their knees, full body visible. - White boy, short blonde hair, white, sleeveless shirt with thin, blue stripes, blue short, holding white and orange-coloured kitten, facing girl on right of photo - White girl, long blonde hair, smiling. White sleeveless shirt with purple & orange flowers, red shorts. Holding white and orange-coloured kitten. Facing boy on left of photo.

2395*	"Glade damer"	Positive	- Close up, shoulders up. Three generations black women. - Young, half-long wavy black hair, wide smile, jeans printed t-shirt - Elder woman, white half-long hair, smiles, blue shirt - Middle aged woman, short, black hair, wide smile, purple and gold printed shirt
2398	"Båttur"	Positive	- Outside at the sea, red and white speedboat. - Two men in boat, partly visible. - Two women on water, to the left of boat, wearing bikinis. One wearing black cap. - Two young girls sitting on boat. On left yellow and blue safe jacket, dark blonde hair, pony tail. On right; blue safe jacket, glasses, light blonde hair, pony tail.
5831#	"Far og sønn"	Positive	- Outside, beach by the sea, surroundings all blue, seagulls overhead - Man with blue shorts, squatting. Lifting left arm to feed seagulls - Toddler, naked.
8499	"Berg og dalbane"	Positive	- close up of a man and two children on a roller coaster. Large yellow sign on left, with black arrow pointing down, "Down" underneath in black letters. - White man, blue t-shirt, glasses, smiling, sitting behind: - White boy on left, 6-8 years, short blonde hair, blue t-shirt, screaming - White girl on right, purple t-shirt, red jacket over. Half long blonde hair, screaming, looking slightly frightened.
8540*	"Medalje-vinnere"	Positive	- Close up of three white women, waist up, presumably on a podium (not seen) - Short blonde hair, Blue t-shirt with white stars, red stripe - flag of USA. Silver medal around neck, lifts bouquet of flowers with right arm. Bites lower lip. Faces right, away from camera. - Short, blonde hair, same costume as woman on left. Gold medal round neck. Raises bouquet of flowers with right arm, smiles. - Short, blonde hair. White t-shirt, black stripes under arm, stripes in colours of German flag over left breast. Bronze medal round neck. Raises bouquet of flowers with right arm.